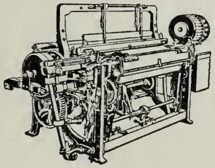
TEXTILE TEXTS

Trade Mark Reg. U. S. Pat. Off.

FOURTH EDITION

DRAPER COMPANY
HOPEDALE MASS.

TEXTILE TEXTS.



Draper Company Works, Hopedale, Mass., 1912.

TEXTILE TEXTS

FOR

COTTON MANUFACTURERS,

INCLUDING SPECIAL ARTICLES ON

CARDING, SPINNING, SPOOLING, WARPING, DYEING, REELING, TWISTING AND WEAVING

ALSO

GENERAL HISTORY, MATHEMATICAL TABLES,

AND A DESCRIPTION OF THE

PATENTED COTTON MACHINERY

INTRODUCED AND SOLD BY

DRAPER COMPANY.

HOPEDALE, MASS., U. S. A.,

1917.

PRINTED BY
MILFORD JOURNAL COMPANY
MILFORD, MASS.

TO OUR CUSTOMERS,

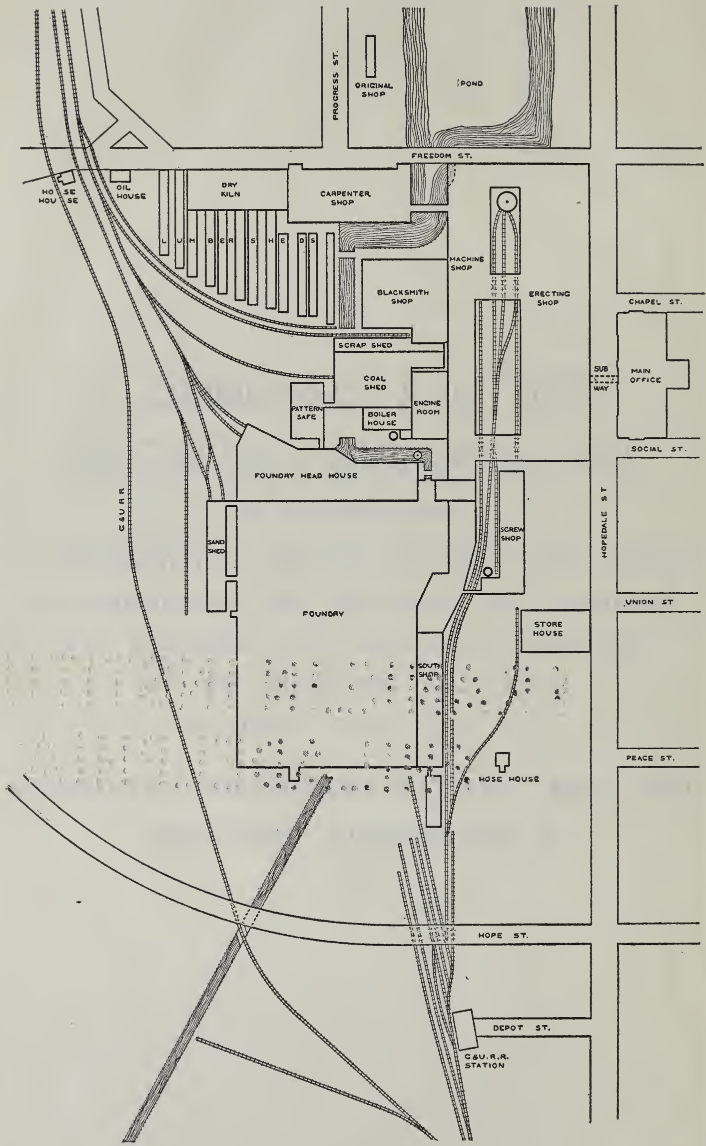
The Cotton Manufacturers of the United States,

WHOSE ENTERPRISE IN

TESTING AND ADOPTING VALUABLE IMPROVEMENTS IN MACHINERY HAS STIMULATED THE DEVELOPMENT OF IMPORTANT INVENTIONS, THUS IMPROVING THE QUALITY AND DIMINISHING THE COST OF THE FABRICS PRODUCED,

THIS, OUR TWELFTH DESCRIPTIVE CATALOGUE,

IS RESPECTFULLY DEDICATED.



Plan View of Our Works, 1913.

The various buildings shown, including their several stories, contain over thirty-three acres of floor space.

PREFACE.

IT is our purpose to make this book a compendium of useful information for everyone connected with the manufacture of cotton cloth or yarns. While some of our specialties are applicable to woolen, worsted and silk manufacture, we feel that the cotton mill is our legitimate field and broad enough to require the greater part of our time. In connection with the general information furnished, we introduce descriptions of our machinery, and rules and tables of interest to the practical manufacturer. These tables in many cases are merely the results of mathematics and formulæ and have been published by us before. Others are figured from actual results gathered from hundreds of mills, and properly averaged. The latter are of great practical value. In this present edition, new tables are presented whenever the conditions have made such change necessary.

This book is copyrighted, and we hope to see that copyright respected. We expect to issue a sufficient number of copies so that all men occupying responsible positions in Cotton Mills may have them on request.

DRAPER COMPANY.

LOCATION OF HOPEDALE.

LOCATION OF HOPEDALE.

Hopedale is located in a triangle formed by lines connecting Boston, Worcester and Providence. It is 34 miles from Boston, 18 miles from Worcester and 26 miles from Providence.

To reach Hopedale from Boston, take the Boston & Albany division of N. Y. Central R. R. via South Framingham to Milford, Mass., our adjoining town; thence by carriage or electric cars to Hopedale, 1 1-2 miles; or Boston and Worcester trolley line to South Framingham, 22 miles, and trolley from South Framingham to Hopedale, 13 1-2 miles; or Boston & Albany line to South Framingham and trolley to Hopedale; there are also several trains per day from Boston to Milford via Ashland and Hopkinton; also another line via Franklin to Milford.

From Worcester take either Boston & Albany train or trolley to North Grafton, 6 miles, thence change to trolley line through Upton to Hopedale, 12 miles.

From Providence take Providence & Worcester division of N. Y., N. H. & Hartford R. R. to Uxbridge, Mass., 25 miles, thence trolley to Hopedale, 7 miles. Or, Providence & Worcester R. R. to Woonsocket, R. I., 16 miles, thence by trolley to Milford, Mass., 12 miles, changing at Milford for Hopedale. Or, trolley from Providence to Woonsocket, connecting with trolley line at Woonsocket for Milford, as above.

We have had this map prepared, in view of frequent requests for information as to where Hopedale is situated and how to reach it.

We extend a cordial invitation to our readers to call and see us.

TELEPHONE AND TELEGRAPH.

We can be reached by either the Western Union or Postal Telegraph Company and by the New England Telephone and Telegraph Company.

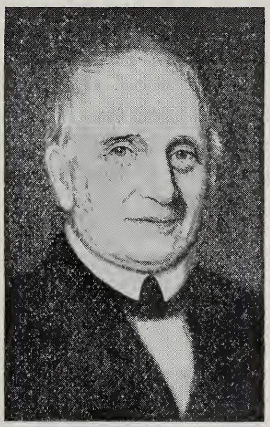
COTTON MANUFACTURE.

The Textile Art is one of the oldest arts known to mankind. It ministers to one of his primal needs, and many a pictorial remnant of civilization that existed at the dawn of history bears on its face some evidence of the art of making cloth. This art very early reached a stage of development both as to the texture, the material used, the beauty, and utility of the finished product, that would compare favorably with the best products of today. The silks of ancient China, the hand woven Persian rugs, and the tapestries of the middle ages are unrivalled. The manufacturer of today has discovered no new product in this art.

The modern world, however, beginning in the middle of the eighteenth century, and continuing to the present day, has brought about ever improving results in the processes of producing textile fabrics. Modern civilization has made two demands upon the textile industry; it has required larger and larger quantities of material for old demands and it has created a constantly increasing diversity of new demands. These requirements have been partly cared for by more and more producing elements and partly by greater and greater efficiency of those elements. The spinning wheel has been replaced by the modern high speed spindle, and the hand loom by the power loom, and this in turn has given way to the automatic loom. The product per operative has been increased a number of thousand times, while the result attained has been very little changed. The evolution in the Textile Art has enabled the value of a single unit in the textile working world to be the productive equal of several thousand of his predecessors of three hundred years ago. This capacity of one to do the work of several thousand leaves the several thousand free to do other work in supplying the requirements of modern society. The evolution of the industry has been in the means and not the end of the art. The product as a product has remained the same, while the means to bring about the result have undergone tremendous developments. The unceasing effort of the textile manufacturer is to increase the product per wage earner without sacrificing the quality of the product. A very large amount of the cloth today could not be distinguished from the product of 1700. The industry of 1700, however, with its now discarded methods, would have needed the labor of the entire country to equal the product of one of our large mills of the present type.

The most important division of the textile art in capital involved, number of wage-earners and volume and value of product is cotton manufacturing. The field of activity of the Draper Company has been in the main confined to this division and its efforts have been devoted to the advancement of this art. There are a large number of our machines doing service in worsted and woolen mills where the processes of manufacture in these materials parallel the cotton processes which our machines perform. Within the limits of our chosen field our history has been intimately connected with and dependent upon the advances made here. The Dutcher Temple, the Bartlett let-off, the Stearns pick motion, the Sawyer and Rabbeth Spindles, the Carroll ring and the Northrop Loom, all marking distinct advances over prior devices, have all been brought out and introduced by us.

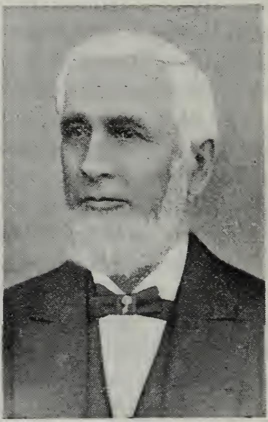
Beginning in 1816, nearly one hundred years ago, in the early and struggling days of the cotton industry in the United States, we find Ira Draper working on improvements in the art of making cotton cloth. Ira Draper, son of Abijah Draper, an officer of the war of independence, was born in Dedham, December 29th, 1764. He moved to Weston, Mass., in 1808, where he spent the rest of his life. He was of an inventive turn of mind, taking out a number of patents, but devoting his main attention to the textile industry. In 1816 he took out his first loom and loom temple patent, which, as was the custom at that time, covered several distinct improvements, the most important of which was the loom temple. This patent showed a temple of the so-called star wheel type, having a row of pins or teeth in it, which held the cloth, and was mounted on the breast beam so that it was largely self-acting. The temples in use up to this time had been of the stretcher type, made of two pieces of wood with teeth in the opposing ends, which were inserted in the cloth by the weaver, and which had to be taken off and re-adjusted as often as the temples travelled a short distance from the fell of the cloth. Ira Draper was the pioneer in recognizing the need of such an improvement and put into operation the



Ira Draper.

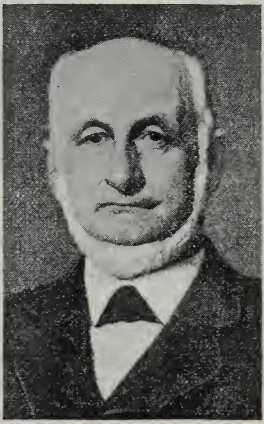
first rotary temple. This improvement was a very important one, as it enabled a weaver to double the number of looms that he could run. The business of introducing these improved loom temples was carried on by Ira Draper from Weston, Mass., for about fifteen years. On the first of April, 1829, he took out another patent on loom temples, covering an improvement in the mounting of his early device.

In 1830 Ira Draper sold these two patents to his eldest son, James Draper, who at once undertook to put them on the market and bring them to the attention of the cotton manufacturers of that time. In the first number of the first volume of the Boston Transcript published July 24, 1830, there appears an advertisement of James Draper, bringing these temples to the attention of the textile trade. He continued the business until March, 1837, when he took into partnership his half brother, E. D. Draper, who assumed the real control of the business.



E. D. DRAPER.

In 1842 E. D. Draper moved to Hopedale, Mass., becoming a member of the Hopedale Community established by the Rev. Adin Ballou; and in 1853 George Draper moved to Hopedale, joining with his brother and forming the partnership of E. D. & G. Draper to sell loom temples and other improvements in cotton machinery.

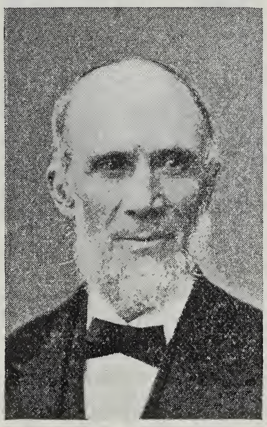


GEORGE DRAPER.

George Draper was born in Weston, Mass., August 16, 1817, and died June 7, 1887. He started early in life in a cotton mill, getting practical experience which proved to be so valuable to him later in his great work of cheapening the processes and bettering the products of cotton machinery.

He started at 14 years of age at North Uxbridge, and afterwards became manager of the Union Mill at Walpole, and left there to become overseer of weaving at Three Rivers. He then made his first venture of introducing patented improvements in cotton machinery. In 1837 he found a position as operative in the Massachusetts Cotton Mills at Lowell. He next was put in charge of the fancy weaving at the Harris Woolen Company Mills of Woonsocket, R. I., and later became Superintendent of a mill of the Otis Company at Ware, Mass., and then Superintendent of all their mills. On October 28, 1840, and again February 21, 1842, he took out patents which embodied improvements on the same type of temple which Ira Draper had originally invented in 1816.

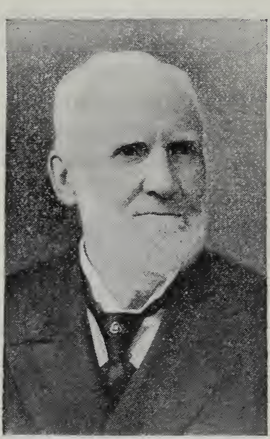
Meantime Elihu and Warren W. Dutcher of North Bennington, Vermont, had taken out two patents on an entirely new type of loom temple; one patent dated December 18, 1851, and the other and more important of the two December 28, 1852. These were the first temples provided with cylindrical rolls; the temples were so constructed as to be reciprocated by the lay in the process of weaving. In this way they were able to hold the cloth much nearer the last pick than any prior temples. The appearance in the field of a formidable rival that bade fair to be a serious competitor in the temple business, led to the purchase by E. D. & G. Draper in 1854 of Elihu Dutcher's interest in the temple patents and business and the firm of W. W. Dutcher & Company, comprising W. W. Dutcher, E. D. and G. Draper, was formed to manufacture this type of loom temples. The temples were manufactured in North Bennington, Vermont, until May 1856, when Mr. Dutcher moved to Hopedale; the firm of E. D. & G. Draper had the agency for the sale of these temples to the mills. Mr. Dutcher was an able inventor, taking out over twenty patents, mostly on temples and machines for making temples. A line of machines for setting temple teeth invented by him is at present in use. They are today



W. W. DUTCHER.

doing service, and are unduplicated and unrivalled. The importance of these inventions is best shown by the fact that this business has continued the temple manufacture of the United States, without any departure from the basic principle of the original patents.

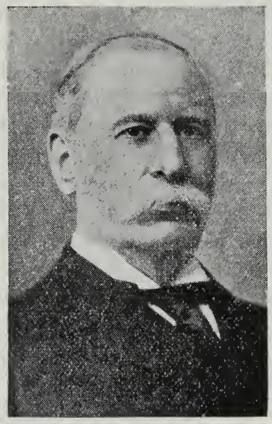
In 1856 the Hopedale Community, which had been in existence for some 14 years, had become involved in financial difficulties, and E. D. & G. Draper assumed its debts and assets; about this time a brother-in-law of the Drapers, Joseph B. Bancroft, who had come to Hopedale in 1847, joined with the two Drapers in a partnership known as the Hopedale Machine Company to manufacture improvements in cotton machinery. At the time of the removal of the Dutcher temple business to Hopedale a local foundry became necessary to make the high grade castings needed for temples and other machinery manufactured by the Hopedale Machine Company, so the Hopedale Furnace Company was formed as a partnership in 1856. This company made all the castings for the Hopedale interests, as well as making job castings for the general outside public. In 1867 corporations were formed to take over the three partnerships; the Dutcher Temple Company succeeded the firm of W. W. Dutcher & Company; the partnership of the Hopedale Machine Company was incorporated under the same name, and the Hopedale Furnace Company as a corporation succeeded the Hopedale Furnace Company as a partnership.



JOSEPH B. BANCROFT.

Early in 1868 E. D. Draper disposed of his interest in the firm of E. D. & G. Draper, and moved to Boston; in that same year the firm of George Draper and Son was formed, by George Draper taking in his eldest son, William F. Draper. The firm name was changed in 1876 to George Draper & Sons when George A. Draper, another son, was admitted as a member; in 1880, Eben S. Draper, a third son, was admitted to the firm; and in 1887 and 1889 William F. Draper, Jr. and George Otis Draper, sons of William F. Draper, were admitted to the partnership of George Draper & Sons.

William F. Draper resigned his active position with the company July 1, 1907, and died January 28, 1910. During his connection with the business he filled many important positions. For a long time he had charge of the finances; later he conducted the experimental department devoted to the perfecting of new devices; also including patents and patent litigation; for several years he was the practical head of the organization and much of its success was due to his ability and untiring efforts.



WILLIAM F. DRAPER.

The business from 1853, when George Draper came to Hopedale until his death in 1887, can be roughly divided into two parts, the period up to 1870 and the period from 1870 to 1887. In the early period the largest share of the business in addition to temples was in improvements of different motions on looms for plain weaving. During this time the Bartlett, Shepard and Young let-offs and the Stearns shuttle motion were introduced and adopted by a large share of the mills. The Stearns shuttle motion was the successful development of which the patent of 1846 to W. W. Dutcher was the pioneer in breaking away from the overhead pick motion, and is now in universal use in this country in a modified form. A large business was also done in shuttle guards, thick and thin place preventors, and other loom improvements.

Beginning about 1870 came the tremendous improvements in the spinning room, with the Sawyer and later the Rabbeth spindle and Carroll double spinning ring. These inventions have practically driven mule spinning from America, except on the very finest numbers. The cheapening of the process of spinning by these inventions has been tremendous, and the amount saved in the manufacture of yarns will run into the hundreds of millions of dollars.

In the late 80's and early 90's the members of George Draper & Sons again turned their attention to the weave room and began a line of very extensive and expensive experiments on automatic looms, which resulted in 1894 in introducing to the cotton manufacturers of this country the Northrop Loom. The experiments had assumed such shape in 1892 that the Northrop Loom Company was organized, but it was not until 1894 that the loom was placed before the textile trade in a commercial way.

In December 1896 the present Draper Company was organized under the laws of Maine, taking over the property and business of the Hopedale Machine Company, the Hopedale Machine Screw Company, the Dutcher Temple Company, the firm of George Draper & Sons, and the United States patents and business of the Northrop Loom Company. Prior to this time the Hopedale Furnace Company and the Hopedale Elastic Goods Company had both been absorbed by the Hopedale Machine Company. This united and brought under one corporate body all the Hopedale interests, and since January 1, 1897 all this business has been done by the Draper Company.

The Draper Company thus from its earliest antecedents has been at work on improving and introducing patented improvements on existing devices and machines. The patent law with its term of seventeen years monopoly is very inadequate protection in a finished art or where the holder of the patent is unwilling or unable to continue his control of his chosen field by constant efforts at improvement. We try to keep seventeen years ahead of the open art by a steady effort to improve our product, cheapen its cost of manufacture and simplify its component parts, Hundreds of thousands of dollars and constant attention to all possible improvements, coupled with a willingness and readiness to recognize and adopt any improvement that will tend to benefit the manufacturer have been the factors that have kept our machines far ahead of anything procurable in the market to accomplish similar results. We are as interested today in inventions in our line as we ever have been in the past. We are anxious to see any device invented for use on our machines. A number of our most important improvements have been invented outside our works and we hope to continue to have opportunities to purchase new ideas in our line. Practical men in the mills, dealing with practical problems that confront them in their regular work, meet these problems, study them, and overcome them, and such solutions are always interesting, often ingenious and sometimes new and patentable. When in our line, we are always interested in such solutions and ready to examine and report to inventors on these devices.

A new device should be useful and patentable to be of value. A useful device is one that either cheapens the cost of production without lowering the quality, or one that betters the quality without increasing the cost of production, or both. Of course the device of greatest value is one that results in cheapening the product to the manufacturer so that his cloth costs him less per yard or his yarn less per pound. If the saving in this way is large the actual cost of manufacture of the new idea is relatively unimportant, for the manufacturer is buying a result rather than a machine. Now granting the result to be new and useful, and thus patentable, to be of real value it should be so novel that the patent issued be a broad patent. An idea that is of the greatest use, that saves the manufacturer great sums of money each year, has little salable value without broad patent protection. The Company taking hold of an idea of this sort, introducing and perfecting it, pushing it through its sales force and by advertising, only ends with the disadvantage, when the device is firmly established in the market, of having this heavy initial expense as a handicap in competing with manufacturers in the same line of machines in an open market. A device then must be capable of adequate patent protection to be of salable value to the machinery manufacturer even granting its producing value to a mill organization. These are the inventions that command large prices and make fortunes for inventor and machine builder alike; these inventions are relatively rare.

Soon after the invention and during the early days of the introduction of some real improvement, there springs up a number of alternate ways to accomplish the new result. These ways are patentable over the original way, but the result being the same may be covered by the claims of the prior patent. They are of no interest except to the holder of the early patent, and only of interest to him where they suggest improvements in design or cheapness of manufacture, where they are purchased to strengthen the position of the broad patent, or where they cover an improved construction when the main patent expires.

The great majority of ideas that are submitted yearly for our examination and to report on never reach the Patent Office. A few are so impractical and unmechanical that they are of no value, but the rest of the ideas are so practical and so good that they have been incorporated into the claims of patents already issued to other inventors. Sometimes a number of inventors hit upon a similar solution of a difficulty which in the nature of the goods produced has arisen in several mills hundreds of miles apart and the controlling factor in a case like this is priority of invention.

During the period of our business relations with the textile trade, manufacturers have tried and adopted a large number of our textile improvements. These improvements sold by us have never cost a single mill a single cent in the way of royalty to other parties, or in the way of defending patents suits. A device bought from us has brought with it complete protection from the expenditure of time and money on patent litigation. Coupled with this immunity from patent prosecution we can conservatively state that we have cut in half the cost of spinning, spooling and weaving.

INTERESTING DATES IN COTTON MACHINERY HISTORY.

The following table of the dates of important inventions or events that are of interest in the history of cotton manufacturing runs down to 1870. The patents mentioned in the table up to 1790 are all English patents and after that date are nearly all American patents; the few foreign inventions after 1790 are specifically indicated.

1730—First cotton yarn spun in England by machinery by Wyatt.

1733—English patent granted John Kay for the invention of the fly shuttle.

1738—Patent granted Lewis Paul for the spinning machinery supposed to have been invented by John Wyatt.

1742—First mill for spinning cotton built at Birmingham; moved by asses; not successful.

1748—Patent on a cylinder card as first used by hand, granted Lewis Paul.

1750—Fly shuttle in general use in England.

1756—Cotton velvets and quiltings first made in England.

1760—Stock cards first used for cotton by James Hargreaves. Drop box invented by Kay.

1762 }
1767 } Spinning-jenny invented by Hargreaves.

1769—Richard Arkwright obtains his first patent on spinning.

1774—Bill passed in England to prevent the export of cotton machinery.

1775—Second patent of Arkwright on carding, drawing and spinning.

1779 { Mule spinning invented by Samuel Crompton.
Peele's patent on carding, roving and spinning.

1782—Watt's patent for the steam engine.

1783—Bounty granted in England for export on certain cotton goods.

1785—Power loom invented by Dr. Edmund Cartwright. Cylinder printing invented by Bell. A warp stop-motion described in Cartwright's patent.

1785—First application of steam to driving textile machinery at Popplewick Notts, England.

1788—First cotton factory built in the United States at Beverly.

1789 { Sea Island cotton first planted in the United States.
Samuel Slater starts cotton machinery in New York.

1790—First cotton factory built in Rhode Island by Slater.

1792—First American loom patent granted to Kirk and Leslie.

1794—Cotton gin patented by Elias Whitney.

1801—Date given for invention of the Jacquard machine in France.

1803—Dressing machine and warper invented in England by Radcliffe, Ross and Johnson.

1804—First cotton mill built in New Hampshire, at New Ipswich.

1805—Power loom successfully introduced in England after many failures.

1806—First cotton mill built in Connecticut, at Pomfret.

1809—First cotton mill built in Maine, at Brunswick.

1811—First cotton mill built at Fall River, Mass.

1814—Cotton opener with lap attachment invented in England by Creighton.

1815—Power loom introduced into the United States at Waltham.

1816—*First loom temple of Ira Draper patented in the United States.

1818—Machinery for preparing sewing cotton invented in England by Holt.

1822—First cotton factory erected at Lowell.

1823 { Differential motion for roving frames patented by Arnold.
First export of raw cotton from Egypt to England.

1824—Tube frame or speeder patented by Charles Danforth.

1825—Self-acting mule patented in England by Roberts.

1828 { Ring spinning patented by John Thorpe.
Cap spinning patented by Danforth.

1829—*Revolving loom temple improvements patented by Ira Draper.

1832—Stop-motion for drawing frames invented by Bachelder.

1833—Ring spinning frames first built by William Mason.

1834 { Weft fork patented in England by Ramsbottom and Hope.
Shuttle-changing loom by Reid and Johnson.

1840 { Automatic loom let-off of E. B. Bigelow invented about this time.
*Important temple improvement patented by George Draper.

1842—Weft fork perfected in England by James Bullough.

1846—*Parallel shuttle-motion patented by W. W. Dutcher.

1849—First cotton mill erected at Lawrence.

1850—*Hayden's patent for railway-head evener.

1851—*Reciprocating temple patent of E. & W. W. Dutcher.

1852—*Important improvement in loom temple patented by E. & W. W. Dutcher.

1853—Card-cleaning patent of G. Wellman.

1857—*Snell & Bartlett's let-off patent.

1859 { Cheetham shuttle-changing loom patent; the first American attempt in this direction.
*William Stearns' shuttle-motion patent.

1862 { *Silas Shepard's let-off patent.
*Card-guide patent of Hervey Kent.

1863—*George Draper's loom stop-motion; used on every side dagger loom in the country.

1865—Thomas Mayor's patent on roving frame improvements.

1866—*First spindle patent, to J. E. Atwood.

1867 { *Cottrell & Draper's double beam let-off patent.
*Important spindle patent granted Rabbeth & Atwood.

1868 { *W. F. Draper's thin place preventer patent for looms.
*First American self-threading shuttle patent of J. A. Metcalf.
*Patent of F. Haythorn, for the first spinning frame separator.

1869 { Important loom patent of Erastus B. Bigelow.
*First bobbin-holder patent of A. M. Wade.
*W. T. Carroll's double flange spinning ring patent.
*First inside-catch shuttle patent, to J. H. Coburn.

1870 { *Patent on the original Walmsley warper stop-motion.
Oliver Pearl's spindle patent.

*These devices all came under control of Hopedale interests at some period of their patent existence.

STATISTICS.

The statistics published in this work were collected from a variety of sources and go to prove the importance of this American industry and its steady continuous advance. The technical tables have been carefully prepared and are as accurate as the nature of the case will allow. They have been adopted only after careful inspection; are compiled from the best sources available; and we trust will continue to be of good service.

LEGAL HOLIDAYS IN THE TEXTILE STATES.

There are no national holidays. Congress has on different occasions appointed special holidays, and recently passed an act making Labor Day a legal holiday in the District of Columbia. It has recognized, but not legalized, as holidays for the District of Columbia certain days that are very generally established as legal holidays throughout the States. The Presidential proclamation of Thanksgiving Day only makes a legal holiday in the District of Columbia and the national territories.

JANUARY 1, NEW YEAR'S DAY. Legal holiday in all the textile states except Kansas and Massachusetts; and in Maine, where it is only a bank holiday.

JANUARY 8, ANNIVERSARY OF THE BATTLE OF NEW ORLEANS. Louisiana.

JANUARY 19, LEE'S BIRTHDAY. Alabama, Georgia, Mississippi, North Carolina, South Carolina and Virginia.

FEBRUARY, MARDI GRAS. In the Parish of Orleans, Louisiana.

FEBRUARY 12, LINCOLN'S BIRTHDAY. California, Colorado, Connecticut, Delaware, Illinois, Indiana, New Jersey, New York, Pennsylvania and West Virginia.

FEBRUARY 12, GEORGIA DAY. Georgia.

February 22, Washington's Birthday. All the textile states.

March 2, Anniversary of Texas' Independence. Texas.

Good Friday, Alabama, Connecticut, Delaware, Louisiana, Maryland, New Jersey, Pennsylvania, Tennessee.

April 12, Anniversary of Halifax Independence Resolutions. North Carolina.

April 13, Jefferson's Birthday. Alabama.

April 19, Patriots' Day. Maine and Massachusetts.

April 21, Anniversary of the Battle of San Jacinto. Texas.

April 26, Confederate Memorial Day. Alabama, Georgia, Mississippi.

May 10, Confederate Memorial Day. North Carolina, South Carolina, and the Second Friday in May in Tennessee.

May 20, Mecklenburg Declaration of Independence. North Carolina.

May 30, Memorial Day. All the textile states except Georgia, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee and Texas.

June 3, Jefferson Davis' Birthday. Alabama, Georgia, South Carolina, Tennessee, Texas; and a public school holiday in Virginia.

July 4, Independence Day. All the textile states.

July, Fourth Saturday, Primary Election Day. Texas.

August 16, Bennington Battle Day. Vermont.

September, First Monday, Labor Day. All Textile states except Louisiana, where it is observed in the Orleans Parish.

September 9, Admission Day. California.

September 12, Old Defenders' Day. In the City of Baltimore, Md.

October 12, Columbus Day. California, Connecticut, Delaware, Illinois, Indiana, Kansas, Kentucky, Maryland, Massachusetts, New Jersey, New York, Pennsylvania, Rhode Island, Texas, Vermont.

November 6, All Saints' Day. Louisiana.

November, General Election Day. Legal holiday throughout the Textile States in such years as state or national elections occur.

NOVEMBER, THANKSGIVING DAY. (Almost universally the last Thursday in November). All the textile states.

DECEMBER 25, CHRISTMAS DAY. All the textile states.

Mississippi has no legal holidays by Statute, but by common consent the 4th of July, Thanksgiving Day and Christmas are universally observed.

Arbor Day is a legal holiday in a few of the textile states, though in some it is only observed when designated by proclamation of the Governor.

There are a number of the states that have by state law established legal holidays every Saturday after twelve o'clock noon, the laws varying in various states. In California in public offices; in Maryland, New York, New Jersey, Pennsylvania, Rhode Island and Virginia it is a banking holiday; also a banking holiday in New Orleans, La., and Charleston, S. C.; in Louisiana in cities exceeding 10,000 inhabitants; in Tennessee it is a legal holiday for city and county offices; in Indiana from the first Saturday in June to the last Saturday in October inclusive for all public offices in counties having a county seat of 100,000 or larger; in New Hampshire it is a legal holiday in the State offices.

GENERAL FACTS OF PHYSICS.

Tenacity is proportioned to the area of the cross section.

A freely falling body traverses a distance of 16.08 feet the first second.

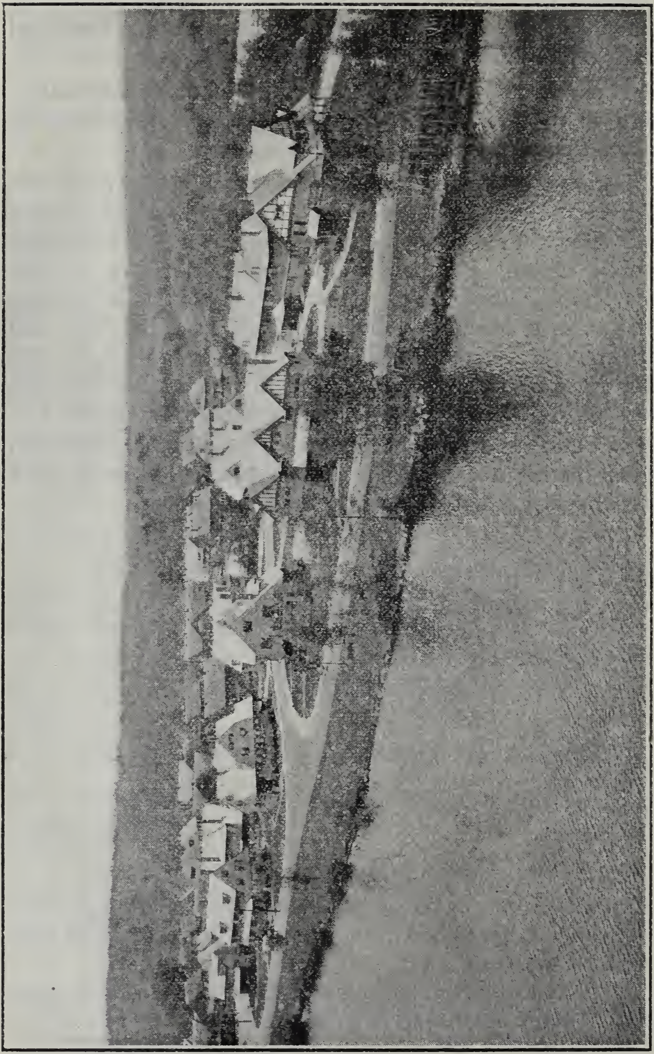
The distance traversed in any number of seconds is equal to 16.08 × number of seconds squared.

The length of a second pendulum is about 39 inches.

A horse power represents the ability to raise 33,000 pounds one foot high in one minute.

Water weighs about 62½ pounds to cubic foot.

The pressure of the atmosphere is about 15 pounds to the square inch.



Draper Company Cottages. Hopedale, Mass.

SILVER MEDAL
PARIS 1900

GOLD MEDAL
LIEGE 1905

GOLD MEDAL
MILAN 1906

GOLD MEDAL
ST. LOUIS 1904

We illustrate medals awarded Draper Company at international expositions, for improved dwellings for employees.

	Capital Invested in Cotton Manufacturing in the United States.	Value of Products.	Number of Spindles.
1801			
1802			
1803			
1804			
1805	...	...	4,500
1806			
1807	...	...	8,000
1808			
1809	...	...	31,000
1810	...	...	87,000
1811			
1812			
1813			
1814	...	...	122,646
1815	...	...	130,000
1816			
1817			
1818			
1819			
1820	...	...	220,000
1821	...	...	230,000
1822			
1823			
1824			
1825			
1826			
1827	...	...	705,000
1828			
1829			
1830			
1831	$40,612,984	$32,000,000	1,246,703
1832			
1833			
1834			
1835	...	...	1,750,000
1836			
1837			
1838			
1839			
1840	...	$46,350,453	2,285,337
1841			
1842			
1843			
1844			
1845			
1846	...	...	2,500,000
1847			
1848			
1849			
1850	$74,500,934	$61,869,184	2,751,078

	Capital Invested in Cotton Manufacturing in the United States.	Value of Products.	Number of Spindles.
1851			
1852			
1853			
1854			
1855			
1856			
1857			
1858			
1859			
1860	$98,585,269	$115,681,774	5,235,727
1861			
1862			
1863			
1864			
1865			
1866			
1867			
1868			
1869	....	....	6,700,557
1870	$140,706,291	$177,489,739	7,132,415
1871			
1872			
1873			
1874	....	....	9,415,383
1875			
1876			
1877			
1878			
1879			
1880	$208,280,346	$192,090,110	10,635,435
1881	....	....	11,375,000
1882	....	....	12,150,000
1883	....	....	12,660,000
1884	....	....	13,300,000
1885	....	....	13,375,000
1886	....	....	13,400,000
1887	....	....	13,500,000
1888	....	....	13,550,000
1889	....	....	14,060,000
1890	$354,020,843	$267,981,724	14,405,000
1891	....	....	14,640,000
1892	....	....	15,200,000
1893	....	....	15,550,000
1894	....	....	15,700,000
1895	....	....	16,100,000
1896	....	....	16,650,000
1897	....	....	17,150,000
1898	....	....	17,450,000
1899	....	....	18,100,000
1900	$460,842,772	$332,806,156	20,000,000

	Capital Invested in Cotton Manufacturing in the United States.	Value of Products.	Number of Spindles.
1901	....	....	20,200,000
1902	....	....	21,400,000
1903	....	....	22,000,000
1904	....	....	22,850,000
1905	....	....	23,687,000
1906	....	....	25,811,681
1907	....	....	26,939,415
1908	....	....	27,964,387
1909	....	....	28,573,435
1910	$822,238,000	$628,392,000	28,929,093
1911			30,803,662

COMPARISON OF CAPITAL INVESTED AND NUMBER OF WAGE EARNERS IN DIFFERENT TEXTILE INDUSTRIES IN 1910.

	Capital.	Wage Earners.
Cotton and cotton small Wares Manufactures	$822,238,000	378,880
Wool and worsted manufactures..	430,579,000	168,722
Hosiery and knit goods..............	163,641,000	129,275
Silk manufactures......................	152,158,000	99,037
Dyeing and finishing..................	114,093,000	44,046
Totals..	$1,682,709,000	819,960

COTTON MILL PRODUCTS, 1910.

ARRANGED IN ORDER OF YARDS WOVEN.

	Square Yards	Rough Percentage of Quantity	Value	Rough Percentage of Value
Total Woven Goods........	6,348,568,593	100	$456,089,401	100
Printers' and Converters' Cloth......	2,224,677,848	35	111,097,889	24
Sheetings and Shirtings	1,484,353,529	23	88,802,985	20
Ginghams	537,430,463	8	37,939,040	8
Fancy Woven Fabrics...	426,710,359	7	47,498,713	10
Twills and Sateens........	388,314,961	6	34,274,107	7
Napped Fabrics	305,655,864	5	25,695,367	6
Ticks, Denims and Stripes	264,870,508	4	27,350,162	6
Drills	238,869,407	4	17,750,151	4
Duck............................	162,476,322	3	27,485,892	6
Upholstery Goods.........	94,840,051	2	14,882,842	3
Bags and Bagging.........	63,107,568	1	4,862,451	1
Mosquito and other Netting	59,100,819		2,103,560	
Cotton Towels	52,778,170		6,037,075	1
Cottonades..................	25,676,286		3,343,533	
Corduroy, Cotton Velvet and Plush	19,706,438		6,965,634	1
	Pounds.			
Yarns for sale..............	470,370,995		109,314,953	
Thread..........................	23,700,957		20,516,269	
Twine..........................	13,715,771		2,417,391	
Cordage and Rope.........	7,603,907		1,164,526	
Cotton Waste sold.........	310,513,348		10,874,386	
Tape and Webbing........			5,531,674	
All other products.........			22,483,213	
Total value of all products			$628,391,813	

COMPARISON OF DIFFERENT TEXTILE INDUSTRIES IN 1910.

Manufactures.	Value of domestic products.	Exports.	Imports.	Total consumption.
Cotton	$628,391,813	$34,414,860	$68,380,780	$662,357,733
Wool	419,743,521	2,123,165	22,058,712	439,679,068
Silk	196,911,667	976,231	32,963,162	228,898,598
Totals	$1,245,047,001	$37,514,256	$123,402,654	$1,330,935,399

PRODUCTION OF YARN IN POUNDS BY STATES, CLASSIFIED ACCORDING TO FINENESS. CENSUS OF 1910.

State.	Total.	Coarse 20's and under	Medium 21's—40's.	Fine 41's and over.
Massachusetts	523,523,228	175,150,251	283,053,920	65,319,057
North Carolina	308,604,753	175,683,089	116,466,984	16,454,680
South Carolina	284,657,472	125,098,888	143,722,335	15,836,249
Georgia	230,771,195	188,303,084	42,102,121	365,990
New Hampshire	122,469,975	68,370,303	51,389,977	2,709,695
Alabama	104,311,123	71,581,923	28,268,986	4,460,214
Rhode Island	93,406,528	11,007,274	57,301,949	25,097,305
Maine	73,887,722	23,826,696	45,282,841	4,778,185
New York	60,403,324	31,215,894	28,391,604	795,826
Connecticut	48,241,048	11,780,876	20,407,387	16,052,785
Virginia	32,927,615	22,891,774	10,035,841	
Tennessee	26,311,310	15,825,402	10,435,908	50,000
Maryland and Delaware	24,449,126	24,390,580	55,546	
Pennsylvania	22,636,781	18,131,579	3,745,849	759,353
New Jersey	14,658,395	7,223,907	3,818,197	3,616,291
Texas	14,373,419	11,796,929	2,576,490	
Mississippi	12,678,372	9,587,216	3,089,156	
Indiana	10,871,116	4,731,055	6,140,061	
Kentucky	8,796,515	4,623,076	4,173,439	
Louisiana and Arkansas	7,547,631	7,547,631		
Vermont	4,359,021		3,594,842	764,179
All other states	7,768,053	5,300,261	2,272,172	195,620
United States	2,037,653,722	1,014,069,688	866,328,605	157,255,429

IMMIGRANT ALIENS ADMITTED TO THE UNITED STATES FOR THE YEAR ENDING JUNE 30, 1912.

African (black)	6,759
Armenian	5,222
Bohemian and Moravian	8,439
Bulgarian, Servian, Montenegrin	10,657
Chinese	1,608
Croatian and Slovenian	24,366
Cuban	3,155
Dalmatian, Bosnian, Herzegovinian	3,672
Dutch and Flemish	10,935
East Indian	165
English	49,689
Finnish	6,641
French	18,382
German	65,343
Greek	31,566
Hebrew	80,595
Irish	33,922
Italian (north)	26,443
Italian (south)	135,830
Japanese	6,172
Korean	33
Lithuanian	14,078
Magyar	23,599
Mexican	22,001
Pacific Islander	3
Polish	85,163
Portuguese	9,403
Roumanian	8,329
Russian	22,558
Ruthenian (Russniak)	21,965
Scandinavian	31,601
Scotch	20,293
Slovak	25,281
Spanish	9,070
Spanish-American	1,342
Syrian	5,525
Turkish	1,336
Welsh	2,239
West Indian (except Cuban)	1,132
Other peoples	3,660
Total	838,172

IMMIGRANT ALIENS ADMITTED TO THE UNITED STATES FOR THE YEAR ENDING JUNE 30, 1912.

Alabama	988
Alaska	276
Arizona	2,902
Arkansas	313
California	28,905
Colorado	4,215
Connecticut	23,227
Delaware	1,081
District of Columbia	1,685
Florida	5,356
Georgia	825
Hawaii	6,654
Idaho	1,480
Illinois	67,118
Indiana	7,753
Iowa	7,147
Kansas	2,901
Kentucky	727
Louisiana	1,811
Maine	5,691
Maryland	5,413
Massachusetts	70,171
Michigan	33,559
Minnesota	12,149
Mississippi	329
Missouri	8,980
Montana	3,565
Nebraska	4,490
Nevada	1,026
New Hampshire	6,120
New Jersey	47,211
New Mexico	757
New York	239,275
North Carolina	421
North Dakota	3,947
Ohio	38,148
Oklahoma	681
Oregon	4,138
Pennsylvania	109,625
Philippine Islands	13
Porto Rico	1,406
Rhode Island	9,795

South Carolina	275
South Dakota	1,792
Tennessee	797
Texas	22,885
Utah	2,631
Vermont	2,847
Virginia	1,510
Washington	11,882
West Virginia	6,212
Wisconsin	14,016
Wyoming	1,051
Total	838,172

Census.	NUMBER OF SPINDLES.				
	Total.	Cotton.	Silk.	Woolen.	Worsted.
1910	33,856,479	28,178,862	1,767,962	2,156,849	1,752,806
1905	28,721,742	23,672,064	1,394,020	2,456,389	1,199,269
1900	23,901,557	19,463,984	1,213,493	2,229,181	994,899
1890	18,092,133*	14,384,180	718,360	2,332,269	657,324
1880	13,170,743*	10,653,435	262,312	1,915,070	339,926
1870	9,338,953*	7,280,800	12,040	1,845,496	200,617

*Included some accessory spindles, except for silk.

NUMBER OF LOOMS.

Class of Looms and Census.	Total.	Used in the Manufacture of— Cotton Goods.	Silk Goods.	Woolen Goods.	Worsted Goods.	Carpets and Rugs.
Power 1910	825,478	665,652	75,406	33,148	39,476	11,796
1905	696,785	559,781	59,775	38,104	28,123	11,002
1900	573,214	455,752	44,257	36,734	26,630	9,841
1890	412,441	324,866	20,822	38,523	19,929	8,301
1880	285,494	227,383	5,321	32,955	11,703	8,132
1870	200,791	157,748	1,281	34,183	6,128	1,451
Hand 1910	248	(1)	(2)	41		207
1905	1,039	(1)	283	66		690
1900	1,311	(1)	173	83		1,055
1890	4,823	(1)	1,747	448		2,628
1880	7,929	(1)	3,153	781		3,995
1870	4,163	(1)	188	(1)		3,975

(1) Not reported. (2) Included with power looms.

ANNUAL EXPORTS OF COTTON GOODS TO THE CHINESE EMPIRE.

Year	Yards of goods	Value
1900	101,687,030	$5,205,802
1901	201,368,671	10,224,215
1902	326,419,489	16,048,455
1903	181,741,678	8,801,964
1904	248,671,197	13,911,566
1905	562,732,721	33,514,818
1906	270,799,275	16,704,823
1907	38,443,859	2,678,528
1908	79,635,264	4,536,209
1909	154,460,002	9,071,601
1910	65,506,099	4,151,340
1911	110,163,246	7,567,334

SPINDLES IN USE.

The total number of spindles in use on August 31, 1912 as given by the International Federation of Master Cotton Spinners' and Manufacturers Associations.

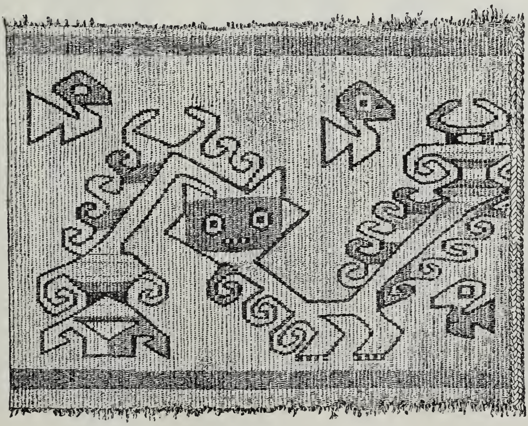
Great Britain	55,317,083
United States	30,313,000
Germany	10,725,732
Russia	8,800,000
France	7,400,000
India	6,195,214
Austria	4,797,935
Italy	4,580,000
Spain	2,200,000
Japan	2,191,960
Switzerland	1,408,456
Belgium	1,387,654
Canada	855,293
Sweden	529,772
Portugal	480,000
Holland	453,752
Denmark	83,684
Norway	73,568
Mexico, Brazil and other countries	2,900,000
Total	140,693,103

COMPARISON OF THE GOVERNMENT ESTIMATE OF THE COTTON CROP WITH THE GOVERNMENT FINAL REPORT OF THE CROP PRODUCED.

	December estimate of Department of Agriculture	Final crop statement of Department of Agriculture
Season of 1899-1900	8,900,000	9,507,000
Season of 1900-1901	10,100,000	10,245,000
Season of 1901-1902	9,674,000	9,748,000
Season of 1902-1903	10,417,000	10,784,000
Season of 1903-1904	9,962,000	10,015,000
Season of 1904-1905	12,168,000	13,697,000
Season of 1905-1906	10,167,000	10,725,000
Season of 1906-1907	12,546,000	13,305,000
Season of 1907-1908	11,678,000	11,325,000
Season of 1908-1909	12,920,000	13,432,000
Season of 1909-1910	10,088,000	10,386,000
Season of 1910-1911	11,426,000	11,965,000
Season of 1911-1912	14,885,000	16,109,000
	144,931,000	151,243,000

The average underestimate by the Department of Agriculture for this period of years is just over 4 per cent.

The number of bales in the final statement given here does not agree with the table on the second page following because in the present case the returns are given for the number of bales and in the latter case the annual yield has been reduced to a statistical bale of 500 pounds net weight.



CLOTH OF PREHISTORIC PERU.

PRINT-CLOTH STATISTICS.

Year.	Highest Price of Print Cloth in Cents.	Lowest Price of Print Cloth in Cents.	Average Price. (Not Average of High and Low.)	Price per Lb. in Cents at 7 yds. per Lb.	Average Price of Middling Uplands per Lb. in Cents.	Probable Cost per Lb. of Cotton Used in Cents, with 15 per cent. Waste.	Margin Between Cotton and Cloth in Cents per Lb.
1860	$5\frac{3}{4}$	$4\frac{7}{8}$	5.44	38.08	11.	12.94	25.14
1861	9	$4\frac{1}{4}$	5.33	37.31	13.01	15.31	22.
1862	$14\frac{1}{2}$	7	9.81	68.67	31.29	36.81	31.86
1863	19	$10\frac{3}{4}$	15.20	106.40	67.21	79.07	27.33
1864	$38\frac{1}{2}$	$16\frac{1}{4}$	23.42	163.94	101.50	119.41	44.53
1865	$27\frac{1}{4}$	10	20.24	141.68	83.38	98.09	43.59
1866	$19\frac{1}{2}$	$11\frac{1}{4}$	14.13	98.91	43.20	50.82	48.09
1867	12	$6\frac{5}{8}$	9.12	63.84	31.59	37.16	26.68
1868	$9\frac{5}{8}$	$6\frac{1}{2}$	8.18	57.26	24.85	29.24	28.02
1869	$9\frac{1}{2}$	$7\frac{1}{8}$	8.30	58.10	29.01	34.13	23.97
1870	$8\frac{1}{4}$	$6\frac{1}{2}$	7.14	49.98	23.98	28.21	21.77
1871	8	$6\frac{1}{2}$	7.41	51.87	16.95	19.94	31.93
1872	9	$7\frac{3}{8}$	7.88	55.16	22.19	26.11	29.05
1873	$7\frac{1}{2}$	$5\frac{3}{4}$	6.69	46.83	20.14	23.69	23.14
1874	$6\frac{1}{8}$	$5\frac{1}{4}$	5.57	38.99	17.95	21.11	17.88
1875	$6\frac{3}{4}$	$4\frac{3}{8}$	5.33	37.31	15.46	18.19	19.12
1876	$4\frac{7}{8}$	$3\frac{5}{8}$	4.10	28.70	12.98	15.27	13.43
1877	$5\frac{1}{4}$	$3\frac{5}{8}$	4.38	30.66	11.82	13.90	16.76
1878	4	$3\frac{1}{8}$	3.44	24.08	11.22	13.20	10.88
1879	$4\frac{1}{2}$	$3\frac{3}{16}$	3.93	27.51	10.84	12.75	14.76
1880	5.87	$3\frac{3}{4}$	4.51	31.57	11.51	13.54	18.03
1881	$4\frac{1}{4}$	$3\frac{3}{4}$	3.95	27.65	12.03	14.15	13.50
1882	3.95	$3\frac{5}{8}$	3.76	26.32	11.56	13.60	12.72
1883	$3\frac{13}{16}$	3.44	3.60	25.20	11.88	13.98	11.22
1884	3.62	3.08	3.36	23.52	10.88	12.80	10.72
1885	$3\frac{1}{4}$	2.98	3.12	21.84	10.45	12.29	9.55
1886	$3\frac{1}{2}$	$3\frac{1}{8}$	3.31	23.17	9.28	10.91	12.26
1887	$3\frac{5}{8}$	$3\frac{1}{4}$	3.33	23.31	10.21	12.01	11.30
1888	4	$3\frac{1}{2}$	3.81	26.67	10.03	11.80	14.87
1889	$4\frac{1}{16}$	$3\frac{1}{2}$	3.81	26.67	10.65	12.52	14.15
1890	$3\frac{9}{16}$	3	3.34	23.38	11.07	13.02	10.36
1891	$3\frac{1}{16}$	$2\frac{3}{4}$	2.95	20.65	8.60	10.11	10.54
1892	$4\frac{1}{16}$	$3\frac{1}{16}$	3.39	23.73	7.71	9.07	14.66
1893	4	$2\frac{3}{4}$	3.30	23.10	8.56	10.07	13.03
1894	3	$2\frac{1}{2}$	2.75	19.25	6.94	8.16	11.09
1895	$3\frac{5}{16}$	$2\frac{7}{16}$	2.86	20.02	7.44	8.75	11.27
1896	3	$2\frac{7}{16}$	2.60	18.20	7.93	9.33	8.87
1897	$2\frac{11}{16}$	$2\frac{1}{4}$	2.48	17.36	7.	8.24	9.12
1898	$2\frac{3}{16}$	$1\frac{7}{8}$	2.06	14.42	5.94	6.99	7.43
1899	$3\frac{1}{4}$	$2\frac{3}{8}$	2.69	18.83	6.88	8.09	10.74
1900	$3\frac{1}{2}$	$2\frac{3}{4}$	3.21	22.47	9.25	10.88	11.59
1901	$3\frac{1}{8}$	$2\frac{3}{8}$	2.84	19.88	8.75	10.29	9.59
1902	$3\frac{3}{8}$	3	3.11	21.77	9.	10.59	11.18
1903	$3\frac{3}{8}$	3	3.25	22.75	11.18	13.15	9.60
1904	4	3	3.44	24.08	11.75	13.82	10.26
1905	$3\frac{3}{4}$	$2\frac{5}{8}$	3.12	21.84	9.80	11.53	10.31
1906	4	$3\frac{1}{4}$	3.62	25.34	11.50	13.53	11.81
1907	$5\frac{1}{4}$	$4\frac{1}{2}$	4.75	33.25	12.10	14.23	19.02
1908	$4\frac{1}{4}$	3	3.35	23.45	10.62	12.49	10.96
1909	4	3	3.59	25.13	12.68	14.92	10.21
1910	$4\frac{1}{4}$	3	3.89	27.23	15.11	17.77	9.46
1911	$3\frac{3}{4}$	3	3.49	24.43	13.08	15.39	9.04

COTTON CROP OF THE UNITED STATES EXPRESSED IN STATISTICAL BALES OF 500 POUNDS NET WEIGHT.

Year.	Crop in thousands of bales.	Average Price in Cents.	Year.	Crop in thousands of bales.	Average Price in Cents.
1788-89	2,000		1851-52	2,676,000	12.14
1789-90	3,000	14.5	1852-53	2,993,000	9.5
1790-91	4,000	26.	1853-54	2,643,000	11.02
1791-92	6,000	26.	1854-55	2,588,000	10.97
1792-93	10,000	29.	1855-56	3,069,000	10.39
1793-94	16,000	32.	1856-57	2,746,000	10.30
1794-95	16,000	33.	1857-58	2,879,000	13.51
1795-96	20,000	36.5	1858-59	3,592,000	12.23
1796-97	22,000	36.5	1859-60	4,582,000	12.08
1797-98	30,000	34.	1860-61	3,672,000	11.
1798-99	40,000	39.	1861-62	4,293,000	13.01
1799-00	70,000	44.	1862-63	1,526,000	31.29
1800-01	96,000	28.	1863-64	429,000	67.21
1801-02	110,000	44.	1864-65	286,000	101.50
1802-03	120,000	19.	1865-66	2,000,000	83.38
1803-04	130,000	19.	1866-67	2,062,000	43.20
1804-05	140,000	20.	1867-68	2,242,000	31.59
1805-06	160,000	23.	1868-69	2,101,000	24.85
1806-07	160,000	22.	1869-70	2,703,000	29.01
1807-08	150,000	21.5	1870-71	3,830,000	23.98
1808-09	164,000	19.	1871-72	2,641,000	16.95
1809-10	170,000	16.	1872-73	3,510,000	22.19
1810-11	160,000	16.	1873-74	3,634,000	20.14
1811-12	150,000	15.5	1874-75	3,393,000	17.95
1812-13	150,000	10.5	1875-76	4,122,000	15.46
1813-14	140,000	12.	1876-77	3,971,000	12.98
1814-15	200,000	15.	1877-78	4,282,000	11.82
1815-16	248,000	21.	1878-79	4,556,000	11.22
1816-17	260,000	29.5	1879-80	5,412,000	10.84
1817-18	250,000	26.5	1880-81	6,062,000	11.51
1818-19	334,000	34.	1881-82	4,904,000	12.03
1819-20	320,000	24.	1882-83	6,452,000	11.56
1820-21	360,000	17.	1883-84	5,225,000	11.88
1821-22	420,000	16.	1884-85	5,198,000	10.88
1822-23	370,000	16.5	1885-86	6,030,000	10.45
1823-24	430,000	11.	1886-87	5,977,000	9.28
1824-25	510,000	15.	1887-88	6,516,000	10.21
1825-26	700,000	21.	1888-89	6,736,000	10.03
1826-27	540,000	11.	1889-90	6,888,000	10.65
1827-28	650,000	9.5	1890-91	8,242,000	11.07
1828-29	730,000	10.25	1891-92	8,526,000	8.60
1829-30	700,000	10.	1892-93	6,318,000	7.71
1830-31	770,000	10.	1893-94	7,115,000	8.56
1831-32	780,000	9.25	1894-95	9,480,000	6.94
1832-33	890,000	10.	1895-96	6,798,000	7.44
1833-34	920,000	11.	1896-97	8,281,000	7.93
1834-35	921,000	13.	1897-98	10,775,000	7.
1835-36	1,014,000	16.5	1898-99	10,940,000	5.94
1836-37	1,078,000	13.25	1899-00	8,997,000	6.88
1837-38	1,365,000	10.14	1900-01	9,991,000	9.25
1838-39	1,045,000	13.36	1901-02	10,344,000	8.75
1839-40	1,668,000	8.92	1902-03	10,274,000	9.
1840-41	1,288,000	9.50	1903-04	9,682,000	11.18
1841-42	1,337,000	7.85	1904-05	13,436,000	11.75
1842-43	1,945,000	7.25	1905-06	10,919,000	9.80
1843-44	1,692,000	7.73	1906-07	13,269,000	11.50
1844-45	1,987 000	5.63	1907-08	11,089,000	12.10
1845-46	1,726,000	7.87	1908-09	13,458,000	10.62
1846-47	1,513,000	11.21	1909-10	10,155,000	12.68
1847-48	2,034,000	8.03	1910-11	11,834,000	15.11
1848-49	2,499,000	7.55	1911-12	15,876,000	13.08
1849-50	2,000,000	11.			
1850-51	2,041,000	12.34			

Read price column with reference to first column of year figures. Prices given are for calendar year.

COTTON.

Historically the source of origin of the cotton plant is shrouded in mystery. It was known in India hundreds of years before the Christian era. Columbus found cotton in the West Indies in 1492; Cortez found it in Mexico in 1519; Pizarro found it in Peru in 1522, and Peruvian mummies have been found wrapped in cotton cloths.

The cotton plant is grown in the Southern states of the United States, in India, Egypt, China, Brazil, Peru, Asiatic Russia and more recently in Central and South Africa. Some few thousand bales have also been raised in Southern California. The South Atlantic and lower Mississippi States are the real source of the cotton supply of the world, raising about 70 percent of the annual yield available for spinning. This crop is the principal product of these states, and has the highest ultimate money value of any crop raised in the entire country. It furnishes the raw material for one of our most important manufacturing industries, and is our largest item of export.

Botanically the cotton plant is of the Malvaceae or Mallow family, and its generic name Gossypium was given it by Pliny during the first century of the Christian era. The plants while naturally perennial and in some countries so treated, are in America cultivated as annuals. The number of distinct botanical species is limited, but the varieties due to changes in soil and methods of cultivation number over one hundred. The long staple Sea Island cotton is a distinct species, and is generally supposed to have been a native of the West Indies.

In the early days of cotton raising it was customary to raise the annual crop in one place through a series of years until the fertility of the soil was exhausted and then to move to virgin territory. In modern times, however, it has become the recognized practice to fertilize the fields and the crop responds freely to this method of treatment.

In the cotton crop statistics, which we give, various sources of information have been consulted, and with the early crops, especially, there is quite a variation between equally good authorities. The list given, however, is accurate enough for practical purposes. The tables from 1870 on are copied by courtesy of the late Colonel A. B. Shepperson, from the various editions of his "Cotton Facts," and since his death the commercial crop as given by the Shepperson Publishing Company has been followed. The prices from 1821 are for Middling Upland in New York City, and the prices are listed to correspond to the first of the dates in year column.

The following are the United States Official Cotton

Grades, established by the Department of Agriculture of the United States Government:

Middling fair
Strict Middling
Good Middling
Strict Good Middling
Middling
Strict low middling
Low middling
Strict good ordinary
Good ordinary.

These grades have been officially adopted by the following cotton exchanges and associations:

New Orleans	Macon
Memphis	Mobile
St. Louis	Oklahoma
Charleston	New England Buyers
Natchez	Arkwright Club
Little Rock	Southern Cotton Buyers
Galveston	Fall River Cotton Buyers

The picking of the cotton crop is still carried on by hand. It is a very expensive and crude way to gather the crop costing millions of dollars annually; there is no doubt that sometime in the future some genius will invent a machine which will save a large share of this waste of energy, and do the actual gathering of the fibre better than it is now done.

Having gathered the crop the next process is separating the lint from the seed. The machines used for this process are known as gins, and are of two distinct types, roller gins and saw gins. The roller gin is the more ancient, and is said to have been used in a crude way by the Hindus from the earliest times. It was a hand process and extremely slow. The advent of the saw gin invented by Eli Whitney revolutionized the process, and gave a new impetus to cotton raising and cotton manufacture. The saw gin is more liable to injure the fibre, but is still used almost exclusively for the main cotton crop, the roller gin being confined to the long stapled Sea Island cotton. Here again is an opening for any inventor who will devise a gin that will give the product of the saw gin and the quality of the roller gin.

By far the largest part of the cotton crop is sold to the manufacturer in bales. The Egyptian bale is packed to an average density of 45 pounds to the cubic foot, as against about 22 pounds for the average American bale.

We think of Egypt as a relic of the past, but in the baling of cotton our twentieth century Americans may well pattern after Egypt. While the Egyptian bale is in every way prepared for the accidents and wear and tear incident to travel, the American bale is anything but a credit to the American farmer, compress owner and exporter.

A few of the Southern cotton mills avoid entirely the baling of cotton by being located in the cotton fields, the cotton being carried directly from the gin to the mills. The advantages consist mainly in examining on the ground the staple and color of the cotton, and in having an opportunity for picking over and selecting from the crop gathered in the neighborhood.

An Alabama Cotton Field.

REVISED NEW ENGLAND TERMS FOR BUYING AND SELLING AMERICAN COTTON (EXCEPT SEA ISLAND).

ACCEPTED BY THE ARKWRIGHT CLUB, THE NEW ENGLAND COTTON BUYERS' ASSOCIATION AND THE FALL RIVER COTTON BUYERS' ASSOCIATION.
IN EFFECT SEPTEMBER 1, 1912.

NOTICE.

Sections designated "Short" apply to short staple cotton only.

Sections designated "Long" apply to long staple cotton only.

Sections designated "Both" apply to both long and short staple.

CLASSIFICATION.

1. (Both.) The United States Government standard classification shall be used.

2. (Both.) Sales calling for even-running grades, or made on type, may contain 5 per cent. half a grade below the grade specified if offset by an equal number of bales half a grade above that specified.

3. (Both.) Sales calling for average grade, or made on type, may contain 5 per cent. half a grade below the lowest grade specified if offset by an equal number of bales half a grade above the highest grade specified.

4. (Both.) Any excess of low grade may be rejected by the purchaser, or claimed for at an allowance. If rejected the seller is to have the right to replace and the purchaser may require replacement. The cost and actual expenses of handling rejections shall be paid by the seller.

5. (Both.) Whenever a specific lot of cotton purchased by actual samples does not equal the samples, the purchaser shall have the right to reject the lot if less than one half is equal to the samples. If one half or more is equal to the samples, the purchaser may reject the portion not equal to the samples, but in either event samples of the entire mark must be exhibited to the seller.

6. (Both.) The cost and actual expenses of handling the rejections shall be paid by the seller, and in case of rejection the seller shall not be called upon to replace.

DEFINITION OF SHORT STAPLE COTTON.

7. (Short.) The phrase "short staple," as used in these terms, is hereby defined to mean any length of staple shorter than 1⅛ inch, regardless of the territory from which it is shipped.

DEFINITION OF LONG STAPLE.

8. (Long.) The phrase "long staple," as used in these terms, is hereby defined to mean 1⅛ inch and longer, regardless of the territory from which it is shipped.

DIFFERENCES BETWEEN GRADES.

9. (Short.) Differences between grades shall be fixed on the third Thursdays of September, November and February, and shall be the average of the differences existing on said dates in the New York, New Orleans, Memphis and Augusta Cotton Exchanges. Claims for allowances on grade of short staple cotton shall be determined as above.

CLASSERS.

10. (Short.) The New England Cotton Buyers' Association or the Fall River Cotton Buyers' Association shall employ three or more cotton classers, three of whom are to act in each case, to class or staple all cotton submitted to them.

11. (Short.) The classers shall not undertake to declare the length of any staple, but shall judge of the length of staple of any lots submitted to them only in comparison with the length of staple of a type which has been agreed upon as a standard by the purchaser and seller, and which must be submitted with the samples of the lot in question.

BOARD OF APPEAL.

12. (Both.) There shall be a Board of Appeal consisting of three members, as follows: One member of the New England Cotton Buyers' Association or the Fall River Cotton Buyers' Association and one manufacturer (with alternates to serve in case of the absence or disqualification of either) and a third to be selected by them. The Board of Appeal shall serve for one year or until their successors are appointed.

13. (Both.) Any dispute between purchaser and seller as to whether a shipment conforms to the terms of a sale, the amount of any allowance, or the interpretation of any section of these terms, shall be referred to the Board of Appeal upon the request of either party in interest. The

decision of the Board of Appeal shall be final. No person interested in the cotton involved shall serve as a member of the Board of Appeal.

REDRAWN SAMPLES.

14. (Both.) In all cases where claims are made for off grade or where cotton is rejected, the purchaser shall furnish full-sized, redrawn samples from each bale of each mark, if required.

SHIPMENTS.

15. (Both.) Unless otherwise specified, cotton sold for prompt or immediate shipment must be shipped and bills of lading dated within 14 days from the date of sale.

16. (Both.) When a sale is made for shipment in a certain month or months, cotton may be shipped at any time the shipper may elect during the month or months specified, but shipments must be made and bills of lading dated within the month or months specified.

SHIPPING WEIGHTS.

17. (Both.) All sales shall be on the basis of guaranteed invoice weights.

18. (Short.) All short staple cotton from the States of Texas, Arkansas and Mississippi (with the exception of the upland portions) and from the New Orleans, Memphis and St. Louis markets shall be sold on the basis of 53,000 pounds for each 100 bales, and from the States of Oklahoma, North Carolina, South Carolina, Georgia, Alabama, Tennessee and the upland portions of Mississippi on the basis of 50,000 pounds for each 100 bales; there may be a variation of 5 per cent. either way, in each case.

19. (Long.) All long staple cotton shall be sold on the basis of 53,000 pounds for each 100 bales, with a variation of 5 per cent. either way.

20. (Both.) If the number of bales shipped does not make the weight as above provided, the shipper may be required to add a sufficient number of bales to bring the total weight of the cotton delivered up to the weight called for on the above basis.

21. (Both.) If a less number of bales than the number sold will give the weight called for on the above basis, the purchaser may require that the number of bales delivered shall be reduced accordingly.

22. (Both.) Written notice of any dissatisfaction with respect to shipping weights under the two preceding sections must be given by the purchaser not later than three days after receipt of invoice.

SCALES.

23. (Both.) The purchaser shall have his scales tested and certified by a Sealer of Weights and Measures at least every three months, and the date when they were last tested shall be shown on all weight and tare returns.

RECEIVING WEIGHTS.

24. (Both.) Cotton must be weighed as promptly as possible, but within 48 hours from the time it is taken from the car, or otherwise unloaded, and before it is stored. The receiving weight shall be tagged on each bale. There shall be ¼ pound per bale allowance after 48 hours for every day's delay in weighing.

25. (Both.) All cotton must be weighed before any samples or bands have been removed.

26. (Both.) All returns of weights must be sworn to or signed by a sworn weigher.

27. (Both.) In case of loss in weight separate detailed weight returns for each mark showing the gross weight of each bale (without any deductions for dampness, extra bands or any other cause) must be given to the seller within 15 days after receipt of cotton by the purchaser.

28. (Both.) When 95 per cent. of the cotton is received, if the balance of the shipment does not arrive within the next 15 days, the weights shall be reported as in Section 27, taking the average invoice weight for the short bales. The loss in weight shall be adjusted on this basis, and such weight settlement shall be final.

29. (Both.) If missing bales do not arrive within 30 days after the date of a claim for loss in weight, the purchaser shall make a claim against the transportation companies for the number of bales missing at that time, at the invoice weight and price, such claim to be filed for collection with the New England Freight Claim Bureau, either directly by the purchaser, or through the seller.

30. (Both.) When cotton is received by the purchaser in a wet or damaged condition it shall be immediately weighed and the seller and the transportation company notified in writing of its condition. The cotton shall be receipted for by

the purchaser to the transportation company under protest, and the seller shall be immediately notified of such protest.

31. (Both.) Such cotton shall be held, giving the shipper an opportunity to investigate; but the purchaser shall not be required to so hold it for a longer period than 10 days.

32. (Both.) Upon request all returns of weights must be dated showing when the cotton arrived and when it was weighed, upon blanks in the following form:

33. (Both.) DATES ARRIVAL AND WEIGHING.

.... 191......

This is to certify that......B/C marked ....shipped........................
191......by...to...

arrived at the mills and were weighed on the dates shown below.

DATE OF ARRIVAL.		DATE WEIGHED.	
......B/C arrived............191......	and were weighed	............191......	weight........
......B/C arrived............191......	and were weighed	............191......	weight........
......B/C arrived ....191......	and were weighed	............191	weight........
......B/C arrived............191......	and were weighed	............191......	weight........
......B/C arrived...... ......191......	and were weighed	....191......	weight........

....

By...

NOTE. Printed blank forms like above will be furnished by the New England or the Fall River Cotton Buyers' Association on request.

CLAIMS—LOSS IN WEIGHT.

34. (Both.) Claims for loss in weight shall be made on the basis of each separate invoice.

35. (Both.) In case of excessive loss in weight, *i. e.*, 5 pounds per bale, from the invoice weight, the cotton shall be held and the seller notified and given an opportunity to reweigh if he desires, but the purchaser shall not be required to hold the cotton for the purpose of reweighing for a longer period than 10 days. Nothing in this section, however, shall be construed to prohibit the seller from weighing a lot losing less than 5 pounds per bale if he so desires and if it is practicable. If the cotton is held in a heated warehouse proper allowance shall be made for extra shrinkage.

36. (Both.) If the seller desires to reweigh and the purchaser cannot furnish immediate access to the cotton, he shall be allowed 10 days to put the cotton in position for reweighing. If at the end of 10 days the purchaser is still unable to afford access to the cotton, he shall allow the seller ¼ pound per bale for each day thereafter until the cotton is accessible for reweighing.

37. (Both.) On reweighed cotton there shall be an allowance of ¼ pound per bale for sampling and 1¼ pounds for each band removed by the purchaser.

38. (Both.) Claims for loss in weight shall be accompanied by the purchaser's detailed weight lists of each mark and by a certificate as follows:

39. (Both). FORM OF WEIGHT RETURN.

....191......

This is to certify that.................B/C marked.................
invoiced to..
were weighed promptly (within 48 hours) after arrival and before any samples or bands were removed from any of the bales by us; also that the individual weights of the bales as shown on the attached detailed weight list are the gross weights of each bale and that the scale on which they were weighed was last tested and certified by a Sealer of Weights and Measures on..............................191......

....

By...

NOTE. Printed blank forms like above will be furnished on application to the New England or the Fall River Cotton Buyers' Association.

40. (Both.) If, on reweighing the reweights agree with the original receiving weights within 1 pound per bale (after due allowance is made for shrinkage, samples and bands, as per Sections 35 and 37), the claim shall be settled on the original receiving weights and the seller shall pay the cost of reweighing, and also the charge for handling.

41. (Both.) If their weights show a gain between 1 and 2 pounds per bale over the original receiving weights (after due allowance is made for shrinkage, samples and bands, as per Sections 35 and 37), the claim shall be settled on the reweights, the seller paying the cost of reweighing, the purchaser making no charge for handling.

42. (Both.) If the reweights show a gain of more than 2 pounds per bale over the original receiving weights (after due allowance is made for shrinkage, samples and bands, as per Sections 35 and 37), the claim shall be settled on the reweights, and the purchaser shall pay the cost of reweighing and shall make no charge for handling.

43. (Both.) The charge for handling on reweighed cotton shall be the amount of the actual cost to the purchaser of handling, but not exceeding 10 cents per bale.

CLAIMS—TARE.

44. (Both.) The first 10 bales of each mark of 100 bales or less taken out of a car, or otherwise unloaded at destination, shall be tagged with a red tag and indicated by

a cross on return of weights to the seller. If there are more than 100 bales in the mark, a number of bales equal to 10 per cent. of the mark shall be thus set aside, tagged and indicated.

45. (Both.) When opened, the bagging and ties on each of the bales so tagged shall be weighed, and a certificate shall be furnished the seller showing: (*a*) the gross weight of each bale at the time of its receipt, (*b*) the number of ties on each bale, and (*c*) the weight of the bagging and ties on each bale. The certificate shall also state that the bales so listed were the first unloaded of the mark and that the bagging was dry when weighed. The average gross tare per bale determined in the above manner shall be taken as the average tare for the entire mark.

46. (Both.) Form of Tare Return.

Tare Test on........B/C, set aside.......................191...... by....................................Mills, being part of ....bales invoiced.........................191...... by..................................

Tag Number Mark. (optional).	Gross Weight of Bale.	Number Bands	Weight Bands (optional).	Weight Bagging (optional.).	Gross Tare.

....

....

....

....

....

....

This is to certify that the above statement is correct and that the bales hereon listed were the first bales of this mark unloaded at the mill and that the bagging was dry when weighed. The scale on which they were weighed was last tested and certified by a Sealer of Weights and Measures on....................................191...

....

....

Note. Printed blank forms like above will be furnished on application to the New England or the Fall River Cotton Buyers' Association.

47. (Both.) All returns for tare must be sworn to or signed by a sworn weigher.

48. (Both.) The allowance for tare shall be an average of 24 pounds per bale. The purchaser shall be reimbursed for all tare in excess of this average at the invoice value less ½ cent per pound.

49. (Both.) All claims for excess tare shall be presented within 20 days from the date on which the average gross tare is ascertained as above, but not later than 9 months from the date of the receipt of the cotton.

50. (Both.) Excess tare claims are entirely independent of claims for loss in weight. Gain in weight of the cotton itself may not be applied against a claim for excess tare.

CLAIMS—GRADE AND STAPLE (SHORT.)

51. (Short.) Claims for grade or staple must be made as soon as possible, but not later than 30 days from the date of the receipt of the cotton.

52. (Short.) When 95 per cent. of the cotton is received, if the balance of the shipment does not arrive within 30 days, claims for grade or staple may be made on the lot as a whole on the average of the cotton received.

53. (Short.) Claims for grade on any portion of a mark must be accompanied by samples of the entire mark. If such samples are not furnished, bales not exceeding 5 per cent of the entire mark shall pass if said bales are not more than one-half grade "off."

54. (Short.) The seller must be notified immediately if the cotton shows "off grade" or "off staple" on inspection. Such notification shall not be delayed until the entire lot is received.

55. (Short.) Claims for allowance on difference in staple or grade of short staple cotton, except 1 1/16–1 1/8 inches, shall be settled according to the differences existing at the time of shipment, as provided in Section 9.

56. (Short.) Claims for allowances on differences on cotton sold as 1 1/16–1 1/8 inches shall be settled (except in case replacement is required, as provided in Section 61) on the prevailing differences existing at the time of shipment, provided no more than 15 per cent. of the mark is off.

57. (Short.) If more than 15 per cent. of the mark is off grade or staple, the entire number of bales of such cotton shall be settled for by the seller on the differences existing at the time of the arrival of the cotton.

58. (Short.) The above terms for claims on grade or staple are not to apply to long staple cotton, *viz.*, 1 1/8 inches and longer; but terms for tare and weight shall apply to American long staple cotton, except Sea Island.

CLAIMS—FALSE, MIXED, WATER-PACKED.

59. (Both.) In case of false-packed, mixed-packed or

water-packed bales, the purchaser shall use the portion of the bale that is right.

60. (Both.) The inferior portion is to be used, if possible, at an allowance; but if not, the purchaser shall return the inferior portion with tags and sworn statement, and be paid for the same at the invoice price of sale.

REPLACEMENT.

61. (Both.) If cotton is rejected by the purchaser on account of its being a quality inferior to the terms of sale, and if a settlement is not made with the purchaser at an allowance, replacement shall be made of the same weight within 5%.

62. (Both.) Replacements must be shipped promptly, but in case of scarcity of the quality required the seller shall be allowed such additional time for replacement as he may show to be necessary, but in any event not over 30 days, except by agreement with purchaser.

63. (Both.) All actual expenses incurred by reason of the necessity of replacement shall be borne by the seller.

ARBITRATION—Short Staple.

64. (Short.) In cases where the seller and the purchaser cannot agree as to the grade or staple of short staple cotton, redrawn samples shall be submitted to the classers, and if their decision is not satisfactory to both parties, or in case any dispute still exists between them, the matter shall be referred to the Board of Appeal upon request of either party.

65. (Short.) No person interested in the cotton involved in the arbitration shall serve as classer.

66. (Short.) The purchaser shall pay the total cost per bale of the arbitration on the number of bales that are found to be equal to the contract, and the seller shall pay at the same rate on the number of bales found to be not equal to the contract. If a bale is off in grade and up in staple, the seller pays for what is off in grade and the buyer pays for stapling.

67. (Short.) In all cases of arbitration between a manufacturer and a member of the New England Cotton Buyers' Association or a member of the Fall River Cotton Buyers' Association a charge of 15 cents per bale shall be made for classing and 15 cents per bale for stapling. For non-members the charge shall be 20 cents for classing and 20 cents for stapling.

68. (Short.) In all cases of arbitration the names of the purchaser and seller shall not appear, nor shall the identifying

marks of the cotton be known, but the cotton shall be submitted to arbitration under bale numbers or lot numbers, as, for example, "Lot No. 6."

INSURANCE.

69. (Both.) Unless otherwise specified on sale note, the purchaser shall cover all his cotton with transit insurance.

70. (Both.) All purchases from or *via* Atlantic ports shall be based on the "rail and water" insurance rates.

71. (Both.) All other purchases shall be based on the "all rail" insurance rates, except shipments by specified sailings from Gulf ports.

72. (Both.) The purchaser shall be reimbursed for any extra insurance on shipments moving from or *via* Gulf ports, except when the cotton is sold specifically as sailing or shipment from such ports, in which case there shall be no claim upon the seller for difference in the insurance rate.

BURNT OR LOST COTTON.

73. (Both.) In all cases where cotton is lost or destroyed in transit, the contract shall be annulled thereby to the extent of such loss or destruction.

CLAIMS—GRADE AND STAPLE (LONG.)

74. (Long.) Claims for grade and staple must be made within 15 days from the date of the receipt of the last portion of a shipment, but the seller must be notified immediately if the cotton shows "off grade" or "off staple" on inspection. Such notification shall not be delayed until the entire lot is received.

75. (Long.) Claims for allowances on differences on staple cotton sold as 1⅛ inches or longer shall be settled (except in case replacement is required as provided in Section 61) on the prevailing differences existing at the time of shipment, provided no more than 15% of the mark is off.

76. (Long.) If more than 15% of the mark is off grade or staple, the entire number of bales of such cotton shall be settled for by the seller on the differences existing at the time of the arrival of the cotton.

ARBITRATION—LONG STAPLE.

77. (Long.) In case of difference of opinion on cottons 1⅛ inches or longer staple sold on type, the purchaser and seller shall each choose an arbitrator. These two arbitrators shall agree on a third, and if these two cannot agree on a

third arbitrator they shall each name an arbitrator and he shall be chosen by lot.

78. (Long.) The arbitrators shall each be paid 10 cents per bale. The entire cost of arbitration, including sampling and other expenses, shall be borne by the purchaser and seller. The purchaser shall pay the total cost per bale of the arbitration on the number of bales found equal to the contract and the seller shall pay at the same rate for the number of bales found not equal to the contract. If a bale is off in grade and up in staple, the seller pays for what is off in grade and the buyer pays for stapling.

79. (Long.) In case of any difference of opinion on long staple cotton sold on description, the purchaser and seller shall agree on a type as a standard of length and character before submitting the same for arbitration. The arbitration shall then be decided by three arbitrators as provided for in the case of long staple cotton sold on type.

80. (Both.' These revised terms shall take effect on all sales made on and after September 1, 1912.

The form of contract sale note for staple gray goods shown on pages 57 to 60 inclusive was approved and adopted by The National Association of Cotton Manfacturers, and the American Cotton Manufacturers' Association in 1910.

CONTRACT SALE NOTE FOR STAPLE GRAY GOODS.

Form approved and adopted by The National Association of Cotton Manufacturers and American Cotton Manufacturers' Association, 1910.

Number

SOLD FOR ACCOUNT OF

TO

QUANTITY

Yards (variation not to exceed 2 % allowed)
pieces of yards each—
bales of yards each

Allowable variation in length of pieces *if special.*

In addition, buyer to take and seller to deliver if made:
% Seconds @
% Tailings at stated contract price if contract is not renewed.

QUALITY

TIME OF DELIVERY
from date hereof
during each week, commencing week ending
during each month, beginning in the month of

WIDTH IN INCHES

COUNT PER INCH, Warp Filling

WEIGHT
No shipment to average ⎧ lighter ⎫ than YARDS TO THE POUND.
No bale to be over 1 %
No piece to be over 3 % ⎩ heavier ⎭

PRICE CENTS PER YARD

TERMS OF PAYMENT:
Net days from date of delivery
Net days from date of delivery less % for payment within days from date of delivery:

PLACE OF DELIVERY:
F. O. B. to carrier at with freight allowance.
F. O. B.

SPECIAL CONDITIONS:

SHIPPING INSTRUCTIONS:

If the production of the seller shall be curtailed during the time above named, by strikes, lockouts, or unavoidable casualties, the deliveries shall be made and accepted in proportion to the production.

The provisions of paragraphs I, II and III, and the allowable variations from specifications as adopted by The American Cotton Manufacturers' Association and The National Association of Cotton Manufacturers, all as printed on the back hereof, are accepted and agreed to as a part of this contract, unless otherwise stated herein.

This sale note is the entire contract between the buyer and seller, and any alteration in or changes from the printed form of this contract must appear on it in writing.

To (Signed) ....

Paragraph I.—PASSING OF TITLE ON DELIVERY. Unless otherwise specified, the title to goods sold passes to the buyer (subject to the right of stoppage *in transitu*) :—

a. Upon delivery F. O. B. to carrier, consigned to buyer, and thereafter goods are at buyer's risk.

b. Upon arrival of goods at destination and delivery to buyer of bill of lading or of goods, in the case of goods to be delivered F. O. B. elsewhere than to carrier.

c. Upon delivery of indorsed bill of lading or of goods, in the case of goods consigned to seller's order.

d. Upon the separation of the goods and holding subject to buyer's order (the invoice to follow by due course of mail), in the case of goods to be held or if buyer fails to give shipping instructions.

Paragraph II.—STORAGE AND INSURANCE. Goods invoiced and held subject to buyer's orders shall be at buyer's risk, but covered by fire insurance effected by sellers in reputable companies.

Paragraph III.—REJECTIONS AND CLAIMS. The buyer cannot reject the goods for delay in delivery unless he notifies the seller within five business days from receipt of bill of lading, or of invoice if goods are to be held. When contract calls for delivery in instalments, the buyer cannot cancel the contract for any default in any one or more instalments not amounting to a substantial breach of contract, but may cancel or replace at seller's expense any delivery that is delayed.

Buyer cannot reject goods for defects in quality or other like defaults (*a*) if he cuts or converts them, nor (*b*) unless he notifies seller within ninety days from receipt by him or at finishing works of goods not held, or within ninety days after date of invoice if goods are invoiced and held; nor (*c*) unless such defects amount to a substantial breach of contract.

Loss of right to reject does not deprive the buyer of his right to claim damages, if any; but no recovery shall be had on any claim not made within one year from receipt of goods or from date of invoice if goods are held.

ALLOWABLE VARIATIONS FROM CONTRACT SPECIFICATIONS.

WIDTH. The width shall not vary anywhere by more than ⅜ of an inch below the stipulated width, nor more than

⅝ of an inch above. The width shall not be uniformly less than the stipulated width, but must, in a majority of places in each piece, be equal to, or greater than, the stipulated width. Goods shall be measured at right angles to the selvages when laid open on a flat, horizontal surface and smoothed out by hand, but not stretched.

WARP COUNT. Except within four inches of each selvage, (where exclusive of the selvage, the count must approximate that stipulated) the number of warp threads per inch shall not vary anywhere by more than one thread per inch below the stipulated count, nor by more than two threads per inch above. The number of threads in each piece must equal the stipulated count multiplied by the stipulated width plus the extra threads used in the selvage.

FILLING COUNT. The number of threads in the filling, or weft, shall not vary anywhere by more than three threads per inch below the stipulated count, nor by more than four above. In the case of sateens, when the count of filling exceeds the count of the warp, the allowance for variation above specified shall be increased by the same percentage that the filling count exceeds that of the warp count. In any case including sateens, the filling count per inch shall not run below the stipulated count throughout the piece, but must, in a majority of places in each piece, equal or be more than, the stipulated count.

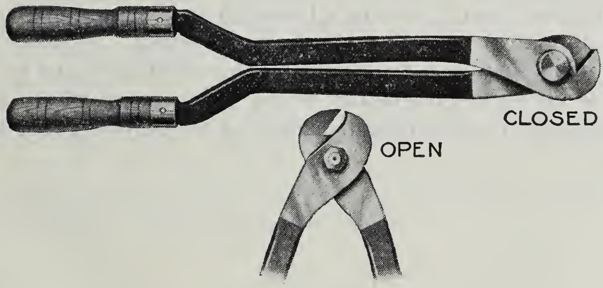
WEIGHT. In case of controversy regarding the weight of goods, decision shall be based on goods which have been exposed for twenty-four hours to normal atmospheric conditions approximating a temperature of 70 degrees F. and a humidity of 70 per cent.

A cotton mill, whether an old one contemplating additions to its existing equipment or a new one starting to build a complete plant, should employ the services of a competent mill engineer.

The question of proper material, situation for the plant itself and the relative proportions of machinery in the different departments is an intricate one, and a great deal of money can be saved or wasted in its solution.

In the designing and manufacture of cotton machinery there are well-known specialists. The machinery field is too broad and complex for any one company to be able to turn out the best products of every class. Realizing this we have devoted our energies to a few special machines and feel confident that in our line we build the best.

COTTON BALE SHEARS.



When the cotton bale arrives at the mill its contents, after the ties that hold the bale together have been cut, are started on a continuous journey through the mill.

We make Cotton Bale Shears that are specially designed for the purpose of cutting these ties. The use of a dull axe, or a hammer and chisel, for this purpose is dangerous owing to the liability of fire from the flying of a spark into the highly inflamable contents of a cotton bale. This practice has been in terms objected to by insurance companies. We have sold a large number of Shears, and they have given satisfaction.

OPENING AND PICKING.

One of the most important things to be considered in laying out the picker room is the care that must be taken to prevent fire. The action of the swiftly revolving beaters is very liable to make sparks should any metallic substance be fed in with the cotton. Hot bearings can also cause fires and should be guarded against. When a fire does start it is as essential to keep the machine feeding out from the beaters as it is to stop the cotton from going into the beaters. This obviously diminishes the amount of cotton burned and so reduces the heat of the fire and the resultant damage.

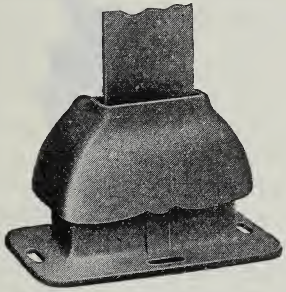
The picking machinery is the heaviest used in the ordinary cotton mill; great care must be used in setting it up and seeing that it is properly leveled. All the revolving shafts should run freely and the beaters should be nicely balanced.

It is essential that an even lap be produced. A good clean lap cannot be made with an over-crowded machine as there is neither time nor opportunity for dirt and leaf to separate from the fibre. Dirt should be removed from under the beaters with regularity, and cleanliness in this department should be vigorously enforced.

The use of modern feeders in the picking room has contributed more towards a thorough opening and mixing of the fibre than any other single improvement. A number of the mills now open their bales in the storehouse, and by the use of air convey the cotton to the picker room where it is distributed to the various machines as the hoppers get empty.

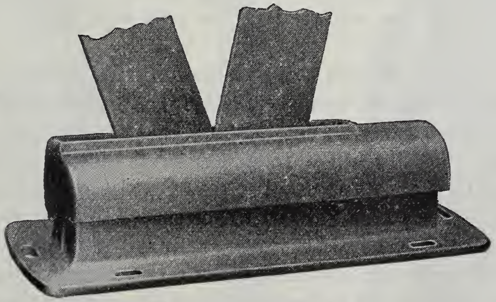
WOOD'S BELT HOLE GUARDS.

We have furnished thousands of these belt hole guards originally patented by Mr. B. L. Wood. We now have a large variety of patterns and can meet the exact requirements in each individual mill.



For Straight Belts.

These belt hole guards have many advantages to recommend them to the mill owner. The rotary movement of the covers of the guards reduces the belt hole in size; for instance, a two inch cross belt requires a hole about four inches wide and six to ten inches in length. These guards reduce the opening to about three-quarters of an inch in width by about nine or ten inches in length, making a reduction in the area of the opening from thirty-two square inches to about six square inches.



For Crossed Belts.

One of the results of reducing this opening is that cotton, waste, yarn or any other articles likely to be on a mill floor have just that much less chance of passing down on to the machinery below. They also prevent heated air from passing from the lower to the upper room, and so simplify the problem of humidification in both places.

For Slanting Belts.

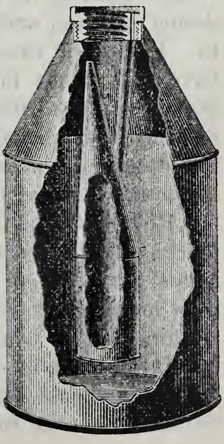
As a preventive of fire damage these guards are endorsed and recommended by the Insurance Companies. If a fire should happen to occur near them, they prevent flames from passing either up or down. The floor of the room where the guards are used can be flooded to a depth of two inches before water will flow through the openings. In this way a small fire in an upper story of a mill, localized and put out with a moderate amount of water, would be limited to fire damage. The practical elimination of water damage in such a case may easily amount to the saving of more than half the total loss suffered if the belt hole guards had not been used.

In addition to the advantages of fire protection, and protection from the various articles passing through the belt holes to the lower floor, these guards have a distinct advantage in their effect upon the belt. They prevent the belt from twisting, keeping it true over the pulleys so saving power, and they also help to keep the belt square on the pulley and prevent the belt from running partly on the tight pulley and partly on the loose, as otherwise often happens.

These guards are so designed that they do not need oiling, and after being installed require no attention.

GETCHELL'S IMPROVED THOMPSON OIL-CAN.

We have manufactured oil-cans for over fifty years; during this period our product has been unrivalled for economy and durability. Since the expiration of the Thompson and Getchell patents the design of our can with its removable air chamber and vent tube has been copied by other manufacturers. Our quality of material, however, and in this way, the durability of our product has not been copied, and the oil-cans made by certain manufacturers are sold for less money than we pay for the raw stock of which our product is made. These cans get hard use in and around the machinery of a mill and a substantially made can is well worth its extra cost. We urge that purchasers give consideration to length of service as well as design in oil-cans, and feel sure they will pay the original introducers of the Thompson can a price that will guarantee them a first class durable article. See that your Thompson oil-cans bear our name.



Our regular sizes are designated as follows:

Large.........	3¼	in. high,	2¾	in. diam.,	holding	3 gills.
Common.....	3	" "	2½	" "	"	2 "
Small.........	2⅜	" "	2⅛	" "	"	1 "

Our standard length of tube is 3¼ inches; other lengths are made to order. The delivery holes in the tubes are made to correspond to wire gauge numbers, that is, a number 19 tube has a hole measuring number 19 gauge. Numbers 19, 20 and 21 are most frequently called for.

CARDING.

The organization of a modern card room consists of revolving flat cards, drawing frames, and coarse and fine roving frames. Railway heads and lap winders are still used to some extent; the increasing use of Egyptian and other long staple cottons has led to a greater use of combers. Cards are designed for certain speeds and production and should not be driven beyond their capacity; no machine in the mill is as sensitive to attempted overproduction as a card. The clothing will be injured and the product damaged by such operation.

As card clothing plays a most important part in the results gained on a carding machine, only the best grades should be used and the grinding should be carefully attended to. Plenty of time should be taken and the grinder should have only what he can do carefully and thoroughly. He should be urged first, to be sure of the quality of his work, making the quantity distinctly secondary to good work. Grinding once in two or three weeks keeps up the standard of the product and fully pays for the time and labor.

Roving frames should be carefully set up and firmly in place. All the parts should be level and in line. The sharp edges of the steel rolls should be removed by rubbing the rolls lengthways with whiting and oil, or a piece of card clothing. All bearings should be properly oiled, being careful to leave no oil where it can damage the product. The machines should be run some time without work in them to limber up all the running parts; each spindle and flyer should have individual attention. If in this preliminary work-out any weak or damaged parts are discovered they should be at once replaced so that the machine will start producing without a weak place in it. Hot bearings damage the machine, are productive of fire, and should be watched for carefully. Attention to the covering of the top rolls will detect any uneven places and save trouble later.

The general increase in the use of metallic rollers is in a large measure doing away with just this trouble.

CARD CLOTHING.

English Counts.	Points per Square Foot.	American No. of Wire.
60s	43,200	28
70s	50,400	30
80s	57,600	31
90s	64,800	32
100s	72,000	33
110s	79,200	34
120s	86,400	35
130s	93,600	36

RULES FOR CARDERS.

To determine the number of hanks or decimal parts of hanks to the pound for carding, drawing, slubbing, roving and yarn, according to a given number of yards reeled or measured:—

Multiply the number of yards by $8\frac{1}{3}$ and divide by their weight in grains; the quotient will be the hanks or decimal parts of hanks required.

One yard of No. 1 roving or yarn weighs $8\frac{1}{3}$ grains.

To ascertain what number of yarn will be produced from a given drawing or sliver:—

Measure off a convenient number of yards of sliver, multiply this number by extent of drawing on roving and spinning heads, then multiply by $8\frac{1}{3}$ and divide by the weight in grains, which will give the number of yarn produced from the given sliver. *Example:* Take two yards of sliver weighing 20 grains, and suppose it is to be drawn 5 on roving and 10 on spinning.

$2\times5\times10\times8\frac{1}{3}=833.3,\div20=$No. 41.6, the number of yarn.

To determine what weight a given length of drawing, slubbing, roving or yarn should be to equal a given number of hanks or decimal parts of hanks:—

Multiply the given number of yards in length by $8\frac{1}{3}$ and divide by the number of hanks or decimal parts of hanks required; the quotient will be the weight, in grains, of the given length of drawing, roving or yarn.

To number the yarn produced from roving:—

Reel or measure off a convenient number of yards of roving; multiply this number by extent of drawing on spinning heads. This product multiplied by $8\frac{1}{3}$ and divided by the weight, will give the number of yarn which would be made from the roving. *Example:* Suppose 5 yards of roving weigh 20 grains, and the draught is 10. Then $5\times10\times8\frac{1}{3}=416.6,\div20=$ 20.8, the number of the yarn.

Given, the weight of lap from the picker, and draught and doublings from the card to the spinning frame: To find the weight at any given point and number of yarn that will be produced:—

Example: Weight of lap, 9 oz.; single carding, draught, 100; railway head, draught, 4; doublings, 14; first drawing, draught, 4, doublings, 3; second drawing, draught, $4\frac{1}{2}$, doublings, 3; slubbers, draught, 4; intermediates, doublings, 2, draught, $5\frac{1}{2}$; fine frames, doublings, 2, draught, $6\frac{1}{2}$; spinning frames, draught, $7\frac{1}{2}$; allowance for flyings and strippings in carding, 12 per cent.; allowance for take up by twist in slubbing, intermediate, fine and spinning frames, $\frac{1}{31}$ each, or about $\frac{1}{7}$ in all; with the following result:—

$9\times437.5=3937.5$ grains in 1 yard of lap.

$3937.5\div100=39.375$ grains in 1 yard after leaving card, were there no loss.

$39.375\times.88=34.65$ grains in 1 yard after deducting 12 per cent. for flyings and strippings.

$34.65\times14\div4=121.27$ grains in 1 yard after leaving railway head.

$121.27\times3\div4=90.95$ grains in 1 yard after leaving first drawing.

$90.95\times3\div4\frac{1}{2}=60.63$ grains in 1 yard after leaving second drawing.

$60.63\div4\times\frac{32}{31}\times12=187.76$ grains in 12 yards after leaving slubbers.

$187.76\times2\div5\frac{1}{2}\times\frac{32}{31}=70.48$ grains in 12 yards after leaving intermediates.

$70.48\times2\div6\frac{1}{2}\times\frac{32}{31}=22.39$ grains in 12 yards after leaving fine frames.

$22.39\div7\frac{1}{2}\times\frac{32}{31}=3.081$ grains in 12 yards after leaving spinning frames.

$3.081\times70=215.67$ grains in 1 hank after leaving spinning frames.

$7000\div215.67=32.45$ number of yarn.

Rule: Multiply the weight in ounces of one yard of lap by 437.5 (grains in an avoirdupois ounce), to reduce to grains; divide by draught of card and multiply by $\frac{88}{100}$ to give weight with allowance for loss in carding; for each successive process, multiply by the doublings and divide by the draught, and on slubbing, intermediate, fine and spinning frames multiply by $\frac{32}{31}$ to allow for increase in weight by twist; at slubbers multiply by 12 for a common number of yards to weigh; and at spinning frames by 70, to give weight per hank, and divide 7000 by the product to determine the number of yarn.

NOTE.—Roving and yarn contract in twisting, and an allowance should be made for this in all computations for a twisted product. This allowance will vary with the number of the yarn and amount of twist put in.

To find the weight of lap required to produce a given number of yarn, and also the weight at any given point, the draught and doublings being known:—

Example: Suppose the draught and doublings the same as in the preceding, and we wish to produce No. 32.45 yarn.

$7000 \div 32.45 = 215.71$ grains per hank.

$215.71 \div 70 = 3.081$ grains per 12 yards.

$3.081 \times \frac{31}{32} \times 7\frac{1}{2} = 22.39$ grains per 12 yards after leaving fine frames.

$22.39 \times \frac{31}{32} \times 6\frac{1}{2} \div 2 = 70.49$ grains per 12 yards after leaving intermediates.

$70.49 \times \frac{31}{32} \times 5\frac{1}{2} \div 2 = 187.78$ grains per 12 yards after leaving slubbers.

$187.78 \times \frac{31}{32} \times 4 \div 12 = 60.63$ grains per 1 yard after leaving second drawing.

$60.63 \times 4\frac{1}{2} \div 3 = 90.95$ grains per 1 yard after leaving first drawing.

$90.95 \times 4 \div 3 = 121.27$ grains per 1 yard after leaving railway-head.

$121.27 \times 4 \div 14 = 34.65$ grains per 1 yard after leaving card.

$34.65 \times 100 \times \frac{100}{88} = 3937.5$ grains per 1 yard of lap.

$3937.5 \div 437.5 = 9$ ounces per 1 yard of lap.

Rule: Divide 7000 by the number of yarn desired, and that quotient by 70 to give the weight of 12 yards; multiply by the draught of each machine and divide by the doublings; for spinning, fine, intermediate and slubbing frames multiply by $\frac{31}{32}$ to allow for decrease in weight by taking out the twist; at second drawing divide by 12 to give the weight of one yard; multiply by $\frac{100}{88}$ at the card to allow for loss, and divide by 437.5 to give weight of lap required in ounces.

The tables for numbering roving which follow have been extended and adapted for numbering from weights in tenths of grains. The twist in all cases is 1.20 times the square root of the number.

TABLE FOR NUMBERING ROVING.

12 yds. weigh grains.	Hank roving.	12 yds. weigh grains.	Hank roving.	12 yds. weigh grains.	Hank roving.	12 yds. weigh grains.	Hank roving.	12 yds. weigh grains.	Hank roving.
1.	100.00	9.	11.11	16.	6.25	23.	4.35	30.	3.33
.2	83.33	.1	10.99	.1	6.21	.1	4.33	.1	3.32
.4	71.43	.2	10.87	.2	6.17	.2	4.31	.2	3.31
.6	62.50	.3	10.75	.3	6.13	.3	4.29	.3	3.30
.8	55.56	.4	10.64	.4	6.10	.4	4.27	.4	3.29
2.	50.00	.5	10.53	.5	6.06	.5	4.26	.5	3.28
.2	45.45	.6	10.42	.6	6.02	.6	4.24	.6	3.27
.4	41.67	.7	10.31	.7	5.99	.7	4.22	.7	3.26
.6	38.46	.8	10.20	.8	5.95	.8	4.20	.8	3.25
.8	35.71	.9	10.10	.9	5.92	.9	4.18	.9	3.24
3.	33.33	10.	10.00	17.	5.88	24.	4.17	31.	3.23
.1	32.26	.1	9.90	.1	5.85	.1	4.15	.1	3.22
.2	31.25	.2	9.80	.2	5.81	.2	4.13	.2	3.21
.3	30.30	.3	9.71	.3	5.78	.3	4.12	.3	3.19
.4	29.41	.4	9.62	.4	5.75	.4	4.10	.4	3.18
.5	28.57	.5	9.52	.5	5.71	.5	4.08	.5	3.17
.6	27.78	.6	9.43	.6	5.68	.6	4.07	.6	3.16
.7	27.03	.7	9.35	.7	5.65	.7	4.05	.7	3.15
.8	26.32	.8	9.26	.8	5.62	.8	4.03	.8	3.14
.9	25.64	.9	9.17	.9	5.59	.9	4.02	.9	3.13
4.	25.00	11.	9.09	18.	5.56	25.	4.00	32.	3.12
.1	24.39	.1	9.01	.1	5.52	.1	3.98	.1	3.12
.2	23.81	.2	8.93	.2	5.49	.2	3.97	.2	3.11
.3	23.26	.3	8.85	.3	5.46	.3	3.95	.3	3.10
.4	22.73	.4	8.77	.4	5.43	.4	3.94	.4	3.09
.5	22.22	.5	8.70	.5	5.41	.5	3.92	.5	3.08
.6	21.74	.6	8.62	.6	5.38	.6	3.91	.6	3.07
.7	21.28	.7	8.55	.7	5.35	.7	3.89	.7	3.06
.8	20.83	.8	8.47	.8	5.32	.8	3.88	.8	3.05
.9	20.41	.9	8.40	.9	5.29	.9	3.86	.9	3.04
5.	20.00	12.	8.33	19.	5.26	26.	3.85	33.	3.03
.1	19.61	.1	8.26	.1	5.24	.1	3.83	.1	3.02
.2	19.23	.2	8.20	.2	5.21	.2	3.82	.2	3.01
.3	18.87	.3	8.13	.3	5.18	.3	3.80	.3	3.00
.4	18.52	.4	8.06	.4	5.15	.4	3.79	.4	2.99
.5	18.18	.5	8.00	.5	5.13	.5	3.77	.5	2.99
.6	17.86	.6	7.94	.6	5.10	.6	3.76	.6	2.98
.7	17.54	.7	7.87	.7	5.08	.7	3.75	.7	2.97
.8	17.24	.8	7.81	.8	5.05	.8	3.73	.8	2.96
.9	16.95	.9	7.75	.9	5.03	.9	3.72	.9	2.95
6.	16.67	13.	7.69	20.	5.00	27.	3.70	34.	2.94
.1	16.39	.1	7.63	.1	4.98	.1	3.69	.1	2.93
.2	16.13	.2	7.58	.2	4.95	.2	3.68	.2	2.92
.3	15.87	.3	7.52	.3	4.93	.3	3.66	.3	2.92
.4	15.62	.4	7.46	.4	4.90	.4	3.65	.4	2.91
.5	15.38	.5	7.41	.5	4.88	.5	3.64	.5	2.90
.6	15.15	.6	7.35	.6	4.85	.6	3.62	.6	2.89
.7	14.93	.7	7.30	.7	4.83	.7	3.61	.7	2.88
.8	14.71	.8	7.25	.8	4.81	.8	3.60	.8	2.87
.9	14.49	.9	7.19	.9	4.78	.9	3.58	.9	2.87
7.	14.29	14.	7.14	21.	4.76	28.	3.57	35.	2.86
.1	14.08	.1	7.09	.1	4.74	.1	3.56	.1	2.85
.2	13.89	.2	7.04	.2	4.72	.2	3.55	.2	2.84
.3	13.70	.3	6.99	.3	4.69	.3	3.53	.3	2.83
.4	13.51	.4	6.94	.4	4.67	.4	3.52	.4	2.82
.5	13.33	.5	6.90	.5	4.65	.5	3.51	.5	2.82
.6	13.16	.6	6.85	.6	4.63	.6	3.50	.6	2.81
.7	12.99	.7	6.80	.7	4.61	.7	3.49	.7	2.80
.8	12.82	.8	6.76	.8	4.59	.8	3.47	.8	2.79
.9	12.66	.9	6.71	.9	4.57	.9	3.46	.9	2.79
8.	12.50	15.	6.67	22.	4.55	29.	3.45	36.	2.78
.1	12.35	.1	6.62	.1	4.52	.1	3.44	.1	2.77
.2	12.20	.2	6.58	.2	4.50	.2	3.42	.2	2.76
.3	12.05	.3	6.54	.3	4.48	.3	3.41	.3	2.75
.4	11.90	.4	6.49	.4	4.46	.4	3.40	.4	2.75
.5	11.76	.5	6.45	.5	4.44	.5	3.39	.5	2.74
.6	11.63	.6	6.41	.6	4.42	.6	3.38	.6	2.73
.7	11.49	.7	6.37	.7	4.41	.7	3.37	.7	2.72
.8	11.36	.8	6.33	.8	4.39	.8	3.36	.8	2.72
.9	11.24	.9	6.29	.9	4.37	.9	3.34	.9	2.71

TABLE FOR NUMBERING ROVING.

12 yds. weigh grains.	Hank roving.	12 yds. weigh grains.	Hank roving.	12 yds. weigh grains.	Hank roving.	12 yds. weigh grains.	Hank roving.	12 yds. weigh grains.	Hank roving.
37.	2.70	48.	2.08	65.	1.54	100	1.00	190	.53
.1	2.70	.2	2.07	.5	1.53	101	.99	192	.52
.2	2.69	.4	2.07	66.	1.52	102	.98	194	.52
.3	2.68	.6	2.06	.5	1.50	103	.97	196	.51
.4	2.67	.8	2.05	67.	1.49	104	.96	198	.51
.5	2.67	49.	2.04	.5	1.48	105	.95	200	.50
.6	2.66	.2	2.03	68.	1.47	106	.94	202	.50
.7	2.65	.4	2.02	.5	1.46	107	.93	204	.49
.8	2.65	.6	2.02	69.	1.45	108	.93	206	.49
.9	2.64	.8	2.01	.5	1.44	109	.92	208	.48
38.	2.63	50.	2.00	70.	1.43	110	.91	210	.48
.1	2.62	.2	1.99	.5	1.42	111	.90	212	.47
.2	2.62	.4	1.98	71.	1.41	112	.89	214	.47
.3	2.61	.6	1.98	.5	1.40	113	.88	216	.46
.4	2.60	.8	1.97	72.	1.39	114	.88	218	.46
.5	2.60	51.	1.96	.5	1.38	115	.87	220	.45
.6	2.59	.2	1.95	73.	1.37	116	.86	222	.45
.7	2.58	.4	1.95	.5	1.36	117	.85	224	.45
.8	2.58	.6	1.94	74.	1.35	118	.85	226	.44
.9	2.57	.8	1.93	.5	1.34	119	.84	228	.44
39.	2.56	52.	1.92	75.	1.33	120	.83	230	.43
.1	2.56	.2	1.92	.5	1.32	121	.83	235	.43
.2	2.55	.4	1.91	76.	1.32	122	.82	240	.42
.3	2.54	.6	1.90	.5	1.31	123	.81	245	.41
.4	2.54	.8	1.89	77.	1.30	124	.81	250	.40
.5	2.53	53.	1.89	.5	1.29	125	.80	255	.39
.6	2.53	.2	1.88	78.	1.28	126	.79	260	.38
.7	2.52	.4	1.87	.5	1.27	127	.79	265	.38
.8	2.51	.6	1.87	79.	1.27	128	.78	270	.37
.9	2.51	.8	1.86	.5	1.26	129	.78	275	.36
40.	2.50	54.	1.85	80.	1.25	130	.77	280	.36
.2	2.49	.2	1.85	.5	1.24	131	.76	285	.35
.4	2.48	.4	1.84	81.	1.23	132	.76	290	.34
.6	2.46	.6	1.83	.5	1.23	133	.75	295	.34
.8	2.45	.8	1.82	82.	1.22	134	.75	300	.33
41.	2.44	55.	1.82	.5	1.21	135	.74	305	.33
.2	2.43	.2	1.81	83.	1.20	136	.74	310	.32
.4	2.42	.4	1.81	.5	1.20	137	.73	315	.32
.6	2.40	.6	1.80	84.	1.19	138	.72	320	.31
.8	2.39	.8	1.79	.5	1.18	139	.72	330	.30
42.	2.38	56.	1.79	85.	1.18	140	.71	340	.29
.2	2.37	.2	1.78	.5	1.17	141	.71	350	.29
.4	2.36	.4	1.77	86.	1.16	142	.70	360	.28
.6	2.35	.6	1.77	.5	1.16	143	.70	370	.27
.8	2.34	.8	1.76	87.	1.15	144	.69	380	.26
43.	2.33	57.	1.75	.5	1.14	145	.69	390	.26
.2	2.31	.2	1.75	88.	1.14	146	.68	400	.25
.4	2.30	.4	1.74	.5	1.13	147	.68	410	.24
.6	2.29	.6	1.74	89.	1.12	148	.68	420	.24
.8	2.28	.8	1.73	.5	1.12	149	.67	430	.23
44.	2.27	58.	1.72	90.	1.11	150	.67	440	.23
.2	2.26	.2	1.72	.5	1.10	152	.66	450	.22
.4	2.25	.4	1.71	91.	1.10	154	.65	460	.22
.6	2.24	.6	1.71	.5	1.09	156	.64	470	.21
.8	2.23	.8	1.70	92.	1.09	158	.63	480	.21
45.	2.22	59.	1.69	.5	1.08	160	.62	490	.20
.2	2.21	.2	1.69	93.	1.08	162	.62	500	.20
.4	2.20	.4	1.68	.5	1.07	164	.61	525	.19
.6	2.19	.6	1.68	94.	1.06	166	.60	550	.18
.8	2.18	.8	1.67	.5	1.06	168	.60	575	.17
46.	2.17	60.	1.67	95.	1.05	170	.59	600	.17
.2	2.16	.5	1.65	.5	1.05	172	.58	625	.16
.4	2.16	61.	1.64	96.	1.04	174	.57	650	.15
.6	2.15	.5	1.63	.5	1.04	176	.57	675	.15
.8	2.14	62.	1.61	97.	1.03	178	.56	700	.14
47.	2.13	.5	1.60	.5	1.03	180	.56	725	.14
.2	2.12	63.	1.59	98.	1.02	182	.55	775	.13
.4	2.11	.5	1.57	.5	1.02	184	.54	825	.12
.6	2.10	64.	1.56	99.	1.01	186	.54	900	.11
.8	2.09	.5	1.55	.5	1.01	188	.53	1000	.10

TWIST OF ROVING.

Hank roving.	Square root.	Twist, 1.2× sq. root.	Hank roving.	Square root.	Twist, 1.2× sq. root.	Hank roving.	Square root.	Twist, 1.2× sq. root.	Hank roving.	Square root.	Twist, 1.2× sq. root.
.10	.316	.38	.80	.894	1.07	2.20	1.483	1.78	4.32	2.078	2.49
.11	.332	.40	.82	.906	1.09	2.22	1.490	1.79	4.36	2.088	2.51
.12	.346	.41	.84	.917	1.10	2.25	1.500	1.80	4.40	2.098	2.52
.13	.361	.43	.86	.927	1.11	2.28	1.510	1.81	4.44	2.107	2.53
.14	.374	.45	.88	.938	1.13	2.31	1.520	1.82	4.48	2.117	2.54
.15	.387	.46	.90	.949	1.14	2.34	1.530	1.84	4.52	2.126	2.55
.16	.400	.48	.92	.959	1.15	2.37	1.539	1.85	4.56	2.135	2.56
.17	.412	.49	.94	.970	1.16	2.40	1.549	1.86	4.60	2.145	2.57
.18	.424	.51	.96	.980	1.18	2.43	1.559	1.87	4.64	2.154	2.58
.19	.436	.52	.98	.990	1.19	2.46	1.568	1.88	4.68	2.163	2.60
.20	.447	.54	1.00	1.000	1.20	2.49	1.578	1.89	4.72	2.173	2.61
.21	.458	.55	1.02	1.010	1.21	2.52	1.587	1.90	4.76	2.182	2.62
.22	.469	.56	1.04	1.020	1.22	2.55	1.597	1.92	4.80	2.191	2.63
.23	.480	.58	1.06	1.030	1.24	2.58	1.606	1.93	4.84	2.200	2.64
.24	.490	.59	1.08	1.039	1.25	2.61	1.616	1.94	4.88	2.209	2.65
.25	.500	.60	1.10	1.049	1.26	2.64	1.625	1.95	4.92	2.218	2.66
.26	.510	.61	1.12	1.058	1.27	2.67	1.634	1.96	4.96	2.227	2.67
.27	.520	.62	1.14	1.068	1.28	2.70	1.643	1.97	5.00	2.236	2.68
.28	.529	.63	1.16	1.077	1.29	2.73	1.652	1.98	5.04	2.245	2.69
.29	.539	.65	1.18	1.086	1.30	2.76	1.661	1.99	5.08	2.254	2.70
.30	.548	.66	1.20	1.095	1.31	2.79	1.670	2.00	5.12	2.263	2.72
.31	.557	.67	1.22	1.105	1.33	2.82	1.679	2.01	5.16	2.272	2.73
.32	.566	.68	1.24	1.114	1.34	2.85	1.688	2.03	5.20	2.280	2.74
.33	.574	.69	1.26	1.122	1.35	2.88	1.697	2.04	5.24	2.289	2.75
.34	.583	.70	1.28	1.131	1.36	2.91	1.706	2.05	5.28	2.298	2.76
.35	.592	.71	1.30	1.140	1.37	2.94	1.715	2.06	5.32	2.307	2.77
.36	.600	.72	1.32	1.149	1.38	2.97	1.723	2.07	5.36	2.315	2.78
.37	.608	.73	1.34	1.158	1.39	3.00	1.732	2.08	5.40	2.324	2.79
.38	.616	.74	1.36	1.166	1.40	3.03	1.741	2.09	5.44	2.332	2.80
.39	.624	.75	1.38	1.175	1.41	3.06	1.749	2.10	5.48	2.341	2.81
.40	.632	.76	1.40	1.183	1.42	3.09	1.758	2.11	5.52	2.349	2.82
.41	.640	.77	1.42	1.192	1.43	3.12	1.766	2.12	5.56	2.358	2.83
.42	.648	.78	1.44	1.200	1.44	3.15	1.775	2.13	5.60	2.366	2.84
.43	.656	.79	1.46	1.208	1.45	3.18	1.783	2.14	5.64	2.375	2.85
.44	.663	.80	1.48	1.217	1.46	3.21	1.792	2.15	5.68	2.383	2.86
.45	.671	.80	1.50	1.225	1.47	3.24	1.800	2.16	5.72	2.392	2.87
.46	.678	.81	1.52	1.233	1.48	3.27	1.808	2.17	5.76	2.400	2.88
.47	.686	.82	1.54	1.241	1.49	3.30	1.817	2.18	5.80	2.408	2.89
.48	.693	.83	1.56	1.249	1.50	3.33	1.825	2.19	5.84	2.416	2.90
.49	.700	.84	1.58	1.257	1.51	3.36	1.833	2.20	5.88	2.425	2.91
.50	.707	.85	1.60	1.265	1.52	3.39	1.841	2.21	5.92	2.433	2.92
.51	.714	.86	1.62	1.273	1.53	3.42	1.849	2.22	5.96	2.441	2.93
.52	.721	.87	1.64	1.281	1.54	3.45	1.857	2.23	6.00	2.449	2.94
.53	.728	.87	1.66	1.288	1.55	3.48	1.865	2.24	6.04	2.458	2.95
.54	.735	.88	1.68	1.296	1.56	3.51	1.873	2.25	6.08	2.466	2.96
.55	.742	.89	1.70	1.304	1.56	3.54	1.881	2.26	6.12	2.474	2.97
.56	.748	.90	1.72	1.311	1.57	3.57	1.889	2.27	6.16	2.482	2.98
.57	.755	.91	1.74	1.319	1.58	3.60	1.897	2.28	6.20	2.490	2.99
.58	.762	.91	1.76	1.327	1.59	3.63	1.905	2.29	6.24	2.498	3.00
.59	.768	.92	1.78	1.334	1.60	3.66	1.913	2.30	6.28	2.506	3.01
.60	.775	.93	1.80	1.342	1.61	3.69	1.921	2.31	6.32	2.514	3.02
.61	.781	.94	1.82	1.349	1.62	3.72	1.929	2.31	6.36	2.522	3.03
.62	.787	.94	1.84	1.356	1.63	3.75	1.936	2.32	6.40	2.530	3.04
.63	.794	.95	1.86	1.364	1.64	3.78	1.944	2.33	6.44	2.538	3.05
.64	.800	.96	1.88	1.371	1.65	3.81	1.952	2.34	6.48	2.546	3.05
.65	.806	.97	1.90	1.378	1.65	3.84	1.960	2.35	6.52	2.553	3.06
.66	.812	.97	1.92	1.386	1.66	3.87	1.967	2.36	6.56	2.561	3.07
.67	.819	.98	1.94	1.393	1.67	3.90	1.975	2.37	6.60	2.569	3.08
.68	.825	.99	1.96	1.400	1.68	3.93	1.982	2.38	6.64	2.577	3.09
.69	.831	1.00	1.98	1.407	1.69	3.96	1.990	2.39	6.68	2.585	3.10
.70	.837	1.00	2.00	1.414	1.70	3.99	1.997	2.40	6.72	2.592	3.11
.71	.843	1.01	2.02	1.421	1.71	4.02	2.005	2.41	6.76	2.600	3.12
.72	.849	1.02	2.04	1.428	1.71	4.05	2.012	2.41	6.80	2.608	3.13
.73	.854	1.02	2.06	1.435	1.72	4.08	2.020	2.42	6.84	2.615	3.14
.74	.860	1.03	2.08	1.442	1.73	4.11	2.027	2.43	6.88	2.623	3.15
.75	.866	1.04	2.10	1.449	1.74	4.14	2.035	2.44	6.92	2.631	3.16
.76	.872	1.05	2.12	1.456	1.75	4.17	2.042	2.45	6.96	2.638	3.17
.77	.877	1.05	2.14	1.463	1.76	4.20	2.049	2.46	7.00	2.646	3.17
.78	.883	1.06	2.16	1.470	1.76	4.23	2.057	2.47	7.04	2.653	3.18
.79	.889	1.07	2.18	1.476	1.77	4.26	2.064	2.48	7.08	2.661	3.19

TWIST OF ROVING.

Hank roving.	Square root.	Twist, 1.2× sq. root.	Hank roving.	Square root.	Twist, 1.2× sq. root.	Hank roving.	Square root.	Twist, 1.2× sq. root.	Hank roving.	Square root.	Twist, 1.2× sq. root.
7.10	2.665	3.20	10.62	3.259	3.91	14.84	3.852	4.62	19.76	4.445	5.33
7.15	2.674	3.21	10.68	3.268	3.92	14.91	3.861	4.63	19.84	4.454	5.35
7.20	2.683	3.22	10.74	3.277	3.93	14.98	3.870	4.64	19.92	4.463	5.36
7.25	2.693	3.23	10.80	3.286	3.94	15.05	3.879	4.66	20.00	4.472	5.37
7.30	2.702	3.24	10.86	3.295	3.95	15.12	3.888	4.67	20.08	4.481	5.38
7.35	2.711	3.25	10.92	3.305	3.97	15.19	3.897	4.68	20.16	4.490	5.39
7.40	2.720	3.26	10.98	3.314	3.98	15.26	3.906	4.69	20.24	4.499	5.40
7.45	2.729	3.28	11.04	3.323	3.99	15.33	3.915	4.70	20.32	4.508	5.41
7.50	2.739	3.29	11.10	3.332	4.00	15.40	3.924	4.71	20.40	4.517	5.42
7.55	2.748	3.30	11.16	3.341	4.01	15.47	3.933	4.72	20.48	4.525	5.43
7.60	2.757	3.31	11.22	3.350	4.02	15.54	3.942	4.73	20.56	4.534	5.44
7.65	2.766	3.32	11.28	3.359	4.03	15.61	3.951	4.74	20.64	4.543	5.45
7.70	2.775	3.33	11.34	3.367	4.04	15.68	3.960	4.75	20.72	4.552	5.46
7.75	2.784	3.34	11.40	3.376	4.05	15.75	3.969	4.76	20.80	4.561	5.47
7.80	2.793	3.35	11.46	3.385	4.06	15.82	3.977	4.77	20.88	4.569	5.48
7.85	2.802	3.36	11.52	3.394	4.07	15.89	3.986	4.78	20.96	4.578	5.49
7.90	2.811	3.37	11.58	3.403	4.08	15.96	3.995	4.79	21.04	4.587	5.50
7.95	2.820	3.38	11.64	3.412	4.09	16.03	4.004	4.80	21.12	4.596	5.51
8.00	2.828	3.39	11.70	3.421	4.10	16.10	4.012	4.81	21.20	4.604	5.52
8.05	2.837	3.40	11.76	3.429	4.12	16.17	4.021	4.83	21.28	4.613	5.54
8.10	2.846	3.42	11.82	3.438	4.13	16.24	4.030	4.84	21.36	4.622	5.55
8.15	2.855	3.43	11.88	3.447	4.14	16.31	4.039	4.85	21.44	4.630	5.56
8.20	2.864	3.44	11.94	3.455	4.15	16.38	4.047	4.86	21.52	4.639	5.57
8.25	2.872	3.45	12.00	3.464	4.16	16.45	4.056	4.87	21.60	4.648	5.58
8.30	2.881	3.46	12.06	3.473	4.17	16.52	4.064	4.88	21.68	4.656	5.59
8.35	2.890	3.47	12.12	3.481	4.18	16.59	4.073	4.89	21.76	4.665	5.60
8.40	2.898	3.48	12.18	3.490	4.19	16.66	4.082	4.90	21.84	4.673	5.61
8.45	2.907	3.49	12.24	3.499	4.20	16.73	4.090	4.91	21.92	4.682	5.62
8.50	2.915	3.50	12.30	3.507	4.21	16.80	4.099	4.92	22.00	4.690	5.63
8.55	2.924	3.51	12.36	3.516	4.22	16.87	4.107	4.93	22.08	4.699	5.64
8.60	2.933	3.52	12.42	3.524	4.23	16.94	4.116	4.94	22.16	4.707	5.65
8.65	2.941	3.53	12.48	3.533	4.24	17.01	4.124	4.95	22.24	4.716	5.66
8.70	2.950	3.54	12.54	3.541	4.25	17.08	4.133	4.96	22.32	4.724	5.67
8.75	2.958	3.55	12.60	3.550	4.26	17.15	4.141	4.97	22.40	4.733	5.68
8.80	2.966	3.56	12.66	3.558	4.27	17.22	4.150	4.98	22.48	4.741	5.69
8.85	2.975	3.57	12.72	3.567	4.28	17.29	4.158	4.99	22.56	4.750	5.70
8.90	2.983	3.58	12.78	3.575	4.29	17.36	4.167	5.00	22.64	4.758	5.71
8.95	2.992	3.59	12.84	3.583	4.30	17.43	4.175	5.01	22.72	4.767	5.72
9.00	3.000	3.60	12.90	3.592	4.31	17.50	4.183	5.02	22.80	4.775	5.73
9.05	3.008	3.61	12.96	3.600	4.32	17.57	4.192	5.03	22.88	4.783	5.74
9.10	3.017	3.62	13.02	3.608	4.33	17.64	4.200	5.04	22.96	4.792	5.75
9.15	3.025	3.63	13.08	3.617	4.34	17.71	4.208	5.05	23.04	4.800	5.76
9.20	3.033	3.64	13.14	3.625	4.35	17.78	4.216	5.06	23.12	4.808	5.77
9.25	3.041	3.65	13.20	3.633	4.36	17.85	4.225	5.07	23.20	4.817	5.78
9.30	3.050	3.66	13.26	3.641	4.37	17.92	4.233	5.08	23.28	4.825	5.79
9.35	3.058	3.67	13.32	3.650	4.38	17.99	4.241	5.09	23.36	4.833	5.80
9.40	3.066	3.68	13.38	3.658	4.39	18.06	4.250	5.10	23.44	4.841	5.81
9.45	3.074	3.69	13.44	3.666	4.40	18.13	4.258	5.11	23.52	4.850	5.82
9.50	3.082	3.70	13.50	3.674	4.41	18.20	4.266	5.12	23.60	4.858	5.83
9.55	3.090	3.71	13.56	3.682	4.42	18.27	4.274	5.13	23.68	4.866	5.84
9.60	3.098	3.72	13.62	3.691	4.43	18.34	4.283	5.14	23.76	4.874	5.85
9.65	3.106	3.73	13.68	3.699	4.44	18.41	4.291	5.15	23.84	4.883	5.86
9.70	3.114	3.74	13.74	3.707	4.45	18.48	4.299	5.16	23.92	4.891	5.87
9.75	3.122	3.75	13.80	3.715	4.46	18.55	4.307	5.17	24.00	4.899	5.88
9.80	3.130	3.76	13.86	3.723	4.47	18.62	4.315	5.18	24.08	4.907	5.89
9.85	3.138	3.77	13.92	3.731	4.48	18.69	4.323	5.19	24.16	4.915	5.90
9.90	3.146	3.78	13.98	3.739	4.49	18.76	4.331	5.20	24.24	4.923	5.91
9.95	3.154	3.79	14.04	3.747	4.50	18.83	4.339	5.21	24.32	4.932	5.92
10.00	3.162	3.79	14.10	3.755	4.51	18.90	4.347	5.22	24.40	4.940	5.93
10.05	3.170	3.80	14.16	3.763	4.52	18.97	4.355	5.23	24.48	4.948	5.94
10.10	3.178	3.81	14.22	3.771	4.53	19.04	4.363	5.24	24.56	4.956	5.95
10.15	3.186	3.82	14.28	3.779	4.53	19.11	4.371	5.25	24.64	4.964	5.96
10.20	3.194	3.83	14.34	3.787	4.54	19.18	4.379	5.26	24.72	4.972	5.97
10.25	3.202	3.84	14.40	3.795	4.55	19.25	4.387	5.26	24.80	4.980	5.98
10.30	3.209	3.85	14.46	3.803	4.56	19.32	4.395	5.27	24.88	4.988	5.99
10.35	3.217	3.86	14.52	3.811	4.57	19.39	4.403	5.28	24.96	4.996	6.00
10.40	3.225	3.87	14.58	3.818	4.58	19.46	4.411	5.29	25.04	5.004	6.00
10.45	3.233	3.88	14.64	3.826	4.59	19.53	4.419	5.30	25.12	5.012	6.01
10.50	3.240	3.89	14.70	3.834	4.60	19.60	4.427	5.31	25.20	5.020	6.02
10.55	3.248	3.90	14.76	3.842	4.61	19.67	4.435	5.32	25.28	5.028	6.03

SPINNING FRAMES.

It is difficult to add anything to the advice we have been giving in previous years as to the use and choice of spinning frames; conditions have not changed materially since the high speed spindle was generally accepted. Most of our recommendations as to detail of construction have been adopted by the regular frame builders. As our position is often misunderstood we again call attention to the fact that we do not build spinning frames. We furnish other builders with spindles, rings, separators, and lever screws, and also supply them for repairs of old frames.

GENERAL CARE OF FRAMES.

New frames should be carefully leveled both ways before starting, and old frames should be gone over with a level at intervals, to see whether they need re-leveling. New frames should be oiled lavishly for several days before starting spinning and well cleaned before use to prevent soiling the yarn. A new frame should be scoured after running a few weeks, wiping out all the bearings carefully. New frames have tight fits and should be watched to see that the cylinder bearings do not get hot.

The inspection and care of frames should be systematic, starting at one corner of the room and taking each frame in order.

CARE OF ROLLS.

New steel rolls may give trouble by catching fibre. If so, they require polishing with whiting and oil or sawdust and oil. The whiting should be mixed with animal oil until it has the consistency of mush. The rolls should be removed from the frame and put on stands made for that purpose. The flutes should then be filled with the paste, and a piece of card clothing also. The clothing should then be rubbed lengthwise of the flutes, and every inch of the roll gone over at least five hundred times, keeping the card clothing well filled with paste all the while. If a roll is scratched, a fine file should be carefully used before it is scoured. After the scouring, a stiff brush should be used to thoroughly clean the flutes. When the rolls are put back, a piece of tallow should be crowded in between the neck of the roll and the stand. Good spinners scour their rolls several times a year.

Leather top rolls can be cleaned while running, with a sponge dipped in a mixture of equal parts of alcohol and water. Back rolls need not be cleaned more than once a week. It is a mistake to use worn rolls as middle rolls.

The middle rolls should be in as good condition as the front rolls. Back rolls are not so important.

When sending worn-out top rolls to be re-covered, they should be cut with a knife so as to spoil the leather and cloth as well, to ensure the use of new cloth by the roll coverer. The leather should not be put on too tight. Rolls perceptibly soft to the "feel" are preferable.

Extra top rolls should be kept in boxes made to hold them perpendicularly and apart from each other. The lid should be cushioned on the under side to prevent damage to the rolls in transit.

Back and middle rolls should be oiled twice a week on their middle bearings, and once a week on their end bearings. Rolls should be placed so as not to run against the end of the lap. The condition of the rolls is perhaps as important as any other single element in the breakage of yarn. Poor rolls will reduce the number of spindles that an operative can tend. It is just as necessary to keep the saddles oiled as the end roll bearings. The pressure of the saddles will consume power if they are not lubricated.

Steel rolls should not be allowed to accumulate laps. By keeping the steel rolls clean there will be much less trouble with roving winding up on the middle roll. If laps get large enough to raise the roll it makes cut yarn. Roving on the middle roll is difficult to remove, and if cut off, the roll is liable to be roughened.

ROLL WEIGHTING.

Stirrup levers should never rub on the steel rolls. Weight levers should be kept level so that the weights will exert all their force. If the weight lever sags, the weight wires may rest on the creel board. The Speakman lever screw is the best device known for keeping the position of the stirrups and weight levers properly regulated.

ROVING GUIDES.

Roving guides should be carefully inspected to see that that they are not bent or loose, and therefore delivering too near each other. If too near, a broken end may run in and make double yarn which, if it gets into the cloth, may make a second and cause loss. The roving guide traverse should be kept in order so that there will be no dwell at the ends of the traverse, thereby wearing ridges in the leather rolls.

GUIDE WIRES.

Guide wires should be set so that they will deliver directly over the center of the spindles. If the spindles are changed in adjustment, the guide wires must also be changed. Guide wires should not be used after they are creased. They should be formed so as to catch kinks, or else have a separate kink catcher attached to the guide wire board. The modern stamped metal guide wire boards are now in general use as are guide board lifters and have special advantages.

SEPARATORS.

Separators after once set practically look after themselves. They should be kept clean, and if the blades get bent out of shape, they should be straightened.

RINGS.

Rings should properly be set with the spindle in the exact centre. They will wear more quickly if out of centre, and will break more ends. Rings are today mostly of the double flange style, and the majority are used with plate holders. Some mills test their rings for roundness, and refuse those badly out of round.

If rings are not made of proper stock or properly hardened, they will wear out rapidly, and no ring manufacturer has yet succeeded in absolutely ensuring uniformity in ring stock at all times. Modern high speeds and the change to finer yarns make extra demands on ring service, for small travelers wear rings faster than heavy travelers. Both rings and ring rails get more or less gummy and dirty in use. The entire ring rail with its rings can be scoured and cleaned by having a trough of proper section made, in which the whole rail may be washed in a hot solution of potash or sal soda, letting the rail soak at least half an hour. It can be rinsed later with hot water.

Some spinners will not take the trouble to turn rings over to use the good flange after the top one is worn. As ring manufacturers, we should have no objection to this practice ; but it is hardly economical. New rings have always started harder than old ones, no matter what the method of polishing or burnishing. This requires the use of lighter travelers at the start, and probably reduces the speed of the frame, which is generally set to starting conditions.

Traveler clearers should be kept in proper relative position. Sometimes they get bent or loosened, according to the style of device used for the purpose.

The ring rail should be kept level, so that the travelers will move around on the rings in a horizontal plane. Careful inspection with use of a spirit level will assist in finding errors.

TRAVELERS.

Some spinners put on new travelers when the old ones break off, and others replace whole sets at intervals. Spinners can be taught to detect worn travelers by feeling of them when piercing an end, and if they make the change at this time they save themselves trouble, providing they are running on the first mentioned plan. Until recent years, it has been customary to use the same bow travelers and the same size ring flange for nearly all yarn numbers. It has been found preferable to use narrow flanges with small bow travelers for light yarn.

It is difficult to give advice on the weight of travelers as the conditions of spinning vary so much. Light travelers make more elastic yarn, but it is not always true that light travelers will reduce end breakage. Heavy travelers get more momentum and help out on weak spots in the yarn through the very momentum obtained. A heavy traveler winds a harder bobbin. Any overseer can make his own experiments by trying different travelers on different frames, keeping a record of the ends broken down while running and while doffing.

LIFTING RODS.

Lifting rods are often too tight on new frames, and should be carefully watched at the start. Later, they may stick from dirt or lint getting into the bearings, and a protection like the Shaw and Flynn cleaner is advisable.

SPINDLES.

New frames should have their spindles banded and run bare for some hours before they are set to the rings. They will need liberal oiling at the start, and for the first two weeks at least.

In setting spindles to rings, it is customary to use a bobbin with a wooden cylinder attached, made slightly less than the rings' inside diameter. Some spindle setters place the ring rail at the middle of the bobbin when setting, so that any variation between top and bottom is divided. A more accurate method is to set spindles to the rings at the bottom, then run the rail up. Any spindles not found in the center of the rings will now need papering, as they are not in proper line. By running the rail up and down a few times and re-papering, spindles can be made to run in the center of the rings at all points. The method of using a spirit level on top of a spindle is not absolutely correct to meet the conditions for the lifting rods may not be perpendicular. Some setters set the spindles with wooden bobbins at the center of the traverse and then let full bobbins be spun, noting whether the rings are central by seeing how the bobbins run in the rings. Never forget that the guide wires need careful re-setting after the setting of the spindles is accomplished. Where only a few spindles are changed in position this is sometimes forgotten.

Spindles that vibrate indicate bad bobbins, crooked blades, poor fit of bolsters or dry bearings. A spindle fault will often be corrected by supplying a different bolster. While a vibrating spindle may be crooked, it does not follow that all crooked spindles will vibrate, for the loose bearings used accommodate themselves to faults in the spindle. A spindle which runs well without a bobbin and badly with a bobbin, usually signifies some fault in the bobbin itself, unless tests with several bobbins show the trouble is elsewhere. Lack of oil will make any spindle vibrate, whether straight or crooked. A vibrating spindle wastes its oil rapidly. This can be shown by holding a piece of paper opposite the edge of the whorl. All spindles waste oil more or less, though we have found by actual tests that our snout spindles can run at least two months, if properly oiled at the start. We do not mean that it is safe to let them run that length of time, for oilers are careless. The oil that is wasted by running over the base, and also by being thrown off the whorl, is not necessarily a disadvantage. The bands absorb considerable of it from the air, and this causes the fibres of the bands to lie closely, and the bands wear longer. We know this for we have tested spindles that used no oil, and their bands would wear very rapidly by perceptibly throwing off loose fibres.

As to choice of oil for spindles, we know of mills using heavy oil because they had bad bobbins which caused the spindles to vibrate and therefore waste oil excessively. Heavy oil consumes large amounts of power. Our own experience leads us to recommend light gravity oils, from 30 to 35. The price should be a small consideration, for cheap oil can prove expensive in many ways. We have found spindles so rusty from use of oil with moisture in it that they used fifty per cent. more power than the same spindles used after cleaning. Moisture in oil stains it a dirty, brownish color. Some oils gum and stick, leaving a varnish like deposit on the spindle which increases the power required to drive it. English spinners make a practice of cleaning out spindle bases so frequently that their spindles are often arranged so that the lower end of the base can be removed.

We believe this unnecessary if good oil is used. If poor oil has been used, it will pay to clean the spindles thoroughly. This may be done by taking bolsters out and soaking them in benzine, naphtha, gasoline, or whatever the name may be for the cleaning fluid ; or they can be cleaned by blowing a steam jet through them. The spindle bases can be pumped out by a syringe, and if there is much dirt in the bottom it can be swabbed out by waste on a stick. Bases can also be removed and cleaned with a steam jet if that is thought preferable.

The second hand should be held responsible for the correction of vibrating spindles. With the Draper type, the adjustment of the bearing usually corrects vibration. With other types, new bolsters may be necessary, and with either type, a badly crooked spindle should be replaced. Spindle bases should be kept reasonably clean, for the lint sometimes gets sucked in between the whorl and the base to such an extent as to slow the spindle and make slack yarn.

BANDING.

On new frames, the cylinder will wear bands rapidly. Bands will also wear faster than usual when driving bare spindles in starting up a frame. Care should be taken to see that bands are made of uniform weight. If the band boy gets careless, he may neglect to put the proper number of strands in the band. With marked bands, spindles can be banded while running without necessarily having the tension too tight.

We have always recommended a band pull of two pounds for the ordinary size spindle. This does not mean that the band should only pull two pounds when put on. It should then pull from three to four pounds, according to the size. We believe in light bands, as they cannot be tied too tightly, and also because they will break of themselves if getting too tight in use. Bands act curiously in use, some growing slacker through stretching, and others growing tighter through absorption of oil and by loading up with lint. If bands are near a vibrating spindle, they will get more oil than usual and these bands will grow tighter than others. Spinners have advised brushing the cylinders at periods to prevent accumulation of lint by the bands. Inspection should prevent the making of slack yarn through too slack bands; slack yarn is one of the greatest evils in cotton mill practice. It should be detected by the spinner or the spooler tender, but sometimes it gets by into the warp where one end may cause the weaver continual labor and trouble until the whole warp is woven out. The second hand should go over the bands when frames are stopped for cleaning, cutting off all which are too tight or too loose.

Recently a number of frame makers have furnished frames with the spindles driven by tape, with an idler to take up the slack. The advantage gained is in having a greater driving surface on the whorl and in the more even tension of the tape. Frames have also been introduced using a round band to drive four spindles and an idler interposed to take up the slack. This style of banding has not gone into general use as yet.

BOBBINS.

New bobbins should be tested before use, as they may change materially after shipment. They should also be tested at intervals while in use. Bad bobbins not only make spindles vibrate, wasting their oil and running dry, but they also rise on the spindles, causing the yarn to run down over the bottom and also making slack yarn. Bobbins may also be perfectly concentric and straight, but rise on the spindles because they do not fit properly. There are many conflicting theories about the proper fit of bobbins. The same theory will not fit all cases, for spindles vary in design. Short spindles usually have a tapering top, while long spindles have a cylindrical top. Bobbins will often drive well with a taper top spindle fitting closely at the top, while they might drive better on a cylindrical top spindle if fitting loosely. It is not intended that the bobbin should be driven by the cup, although it does no harm if the bobbin fits both the cup and the whorl. If the bobbin is too small for the whorl and gets wedged down on it, it will often shake loose and rise much worse than a bobbin which fits loosely. If a bobbin is to fit loosely at the whorl, it should fit tight at the top. Poor bobbins can be reamed, but they should be tested after reaming and thrown away if they do not then run well.

Bobbins should be made from thoroughly seasoned stock. Warp bobbins should be at least seven-eighths of an inch in diameter, for yarns number 28 and under. They should have some protection at the bottom in the shape of a ring or its equivalent to prevent splitting. The upper bearing should be at least three quarters of an inch long. Bobbins ought to be oil soaked as well as shellacced. The difference in life will more than offset the difference in cost.

Hastings' patent metal bushed filling bobbin introduced by us is of importance on Northrop Looms. The feature of its construction is the insertion of a metal bushing in the base of the bobbin opposite the rings on the exterior. This bushing co-operates with the rings to hold the wood in place when subjected to extremes of heat or moisture and thus secures greater durability.

Bobbins for use with centrifugal clutch spindles should be made with the hole in the base of such size that its diameter is larger than the spindle clutch when closed and smaller than the clutch when opened. This reduces the amount of reaming and also allows the bobbins to be carried at a uniform level on the spindles. This has two advantages; it gives the full length of traverse and maximum load on the bobbin; and where the filling feeler is used locates the bunch at the proper point on all the bobbins; the hole at the bottom of the bobbins should be slightly rounded over or chamfered on the inside.

At the tops the fit should be such that the bobbins will drop down on the spindle, but not to be loose enough to vibrate. The length of the top bearing should not be less than one and one-eighth inches; this measurement to be the actual bearing on the spindle. With the spindle having six inch blade and straight bearing at the top, the bottom of top bearing in the bobbin should clear the top of shoulder on the spindle one-eighth inch.

The bottom of the bobbin where bored out to take in the expanding segments which make up the centrifugal clutch should be bored sufficiently deep so that it cannot by any possibility come down on to the top of the segments. To insure this result the depth of the bore should be at least one-eighth inch more than the distance from the top of the segments to the shoulder of the spindle on which the bottom of the bobbin rests.

GENERAL DETAILS.

Loose pulleys should have their collars set snugly and their bearings kept well fitted. They should be a little less in diameter than the tight pulleys, as they do no work and do not need so tight a belt. A shaking pulley can communicate wear and vibration to the whole frame. The driving pulley should be of good size, else it will need a tight belt, consuming more power at the cylinder bearing. If frames are to run at high speed, they should have large cylinders, even if this necessitates wider frames. The improvement in rings and spindles allows an increase in speed beyond the old standards. Black oil must always be considered as evidence of unnecessary wear, except in cases where the bearings are new.

PURCHASE OF NEW FRAMES.

There are several excellent makes of spinning frame sold in this country. Some of the builders buy their spindles, rings, separators and lever screws from us. Others supply their own. Even those who make their own specialties, will usually furnish our parts, if the buyers insist. We know our spindles are superior to any manufactured, because we have not only had more experience than any other builder in the making and testing of spindles, but we employ processes which are superior, several of which are protected by patents. We urge the choice of our spindles to customers, from our knowledge of their detail as well as their design. We furnish all the standard varieties.

As to rings, we are equally positive as to recommendation of our own product, and for similar reasons. We explain more in detail in another section of this book.

Our Rhoades-Chandler separators are well known and unequalled in efficiency.

Our lever screws are copied since our patent expired, but we believe the product of our shops is more accurately made and more carefully inspected than those made by others, for we have a special department for turned work of this nature, in which the entire equipment is of tools of our own design and manufacture.

Referring to general details of the frame, it is growing customary in foreign countries to use frames of great length with many spindles. We doubt the expediency of this movement. There may be a slight saving in floor space, but the additional power demands a tighter belt, there is more torsion on the rolls and cylinder, and a greater proportion of the spindles are stopped for doffing or other purposes. There is more difficulty in keeping the long frames properly leveled. Purchasers of frames should anticipate the possible increase in speed by having extra weight and good width of frame, with large cylinders. Nearly all frames are now made with outside bearings.

SPINDLE POWER.

In a modern weaving mill producing cotton goods, and of sufficient size to be operated to advantage, the power used in the spinning room is estimated by mill engineers to average about forty-five per cent of the total power used in the mill.

Given proper conditions, there is but little difference in power consumed between the several standard types of high speed spindles of similar size. We have tried numerous variations in size and fit of the various parts, but find that if we loosen the fit of the bearings to save power under certain conditions, we get more vibration. Nothing yet tested has equalled our present type, taking consumption of power and smoothness of running into consideration. Variations in power between different types of spindles of the same general class are slight, compared with the variations produced by improper conditions. If the spindle is crooked it will vibrate more and take more power. Large, heavy spindles take more power than lighter spindles.

As to the conditions of use, possibly poor oil is the most common consumer of power. A combination of low gravity oil with the rust produced by moisture or acid represents about the maximum of evil. For years we have recommended spindle users to buy a good light oil. The best is none too good. The difference in price between a good oil and a poor oil is as nothing compared with the real saving obtainable. We now refer to our standard spindles with bearings enclosed in an oil bath. Sawyer and other double rail spindles require heavier oil on the upper bearings.

A tight band pull adds to the power consumed, in fact it may run to excessive limits. Spinners are better trained than formerly and a band pull of from six to ten pounds is not of as frequent occurrence as years ago.

Poor bobbins consume power by causing the spindles to vibrate, and so do rings that are out of center. The other elements of the frame, such as the cylinder and rolls, take more power if the bearings are poorly oiled, or if the rolls are too heavily weighted. A tight driving belt on the pulley will add to the whole power of the frame.

The work put on the spindle by the act of spinning—that is, carrying the thread and traveler around the ring, is an important element in power consumption, but it is a necessary element and not easily modified except by variation in the weight of the traveler and the size of the ring. The pull on the yarn varies in proportion to the diameter of the bobbin compared with the diameter of the ring, especially when spinning near the bare bobbin. The modern practice of spinning with larger bobbins and larger ring diameters adds to power used, unless the speed be reduced. The question of speed enters into the question of power; that is, the power consumed per product is larger as the speed increases. The power consumed by a frame varies with conditions of atmosphere and temperature. Excess of moisture in the air causes the bands to become tighter. When a mill gets cold over night, the oil congeals more or less, making the frames harder to start in the morning. Bands also contract while at rest. Spindles consume less power after running some time, as they smooth their bearings and cure any trouble in tight or cramped bearings.

PRACTICAL METHODS OF POWER TESTING.

If data are needed to determine what style or size of spindle is to be used, it is advisable to consult the maker of the spindles as to the data he himself has obtained. The power tests of a whole frame for this purpose are apt to be misleading, for the spindles themselves consume but a fraction of the whole power, and there may be serious variations in other parts of the frame. These variations are certainly present where one frame is tested against another.

If the tests be made to determine the selection of an oil, it is best to make them on the same frame and the same spindles, changing the oil in the bases with thorough cleansing between. Interesting tests may be made to show the difference between a frame as ordinarily run and the same frame after being put into proper condition. In order to have the test amount to anything it should be made by a man who takes pains to have the conditions uniform, or by a man who has had sufficient experience to allow for variations in conditions; for instance, a frame tested Monday morning would show worse results than on Tuesday morning, simply because resting over Sunday would affect the bands and also the oil, if the mill were cool in the interim. Frames as a rule run lighter in the afternoon than in the morning, and they run lighter on a warm, sunny day than on a cool, muggy day.

Since there are many possibilities for unexpected variations, it is well not only to make several tests, but to definitely compare the different elements of power consumption which make up the total. To do this, it is advisable to know in each test how much power is consumed by the rolls, gearing and builder; how much by the drag of the yarn; and how much by the load on the spindle. We advise the following method of power testing to meet these conditions.

Take records of the power for several minutes just before doffing time; then take the records for several minutes after doffing. Take all readings when the rail is at the center of the traverse. By adding these records and dividing by 2, the average power of the frame while spinning is approximately obtained. Now, break the ends down, and keep the rolls running and record the power. Next, throw the rolls and builder out of gear and run the spindles with their bobbins. The difference between the latter two records will give the power consumed by the rolls, gears and builder. Now, take the empty bobbins off and replace them with the full bobbins, running the spindles without rolls as before. By adding this record to the record of the empty bobbins without rolls, and dividing by 2, we have the power taken by the average weight of the yarn load and bobbins with the spindles. Now, take the bobbins off and run the spindles bare. Subtracting this record from the former one will show the power taken by the average yarn load and bobbin. If necessary to differentiate further, it is possible to get the power of the average yarn load without the bobbin, by putting bare bobbins on the spindles and finding the actual power taken by the bobbins without yarn. If the power taken by the average yarn load, bobbin and spindle, is subtracted from the average of the entire power while spinning, after eliminating the power of the rolls, gears and builder, it is possible to determine the power taken by the drag of the traveler and the resistance of the air to the yarn while spinning. The power taken by the cylinder can be easily found by cutting off bands and running the cylinder by itself.

If these elements of power consumed are sub-divided on comparative tests, it is easy to see whether the conditions are uniform, for there should be no perceptible variation between the power taken by any of these elements with the same spindles.

Spindles of different construction show curious variations in the division of power between these elements. It is easy to discover what type of spindle carries its yarn best and which one is best adapted to meet the strain of the pull of the yarn. It must always be borne in mind that the percentage of gain by one frame of spindles over another by no means shows the true proportionate worth of the spindles themselves, for a spindle that is materially better than another has its percentage reduced when several other elements of power consumption are added into the total result.

In testing oils, it is not necessary to spin if a quick test is wanted, as any real difference in the quality of the oil will show with the bare spindles.

No comparative power tests are of the slightest use unless the band tension is the same, or unless proper variation of proportion is figured. A band scale is indispensable. In preparing a frame for tests, it should be accurately leveled, cleaned and scoured. The spindles, rings and guide wires should be set with accuracy. The spindles themselves should be cleaned by removing all the oil and dirt with a pump and swab, or steam jet. If the spindles have been adjusted badly, the fit should be made uniform. New bands should be applied, running them enough to take out the first stretch, then carefully weighing and cutting off any abnormally tight or loose bands till the average is as near the standard two pounds as possible. The band tension should be weighed at least twice a day while testing, and the average pull made uniform by new bands, as necessary.

If spindles with adjustable bearings are tested against spindles with straight bearings, the looseness of fit in the adjustable bearings should be made as uniform as possible with the average fit in the other. We mention this because we have seen spindles submitted for comparative tests in which the fits were much looser than in the regular trade practice. A loose bearing will reduce power, unless the looseness is carried to sufficient extent to seriously affect the running of the spindle.

The size of the band affects the power problem, not only because it is tied tighter, but also because there is more air resistance. The weight of a spindle is not as important as the size of its bearing. We have seen spindles made so small and short at the bearing that they consumed more power than larger spindles because they had to be fitted tightly in their bearings to prevent vibration. If a spindle blade vibrates through the actual bending of the blade itself, it will consume much power. The taper bearing blade is stronger than any other in comparison with the average size of its bearing.

We have given special attention to the subject of power ever since the Sawyer spindle was invented. The tests during this period have included comparisons to determine the value of different inventions, many of which have never been seen by our customers. There are certain general conclusions reached by these comparisons which may have value as preventing the repetition of useless experiments.

Ball bearing spindles offer an interesting field for power tests. There is no question that ball bearing spindles can be made to run with light consumption of power; but they are expensive in construction, and it is difficult to make them in large lots so that they will run uniformly.

Oilless bearing spindles have been found to consume little power, but their bands wear out rapidly and so far as our own experience has determined there are objections not yet met satisfactorily.

Anti-friction step bearings are common as inventions, but the vertical friction of a spindle is so little that it is hardly perceptible in the general showing.

Spindles have been constructed with bearings and fits so loose that they could be driven to speed by the ordinary store twine, but they had certain peculiarities and eccentricities of motion so that they would not run constantly in the center of the ring. Spindles can be designed to run well for short periods that would wear out rapidly in constant use. Others may run well for a few days, but are so designed that they cannot hold oil.

To anticipate possible suggestions, will say that we have, covering a long period, tried spindles with loose bearings and tight bearings; long bearings and short bearings; bolsters with many degrees of looseness; bolsters locked, unlocked and spring locked; spindles with pointed steps and flat steps; bolsters with different packings, no packings, and many forms of spring packings; spindles with self-adjustable fits; spindle blades with different tapers, different lengths and different diameters—in fact, almost every mechanical variation that the ingenuity of many minds has been able to suggest.

POWER CONSUMPTION ANALYZED.

In spinning No. 28 yarn in 1¾ inch ring with a band tension of 2 lbs., the power units are approximately as follows:

Power consumed by cylinder,....................	2.5	per cent.
Bands and bare spindles,..........................	50.	" "
Bare bobbins, ...	2.5	" "
Average yarn load,................................	15.	" "
Traveler pull,..	22.	" "
Rolls, builder and gearing,...	8.	" "
	100	

The proportions will vary according to the oil, the size of ring, speed, etc.

It is difficult to advise just how much power will be taken by any given conditions, because the range of actual experience in power testing is too limited to cover the many possible combinations. Neither is it safe to figure out this proportionate variation to allow for differences in conditions.

For example, it is proper to assume that increase of speed will increase the power taken inversely as the square of the speeds. In actual practise, the results do not conform to this assumption; not for any fault in the laws of science, but because of changes in conditions which may not always be taken into consideration. For instance, if we start with a certain band tension, at a certain speed, an increase of speed will lessen the band tension. An increase of speed will also raise the temperature of the oil. As a matter of fact, the power taken by any one spinning frame does not increase in the degree expected, but in a less degree.

PRODUCTION TABLES.

The details of the figures given for production and speeds do not coincide with those given by any other authority. In order to prepare them we asked for information from every mill in this country having frame spindles, and while a statistical table must necessarily conform to some rule of progression, the results indicated can be paralleled by actual facts.

These tables are not made up from average results, but rather represent a high average, though not a maximum. Most tables figure out revolutions of the front rolls in decimals, from an assumed spindle speed. Our tables give roll speed, spindle speed and hank production in even figures for greater convenience of application. The warp twist is figured from the ordinary warp twist table up to and including No. 35. This standing is made by multiplying the square root of the number of the yarn by 4.75. The use of longer stapled cotton for numbers above 35 has led to a reduction in twist for finer yarns. In our tables we use a twist from Nos. 40 to 80, figured by multiplying the square root of the number of the yarn by 4.50. From 36s to 39s, inclusive, the twist is graduated between the two standards. From 80 to 110 the twist is figured by multiplying the square root of the number of the yarn by 4.25.

It is impossible to meet all the conditions of twist in a table of this nature, as yarn is used for so many purposes. We have tried to make it conform to the practice of the majority of mills.

The production in hanks is necessarily figured from the delivery of the front roll, making proper allowance for doffing, and the contraction of the yarn due to the twist. Of course more time must be allowed for doffing with coarse yarn. The revolutions of the spindle must be sufficient to not only put in the necessary twist per inch, but also to wind the yarn on the bobbin.

In our table of filling yarn the twist is computed from a varying standard as follows:

Up to and including No. 25, the mule filling twist of 3.25 times the square root is used, as returns from the mills seem to show that the coarser numbers can be spun with this amount of slackness, to advantage. From No. 25 to No. 30, inclusive, the twist is figured at 3.50 times the square root, and above No. 30 at 3.75, which is the mule warp twist.

It has been thought useless to give theoretical spindle speeds, as the usual facilities for counting speed are not adapted to fine results. No variation is figured at less than one hundred turns per minute. This seems near enough, as the speed varies, more or less, from frame to frame and from hour to hour.

The comparative tables show actual figures from mills as compared with the computation of estimated progression. Figures from the standard table are first placed opposite the number of yarn and figures then follow, giving actual results on the same yarn. We show one or two instances where the mill results are greatly in excess of our own table. We could have given many more, if necessary, to prove our own recommendations moderate. It is not safe to rely absolutely on the spindle speeds that are quoted from the mills, as they are often estimated, or figured without allowing for slip of bands.

CONSTANTS.

While certain twist constants are universally used in figuring textile operations, the application of this principle, is not, so far as we know, carried out for convenience in other relations. Mr. George A. Vaughan, superintendent of the Putnam Mfg. Co., has sent us the following data, which he uses in his own mill. By following the same principle, one could work out other constants for application in other mills where the conditions are different.

PRODUCTION CONSTANTS.

CONSTANTS.	
	SPEEDERS.
.467 for $1\frac{1}{4}''$ roll. .421 for $1\frac{1}{8}''$ roll.	Rule—Divide .467 (slubbers and intermediate), or .421 (fine speeders and jacks), by the hank number and multiply the quotient by the revolutions per minute of the front roll. The result is the production at 100 per cent. in lbs. per spindle per week of 60 hours.
	SPINNING FRAMES.
.374 for $1''$ roll.	Rule—Divide .374 by number of yarn and multiply the quotient by R. P. M. of the front roll. The result is the production at 100 per cent. in lbs. per spindle per week of 60 hours. For week of 58 hours the constant would be .362 and for 66 hours, .411.
	MULES.
7.143 for $60''$ stretch. 7.619 for $64''$ stretch. 7.976 for $67''$ stretch.	Rule—Divide the constant by the number of yarn, and multiply the quotient by the number of stretches per minute. The result is the production at 100 per cent. in lbs. per spindle per week of 60 hours.
	LOOMS.
.100	Multiply 100 by the number of picks per minute and divide by the picks per inch. Result is the production at 100 per cent. in yards per week of 60 hours.

The spinning constants given above allow no time for doffing, etc. The table on page 96 gives a system of progressional constants in which allowance for loss of time has been made in conformity with the results as shown in our production table. It will be found useful for conditions where it is desirable to know what production should be obtained from frames having roll speeds which differ from those we have assumed.

For instance, taking the constant .328 for No. 28 warp yarn on 58 hours run we find production at the roll speed given of 124 turns as follows:

```
28) .328  |  .0117
    28    |    124
   ----   |  ------
     48   |    468
     28   |   234
   ----   |  117
    200   |  ------
    196   |  1.4508 Answer.
```

Our warp production table gives 1.45 or the same result. Now to find the comparative production on No. 28 warp yarn at 120 revolutions of the front roll, multiply .0117 by 120=1.40.

For No. 29 to No. 34 yarn the same constant would be used; that is wherever there is a blank, use the constant given above it.

The figures of the five following tables are all made up with allowances for loss in doffing and for the contraction of the yarn due to the twist.

These tables are based upon 58, 60 and 66 hours per week. Other standards may readily be figured from the 60 hour column. For instance, 54 hours will be one-tenth less than 60; 55 hours one-twelfth less, etc.

Production Table of Ring Warp Yarn.

Front Roll 1 Inch in Diameter.

No. of Yarn.	Size of Spindle.	Gauge of frame.	Diameter of ring.	Length of traverse.	Twist per inch.	Revolutions of front roll per minute.	Revolutions of spindle per minute.	Hanks per spindle per day of 10 hours.	Pounds per spindle per week of 58 hours.	Pounds per spindle per week of 60 hours.	Pounds per spindle per week of 66 hours.
4	Draper No. 4.	3 inches.	2¼	7 or more	9.50	204	6200	10.50	15.22	15.75	17.32
5					10.62	200	6800	10.40	12.06	12.48	13.72
6					11.64	196	7300	10.30	9.95	10.30	11.33
7					12.57	192	7700	10.20	8.45	8.74	9.61
8					13.44	188	8100	10.10	7.32	7.57	8.33
9					14.25	184	8400	10.00	6.44	6.66	7.33
10			2⅛		15.02	180	8600	9.80	5.68	5.88	6.46
11					15.75	176	8800	9.60	5.06	5.23	5.76
12					16.45	172	9000	9.40	4.54	4.70	5.17
13					17.13	168	9000	9.20	4.10	4.24	4.67
14					17.77	164	9000	9.00	3.72	3.85	4.24
15					18.40	160	9300	8.80	3.40	3.52	3.86
16		2¾ inches.	2		19.	156	9400	8.60	3.11	3.22	3.54
17					19.58	152	9400	8.40	2.86	2.96	3.26
18					20.15	148	9400	8.20	2.64	2.73	3.00
19					20.71	144	9400	8.00	2.44	2.52	2.77
20	Draper No. 2.				21.24	140	9400	7.80	2.26	2.34	2.57
21					21.77	138	9400	7.70	2.12	2.20	2.42
22					22.28	136	9500	7.60	2.00	2.07	2.28
23					22.78	134	9500	7.50	1.89	1.95	2.15
24					23.27	132	9600	7.40	1.78	1.85	2.03
25			1¾	6½	23.75	130	9600	7.30	1.69	1.75	1.92
26					24.22	128	9700	7.20	1.60	1.66	1.82
27					24.68	126	9700	7.10	1.52	1.57	1.73
28					25.13	124	9700	7.00	1.45	1.50	1.65
29					25.58	122	9800	6.90	1.38	1.42	1.57
30					26.02	120	9800	6.80	1.31	1.36	1.49
31			1⅝		26.45	120	9900	6.80	1.27	1.31	1.44
32					26.87	118	10000	6.70	1.21	1.25	1.38
33					27.29	118	10100	6.70	1.17	1.21	1.34
34					27.70	116	10200	6.60	1.12	1.16	1.28
35					28.10	116	10300	6.60	1.09	1.13	1.24
36					28.17	114	10200	6.50	1.04	1.08	1.19
37					28.24	114	10100	6.50	1.01	1.05	1.15
38					28.31	112	10000	6.40	.97	1.01	1.11
39					28.38	112	10000	6.40	.95	.98	1.08
40					28.46	110	10000	6.30	.91	.94	1.03
41			1½	6	28.81	110	10000	6.30	.89	.92	1.01
42					29.16	108	10000	6.20	.85	.88	.97
43					29.50	108	10000	6.20	.83	.86	.95
44					29.65	106	10000	6.10	.80	.83	.91
45					30.19	106	10000	6.10	.78	.81	.89
46					30.51	104	10000	6.	.75	.78	.86
47					30.85	104	10000	6.	.74	.76	.84
48					31.18	102	10000	5.90	.71	.73	.81
49					31.50	102	10000	5.90	.69	.72	.79
50					31.81	100	10000	5.80	.67	.69	.76
55					33.37	96	10000	5.60	.59	.61	.67
60					34.86	92	10000	5.40	.52	.54	.59
65			1⅜	5 to 5½	36.28	88	10000	5.20	.46	.48	.52
70					37.65	84	10000	5.	.41	.42	.47
75					38.97	80	9800	4.80	.37	.38	.42
80					39.08	78	9600	4.70	.34	.35	.38
85					39.18	76	9400	4.60	.31	.32	.35
90					40.32	74	9400	4.50	.29	.30	.33
95					41.22	72	9400	4.35	.26	.27	.30
100					42.50	70	9400	4.20	.24	.25	.27

Comparative Production Table of Ring Warp Yarn.

No. of Yarn.	Size of spindle.	Gauge of frame.	Diameter of ring.	Length of traverse.	Twist per inch.	Revolutions of front roll per minute.	Revolutions of spindle per minute.	Hanks per spindle per day of 10 hours.	Pounds per spindle per week of 58 hours.	Pounds per spindle per week of 60 hours.	Pounds per spindle per week of 66 hours.
6	Draper No. 4	3	2¼ 1⅞	7 7	11.64	196 180	7300 6800	10.30	9.95	10.30	11.33 10.10
10		3	2⅛ 1⅞	7 7	15.02	180 178	8600 8500	9.80	5.68	5.88	6.46 6.68
12		3	2⅛ 1⅞	7 6	16.45	172 185	9000 8700	9.40	4.54	4.70	5.17 5.40
13		3	2⅛ 2	7 7	17.13	168 160	9000 8500	9.20	4.10	4.24	4.67 4.48
14		3	2⅛ 1½	7 6¼	17.77	164 169	9000 8100	9.00	3.72	3.85	4.24 4.66
18		2¾	2 1⅞	7 6	20.15	148 150	9400 8800	8.20	2.64	2.73	3.00 3.37
20		2¾	2 1¾	7 7	21.24	140 140	9400 9400	7.80	2.26	2.34	2.57 2.49
22	Draper No. 2	2¾	2 1¾	7 6	22.28	136 136	9500 9500	7.60	2.00	2.07 2.10	2.28
25		2¾	1¾ 1⅝	6½ 7	23.75	130 130	9600 9500	7.30	1.69 1.69	1.75	1.92
26		2¾	1¾ 1⅝	6½ 6	24.22	128 136	9700 10000	7.20	1.60	1.66	1.82 1.80
28		2¾	1¾ 1½	6½ 5½	25.13	124 122	9700 9750	7.00	1.45 1.47	1.50	1.65
30		2¾	1¾ 1¾ 1½	6½ 6½ 5½	26.02	120 120 122	9800 9750 10000	6.80	1.31 1.34	1.36	1.49 1.48
32		2¾	1⅝ 1¾ 1⅝	6½ 6 6½	26.87	118 115 118	10000 9500 9600	6.70	1.21	1.25 1.30	1.38 1.35
34		2¾	1⅝ 1⅝	6½ 6⅛	27.70	116 120	10200 9500	6.60	1.12	1.16 1.20	1.28
38		2¾	1⅝ 1⅝	6½ 6½	28.31	112 112	10000 9700	6.40	.97	1.01 1.00	1.11
40		2¾	1⅝ 1⅝	6½ 6¼	28.46	110 115	10000 10000	6.30	.91 .95	.94	1.03
42		2¾	1½ 1⅝	6 6	29.16	108 100	10000 9200	6.20	.85 .81	.88	.97
50		2¾	1½ 1⅝	6 6	31.81	100 100	10000 10000	5.80	.67 .67	.69	.76
60		2¾	1½ 1⅝	6 6	34.86	92 92	10000 10000	5.40	.52 .57	.54	.59
70		2¾	1⅜ 1⅝	5½ 6	37.65	84 83	10000 9700	5.	.41	.42 .46	.47
80		2¾	1⅜ 1½	5½ 5½	39.08	78 78	9600 9700	4.70	.34	.35 .36	.38
90		2¾	1⅜ 1⅜	5½ 5½	40.32	74 68	9400 9400	4.50	.29 .27	.30	.33
100		2¾	1⅜ 1⅜	5 5½	42.50	70 68	9400 9400	4.20	.24 .24	.25	.27

PRODUCTION TABLE OF RING FILLING YARN.

FRONT ROLL 1 INCH IN DIAMETER.

No. of Yarn.	Size of Spindle.	Gauge of frame.	Diameter of ring.	Length of Traverse.	Twist per inch.	Revolutions of front roll per minute.	Revolutions of spindle per minute.	Hanks per spindle per day of 10 hours.	Pounds per spindle per week of 58 hours.	Pounds per spindle per week of 60 hours.	Pounds per spindle per week of 66 hours.
4					6.50	240	5000	10.00	14.40	14.88	16.37
5					7.27	230	5400	10.00	11.50	11.95	13.15
6					7.96	220	5600	9.85	9.53	9.86	10.84
7					8.60	214	5800	9.85	8.13	8.40	9.24
8				7 inches.	9.19	208	6000	9.75	7.07	7.31	8.04
9					9.75	202	6200	9.65	6.24	6.46	7.10
10					10.28	196	6400	9.60	5.56	5.76	6.33
11					10.78	190	6500	9.50	5.00	5.18	5.70
12					11.26	184	6600	9.40	4.54	4.70	5.17
13					11.72	180	6700	9.35	4.15	4.29	4.72
14			1½ to 1⅝.		12.16	176	6800	9.25	3.82	3.95	4.35
15					12.59	172	6900	9.15	3.53	3.65	4.02
16					13.	168	7000	9.05	3.28	3.39	3.73
17					13.40	166	7100	9.00	3.07	3.17	3.48
18					13.79	162	7200	8.80	2.84	2.93	3.22
19				6½	14.17	158	7200	8.70	2.64	2.74	3.02
20					14.53	156	7300	8.60	2.49	2.58	2.83
21					14.89	154	7300	8.50	2.34	2.42	2.67
22					15.24	152	7400	8.40	2.21	2.29	2.52
23					15.59	150	7400	8.30	2.09	2.16	2.38
24					15.92	148	7600	8.20	1.98	2.05	2.25
25					16.25	146	7600	8.10	1.87	1.94	2.13
26					17.84	144	8000	7.95	1.77	1.83	2.01
27					18.19	142	8200	7.85	1.68	1.74	1.91
28					18.52	140	8200	7.75	1.60	1.66	1.83
29				6	18.84	138	8300	7.60	1.52	1.57	1.73
30					19.17	136	8300	7.55	1.45	1.51	1.66
31			1⅜		20.88	134	8800	7.45	1.39	1.44	1.58
32	Draper No. 2, for all Numbers.	2¾ for all Numbers.			21.21	132	8800	7.35	1.33	1.38	1.52
33					21.54	130	8900	7.25	1.27	1.31	1.44
34					21.87	128	8900	7.20	1.22	1.27	1.39
35					22.19	126	8900	7.10	1.17	1.21	1.33
36					22.50	124	8900	7.00	1.12	1.16	1.28
37					22.81	122	8800	6.90	1.08	1.11	1.23
38					23.12	120	8800	6.80	1.03	1.07	1.18
39					23.42	118	8800	6.70	.99	1.03	1.13
40					23.72	116	8800	6.65	.96	1.00	1.10
41					24.01	114	8700	6.55	.92	.96	1.06
42				5½	24.30	112	8700	6.40	.88	.91	1.00
43					24.59	110	8600	6.30	.84	.87	.96
44					24.87	108	8600	6.20	.81	.84	.93
45					25.16	106	8500	6.10	.78	.81	.89
46					25.43	104	8500	6.	.75	.78	.86
47					25.71	104	8500	6.	.74	.76	.84
48					25.98	102	8400	5.90	.71	.73	.81
49					26.25	102	8300	5.90	.69	.72	.79
50			1¼		26.52	100	8200	5.80	.67	.69	.76
55					27.00	96	8200	5.50	.58	.60	.66
60					27.00	92	8000	5.30	.51	.53	.58
65					27.00	88	7700	5.10	.45	.47	.52
70					27.19	84	7400	4.90	.40	.42	.47
75				5	28.15	82	7400	4.80	.37	.38	.42
80					29.07	80	7400	4.60	.33	.34	.37
85					29.96	78	7400	4.60	.31	.32	.35
90					31.00	76	7400	4.40	.28	.29	.32
95					31.68	74	7400	4.40	.26	.27	.30
100					32.50	72	7400	4.30	.24	.25	.28

Comparative Production Table of Ring Filling Yarn.

No. of Yarn.	Size of spindle.	Gauge of frame.	Diameter of ring.	Length of traverse.	Twist per inch.	Revolutions of front roll per minute.	Revolutions of spindle per minute.	Hanks per spindle per day of 10 hours.	Pounds per spindle per week of 58 hours.	Pounds per spindle per week of 60 hours.	Pounds per spindle per week of 66 hours.
6		2¾	1⅝	7	7.96	220	5600	9.85	9.53	9.86	10.84
			1½	6½		240	5600		10.20		
8		2¾	1⅝	7	9.19	208	6000	9.75	7.07	7.31	8.04
			1⅝	6½		204	5600			7.30	
10		2¾	1⅝	7	10.28	196	6400	9.60	5.56	5.76	6.33
			1½	7		190	6250		5.		
12		2¾	1⅝	7	11.26	184	6600	9.40	4.54	4.70	5.17
			1½	7		184	6650		4.60		
			1⅝	7		185	6800				4.75
14		2¾	1⅝	7	12.16	176	6800	9.25	3.82	3.95	4.35
			1½	7		160	6400		3.75		
			$1\frac{7}{16}$	6		170					4.07
16		2¾	1½	6½	.13	168	7000	9.05	3.28	3.39	3.73
			1½	6½		166	6700				4.08
18		2¾	1½	6½	13.79	162	7200	8.80	2.84	2.93	3.22
			1⅜	5½			7600			2.90	
20		2¾	1½	6½	14.53	156	7300	8.60	2.49	2.58	2.83
			$1\frac{7}{16}$	6		154	7200				3.10
22		2¾	1½	6½	15.24	152	7400	8.40	2.21	2.29	2.52
			$1\frac{5}{16}$	5½		172	8330		2.90		
24		2¾	1½	6½	15.92	148	7600	8.20	1.98	2.05	2.25
			1¾	7		156	7800				2.48
25		2¾	1½	6	16.25	146	7600	8.10	1.87	1.94	2.13
			$1\frac{7}{16}$	6		148	7650			2.10	
	No. 2.					156			1.91		
26		2¾	1⅜	6	17.84	144	8000	7.95	1.77	1.83	2.01
			$1\frac{7}{16}$	6		140	7600				2.00
			1⅜	6¼		142	9100			1.80	
34		2¾	1⅜	6	21.87	128	8900	7.20	1.22	1.27	1.39
			1¼	6½		128	9000			1.28	
36		2¾	1⅜	5½	22.50	124	8900	7.00	1.12	1.16	1.28
			1¼	5½		124	8800		1.12		
			1¼	6¼		132	9500			1.23	
38		2¾	1⅜	5½	23.12	120	8800	6.80	1.03	1.07	1.18
			1⅜	6		122	8800				1.35
40		2¾	1⅜	5½	23.72	116	8800	6.65	.96	1.00	1.10
			1⅜	6		110	8700		.94		
			1⅜	5½		118	9500				1.10
42		2¾	1¼	5½	24.30	112	8700	6.40	.88	.91	1.00
			1¼	5½		114	9000		.80		
			1¼	6		129	9000		1.07		
44		2¾	1¼	5½	24.87	108	8600	6.20	.81	.84	.93
			1¼	5½		103	8200		.81		
48		2¾	1¼	5½	25.98	102	8400	5.90	.71	.73	.81
			1¼	5½		103	8200		.74		
50		2¾	1¼	5½	26.52	100	8200	5.80	.67	.69	.76
			1⅜	5½			8400		.74		
60		2¾	1¼	5	27.	92	8000	5.30	.51	.53	.58
			1⅜	6½		88	7300				
70		2¾	1¼	5	27.19	84	7400	4.90	.40	.42	.47
						72	7200		.34		
			1⅜	5¾		98	8000		.49		

Table of Constants.

Number of yarn.	Revolutions of front roll recommended by our warp table.	Constant for warp for 58 hours production in pounds.	Constant for warp for 60 hours production in pounds.	Constant for warp for 66 hours production in pounds.	Revolutions of front roll recommended by our filling table.	Constant for filling for 58 hours production in pounds.	Constant for filling for 60 hours production in pounds.	Constant for filling for 66 hours production in pounds.
4	204	.298	.308	.338	240	.240	.248	.273
5	200	.302	.312	.343	236	.250	.258	.284
6	196	.305	.315	.346	220	.260	.268	.295
7	192	.308	.318	.350	214	.266	.275	.302
8	188	.311	.321	.353	208	.272	.281	.309
9	184	.315	.326	.357	202	.278	.287	.316
10	180				196	.284	.293	.323
11	176	.316	.326	.359	190	.290	.300	.330
12	172				184	.296	.306	.337
13	168	.317	.328	.360	180	.300	.310	.341
14	164	.318	.328	.361	176	.304	.314	.346
15	160				172	.308	.318	.350
16	156	.319	.329	.362	168	.312	.322	.355
17	152	.320	.330	.363	166	.314	.324	.357
18	148	.321	.331	.364	162	.316	.326	.359
19	144	.322	.333	.365	158	.318	.328	.361
20	140				156	.320	.330	.363
21	138	.323	.334	.367	154			
22	136	.324	.335	.368	152			
23	134				150			
24	132				148			
25	130	.325	.336	.369	146			
26	128				144			
27	126				142			
28	124	.328	.339	.373	140			
29	122				138			
30	120				136			
31	120				134	.321	.331	.364
32	118				132	.322	.333	.365
33	118				130	.323	.334	.367
34	116				128	.324	.335	.368
35	116	.329	.340	.374	126	.325	.336	.369
36	114				124	.326	.337	.370
37	114				122	.327	.338	.371
38	112				120	.328	.339	.373
39	112				118	.329	.340	.374
40	110	.330	.341	.375	116	.330	.341	.375
41	110				114			
42	108	.331	.342	.376	112	.331	.342	.376
43	108				110			
44	106	.332	.343	.377	108	.332	.343	.377
45	106				106			
46	104	.333	.334	.378	104	.333	.344	.378
47	104				104			
48	102	.334	.345	.379	102	.334	.345	.379
49	102				102			
50	100	.335	.346	.380	100	.335	.346	.380
55	96	.337	.349	.383	96			
60	92	.339	.350	.385	92			
65	88	.341	.352	.387	88			
70	84	.343	.354	.390	84			
75	80				82			
80	78				80			
85	76				78			
90	74				76			
95	72				74			
100	70				72			

SPINNING FRAME DIMENSIONS.

American frames are built in widths of 36 and 39 inches. The length varies slightly between different makes of frame, so that these figures must not be relied upon as exact. They are merely intended to give a fair idea for approximate figuring.

NUMBER OF SPINDLES.	2½ IN. GAUGE.		2⅝ IN. GAUGE.		2¾ IN. GAUGE.	
	FT.	IN.	FT.	IN.	FT.	IN.
112	13	7	14	2	15	
128	15	3	15	11	16	7
144	16	11	17	8	18	5
160	18	7	19	5	20	3
176	20	3	21	2	22	1
192	21	11	22	11	23	11
208	23	7	24	8	25	9
224	25	3	26	5	27	7
240	26	11	28	2	29	5
256	28	7	29	11	31	3
272	30	3	31	8	33	1
288	31	11	33	5	34	11
304	33	7	35	2	36	9
320	35	3	36	11	38	7
336	36	11	38	8	40	5

NUMBER OF SPINDLES.	3 IN. GAUGE.		3¼ IN. GAUGE.		3½ IN. GAUGE.	
	FT.	IN.	FT.	IN.	FT.	IN.
120	16	11	18	2	19	5
132	18	5	19	9	21	2
144	19	11	21	5	22	11
156	21	5	23	½	24	8
168	22	11	24	8	26	5
180	24	5	26	3½	28	2
192	25	11	27	11	29	11
204	27	5	29	6½	31	8
216	28	11	31	2	33	5
228	30	5	32	9½	35	2
240	31	11	34	5	36	11
252	33	5	36	½	38	8
264	34	11	37	8	40	5
276	36	5	39	3½	42	2

The above lengths of frames over all are figured with tight and loose pulleys of 2½ inch face. If 3 inch face pulleys are figured, add 1 inch to the above lengths.

TABLE OF NUMBERS AND WEIGHTS OF SPINNING TRAVELERS.

WEIGHT OF TEN TRAVELERS, IN GRAINS.

Number.	Weight Grains.	Number.	Weight Grains.	Number.	Weight Grains.	Number.	Weight Grains.
25-0	1	1½-0	8½	24	60	49	110
24-0	1¼	1-0	9	25	62	50	112
23-0	1½	1	10	26	64	51	114
22-0	1¾	2	11	27	66	52	116
21-0	2	3	12	28	68	53	118
20-0	2¼	4	13	29	70	54	120
19-0	2½	5	14	30	72	55	122
18-0	2¾	6	16	31	74	56	124
17-0	3	7	18	32	76	57	126
16-0	3¼	8	20	33	78	58	128
15-0	3½	9	23	34	80	59	130
14-0	3¾	10	26	35	82	60	132
13-0	4	11	30	36	84	61	134
12-0	4¼	12	33	37	86	62	136
11-0	4½	13	36	38	88	63	138
10-0	4¾	14	39	39	90	64	140
9-0	5	15	42	40	92	65	142
8-0	5¼	16	44	41	94	66	144
7-0	5½	17	46	42	96	67	146
6½-0	5¾	18	48	43	98	68	148
6-0	6	19	50	44	100	69	150
5-0	6½	20	52	45	102	70	152
4-0	7	21	54	46	104	71	154
3-0	7½	22	56	47	106	72	156
2-0	8	23	58	48	108	73	158

ARTIFICIAL HUMIDIFICATION.

The humidification of a cotton mill is mainly artificial in character, and is closely associated with other conditions of the atmosphere which should be considered with relation to it. Artificial humidification is needed for several reasons. First, because of loss of weight in the cotton or cloth if the air is too dry and the natural amount of moisture not present. Second, because of trouble in the card room from electricity unless there is a suitable amount of moisture in the air. Third, because the moisture favorably affects the grip of the cotton fibers on each other, making less breakage of ends in the spinning and weaving rooms, and less loss of fiber in the form of invisible waste. Fourth, because of the freshening and cooling effect making the air more agreeable to the operatives.

Considering the matter first from the standpoint of cheap product, it is possible that the principal advantage in artificial humidification is in getting more product from the operative because of the beneficial physical effect of a suitable atmosphere, and the lessening of labor required on the machinery. The human system is fed by oxygen in the air. A room may be well moistened, yet poorly ventilated. Proper systems of humidification cleanse and cool the air and absorb a certain amount of soluble gases. To replace the waste of oxygen new air must be supplied. If ventilation is not continuous by means of the methods in use, the rooms should be ventilated before running hours and the fresh air humidified before the help come in.

The same percentage of humidity, or the "relative humidity," as it is known, does not necessarily produce the same physical result at all temperatures. A definite percentage of humidity at one temperature may make the conditions very disagreeable to the operative at another temperature. The English Factory Laws, for instance, allow a relative humidity of 88 per cent. at 60 degrees of the dry bulb, but only 64 per cent. at 100 degrees. The 75 per cent. which some accept as a general standard, is only authorized by the Cotton Factory Act, at a dry bulb temperature of less than 82 degrees. It is generally understood that the operatives prefer a temperature of between 70 degrees and 76 degrees of the dry bulb, but it is not always possible to regulate the temperature as desired in hot weather. The use of humidification to cool the air in hot weather often produces a higher percentage of humidity than is recommended in any standard table. The cooling effect lessens as the humidity increases. It must be understood that proper humidification is impossible unless good thermometers are used, and unless the wet bulb is properly moistened, and used with clean wicking. The wet bulb thermometer should be at sufficient distance so that the moisture in the wick, or the water holder, will not affect the dry bulb. Wet and dry bulb thermometers give the conditions of the atmosphere in their immediate vicinity. In large rooms it is necessary to have several sets of apparatus. By having several sets, errors can be readily found by hanging them in pairs to note whether they register alike. A uniform standard of humidification assists the operation of such machinery as relies for its regularity of operation upon climatic conditions. Looms have a delicate adjustment of pick which is affected by moisture. Cards are affected by electricity when the air is dry. Spinning frames vary their band tension as the humidification changes, etc.

While we give tables of relative and actual humidity, the average mill man merely needs to know how low his wet bulb thermometer should read by comparison with the dry bulb. We have tried to submit a table in simple, usable form for mill managers, without fractions or decimals.

While our table is not like any other printed, it varies but slightly from those adopted by the leading makers of humidifying apparatus, the weave room standard being similar to the limits allowed by the English Cotton Factory Act used by the American Moistening Company, and the first two tables vary little from those published for use with the Cramer Automatic Regulator.

DRAPER TABLE OF RECOMMENDED HUMIDITY
For Cotton Mill Conditions.

DRY BULB.	WEAVE ROOM.	SPINNING ROOM.	CARD ROOM.
	WET BULB.	WET BULB.	WET BULB.
60	58	56	52
61	59	57	53
62	60	58	54
63 64	61	59	55
65	62	60	56
66	63	61	57
67	64	62	58
68	65	63	59
69 **70**	66	64	60
71	67	65	61
72	68	66	62
73	69	67	63
74	70	68	64
75	71	69	65
76	72	70	66
77 78	73	71	67
79	74	72	68
80	75	73	69
81 82	76	74	70 71
83	77	75	72
84	78	76	73
85 86	79	77	74
87	80	78	75
88	81	79	76
89 **90**	82	80	77
91	83	81	78
92	84	82	79
93 94	85	83	80 81
95	86	84	82
96	87	85	83
97 98	88	86	84
99	89	87	85
100	90	88	86

We print this table on a stiff card for convenience of mill superintendents and overseers, and we will furnish same on application.

RELATIVE AND ACTUAL HUMIDITY.

In our catalogue of 1887, we printed tables of relative and actual humidity like those in use by the United States Signal Service and have reproduced them in later issues. These tables, however, are not prepared by use of the ordinary wet and dry bulb thermometers, and vary slightly from the English tables of James Glaisher, F. R. S. which are based on wet and dry bulb thermometers similar to those in ordinary use. The Glaisher tables are based on a barometric pressure of 29 inches, and since they are used by the leading introducers of air moistening machinery, we prefer to follow them, under the present conditions. In order to condense we only give such readings as are thought necessary for the conditions in Cotton Mills.

Reading of Thermometer.		Degree of Humidity.	Vapor in a Cubic foot of Air.	Reading of Thermometer.		Degree of Humidity.	Vapor in a Cubic foot of Air.	Reading of Thermometer.		Degree of Humidity.	Vapor in a Cubic foot of Air.	Reading of Thermometer.		Degree of Humidity.	Vapor in a Cubic foot of Air.
Dry.	Wet.			Dry.	Wet.			Dry.	Wet.			Dry.	Wet.		
60	60	100	5.8	**65**	65	100	6.8	**70**	70	100	8.	**75**	75	100	9.4
	59	94	5.4		64	94	6.4		69	94	7.5		74	94	8.9
	58	88	5.1		63	88	6.		68	88	7.1		73	89	8.4
	57	82	4.7		62	83	5.6		67	83	6.7		72	84	7.9
	56	76	4.4		61	78	5.3		66	78	6.3		71	79	7.4
	55	71	4.1		60	73	4.9		65	73	5.9		70	74	7.
	54	66	3.8		59	68	4.6		64	69	5.5		69	70	6.6
	53	62	3.6		58	63	4.3		63	65	5.2		68	66	6.2
	52	58	3.3		57	59	4.		62	61	4.9		67	62	5.8
	51	54	3.1		56	55	3.8		61	57	4.6		66	58	5.5
	50	50	2.9		55	51	3.5		60	53	4.3		65	55	5.2
	49	46	2.7		54	48	3.3		59	50	4.		64	52	4.9
61	61	100	6.	**66**	66	100	7.	**71**	71	100	8.3	**76**	76	100	9.7
	60	94	5.6		65	94	6.6		70	94	7.8		75	94	9.2
	59	88	5.2		64	88	6.2		69	88	7.3		74	89	8.6
	58	82	4.9		63	83	5.8		68	83	6.9		73	84	8.2
	57	77	4.6		62	78	5.5		67	78	6.5		72	79	7.7
	56	72	4.3		61	73	5.1		66	73	6.1		71	75	7.2
	55	67	4.		60	68	4.8		65	69	5.7		70	71	6.8
	54	62	3.7		59	64	4.5		64	65	5.4		69	67	6.4
	53	58	3.5		58	60	4.2		63	61	5.1		68	63	6.1
	52	54	3.2		57	56	3.9		62	57	4.7		67	59	5.7
	51	50	3.		56	52	3.7		61	53	4.4		66	55	5.4
	50	47	2.8		55	48	3.4		60	50	4.2		65	52	5.1
62	62	100	6.2	**67**	67	100	7.3	**72**	72	100	8.5	**77**	77	100	10.
	61	94	5.8		66	94	6.8		71	94	8.		76	94	9.5
	60	88	5.4		65	88	6.4		70	89	7.6		75	89	8.9
	59	82	5.1		64	83	6.		69	84	7.1		74	84	8.4
	58	77	4.7		63	78	5.6		68	79	6.7		73	79	8.
	57	72	4.4		62	73	5.3		67	74	6.3		72	75	7.5
	56	67	4.1		61	68	5.		66	69	5.9		71	71	7.1
	55	62	3.9		60	64	4.7		65	65	5.6		70	67	6.7
	54	58	3.6		59	60	4.4		64	61	5.3		69	63	6.3
	53	54	3.4		58	56	4.1		63	57	5.		68	59	5.9
	52	50	3.1		57	52	3.8		62	54	4.7		67	56	5.6
	51	47	2.9		56	49	3.6		61	51	4.4		66	53	5.3
63	63	100	6.4	**68**	68	100	7.5	**73**	73	100	8.8	**78**	78	100	10.3
	62	94	6.		67	94	7.1		72	94	8.3		77	94	9.7
	61	88	5.6		66	88	6.6		71	89	7.6		76	89	9.2
	60	82	5.2		65	83	6.2		70	84	7.4		75	84	8.7
	59	77	4.9		64	78	5.8		69	79	7.0		74	79	8.2
	58	72	4.6		63	73	5.5		68	74	6.6		73	75	7.8
	57	67	4.3		62	68	5.2		67	70	6.2		72	71	7.3
	56	63	4.		61	64	4.8		66	66	5.8		71	67	6.9
	55	59	3.7		60	60	4.5		65	62	5.4		70	63	6.5
	54	55	3.5		59	56	4.2		64	58	5.1		69	59	6.2
	53	51	3.3		58	52	4.		63	54	4.8		68	56	5.8
	52	47	3.		57	49	3.7		62	51	4.5		67	53	5.5
64	64	100	6.6	**69**	69	100	7.8	**74**	74	100	9.1	**79**	79	100	10.6
	63	94	6.2		68	94	7.3		73	94	8.6		78	95	10.1
	62	88	5.8		67	88	6.9		72	89	8.1		77	90	9.5
	61	82	5.4		66	83	6.5		71	84	7.6		76	85	9.
	60	77	5.1		65	78	6.1		70	79	7.2		75	80	8.5
	59	72	4.8		64	73	5.7		69	74	6.8		74	75	8.
	58	67	4.5		63	68	5.3		68	70	6.4		73	71	7.6
	57	63	4.2		62	64	5.		67	66	6.		72	67	7.2
	56	59	3.9		61	60	4.7		66	62	5.6		71	63	6.8
	55	55	3.6		60	56	4.4		65	58	5.3		70	59	6.4
	54	51	3.4		59	53	4.1		64	55	5.		69	56	6.
	53	48	3.2		58	50	3.9		63	52	4.7		68	53	5.6

Reading of Thermometer.		Degree of Humidity.	Vapor in a Cubic foot of Air.	Reading of Thermometer.		Degree of Humidity.	Vapor in a Cubic foot of Air.	Reading of Thermometer.		Degree of Humidity.	Vapor in a Cubic foot of Air.	Reading of Thermometer.		Degree of Humidity.	Vapor in a Cubic foot of Air.
Dry.	Wet.			Dry.	Wet.			Dry.	Wet.			Dry.	Wet.		
80	80	100	11.	**85**	85	100	12.8	**90**	90	100	14.8	**95**	95	100	17.2
	79	95	10.4												
	78	90	9.8		81	80	10.3		85	77	11.4		90	78	13.4
	77	85	9.3		80	76	9.7		84	73	10.8		89	74	12.7
	76	80	8.8		79	72	9.2		83	69	10.3		88	70	12.1
	75	75	8.3		78	68	8.7		82	65	9.7		87	66	11.5
	74	71	7.8		77	64	8.3		81	62	9.2		86	63	10.9
	73	67	7.4		76	61	7.8		80	59	8.7		85	60	10.3
	72	63	7.0		75	58	7.4		79	56	8.3		84	57	9.8
	71	59	6.6		74	55	7.		78	53	7.8		83	54	9.3
	70	56	6.2		73	52	6.6		77	50	7.4		82	51	8.8
	69	53	5.8		72	49	6.2		76	47	7.0		81	48	8.3
81	81	100	11.3	**86**	86	100	13.2	**91**	91	100	15.3	**96**	96	100	17.7
	80	95	10.7												
	79	90	10.1		82	80	10.6		86	78	11.8		91	78	13.8
	78	85	9.5		81	76	10.1		85	74	11.2		90	74	13.1
	77	80	9.1		80	72	9.5		84	70	10.6		89	70	12.4
	76	76	8.6		79	68	9.		83	66	10.1		88	66	11.8
	75	72	8.1		78	64	8.5		82	62	9.5		87	63	11.2
	74	68	7.6		77	61	8.1		81	59	9.		86	60	10.7
	73	64	7.2		76	58	7.6		80	56	8.5		85	57	10.1
	72	60	6.8		75	55	7.2		79	53	8.1		84	54	9.6
	71	56	6.4		74	52	6.8		78	50	7.7		83	52	9.1
	70	53	6.0		73	49	6.4		77	47	7.2		82	49	8.6
82	82	100	11.7	**87**	87	100	13.6	**92**	92	100	15.7	**97**	97	100	18.2
	81	95	11.1												
	80	90	10.5		83	81	11.		87	77	12.2		92	78	14.2
	79	85	9.9		82	77	10.4		86	73	11.6		91	74	13.5
	78	80	9.4		81	73	9.8		85	70	11.		90	70	12.8
	77	76	8.9		80	69	9.3		84	66	10.4		89	67	12.2
	76	72	8.4		79	65	8.8		83	62	9.9		88	64	11.6
	75	68	7.9		78	61	8.3		82	59	9.3		87	60	11.
	74	64	7.5		77	58	7.9		81	56	8.8		86	57	10.4
	73	60	7.1		76	55	7.4		80	53	8.3		85	54	9.9
	72	57	6.7		75	52	7.		79	50	7.9		84	52	9.4
	71	54	6.3		74	49	6.6		78	47	7.5		83	49	8.9
83	83	100	12.	**88**	88	100	14.	**93**	93	100	16.2	**98**	98	100	18.7
	82	95	11.7												
	81	90	10.8		84	81	11.4		88	78	12.6		93	78	14.6
	80	85	10.2		83	77	10.8		87	74	11.9		92	74	13.9
	79	80	9.7		82	73	10.2		86	70	11.3		91	70	13.2
	78	76	9.1		81	69	9.6		85	66	10.7		90	67	12.6
	77	72	8.6		80	65	9.1		84	63	10.2		89	64	12.
	76	68	8.2		79	61	8.6		83	60	9.6		88	61	11.4
	75	64	7.7		78	58	8.1		82	57	9.1		87	58	10.8
	74	60	7.3		77	55	7.7		81	54	8.7		86	55	10.2
	73	57	6.9		76	52	7.3		80	51	8.2		85	52	9.7
	72	54	6.5		75	49	6.9		79	48	7.8		84	49	9.2
84	84	100	12.4	**89**	89	100	14.4	**94**	94	100	16.7	**99**	99	100	19.3
	83	95	11.7												
	82	90	11.1		85	81	11.7		89	78	13.		94	79	15.1
	81	85	10.5		84	77	11.1		88	74	12.3		93	75	14.4
	80	80	10.		83	73	10.5		87	70	11.7		92	71	13.7
	79	76	9.4		82	69	10.		86	66	11.1		91	67	13.
	78	72	8.9		81	65	9.4		85	63	10.5		90	64	12.3
	77	68	8.5		80	61	8.9		84	60	10.		89	61	11.7
	76	64	8.		79	58	8.4		83	57	9.5		88	58	11.1
	75	60	7.5		78	55	8.		82	54	9.		87	55	10.5
	74	57	7.1		77	52	7.5		81	51	8.5		86	52	10.
	73	54	6.7		76	49	7.1		80	48	8.		85	49	9.5

BREAKING STRENGTH OF YARN.

In 1886 we prepared a breaking strength table after testing samples from two hundred and twenty-five representative mills. We print it alongside our present table for comparison.

In 1886 there were very few combers in use in this country, and a large proportion of the yarn was made from single roving with old-fashioned top flat cards, smaller rings and lower speeds than are now used. Some of these conditions favor the quality of the yarn, but to offset them we have a higher general skill in management, improved machinery and better knowledge of how to get good results from the machines.

In American mills, the breaking strength is ascertained by use of a strength tester, operated by hand or power, which handles a skein made with 80 revolutions of a reel a yard and a half in circumference. As the skein is in the form of a loop, the machine really tests the strength of 160 strands of yarn. This number is arranged so that the result in pounds will read just ten times the result in ounces by testing single yarn strands with a single thread tester; for, if we take the result in ounces and divide by 16 to get the quotient in pounds, we arrive at the same figures as when dividing the record of the skein tester by 160 to get the single thread quotient. Breaking strength is usually taken by reeling skeins from at least four bobbins and averaging the results from all after breaking one or more skeins from each bobbin. In such a system it is evident that the average result produced by no means shows the variation in single yarns. This fact is emphasized when the same yarn is tested by a single thread tester. It must be remembered that the machine for testing the breaking strength of skeins cannot give the actual average strength of the yarn, for it is impossible to get the tension on all the 160 separate yarn sections equal. A few strands break first, bringing the whole strain on a lesser number. The error is fairly constant, so that the machine answers for comparative purposes.

The hand driven tester is not suitable for accurate comparisons, for the operator cannot give a steady motion to the wheel under a continually increasing strain. We have seen the same yarn show wide comparative differences when tested on a hand breaker and a power breaker. Owing to the steadier strain, the yarn breaks stronger with a power-driven tester; and it must be remembered that our table is made up from results so obtained. Ours is a Brown Bros. tester run at a speed of 190 revolutions per minute. We are glad at any time to test yarn for mills which have no power driven tester so that they may see how nearly their yarn comes to our table when tested under similar conditions. Those whose yarn does not break as well as our table, when tested with a hand tester, need not necessarily assume that their yarn is inferior.

As the usable value of yarn does not consist in the strength of a combined number of threads but in the regularity of strength of single threads, a single-thread yarn tester is desirable. We are agents for a power driven machine which automatically makes 80 breaks of single threads drawn from six bobbins simultaneously. Each break is recorded on a chart and the weak places in the yarn are exposed. A single-thread tester gives higher results than a skein tester. We have found it to vary from 15 to 20 per cent. The variation in single yarns is naturally much greater than in skeins, since the breaking of many strands together necessarily trends toward uniformity. We have found yarn that broke in skeins from 46 to 54 pounds, show from 4 to 7 ounces on a single-thread tester, which is equivalent to 40 to 70 pounds on the skein. Skeins showing from 105 to 128 pounds on the skein tester, varied from 12 ounces to 20 ounces, or from 120 to 200 pounds on the single-thread tester. Yarn showing 152 to 208 pounds on skein tests, varied from 16 ounces to 23½ ounces on single-thread test, or equivalent to 160 to 235 for skein test.

Variations in strength of yarn are due, in part, to variations in size, but they do not necessarily follow the variations in size with uniformity. Yarn is made weak by lack of twist, and also made weak by excessive twist. Different bobbins from the same frame will vary on account of differences in rolls, rings, travelers, ring setting, etc. It is not safe to draw conclusions from single tests or single lots. Variations in size or number are important since a variation from standard may give the mill's customer less or more product than called for. Variation in yarn is evidence of improper selection of processes, or improper running of the machinery in the preparatory department. No one has definitely settled by comparative tests the best and most economical method of preparing strong, even yarn. There are still those who claim that a multiplicity of doublings and drawings weakens the yarn, and it is not proven just where the doublings should be made. It is possible that we may some day find that a proper doubling and evening of the sliver at some particular stage of manufacture will allow less processes, or less doublings, in other stages.

There is a general impression that yarn wound from a full bobbin is stronger than that wound off nearer the bare bobbin. We have gone into exhaustive tests to determine whether this theory is correct, and find that while there is no uniformity, the yarn first spun often breaks stronger while actually finer in number. In one test we tested all the yarn on four bobbins made from Middling cotton, single carding, twist 24.40, spun with 1⅞ inch ring, 6½ inches traverse. There were 17 skeins of yarn on each bobbin, making 68 skeins tested in all. The yarn averaged in number 15.82 and the breaking strength averaged 109. The weakest skein broke 95 pounds and the strongest 125. The number of yarn varied from 14.93 to 17.33. The first 16 skeins averaged in number 15.55, breaking an average of 106. The last sixteen skeins averaged in number 16.03, breaking 113.6.

To show the difference between yarn tested under different conditions of humidity, we took four bobbins of yarn made from Good Middling cotton grown in South Carolina, single carding, 28.45 twist, spun on 1¾ inch ring, 6½ inches traverse, dry bulb showed 71, wet bulb 66. The average breaking strength was 60 pounds per skein, while the average number of the yarn was 29. We then kept this yarn 24 hours in a dry kiln with a temperature of 120 degrees for that period. The average breaking strength was now 55 pounds, while the average number was 29.78. Next, we soaked the yarn five minutes under water, merely drying off the outside with a towel. It then showed 64 pounds breaking strength, average number 28.70. We next soaked the yarn 40 hours under water and it broke 66.50, average number of yarn 26.13. The variation in the yarn numbering came from the additional weight of the water absorbed. This would show the extremes of dryness and wetness to be about 10 per cent. below or above the standard.

The warp yarn tested for the tables was mostly single carded on revolving flat cards, and averaged about Strict Middling in grade. The combed yarn tests were made from American yarn sent in, which averaged slightly under Good Middling in grade. The soft-twisted yarn was of various kinds and used for various purposes. In these tests the stronger twisted filling was eliminated. The average twist of the yarn tested was very close to 3.25 times the square root of the number.

The most surprising thing about the tests was the strength of the soft twisted yarn in the coarser numbers, this running at times higher than our old standard for warp.

Owing to delay in arrival of yarn and in getting proper machinery for testing, the yarn tested probably averaged an aging of at least six months. It was kept in our weave room during this time under fairly uniform conditions of humidity. At the time of the tests the humidity in the weave room averaged quite closely to the humidity standard which we recommend for the spinning room. Certain mills made much more even yarn than others on the same numbers. It was noticed that the combed yarn varied considerably in number. There was not enough yarn supplied to make a comparative test of Combed Egyptian, Sea Island and American cotton. Sea Island and Fancy Georgia cottons naturally broke stronger than the ordinary American grades, and also better than the Egyptian grades. No attempt was made to classify according to length of staple. It must be remembered that these tables represent an average breaking strength, although it is natural that our samples should largely come from the mills that are making the better yarns.

As the yarn numbers vary constantly, and as the twist in different classes of yarn is also fairly constant, the curve plotted from the breaking strengths should also be a constant curve. The purpose of testing the hundreds of sample yarns sent has been to find out by the actual results just what constant curve will most uniformly meet the actual conditions. The results given in the tables are taken from constant curves without giving the decimals, as the strength tester cannot be read to decimal results. Anyone wishing to make a very careful or scientific comparison of yarns should accurately compute the result to decimals, using the following rules.

STANDARD WARP YARN.

Weigh the skein after breaking and divide 1000 by the weight to get number of yarn (or use tables in our book or the table printed on one sheet which we supply); then add this to 1900 and divide by the number.

Example: Skein weighs 45.3 grains. 1000 divided by 45.3 gives 22.08 the number of the yarn. 1900+22.08= 1922.08÷22.08=87.05 which is the standard breaking weight for this number.

If several skeins are broken the average weight can be used.

For combed warp yarn the standard is obtained by multiplying the number by four, subtracting from 2600 and dividing the remainder by the number.

For soft twisted yarn the standard is obtained by multiplying the number by 13, subtracting from 1900 and dividing the remainder by the number.

Our tables do not give figures for carded warp or soft twist above number 50. They can be easily figured if required. The + and — signs signify decimals. For instance 62.30 would be given as 62+ while 62.70 would be given as 63—. 31.51 would be given as 32— while 31.50 would be given as 31+.

DRAPER TABLES
OF
BREAKING WEIGHTS OF AMERICAN YARNS
SPUN FROM AMERICAN COTTON.
AVERAGED FROM SAMPLE SKEIN TESTS FROM SEVERAL HUNDRED AMERICAN MILLS.

120 yards Weight in Grains.	Number of Yarn.	OLD Breaking Weight of Warp Yarn.	NEW Breaking Weight of Warp Yarn.	NEW Breaking Weight Combed Warp.	NEW Breaking Weight Soft Twist Yarn.	120 yards Weight in Grains.	Number of Yarn.	OLD Breaking Weight of Warp Yarn.	NEW Breaking Weight Combed Warp.
1000	1					19.6	51	36.6	47—
500	2					19.2	52	36.1	46
333.3	3	530	634+	863—	620+	18.9	53	35.5	45+
250	4	410	476—	646	462	18.5	54	34.9	44+
200	5	330	381	516	367	18.2	55	34.4	43+
166.7	6	275	318—	429+	304—	17.9	56	33.8	42+
142.9	7	237.6	272+	367+	258+	17.5	57	33.4	42—
125	8	209	238+	321	224+	17.2	58	32.8	41—
111.1	9	186.5	212+	285—	198+	17	59	32.3	40+
100	**10**	168.7	191	256	177	16.7	**60**	31.7	39+
90.9	11	154.1	174—	232+	160—	16.4	61	31.3	39—
83.3	12	142	159+	213—	145+	16.1	62	30.8	38—
76.9	13	131.5	147+	196	133+	15.9	63	30.4	37+
71.4	14	122.8	137—	182—	123—	15.6	64	30	37—
66.7	15	115.1	128—	169+	114—	15.4	65	29.6	36
62.5	16	108.4	120—	158+	106—	15.2	66	29.2	35+
58.8	17	102.5	113—	149—	99—	14.9	67	28.8	35—
55.6	18	97.3	107—	140+	93—	14.7	68	28.5	34+
52.6	19	92.6	101	133—	87	14.5	69	28.2	34—
50	**20**	88.3	96	126	82	14.3	**70**	27.8	33+
47.6	21	83.8	91+	120—	77+	14.1	71	27.4	33—
45.5	22	79.7	87+	114+	73+	13.9	72	27.1	32+
43.5	23	75.9	84—	109+	70—	13.7	73	26.8	32—
41.7	24	72.4	80+	104+	66+	13.5	74	26.5	31+
40	25	69.2	77	100	63	13.3	75	26.2	31—
38.5	26	66.3	74+	96	60+	13.2	76	25.8	30+
37	27	63.6	71+	92+	57+	13	77	25.5	30—
35.7	28	61.3	69—	89—	55—	12.8	78	25.3	29+
34.5	29	59.2	67—	86—	53—	12.7	79	24.9	29—
33.3	**30**	57.3	64+	83—	50+	12.5	**80**	24.6	28+
32.3	31	55.6	62+	80—	48+	12.4	81	24.3	28+
31.3	32	54	60+	77+	46+	12.2	82	24	28—
30.3	33	52.6	59—	75—	45—	12.1	83	23.7	27+
29.4	34	51.2	57—	72+	43—	11.9	84	23.4	27—
28.6	35	50	55+	70+	41+	11.8	85	23.2	27—
27.8	36	48.7	54—	68+	40—	11.6	86	22.8	26+
27	37	47.6	52+	66+	38+	11.5	87	22.6	26—
26.3	38	46.5	51	64+	37	11.4	88	22.4	26—
25.6	39	45.5	50—	63—	36—	11.2	89	22.2	25+
25	**40**	44.6	48+	61	34+	11.1	**90**	22	25—
24.4	41	43.8	47+	59+	33+	11	91	21.7	25—
23.8	42	43	46+	58—	32+	10.9	92	21.5	24+
23.3	43	42.2	45+	56+	31+	10.8	93	21.3	24—
22.7	44	41.4	44+	55+	30+	10.6	94	21.2	24—
22.2	45	40.7	43+	54—	29+	10.5	95	21	23+
21.7	46	40	42+	53—	28+	10.4	96	20.7	23+
21.3	47	39.3	41+	51+	27+	10.3	97	20.5	23—
20.8	48	38.6	41—	50+	27—	10.2	98	20.4	23—
20.4	49	37.9	40—	49+	26—	10.1	99	20.2	22+
20	**50**	37.3	39	48	25	10	**100**	20	22

RULES FOR SPINNERS.

To find the draught of a spinning frame:—

Write down the number of teeth in all the driving-wheels, and multiply them together. Then write down the number of teeth in all the wheels that are driven, and multiply them together in like manner. If there is any difference in the diameter of the rollers, multiply the least, or driver's product, by the diameter of the back roller; and the largest product, or that of the driven wheels, by the diameter of the front roller. Divide the product of the driven wheels by that of the drivers, and the quotient will be the draught of the machine.

To change the draught-gear on a spinning-frame when changing to a different number of yarn and the draught and roving have both to be altered:—

Multiply the number of yarn being spun, by the hank roving desired, and that product by the number of teeth in the change pinion being used; divide the product thus obtained by the number of yarn desired, multiplied by the hank roving being used. The quotient will show the change pinion required.

To change the draught gear when changing from one number of yarn to another without changing the roving:—

Multiply the number of teeth in the change pinion in use by the number of yarn spun. This product divided by the number of yarn desired will give the change pinion required.

To change the twist-gear when changing to a different number of yarn:—

Square the number of teeth in the present gear, and multiply by the number of yarn being spun. Divide this product by the number of the yarn desired; the square root of the quotient will show the proper number of teeth for the new gear.

To find what per cent. yarn contracts in twisting:—

Divide the number of the yarn by the product of the draught and hank roving, and subtract the quotient from 1. *Example:* Suppose No. 28.5 yarn is being spun from 4-hank roving, with a draught of 7.26. $7.26 \times 4 = 29.04$. $28.5 \div 29.04 = 0.98$, which subtracted from 1.00 leaves .02, or two per cent.=the contraction in length.

To find the loss of twist in spinning:—

By the "loss of twist" is meant the amount the actual twist is less than that found by computing from the speed of the spindle. *Rule:* Divide 1 by the circumference of the bobbin in inches. *Example:* Suppose a filling bobbin is 1½ inches in circumference at the barrel. $1 \div 1.5 = 0.67$=loss there. If it is 3 inches in circumference at the outside the loss there=$1 \div 3 = 0.33$. Average loss from computed twist 0.50, or half a turn per inch.

The best way to find the actual speed of spindles:—

Make some mark on the end of the cylinder so an assistant can turn it by hand slowly just once around. Mark the heads of several bobbins, or mark the whorls of the spindles, so as to be able to count the average number of turns of the spindle to one turn of the cylinder. Then multiply this number by the revolutions per minute the cylinder makes, ascertained carefully with a good speed-counter; or, attach revolving-shaft of a speed-counter to tip of spindle with a rubber tube.

The result obtained by either of these methods is nearer the actual speed of the spindle than the result obtained from computation in the usual way, because of the differences due to the size of the banding and the angle of the groove in the whorl.

To find the length of yarn on a bobbin:—

Multiply the circumference of the front roll in inches by the number of revolutions per minute, and this product by the number of minutes required to fill the bobbin; divide by 36 and deduct the contraction in twisting, and the result will be the number of yards on the bobbin.

To determine the twist of a spinning frame:—

Multiply the teeth in driven gears for a dividend; divide this by the teeth in cylinder gear; then multiply this by the ratio between the cylinder and whorl and then divide by

3.1416 for a constant. This constant divided by the twist gear used will give the twist in one inch of yarn, thus:

Drivers.	cyl.	Ratio between cyl. & whorl.		
85 × 91=7735÷30	=257.8	×7.60=1959.28	÷3.1416	=623.65

= constant.

This divided by twist gear will give the twist in one inch of yarn, or divided by twist required will give the twist gear.

To determine the size of a cord, when yarn of several different sizes have been used to make it:—

Reduce each yarn to grains, add the grains together and divide 1000 by their sum; the result will be the size of cord. Thus:

12s, 16s & 18s twisted together.

12s reduced to grains equals	83.33
16s " " " "	62.50
18s " " " "	55.56
	201.39 divided into 1000 equals 4.96 equals the size of the cord.

One way to determine a constant for twist:—

Spin together two rovings of the same hank, one white and one black; then count the turns of twist in one inch. This multiplied by teeth in the twist gear will give constant; this constant divided by twist required will give twist gear to use, or dividing by twist gear used will give twist in one inch of yarn.

Another way to find the draft on a spinning frame:—

Multiply the driving gears together, and this product by 7 if the middle and back rolls are ⅞ inches in diameter, for a divisor; multiply all driven gears together, and that product by 8, if the front rolls are one inch in diameter, for a dividend; and the quotient will be the draft. If you want a constant number, multiply the teeth of the change gears that you use on these frames by the draft thus obtained, and the result is the constant number, thus:

Back Stud Roll		Front Roll Draft	Draft of Frame	Constant.
(70×55×8)	÷	(20×30×7)	=7.333 × 30	=220.

This divided by draft required will give gear to use.

To determine the product of a spindle per week:—

Divide the number of revolutions of the front roll per minute by 3, for a week of 60 hours; the quotient will be the number of hanks per week; to reduce to pounds, divide by the yarn number.

For weeks of different hours the divisors are as follows: —

60 hours, divisor = 3.
58 hours, divisor = 3.1
56 hours, divisor = 3.21
55 hours, divisor = 3.27
54 hours, divisor = 3.33
50 hours, divisor = 3.6

The result by this rule makes allowance for loss in doffing, etc.

To determine the ratio between the cylinder and whorl:—

Divide the diameter of the cylinder plus the diameter of the band by the diameter of whorl plus the diameter of band, thus,

Cylinder,	7 in.
Dia. of band	$\frac{1}{8}$ "
	$7\frac{1}{8}$ in.

$$7\tfrac{1}{8} \text{ in.} = \frac{57}{8} \div \frac{15}{16} = 7.6$$

The whorl is $\frac{13}{16}$ and band is $\frac{1}{8}$ inches, added together equals $\frac{15}{16}$ inches.

Therefore, a cylinder 7 inches in diameter, running with a whorl $\frac{13}{16}$ inches in diameter will turn the spindle 7.6 times.

Avoirdupois Weight.

Grains.	Drachms.	Ounces.	Pounds.	Ton.	Grammes.	Kilog.
27.34 =	1				= 1.77184	
437.5 =	16 =	1			= 28.34954	
7,000.0 =	256 =	16 =	1		= 453.59265	
			2000 =	1		= 907.18

Long Measure.

Inches.	Feet.	Yards.	Rods.	Furlongs.	Mile.	Metres.
12 =	1				=	.3048
36 =	3 =	1			=	.9144
198 =	16.5 =	5.5 =	1		=	5.0291
7,920 =	660 =	220 =	40 =	1	=	201.1643
63,360 =	5,280 =	1,760 =	320 =	8	1 =	1,609.3145

DIMENSIONS OF CIRCLES.

Diameter.		Circumference.	Area.	Diameter.		Circumference.	Area.
1-64	.015625	.04909	.00019	3-4	.75	2.35619	.44179
1-32	.03125	.09817	.00077	25-32	.78125	2.45437	.47937
3-64	.046875	.14726	.00173	13-16	.8125	2.55254	.51849
1-16	.0625	.19635	.00307	27-32	.84375	2.65072	.55914
3-32	.09375	.29452	.00690	7-8	.875	2.74889	.60132
1-8	.125	.39270	.01227	29-32	.90625	2.84707	.64504
5-32	.15625	.49087	.01917	15-16	.9375	2.94524	.69029
3-16	.1875	.58905	.02761	31-32	.96875	3.04342	.73708
7-32	.21875	.68722	.03758	**1**	**1.**	**3.14159**	**.78540**
1-4	.25	.78540	.04909	1-16	1.0625	3.33794	.88664
9-32	.28125	.88357	.06213	1-8	1.125	3.53429	.99402
5-16	.3125	.98175	.07670	3-16	1.1875	3.73064	1.1075
11-32	34375	1.07992	.09281	1-4	1.25	3.92699	1.2272
3-8	.375	1.17810	.11045	5-16	1.3125	4.12334	1.3530
13-32	.40625	1.27627	.12962	3-8	1.375	4.31969	1.4849
7-16	.4375	1.37445	.15033	7-16	1.4375	4.51604	1.6230
15-32	.46875	1.47262	.17257	1-2	1.5	4.71239	1.7671
1-2	.5	1.57080	.19635	9-16	1.5625	4.90874	1.9175
17-32	.53125	1.66897	.22166	5-8	1.625	5.10509	2.0739
9-16	.5625	1.76715	.24850	11-16	1.6875	5.30144	2.2365
19-32	.59375	1.86532	.27688	3-4	1.75	5.49779	2.4053
5-8	.625	1.96350	.30680	13-16	1.8125	5.69414	2.5802
21-32	.65625	2.06167	.33824	7-8	1.875	5.89049	2.7612
11-16	.6875	2.15984	.37122	15-16	1.9375	6.08684	2.9483
23-32	.71875	2.25802	.40574	**2**	**2.**	**6.28319**	**3.1416**

NUMBERING YARNS.

Yarn is weighed by avoirdupois weight.

Silk.

The silk-worm forms the cocoon of two parallel filaments of silk; three to six cocoons are usually reeled off together, making a thread of raw silk containing six to twelve filaments. One authority states that 500 yards of five twin filaments weigh about 2.5 grains. The number of drachms (27.34 grains) that 1000 yards of this raw silk weighs is the number.

Silk is sold in the United States by the number of yards in one ounce.

Sewing silk is numbered irregularly by letters:

Letter,	000	00	0	A	B	C	D	E	EE	F	FF	G
Yards in one oz.,	2000	1600	1300	1000	850	650	550	400	330	262	212	125

Letter A silk has 16,000 yards in a pound, and equals about a No. 60 cotton sewing thread in weight.

Silk that cannot be reeled is carded, spun and numbered like cotton yarn, and is called spun silk.

Linen and Jute.

Barlow's History of Weaving, London (1878), gives the following table:

2½ yards= 1 thread or round of the linen reel.
300 " = 120 " = 1 cut.
600 " = 240 " = 2 " = 1 heer.
1,800 " = 720 " = 6 " = 3 " =1 slip.
3,600 " =1,440 " =12 " = 6 " =2 " =1 hank.
7,200 " =2,880 " =24 " =12 " =4 " =2 " =1 hasp.
14,400 " =5,760 " =48 " =24 " =8 " =4 " =2 " = 1 spyndle.

The number of cuts in one pound is the number of linen yarn.

The number of yards of linen yarn that weigh 23.33 grains is the number of the yarn.

The numbers by which linen sewing threads are sold represent three threads of the number twisted together, that is, No. 35 standard thread has three strands of No. 35 yarn in it.

Table for numbering Linen Yarn by the weight in grains of 300 yards or 1 lea (or cut).

Grains.	Number of yarn.	Grains.	Number of yarn.	Grains.	Number of yarn.	Grains.	Number of yarn.	Grains.	Number of yarn.	Grains.	Number of yarn.
100	70.	260	26.92	420	16.67	580	12.07	800	8.75	1500	4.67
110	63.64	270	25.93	430	16.28	590	11.86	825	8.48	1600	4.37
120	58.33	280	25.	440	15.91	600	11.67	850	8.24	1700	4.12
130	53.85	290	24.14	450	15.56	610	11.48	875	8.	1800	3.89
140	50.	300	23.33	460	15.22	620	11.29	900	7.78	1900	3.68
150	46.67	310	22.58	470	14.89	630	11.11	925	7.57	2000	3.50
160	43.75	320	21.87	480	14.58	640	10.94	950	7.37	2250	3.11
170	41.18	330	21.21	490	14.29	650	10.77	975	7.18	2500	2.80
180	38.89	340	20.59	500	14.	660	10.61	1000	7.	2750	2.55
190	36.84	350	20.	510	13.73	670	10.45	1050	6.67	3000	2.33
200	35.	360	19.44	520	13.46	680	10.29	1100	6.36	3250	2.15
210	33.33	370	18.92	530	13.21	690	10.14	1150	6.09	3500	2.
220	31.82	380	18.42	540	12.96	700	10.	1200	5.83	4000	1.75
230	30.43	390	17.95	550	12.73	725	9.66	1250	5.60	5000	1.40
240	29.17	400	17.50	560	12.50	750	9.33	1300	5.38	6000	1.17
250	28.	410	17.07	570	12.28	775	9.03	1400	5.	7000	1.

Woollen.

1 yard=1 thread or round of the woollen reel.
80 " =1 knot.
300 " =$3\frac{3}{4}$ " =1 cut.
1,600 " =20 " =$5\frac{1}{3}$ " =1 run.
2,000 " =25 " =$6\frac{2}{3}$ " =$1\frac{1}{4}$ " =1 bier.

The number of runs in one pound is the number of woollen yarn.

The number of yards of woollen yarn that weigh 4.375 grains is the number of the yarn.

Table for numbering Woollen Yarn by the weight in grains of twenty yards, or one fourth of a knot.

Grains.	Runs.	Grains.	Runs.	Grains.	Runs.	Grains.	Runs.	Grains.	Runs.	Grains.	Runs.
1	87.50	18	4.86	35	2.50	52	1.68	69	1.27	86	1.02
2	43.75	19	4.61	36	2.43	53	1.65	70	1.25	87	1.01
3	29.17	20	4.37	37	2.36	54	1.62	71	1.23	88	.99
4	21.87	21	4.17	38	2.30	55	1.59	72	1.22	89	.98
5	17.50	22	3.98	39	2.24	56	1.56	73	1.20	90	.97
6	14.58	23	3.80	40	2.19	57	1.54	74	1.18	91	.96
7	12.50	24	3.65	41	2.13	58	1.51	75	1.17	92	.95
8	10.94	25	3.50	42	2.08	59	1.48	76	1.15	93	.94
9	9.72	26	3.37	43	2.03	60	1.46	77	1.14	94	.93
10	8.75	27	3.24	44	1.99	61	1.43	78	1.12	95	.92
11	7.95	28	3.12	45	1.94	62	1.41	79	1.11	96	.91
12	7.29	29	3.02	46	1.90	63	1.38	80	1.09	97	.90
13	6.73	30	2.92	47	1.86	64	1.37	81	1.08	98	.89
14	6.25	31	2.82	48	1.82	65	1.35	82	1.07	99	.88
15	5.83	32	2.73	49	1.79	66	1.33	83	1.05	100	.87
16	5.47	33	2.65	50	1.75	67	1.31	84	1.04		
17	5.15	34	2.57	51	1.72	68	1.29	85	1.03		

The number of yarn of different sizes represents the proportionate size of No. 1 yarn, and to determine the size or number of a thread composed of strands of different numbers twisted together, it is only necessary to add together the proportionate sizes of the separate strands. A single example will illustrate : 3 run, 4 run, 5 run and 6 run twisted together will make yarn the size of $\frac{1}{3}+\frac{1}{4}+\frac{1}{5}+\frac{1}{6}$ of 1 run, or $\frac{20}{60}+\frac{15}{60}+\frac{12}{60}+\frac{10}{60}=\frac{57}{60}$ of 1 run ; not quite so large as one run, but exactly 57÷60=.95 run.

Worsted.

1 yard, =1 thread or round of the worsted reel.
80 " =80 " =1 lea or knot.
560 " =560 " =7 " " =1 hank.

The number of hanks in one pound is the number of worsted yarn.

The number of a worsted yarn of a given length which equals in weight a cotton yarn of the same length, is equal to the cotton number multiplied by 1.5. No. 60 cotton No. 90 worsted.

The number of yards of worsted yarn that weigh 12.5 grains is the number of the yarn.

Table for numbering Worsted Yarn by the weight in grains of twenty yards, or one fourth of a knot.

Grains.	No. of Yarn.	Grains.	No. of Yarn.	Grains.	No. of Yarn.	Grains.	No. of Yarn.	Grains.	No. of Yarn.	Grains.	No. of Yarn.
1	250.	19	13.16	37	6.76	55	4.55	73	3.42	91	2.75
2	125.	20	12.50	38	6.58	56	4.46	74	3.38	92	2.72
3	83.33	21	11.90	39	6.41	57	4.39	75	3.33	93	2.69
4	62.50	22	11.36	40	6.25	58	4.31	76	3.29	94	2.66
5	50.	23	10.87	41	6.10	59	4.24	77	3.25	95	2.63
6	41.67	24	10.42	42	5.95	60	4.17	78	3.21	96	2.60
7	35.71	25	10.	43	5.81	61	4.10	79	3.17	97	2.58
8	31.25	26	9.62	44	5.68	62	4.03	80	3.12	98	2.55
9	27.78	27	9.26	45	5.56	63	3.97	81	3.09	99	2.52
10	25.	28	8.93	46	5.43	64	3.91	82	3.05	100	2.50
11	22.73	29	8.62	47	5.32	65	3.85	83	3.01	105	2.38
12	20.83	30	8.33	48	5.21	66	3.79	84	2.98	110	2.27
13	19.23	31	8.06	49	5.10	67	3.73	85	2.94	115	2.17
14	17.86	32	7.81	50	5.	68	3.68	86	2.91	120	2.08
15	16.67	33	7.58	51	4.90	69	3.62	87	2.87	125	2.
16	15.62	34	7.35	52	4.81	70	3.57	88	2.84	150	1.67
17	14.71	35	7.14	53	4.72	71	3.52	89	2.81	175	1.43
18	13.89	36	6.94	54	4.63	72	3.47	90	2.78	200	1.25

Cotton.

1½ yards =1 thread or round of the cotton reel.
120 " =80 " =1 skein, ley or lea.
840 " =560 " =7 skeins=1 hank.

The number of hanks in one pound, is the number of cotton yarn.

The number of yards of cotton yarn that weigh 8.33 grains, is the number of the yarn.

The numbers by which cotton sewing threads are sold represent three threads of the number twisted together, that is, No. 60 standard thread has three strands of No. 60 yarn in it. In a six-cord thread each of the three strands is made up of two threads twisted together. Six threads of No. 120 make six-cord No. 60.

The French system of numbering is based on the Metric system. The metre=39.37 inches, and is the standard of length. The kilogram (2.2047 pounds) is the standard weight in numbering yarn, and the number of thousand metres in a kilogram is the number of the yarn. No. 28 yarn would be No. 47.42 in France.

By the various standards, No. 1 yarn has the following numbers of yards in one pound:

Cotton and spun silk	840
Linen	300
Woollen	1,600
Worsted	560

The following tables have been carefully computed, and are, we believe, correct.

The tables for numbering cotton yarn by the weight of one skein are also printed separately for the use of spinners, and we will mail a copy to any overseer on request.

Comparative Numbers of Yarn of different materials of the same weight per yard.

Cot. Hanks of 840 yards.	Woollen. Runs of 1,600 yards.	Worst. Hanks of 560 yards.	Linen. Cuts of 300 yards.	Silk. Yards in one ounce.	Cot. Hanks of 840 yards.	Woollen. Runs of 1,600 yards.	Worst. Hanks of 560 yards.	Linen. Cuts of 300 yards.	Silk. Yards in one ounce.
1	.525	1.5	2.8	52.5	71	37.275	106.5	198.8	3727.5
2	1.05	3.	5.6	105.	72	37.8	108.	201.6	3780.
3	1.575	4.5	8.4	157.5	73	38.325	109.5	204.4	3832.5
4	2.1	6.	11.2	210.	74	38.85	111.	207.2	3885.
5	2.625	7.5	14.	262.5	75	39.375	112.5	210.	3937.5
6	3.15	9.	16.8	315.	76	39.9	114.	212.8	3990.
7	3.675	10.5	19.6	367.5	77	40.425	115.5	215.6	4042.5
8	4.2	12.	22.4	420.	78	40.95	117.	218.4	4095.
9	4.725	13.5	25.2	472.5	79	41.475	118.5	221.2	4147.5
10	5.25	15.	28.	525.	**80**	42.	120.	224.	4200.
11	5.775	16.5	30.8	577.5	81	42.525	121.5	226.8	4252.5
12	6.3	18.	33.6	630.	82	43.05	123.	229.6	4305.
13	6.825	19.5	36.4	682.5	83	43.575	124.5	232.4	4357.5
14	7.35	21.	39.2	735.	84	44.1	126.	235.2	4410.
15	7.875	22.5	42.	787.5	85	44.625	127.5	238.	4462.5
16	8.4	24.	44.8	840.	86	45.15	129.	240.8	4515.
17	8.925	25.5	47.6	892.5	87	45.675	130.5	243.6	4567.5
18	9.45	27.	50.4	945.	88	46.2	132.	246.4	4620.
19	9.975	28.5	53.2	997.5	89	46.725	133.5	249.2	4672.5
20	10.5	30.	56.	1050.	**90**	47.25	135.	252.	4725.
21	11.025	31.5	58.8	1102.5	91	47.775	136.5	254.8	4777.5
22	11.55	33.	61.6	1155.	92	48.3	138.	257.6	4830.
23	12.075	34.5	64.4	1207.5	93	48.825	139.5	260.4	4882.5
24	12.6	36.	67.2	1260.	94	49.35	141.	263.2	4935.
25	13.125	37.5	70.	1312.5	95	49.875	142.5	266.	4987.5
26	13.65	39.	72.8	1365.	96	50.4	144.	268.8	5040.
27	14.175	40.5	75.6	1417.5	97	50.925	145.5	271.6	5092.5
28	14.7	42.	78.4	1470.	98	51.45	147.	274.4	5145.
29	15.225	43.5	81.2	1522.5	99	51.975	148.5	277.2	5197.5
30	15.75	45.	84.	1575.	**100**	52.5	150.	280.	5250.
31	16.275	46.5	86.8	1627.5	101	53.025	151.5	282.8	5302.5
32	16.8	48.	89.6	1680.	102	53.55	153.	285.6	5355.
33	17.325	49.5	92.4	1732.5	103	54.075	154.5	288.4	5407.5
34	17.85	51.	95.2	1785.	104	54.6	156.	291.2	5460.
35	18.375	52.5	98.	1837.5	105	55.125	157.5	294.	5512.5
36	18.9	54.	100.8	1890.	106	55.65	159.	296.8	5565.
37	19.425	55.5	103.6	1942.5	107	56.175	160.5	299.6	5617.5
38	19.95	57.	106.4	1995.	108	56.7	162.	302.4	5670.
39	20.475	58.5	109.2	2047.5	109	57.225	163.5	305.2	5722.5
40	21.	60.	112.	2100.	**110**	57.75	165.	308.	5775.
41	21.525	61.5	114.8	2152.5	111	58.275	166.5	310.8	5827.5
42	22.05	63.	117.6	2205.	112	58.8	168.	313.6	5880.
43	22.575	64.5	120.4	2257.5	113	59.325	169.5	316.4	5932.5
44	23.1	66.	123.2	2310.	114	59.85	171.	319.2	5985.
45	23.625	67.5	126.	2362.5	115	60.375	173.5	322.	6037.5
46	24.15	69.	128.8	2415.	116	60.9	174.	324.8	6090.
47	24.675	70.5	131.6	2467.5	117	61.425	175.5	327.6	6142.5
48	25.2	72.	134.4	2520.	118	61.95	177.	330.4	6195.
49	25.725	73.5	137.2	2572.5	119	62.475	178.5	333.2	6247.5
50	26.25	75.	140.	2625.	**120**	63.	180.	336.	6300.
51	26.775	76.5	142.8	2677.5	121	63.525	181.5	338.8	6352.5
52	27.3	78.	145.6	2730.	122	64.05	183.	341.6	6405.
53	27.825	79.5	148.4	2782.5	123	64.575	184.5	344.4	6457.5
54	28.35	81.	151.2	2835.	124	65.1	186.	347.2	6510.
55	28.875	82.5	154.	2887.5	125	65.625	187.5	350.	6562.5
56	29.4	84.	156.8	2940.	126	66.15	189.	352.8	6615.
57	29.925	85.5	159.6	2992.5	127	66.675	190.5	355.6	6667.5
58	30.45	87.	162.4	3045.	128	67.2	192.	358.4	6720.
59	30.975	88.5	165.2	3097.5	129	67.725	193.5	361.2	6772.5
60	31.5	90.	168.	3150.	**130**	68.25	195.	364.	6825.
61	32.025	91.5	170.8	3202.5	131	68.775	196.5	366.8	6877.5
62	32.55	93.	173.6	3255.	132	69.3	198.	369.6	6930.
63	33.075	94.5	176.4	3307.5	133	69.825	199.5	372.4	6982.5
64	33.6	96.	179.2	3360.	134	70.35	201.	375.2	7035.
65	34.125	97.5	182.	3412.5	135	70.875	202.5	378.	7087.5
66	34.65	99.	184.8	3465.	136	71.4	204.	380.8	7140.
67	35.175	100.5	187.6	3517.5	137	71.925	205.5	383.6	7192.5
68	35.7	102.	190.4	3570.	138	72.45	207.	386.4	7245.
69	36.225	103.5	193.2	3622.5	139	72.975	208.5	389.2	7297.5
70	36.75	105.	196.	3675.	**140**	73.5	210.	392	7350.

Table for numbering Cotton Yarn by the weight in grains of 120 yards or 1 skein.

120yds. weigh grains.	Number of Yarn.	120yds. weigh grains.	Number of Yarn.	120yds. weigh grains.	Number of Yarn.	120yds. weigh grains.	Number of Yarn	120yds. weigh grains.	Number of Yarn.
1.	1000.	**14.**	71.43	**21.**	47.62	**28.**	35.71	**35.**	28.57
2.	500.	.1	70.92	.1	47.39	.1	35.59	.1	28.49
3.	333.3	.2	70.42	.2	47.17	.2	35.46	.2	28.41
4.	250.0	.3	69.93	.3	46.95	.3	35.34	.3	28.33
5.	200.0	.4	69.44	.4	46.73	.4	35.21	.4	28.25
5.5	181.8	.5	68.97	.5	46.51	.5	35.09	.5	28.17
6.	166.7	.6	68.49	.6	46.30	.6	34.97	.6	28.09
6.5	153.8	.7	68.03	.7	46.08	.7	34.84	.7	28.01
7.	142.9	.8	67.57	.8	45.87	.8	34.72	.8	27.93
7.5	133.3	.9	67.11	.9	45.66	.9	34.60	.9	27.86
8.	125.0	**15.**	66.67	**22.**	45.45	**29.**	34.48	**36.**	27.78
.1	123.5	.1	66.23	.1	45.25	.1	34.36	.1	27.70
.2	122.0	.2	65.79	.2	45.05	.2	34.25	.2	27.62
.3	120.5	.3	65.36	.3	44.84	.3	34.13	.3	27.55
.4	119.0	.4	64.94	.4	44.64	.4	34.01	.4	27.47
.5	117.6	.5	64.52	.5	44.44	.5	33.90	.5	27.40
.6	116.3	.6	64.10	.6	44.25	.6	33.78	.6	27.32
.7	114.9	.7	63.69	.7	44.05	.7	33.67	.7	27.25
.8	113.6	.8	63.29	.8	43.86	.8	33.56	.8	27.17
.9	112.4	.9	62.89	.9	43.67	.9	33.44	.9	27.10
9.	111.1	**16.**	62.50	**23.**	43.48	**30.**	33.33	**37.**	27.03
.1	109.9	.1	62.11	.1	43.29	.1	33.22	.1	26.95
.2	108.7	.2	61.73	.2	43.10	.2	33.11	.2	26.88
.3	107.5	.3	61.35	.3	42.92	.3	33.00	.3	26.81
.4	106.4	.4	60.98	.4	42.74	.4	32.89	.4	26.74
.5	105.3	.5	60.61	.5	42.55	.5	32.79	.5	26.67
.6	104.2	.6	60.24	.6	42.37	.6	32.68	.6	26.60
.7	103.1	.7	59.88	.7	42.19	.7	32.57	.7	26.53
.8	102.0	.8	59.52	.8	42.02	.8	32.47	.8	26.46
.9	101.0	.9	59.17	.9	41.84	.9	32.36	.9	26.39
10.	100.0	**17.**	58.82	**24.**	41.67	**31.**	32.26	**38.**	26.32
.1	99.01	.1	58.48	.1	41.49	.1	32.16	.1	26.25
.2	98.04	.2	58.14	.2	41.32	.2	32.05	.2	26.18
.3	97.09	.3	57.80	.3	41.15	.3	31.95	.3	26.11
.4	96.15	.4	57.47	.4	40.98	.4	31.85	.4	26.04
.5	95.24	.5	57.14	.5	40.82	.5	31.75	.5	25.97
.6	94.34	.6	56.82	.6	40.65	.6	31.65	.6	25.91
.7	93.46	.7	56.50	.7	40.49	.7	31.55	.7	25.84
.8	92.59	.8	56.18	.8	40.32	.8	31.45	.8	25.77
.9	91.74	.9	55.87	.9	40.16	.9	31.35	.9	25.71
11.	90.91	**18.**	55.56	**25.**	40.00	**32.**	31.25	**39.**	25.64
.1	90.09	.1	55.25	.1	39.84	.1	31.15	.1	25.58
.2	89.29	.2	54.95	.2	39.68	.2	31.06	.2	25.51
.3	88.50	.3	54.64	.3	39.53	.3	30.96	.3	25.45
.4	87.72	.4	54.35	.4	39.37	.4	30.86	.4	25.38
.5	86.96	.5	54.05	.5	39.22	.5	30.77	.5	25.32
.6	86.21	.6	53.76	.6	39.06	.6	30.67	.6	25.25
.7	85.47	.7	53.48	.7	38.91	.7	30.58	.7	25.19
.8	84.75	.8	53.19	.8	38.76	.8	30.49	.8	25.13
.9	84.03	.9	52.91	.9	38.61	.9	30.40	.9	25.06
12.	83.33	**19.**	52.63	**26.**	38.46	**33.**	30.30	**40.**	25.00
.1	82.64	.1	52.36	.1	38.31	.1	30.21	.1	24.94
.2	81.97	.2	52.08	.2	38.17	.2	30.12	.2	24.88
.3	81.30	.3	51.81	.3	38.02	.3	30.03	.3	24.81
.4	80.65	.4	51.55	.4	37.88	.4	29.94	.4	24.75
.5	80.00	.5	51.28	.5	37.74	.5	29.85	.5	24.69
.6	79.37	.6	51.02	.6	37.59	.6	29.76	.6	24.63
.7	78.74	.7	50.76	.7	37.45	.7	29.67	.7	24.57
.8	78.12	.8	50.51	.8	37.31	.8	29.59	.8	24.51
.9	77.52	.9	50.25	.9	37.17	.9	29.50	.9	24.45
13.	76.92	**20.**	50.00	**27.**	37.04	**34.**	29.41	**41.**	24.39
.1	76.34	.1	49.75	.1	36.90	.1	29.33	.1	24.33
.2	75.76	.2	49.50	.2	36.77	.2	29.24	.2	24.27
.3	75.19	.3	49.26	.3	36.63	.3	29.15	.3	24.21
.4	74.63	.4	49.02	.4	36.50	.4	29.07	.4	24.15
.5	74.07	.5	48.78	.5	36.36	.5	28.99	.5	24.10
.6	73.53	.6	48.54	.6	36.23	.6	28.90	.6	24.04
.7	72.99	.7	48.31	.7	36.10	.7	28.82	.7	23.98
.8	72.46	.8	48.08	.8	35.97	.8	28.74	.8	23.92
.9	71.94	.9	47.85	.9	35.84	.9	28.65	.9	23.87

Table for numbering Cotton Yarn by the weight in grains of 120 yards or 1 skein,

120yds. weigh grains.	Number of Yarn.	120yds. weigh grains.	Number of Yarn.	120yds. weigh grains.	Number of Yarn.	120yds. weigh grains.	Number of Yarn.	120yds. weigh grains.	Number of Yarn.
42.	23.81	**49.**	20.41	**56.**	17.86	**63.**	15.87	**70.**	14.29
.1	23.75	.1	20.37	.1	17.83	.1	15.85	.1	14.27
.2	23.70	.2	20.33	.2	17.79	.2	15.83	.2	14.25
.3	23.64	.3	20.28	.3	17.76	.3	15.80	.3	14.22
.4	23.58	.4	20.24	.4	17.73	.4	15.77	.4	14.20
.5	23.53	.5	20.20	.5	17.70	.5	15.75	.5	14.18
.6	23.47	.6	20.16	.6	17.67	.6	15.72	.6	14.16
.7	23.42	.7	20.12	.7	17.64	.7	15.70	.7	14.14
.8	23.36	.8	20.08	.8	17.61	.8	15.67	.8	14.12
.9	23.31	.9	20.04	.9	17.57	.9	15.65	.9	14.10
43.	23.26	**50.**	20.00	**57.**	17.54	**64.**	15.62	**71.**	14.08
.1	23.20	.1	19.96	.1	17.51	.1	15.60	.1	14.06
.2	23.15	.2	19.92	.2	17.48	.2	15.58	.2	14.04
.3	23.09	.3	19.88	.3	17.45	.3	15.55	.3	14.03
.4	23.04	.4	19.84	.4	17.42	.4	15.53	.4	14.01
.5	22.99	.5	19.80	.5	17.39	.5	15.50	.5	13.99
.6	22.94	.6	19.76	.6	17.36	.6	15.48	.6	13.97
.7	22.88	.7	19.72	.7	17.33	.7	15.46	.7	13.95
.8	22.83	.8	19.69	.8	17.30	.8	15.43	.8	13.93
.9	22.78	.9	19.65	.9	17.27	.9	15.41	.9	13.91
44.	22.73	**51.**	19.61	**58.**	17.24	**65.**	15.38	**72.**	13.89
.1	22.68	.1	19.57	.1	17.21	.1	15.36	.1	13.87
.2	22.62	.2	19.53	.2	17.18	.2	15.34	.2	13.85
.3	22.57	.3	19.49	.3	17.15	.3	15.31	.3	13.83
.4	22.52	.4	19.46	.4	17.12	.4	15.29	.4	13.81
.5	22.47	.5	19.42	.5	17.09	.5	15.27	.5	13.79
.6	22.42	.6	19.38	.6	17.06	.6	15.24	.6	13.77
.7	22.37	.7	19.34	.7	17.04	.7	15.22	.7	13.76
.8	22.32	.8	19.31	.8	17.01	.8	15.20	.8	13.74
.9	22.27	.9	19.27	.9	16.98	.9	15.17	.9	13.72
45.	22.22	**52.**	19.23	**59.**	16.95	**66.**	15.15	**73.**	13.70
.1	22.17	.1	19.19	.1	16.92	.1	15.13	.1	13.68
.2	22.12	.2	19.16	.2	16.89	.2	15.11	.2	13.66
.3	22.08	.3	19.12	.3	16.86	.3	15.08	.3	13.64
.4	22.03	.4	19.08	.4	16.84	.4	15.06	.4	13.62
.5	21.98	.5	19.05	.5	16.81	.5	15.04	.5	13.61
.6	21.93	.6	19.01	.6	16.78	.6	15.02	.6	13.59
.7	21.88	.7	18.98	.7	16.75	.7	14.99	.7	13.57
.8	21.83	.8	18.94	.8	16.72	.8	14.97	.8	13.55
.9	21.79	.9	18.90	.9	16.69	.9	14.95	.9	13.53
46.	21.74	**53.**	18.87	**60.**	16.67	**67.**	14.93	**74.**	13.51
.1	21.69	.1	18.83	.1	16.64	.1	14.90	.1	13.50
.2	21.65	.2	18.80	.2	16.61	.2	14.88	.2	13.48
.3	21.60	.3	18.76	.3	16.58	.3	14.86	.3	13.46
.4	21.55	.4	18.73	.4	16.56	.4	14.84	.4	13.44
.5	21.51	.5	18.69	.5	16.53	.5	14.81	.5	13.42
.6	21.46	.6	18.66	.6	16.50	.6	14.79	.6	13.40
.7	21.41	.7	18.62	.7	16.47	.7	14.77	.7	13.39
.8	21.37	.8	18.59	.8	16.45	.8	14.75	.8	13.37
.9	21.32	.9	18.55	.9	16.42	.9	14.73	.9	13.35
47.	21.28	**54.**	18.52	**61.**	16.39	**68.**	14.71	**75.**	13.33
.1	21.23	.1	18.48	.1	16.37	.1	14.68	.1	13.32
.2	21.19	.2	18.45	.2	16.34	.2	14.66	.2	13.30
.3	21.14	.3	18.42	.3	16.31	.3	14.64	.3	13.28
.4	21.10	.4	18.38	.4	16.29	.4	14.62	.4	13.26
.5	21.05	.5	18.35	.5	16.26	.5	14.60	.5	13.25
.6	21.01	.6	18.32	.6	16.23	.6	14.58	.6	13.23
.7	20.96	.7	18.28	.7	16.21	.7	14.56	.7	13.21
.8	20.92	.8	18.25	.8	16.19	.8	14.53	.8	13.19
.9	20.88	.9	18.21	.9	16.16	.9	14.51	.9	13.18
48.	20.83	**55.**	18.18	**62.**	16.13	**69.**	14.49	**76.**	13.16
.1	20.79	.1	18.15	.1	16.10	.1	14.47	.1	13.14
.2	20.75	.2	18.12	.2	16.08	.2	14.45	.2	13.12
.3	20.70	.3	18.08	.3	16.05	.3	14.43	.3	13.11
.4	20.66	.4	18.05	.4	16.03	.4	14.41	.4	13.09
.5	20.62	.5	18.02	.5	16.00	.5	14.39	.5	13.07
.6	20.57	.6	17.99	.6	15.97	.6	14.37	.6	13.05
.7	20.53	.7	17.95	.7	15.95	.7	14.35	.7	13.04
.8	20.49	.8	17.92	.8	15.92	.8	14.33	.8	13.02
.9	20.45	.9	17.89	.9	15.90	.9	14.31	.9	13.00

Table for numbering Cotton Yarn by the weight in grains of 120 yards or 1 skein.

120yds. weigh grains.	Number of Yarn.	120yds. weigh grains.	Number of Yarn.	120yds. weigh grains.	Number of Yarn.	120yds. weigh grains.	Number of Yarn.	120yds. weigh grains.	Number of Yarn.
77.	12.99	**84.**	11.90	**91.**	10.99	**98.**	10.20	**105.**	9.52
.1	12.97	.1	11.89	.1	10.98	.1	10.19	.1	9.51
.2	12.95	.2	11.88	.2	10.96	.2	10.18	.2	9.51
.3	12.94	.3	11.86	.3	10.95	.3	10.17	.3	9.50
.4	12.92	.4	11.85	.4	10.94	.4	10.16	.4	9.49
.5	12.90	.5	11.83	.5	10.93	.5	10.15	.5	9.48
.6	12.89	.6	11.82	.6	10.92	.6	10.14	.6	9.47
.7	12.87	.7	11.81	.7	10.91	.7	10.13	.7	9.46
.8	12.85	.8	11.79	.8	10.89	.8	10.12	.8	9.45
.9	12.84	.9	11.78	.9	10.88	.9	10.11	.9	9.44
78.	12.82	**85.**	11.76	**92.**	10.87	**99.**	10.10	**106.**	9.43
.1	12.80	.1	11.75	.1	10.86	.1	10.09	.1	9.43
.2	12.79	.2	11.74	.2	10.85	.2	10.08	.2	9.42
.3	12.77	.3	11.72	.3	10.83	.3	10.07	.3	9.41
.4	12.76	.4	11.71	.4	10.82	.4	10.06	.4	9.40
.5	12.74	.5	11.70	.5	10.81	.5	10.05	.5	9.39
.6	12.72	.6	11.68	.6	10.80	.6	10.04	.6	9.38
.7	12.71	.7	11.67	.7	10.79	.7	10.03	.7	9.37
.8	12.69	.8	11.66	.8	10.78	.8	10.02	.8	9.36
.9	12.67	.9	11.64	.9	10.76	.9	10.01	.9	9.35
79.	12.66	**86.**	11.63	**93.**	10.75	**100.**	10.00	**107.**	9.35
.1	12.64	.1	11.61	.1	10.74	.1	9.99	.1	9.34
.2	12.63	.2	11.60	.2	10.73	.2	9.98	.2	9.33
.3	12.61	.3	11.59	.3	10.72	.3	9.97	.3	9.32
.4	12.59	.4	11.57	.4	10.71	.4	9.96	.4	9.31
.5	12.58	.5	11.56	.5	10.70	.5	9.95	.5	9.30
.6	12.56	.6	11.55	.6	10.68	.6	9.94	.6	9.29
.7	12.55	.7	11.53	.7	10.67	.7	9.93	.7	9.29
.8	12.53	.8	11.52	.8	10.66	.8	9.92	.8	9.28
.9	12.52	.9	11.51	.9	10.65	.9	9.91	.9	9.27
80.	12.50	**87.**	11.49	**94.**	10.64	**101.**	9.90	**108.**	9.26
.1	12.48	.1	11.48	.1	10.63	.1	9.89	.1	9.25
.2	12.47	.2	11.47	.2	10.62	.2	9.88	.2	9.24
.3	12.45	.3	11.45	.3	10.60	.3	9.87	.3	9.23
.4	12.44	.4	11.44	.4	10.59	.4	9.86	.4	9.23
.5	12.42	.5	11.43	.5	10.58	.5	9.85	.5	9.22
.6	12.41	.6	11.42	.6	10.57	.6	9.84	.6	9.21
.7	12.39	.7	11.40	.7	10.56	.7	9.83	.7	9.20
.8	12.38	.8	11.39	.8	10.55	.8	9.82	.8	9.19
.9	12.36	.9	11.38	.9	10.54	.9	9.81	.9	9.18
81.	12.35	**88.**	11.36	**95.**	10.53	**102.**	9.80	**109.**	9.17
.1	12.33	.1	11.35	.1	10.52	.1	9.79	.2	9.16
.2	12.32	.2	11.34	.2	10.50	.2	9.78	.4	9.14
.3	12.30	.3	11.33	.3	10.49	.3	9.78	.6	9.12
.4	12.29	.4	11.31	.4	10.48	.4	9.77	.8	9.11
.5	12.27	.5	11.30	.5	10.47	.5	9.76	110.	9.09
.6	12.25	.6	11.29	.6	10.46	.6	9.75	.2	9.07
.7	12.24	.7	11.27	.7	10.45	.7	9.74	.4	9.06
.8	12.22	.8	11.26	.8	10.44	.8	9.73	.6	9.04
.9	12.21	.9	11.25	.9	10.43	.9	9.72	.8	9.03
82.	12.20	**89.**	11.24	**96.**	10.42	**103.**	9.71	**111.**	9.01
.1	12.18	.1	11.22	.1	10.41	.1	9.70	.2	8.99
.2	12.17	.2	11.21	.2	10.40	.2	9.69	.4	8.98
.3	12.15	.3	11.20	.3	10.38	.3	9.68	.6	8.96
.4	12.14	.4	11.19	.4	10.37	.4	9.67	.8	8.94
.5	12.12	.5	11.17	.5	10.36	.5	9.66	112.	8.93
.6	12.11	.6	11.16	.6	10.35	.6	9.65	.2	8.91
.7	12.09	.7	11.15	.7	10.34	.7	9.64	.4	8.90
.8	12.08	.8	11.14	.8	10.33	.8	9.63	.6	8.88
.9	12.06	.9	11.12	.9	10.32	.9	9.62	.8	8.87
83.	12.05	**90.**	11.11	**97.**	10.31	**104.**	9.62	**113.**	8.85
.1	12.03	.1	11.10	.1	10.30	.1	9.61	.2	8.83
.2	12.02	.2	11.09	.2	10.29	.2	9.60	.4	8.82
3	12.00	.3	11.07	.3	10.28	.3	9.59	.6	8.80
.4	11.99	.4	11.06	.4	10.27	.4	9.58	.8	8.79
.5	11.98	.5	11.05	.5	10.26	.5	9.57	114.	8.77
.6	11.96	.6	11.04	.6	10.25	.6	9.56	.2	8.76
.7	11.95	.7	11.03	.7	10.24	.7	9.55	.4	8.74
.8	11.93	.8	11.01	.8	10.22	.8	9.54	.6	8.73
.9	11.92	.9	11.00	.9	10.21	.9	9.53	.8	8.71

Table for numbering Cotton Yarn by the weight in grains of 120 yards or 1 skein.

120yds. weigh grains.	Number of Yarn.	120yds. weigh grains.	Number of Yarn.	120yds. weigh grains.	Number of Yarn.	120yds. weigh grains.	Number of Yarn	120yds. weigh grains.	Number of Yarn.
115.	8.70	**140.**	7.14	**180.**	5.56	**250.**	4.00	**400.**	2.50
.2	8.68	.5	7.12	181.	5.52	252.	3.97	405.	2.47
.4	8.67	141.	7.09	182.	5.49	254.	3.94	410.	2.44
.6	8.65	.5	7.07	183.	5.46	256.	3.91	415.	2.41
.8	8.64	142.	7.04	184.	5.43	258.	3.88	420.	2.38
116.	8.62	.5	7.02	185.	5.41	260.	3.85	425.	2.35
.2	8.61	143.	6.99	186.	5.38	262.	3.82	430.	2.33
.4	8.59	.5	6.97	187.	5.35	264.	3.79	435.	2.30
.6	8.58	144.	6.94	188.	5.32	266.	3.76	440.	2.27
.8	8.56	.5	6.92	189.	5.29	268.	3.73	445.	2.25
117.	8.55	**145.**	6.90	**190.**	5.26	**270.**	3.70	**450.**	2.22
.2	8.53	.5	6.87	191.	5.24	272.	3.68	455.	2.20
.4	8.52	146.	6.85	192.	5.21	274.	3.65	460.	2.17
.6	8.50	.5	6.83	193.	5.18	276.	3.62	465.	2.15
.8	8.49	147.	6.80	194.	5.15	278.	3.60	470.	2.13
118.	8.47	.5	6.78	195.	5.13	280.	3.57	475.	2.11
.2	8.46	148.	6.76	196.	5.10	282.	3.55	480.	2.08
.4	8.45	.5	6.73	197.	5.08	284.	3.52	485.	2.06
.6	8.43	149.	6.71	198.	5.05	286.	3.50	490.	2.04
.8	8.42	.5	6.69	199.	5.03	288.	3.47	495.	2.02
119.	8.40	**150.**	6.67	**200.**	5.00	**290.**	3.45	**500.**	2.00
.2	8.39	.5	6.64	201.	4.98	292.	3.42	505.	1.98
.4	8.38	151.	6.62	202.	4.95	294.	3.40	510.	1.96
.6	8.36	.5	6.60	203.	4.93	296.	3.38	515.	1.94
.8	8.35	152.	6.58	204.	4.90	298.	3.36	520.	1.92
120.	8.33	.5	6.56	205.	4.88	300.	3.33	525.	1.90
.2	8.32	153.	6.54	206.	4.85	302.	3.31	530.	1.89
.4	8.31	.5	6.51	207.	4.83	304.	3.29	535.	1.87
.6	8.29	154.	6.49	208.	4.81	306.	3.27	540.	1.85
.8	8.28	.5	6.47	209.	4.78	308.	3.25	545.	1.83
121.	8.26	**155.**	6.45	**210.**	4.76	**310.**	3.23	**550.**	1.82
.4	8.24	.5	6.43	211.	4.74	312.	3.21	555.	1.80
.6	8.22	156.	6.41	212.	4.72	314.	3.18	560.	1.79
.8	8.21	.5	6.39	213.	4.69	316.	3.17	565.	1.77
122.	8.20	157.	6.37	214.	4.67	318.	3.14	570.	1.75
.5	8.16	.5	6.35	215.	4.65	320.	3.12	575.	1.74
123.	8.13	158.	6.33	216.	4.63	322.	3.11	580.	1.72
.5	8.10	.5	6.31	217.	4.61	324.	3.09	585.	1.71
124.	8.06	159.	6.29	218.	4.59	326.	3.07	590.	1.69
.5	8.03	.5	6.27	219.	4.57	328.	3.05	595.	1.68
125.	8.00	**160.**	6.25	**220.**	4.55	**330.**	3.03	**600.**	1.67
.5	7.97	.5	6.23	221.	4.52	332.	3.01	610.	1.64
126.	7.94	161.	6.21	222.	4.50	334.	2.99	620.	1.61
.5	7.91	.5	6.19	223.	4.48	336.	2.98	630.	1.59
127.	7.87	162.	6.17	224.	4.46	338.	2.96	640.	1.56
.5	7.84	.5	6.15	225.	4.44	340.	2.94	650.	1.54
128.	7.81	163.	6.13	226.	4.42	342.	2.92	660.	1.52
.5	7.78	.5	6.12	227.	4.41	344.	2.91	670.	1.49
129.	7.75	164.	6.10	228.	4.39	346.	2.89	680.	1.47
.5	7.72	.5	6.08	229.	4.37	348.	2.87	690.	1.45
130.	7.69	**165.**	6.06	**230.**	4.35	**350.**	2.86	**700.**	1.43
.5	7.66	.5	6.04	231.	4.33	352.	2.84	710.	1.41
131.	7.63	166.	6.02	232.	4.31	354.	2.82	720.	1.39
.5	7.60	.5	6.01	233.	4.29	356.	2.81	730.	1.37
132.	7.58	167.	5.99	234.	4.27	358.	2.79	740.	1.35
.5	7.55	.5	5.97	235.	4.26	360.	2.78	750.	1.33
133.	7.52	168.	5.95	236.	4.24	362.	2.76	760.	1.32
.5	7.49	.5	5.93	237.	4.22	364.	2.75	770.	1.30
134.	7.46	169.	5.92	238.	4.20	366.	2.73	780.	1.28
.5	7.43	.5	5.90	239.	4.18	368.	2.72	790.	1.27
135.	7.41	**170.**	5.88	**240.**	4.17	**370.**	2.70	**800.**	1.25
.5	7.38	171.	5.85	241.	4.15	372.	2.69	820.	1.22
136.	7.35	172.	5.81	242.	4.13	374.	2.67	840.	1.19
.5	7.33	173.	5.78	243.	4.12	376.	2.66	860.	1.16
137.	7.30	174.	5.75	244.	4.10	378.	2.65	880.	1.14
.5	7.27	175.	5.71	245.	4.08	380.	2.63	900.	1.11
138.	7.25	176.	5.68	246.	4.07	382.	2.62	925.	1.08
.5	7.22	177.	5.65	247.	4.05	385.	2.60	950.	1.05
139.	7.19	178.	5.62	248.	4.03	390.	2.56	975.	1.03
.5	7.17	179.	5.59	249.	4.02	395.	2.53	1000.	1.00

TWIST TABLE,

Showing the square root of the numbers or counts from 1 to 140 hanks in the pound, with the twist per inch for different kinds of yarn.

Counts or Numbers.	Square Root.	Ordinary Warp Twist.	Whitman's Warp Twist.	Extra Mule Warp Twist.	Mule Warp Twist.	Mule Filling Twist.
1	**1.0000**	**4.75**	**4.50**	**4.00**	**3.75**	**3.25**
2	1.4142	6.72	6.36	5.66	5.30	4.60
3	1.7321	8.23	7.79	6.93	6.50	5.63
4	2.0000	9.50	9.00	8.00	7.50	6.50
5	2.2361	10.62	10.06	8.94	8.39	7.27
6	2.4495	11.64	11.02	9.80	9.19	7.96
7	2.6458	12.57	11.91	10.58	9.92	8.60
8	2.8284	13.44	12.73	11.31	10.61	9.19
9	3.0000	14.25	13.50	12.00	11.25	9.75
10	3.1623	15.02	14.23	12.65	11.86	10.28
11	3.3166	15.75	14.92	13.27	12.44	10.78
12	3.4641	16.45	15.59	13.86	12.99	11.26
13	3.6056	17.13	16.22	14.42	13.52	11.72
14	3.7417	17.77	16.84	14.97	14.03	12.16
15	3.8730	18.40	17.43	15.49	14.52	12.59
16	4.0000	19.00	18.00	16.00	15.00	13.00
17	4.1231	19.58	18.55	16.49	15.46	13.40
18	4.2426	20.15	19.09	16.97	15.91	13.79
19	4.3589	20.70	19.62	17.44	16.35	14.17
20	4.4721	21.24	20.12	17.89	16.77	14.53
21	4.5826	21.77	20.62	18.33	17.18	14.89
22	4.6904	22.28	21.11	18.76	17.59	15.24
23	4.7958	22.78	21.58	19.18	17.98	15.59
24	4.8990	23.27	22.05	19.60	18.37	15.92
25	5.0000	23.75	22.50	20.00	18.75	16.25
26	5.0990	24.22	22.95	20.40	19.12	16.57
27	5.1962	24.68	23.38	20.78	19.49	16.89
28	5.2915	25.13	23.81	21.17	19.84	17.20
29	5.3852	25.58	24.23	21.54	20.19	17.50
30	5.4772	26.02	24.65	21.91	20.54	17.80
31	5.5678	26.45	25.05	22.27	20.88	18.10
32	5.6569	26.87	25.46	22.63	21.21	18.38
33	5.7446	27.29	25.85	22.98	21.54	18.67
34	5.8310	27.70	26.24	23.32	21.87	18.95
35	5.9161	28.10	26.62	23.66	22.19	19.23
36	6.0000	28.50	27.00	24.00	22.50	19.50
37	6.0828	28.89	27.37	24.33	22.81	19.77
38	6.1644	29.28	27.74	24.66	23.12	20.03
39	6.2450	29.66	28.10	24.98	23.42	20.30
40	6.3246	30.04	28.46	25.30	23.72	20.55
41	6.4031	30.41	28.81	25.61	24.01	20.81
42	6.4807	30.78	29.16	25.92	24.30	21.06
43	6.5574	31.15	29.51	26.23	24.59	21.31
44	6.6332	31.51	29.85	26.53	24.87	21.56
45	6.7082	31.86	30.19	26.83	25.16	21.80
46	6.7823	32.22	30.52	27.13	25.43	22.04
47	6.8557	32.56	30.85	27.42	25.71	22.28
48	6.9282	32.91	31.18	27.71	25.98	22.52
49	7.0000	33.25	31.50	28.00	26.25	22.75
50	7.0711	33.59	31.82	28.28	26.52	22.98
51	7.1414	33.92	32.14	28.57	26.78	23.21
52	7.2111	34.25	32.45	28.85	27.04	23.44
53	7.2801	34.58	32.76	29.12	27.30	23.66
54	7.3485	34.91	33.07	29.39	27.56	23.88
55	7.4162	35.23	33.37	29.66	27.81	24.10
56	7.4833	35.55	33.67	29.93	28.06	24.32
57	7.5498	35.86	33.97	30.20	28.31	24.54
58	7.6158	36.17	34.27	30.46	28.56	24.75
59	7.6811	36.49	34.57	30.72	28.80	24.96
60	7.7460	36.79	34.86	30.98	29.05	25.17
61	7.8102	37.10	35.15	31.24	29.29	25.38
62	7.8740	37.40	35.43	31.50	29.53	25.59
63	7.9373	37.70	35.72	31.75	29.76	25.80
64	8.0000	38.00	36.00	32.00	30.00	26.00
65	8.0623	38.30	36.28	32.25	30.23	26.20
66	8.1240	38.59	36.56	32.50	30.47	26.40
67	8.1854	38.88	36.83	32.74	30.70	26.60
68	8.2462	39.17	37.11	32.98	30.92	26.80
69	8.3066	39.46	37.38	33.23	31.15	27.00
70	8.3666	39.74	37.65	33.47	31.37	27.19

TWIST TABLE.

Counts or Numbers.	Square Root.	Ordinary Warp Twist.	Whitman's Warp Twist.	Extra Mule Warp Twist.	Mule Warp Twist.	Mule Filling Twist.
71	8.4261	40.02	37.92	33.70	31.60	27.38
72	8.4853	40.31	38.18	33.94	31.82	27.58
73	8.5440	40.58	38.45	34.18	32.04	27.77
74	8.6023	40.86	38.71	34.41	32.26	27.96
75	8.6603	41.14	38.97	34.64	32.48	28.15
76	8.7178	41.41	39.23	34.87	32.69	28.33
77	8.7750	41.68	39.49	35.10	32.91	28.52
78	8.8318	41.95	39.74	35.33	33.12	28.70
79	8.8882	42.22	40.00	35.55	33.33	28.89
80	8.9443	42.49	40.25	35.78	33.54	29.07
81	9.0000	42.75	40.50	36.00	33.75	29.25
82	9.0554	43.01	40.75	36.22	33.96	29.43
83	9.1104	43.27	41.00	36.44	34.16	29.61
84	9.1652	43.53	41.24	36.66	34.37	29.79
85	9.2195	43.79	41.49	36.88	34.57	29.96
86	9.2736	44.05	41.73	37.09	34.78	30.14
87	9.3274	44.31	41.97	37.31	34.98	30.31
88	9.3808	44.56	42.21	37.52	35.18	30.49
89	9.4340	44.81	42.45	37.74	35.38	30.66
90	9.4868	45.06	42.69	37.95	35.58	30.83
91	9.5394	45.31	42.93	38.16	35.77	31.00
92	9.5917	45.56	43.16	38.37	35.97	31.17
93	9.6437	45.81	43.40	38.57	36.16	31.34
94	9.6954	46.05	43.63	38.78	36.36	31.51
95	9.7468	46.30	43.86	38.99	36.55	31.68
96	9.7980	46.54	44.09	39.19	36.74	31.84
97	9.8489	46.78	44.32	39.40	36.93	32.01
98	9.8995	47.02	44.55	39.60	37.12	32.17
99	9.9499	47.26	44.77	39.80	37.31	32.34
100	10.0000	47.50	45.00	40.00	37.50	32.50
101	10.0499	47.74	45.22	40.20	37.69	32.66
102	10.0995	47.97	45.45	40.40	37.87	32.82
103	10.1489	48.21	45.67	40.60	38.06	32.98
104	10.1980	48.44	45.89	40.79	38.24	33.14
105	10.2470	48.67	46.11	40.99	38.43	33.30
106	10.2956	48.90	46.33	41.18	38.61	33.46
107	10.3441	49.13	46.55	41.38	38.79	33.62
108	10.3973	49.36	46.77	41.57	38.97	33.77
109	10.4403	49.59	46.98	41.76	39.15	33.93
110	10.4881	49.82	47.20	41.95	39.33	34.09
111	10.5357	50.04	47.41	42.14	39.51	34.24
112	10.5830	50.27	47.62	42.33	39.69	34.39
113	10.6301	50.49	47.84	42.52	39.86	34.55
114	10.6771	50.72	48.05	42.71	40.04	34.70
115	10.7238	50.94	48.26	42.90	40.21	34.85
116	10.7703	51.16	48.47	43.08	40.39	35.00
117	10.8167	51.38	48.67	43.27	40.56	35.15
118	10.8628	51.60	48.88	43.45	40.74	35.30
119	10.9087	51.82	49.09	43.63	40.91	35.45
120	10.9545	52.03	49.30	43.82	41.08	35.60
121	11.0000	52.25	49.50	44.00	41.25	35.75
122	11.0454	52.47	49.70	44.18	41.42	35.90
123	11.0905	52.68	49.91	44.36	41.59	36.04
124	11.1355	52.89	50.11	44.54	41.73	36.19
125	11.1803	53.11	50.31	44.72	41.93	36.34
126	11.2250	53.32	50.51	44.90	42.09	36.48
127	11.2694	53.53	50.71	45.08	42.26	36.63
128	11.3137	53.74	50.91	45.25	42.43	36.77
129	11.3578	53.95	51.12	45.43	42.59	36.91
130	11.4018	54.16	51.31	45.61	42.76	37.06
131	11.4455	54.37	51.50	45.78	42.92	37.20
132	11.4891	54.57	51.70	45.96	43.08	37.34
133	11.5326	54.78	51.90	46.13	43.25	37.48
134	11.5758	54.99	52.09	46.30	43.41	37.62
135	11.6190	55.19	52.29	46.48	43.57	37.76
136	11.6619	55.39	52.48	46.65	43.73	37.90
137	11.7047	55.60	52.67	46.82	43.89	38.04
138	11.7473	55.80	52.86	47.99	44.05	38.18
139	11.7898	56.00	53.05	47.16	44.21	38.32
140	11.8322	56.20	53.24	47.33	44.37	38.45

TWO PLY.

No. of yarn to be twist'd.	No. of twisted yarn.	Sq. root of No. twisted yarn.	Square root multiplied by			No. of yarn to be twist'd.	No. of twisted yarn.	Sq. root of No. twisted yarn.	Square root multiplied by	
			4	5	6				5	6
1	.5	.7071	2.83	3.54	4.24	76	38.	6.1644	30.82	36.99
2	1.	1.	4.	5.	6.	77	38.5	6.2049	31.02	37.23
3	1.5	1.2247	4.90	6.12	7.35	78	39.	6.2450	31.22	37.47
4	2.	1.4142	5.66	7.07	8.49	79	39.5	6.2849	31.42	37.71
5	2.5	1.5811	6.32	7.91	9.49	80	40.	6.3246	31.62	37.95
6	3.	1.7321	6.93	8.66	10.39	81	40.5	6.3640	31.82	38.18
7	3.5	1.8708	7.48	9.35	11.22	82	41.	6.4031	32.02	38.42
8	4.	2.	8.	10.	12.	83	41.5	6.4420	32.21	38.65
9	4.5	2.1213	8.49	10.61	12.73	84	42.	6.4807	32.40	38.88
10	5.	2.2361	8.94	11.18	13.42	85	42.5	6.5192	32.60	39.12
11	5.5	2.3452	9.38	11.73	14.07	86	43.	6.5574	32.79	39.34
12	6.	2.4495	9.80	12.25	14.70	87	43.5	6.5955	32.98	39.57
13	6.5	2.5495	10.20	12.75	15.30	88	44.	6.6332	33.17	39.80
14	7.	2.6458	10.58	13.23	15.87	89	44.5	6.6708	33.35	40.02
15	7.5	2.7386	10.95	13.69	16.43	90	45.	6.7082	33.54	40.25
16	8.	2.8284	11.31	14.14	16.97	91	45.5	6.7454	33.73	40.47
17	8.5	2.9155	11.66	14.58	17.49	92	46.	6.7823	33.91	40.69
18	9.	3.	12.	15.	18.	93	46.5	6.8191	34.10	40.91
19	9.5	3.0822	12.33	15.41	18.49	94	47.	6.8557	34.28	41.13
20	10.	3.1623	12.65	15.81	18.97	95	47.5	6.8920	34.46	41.35
21	10.5	3.2404	12.96	16.20	19.44	96	48.	6.9282	34.64	41.57
22	11.	3.3166	13.27	16.58	19.90	97	48.5	6.9642	34.82	41.79
23	11.5	3.3912	13.56	16.96	20.35	98	49.	7.	35.	42.
24	12.	3.4641	13.86	17.32	20.78	99	49.5	7.0356	35.18	42.21
25	12.5	3.5355	14.14	17.68	21.21	100	50.	7.0711	35.36	42.43
26	13.	3.6056	14.42	18.03	21.63	101	50.5	7.1063	35.53	42.64
27	13.5	3.6742	14.70	18.37	22.05	102	51.	7.1414	35.70	42.85
28	14.	3.7417	14.97	18.71	22.45	103	51.5	7.1763	35.88	43.06
29	14.5	3.8079	15.23	19.04	22.85	104	52.	7.2111	36.06	43.27
30	15.	3.8730	15.49	19.37	23.24	105	52.5	7.2457	36.23	43.47
31	15.5	3.9370	15.75	19.69	23.62	106	53.	7.2801	36.40	43.68
32	16.	4.	16.	20.	24.	107	53.5	7.3144	36.57	43.89
33	16.5	4.0620	16.25	20.31	24.37	108	54.	7.3485	36.74	44.09
34	17.	4.1231	16.49	20.62	24.74	109	54.5	7.3824	36.91	44.29
35	17.5	4.1833	16.73	20.92	25.10	110	55.	7.4162	37.08	44.50
36	18.	4.2426	16.97	21.21	25.46	111	55.5	7.4498	37.25	44.70
37	18.5	4.3012	17.20	21.51	25.81	112	56.	7.4833	37.42	44.90
38	19.	4.3589	17.44	21.79	26.15	113	56.5	7.5166	37.58	45.10
39	19.5	4.4159	17.66	22.08	26.50	114	57.	7.5498	37.75	45.30
40	20.	4.4721	17.89	22.36	26.83	115	57.5	7.5829	37.91	45.50
41	20.5	4.5277	18.11	22.64	27.17	116	58.	7.6158	38.08	45.69
42	21.	4.5826	18.33	22.91	27.50	117	58.5	7.6485	38.24	45.89
43	21.5	4.6368	18.55	23.18	27.82	118	59.	7.6811	38.41	46.09
44	22.	4.6904	18.76	23.45	28.14	119	59.5	7.7136	38.57	46.28
45	22.5	4.7434	18.97	23.72	28.46	120	60.	7.7460	38.73	46.48
46	23.	4.7958	19.18	23.98	28.77	121	60.5	7.7782	38.89	46.67
47	23.5	4.8477	19.39	24.24	29.09	122	61.	7.8102	39.05	46.86
48	24.	4.8990	19.60	24.49	29.39	123	61.5	7.8422	39.21	47.05
49	24.5	4.9497	19.80	24.75	29.70	124	62.	7.8740	39.37	47.24
50	25.	5.	20.	25.	30.	125	62.5	7.9057	39.53	47.43
51	25.5	5.0498	20.20	25.25	30.30	126	63.	7.9373	39.69	47.62
52	26.	5.0990	20.40	25.50	30.59	127	63.5	7.9687	39.84	47.81
53	26.5	5.1478	20.59	25.74	30.89	128	64.	8.	40.	48.
54	27.	5.1962	20.78	25.98	31.18	129	64.5	8.0312	40.16	48.19
55	27.5	5.2440	20.98	26.22	31.46	130	65.	8.0623	40.31	48.37
56	28.	5.2915	21.17	26.46	31.75	131	65.5	8.0932	40.47	48.56
57	28.5	5.3385	21.35	26.69	32.03	132	66.	8.1240	40.62	48.74
58	29.	5.3852	21.54	26.93	32.31	133	66.5	8.1548	40.77	48.93
59	29.5	5.4314	21.73	27.16	32.59	134	67.	8.1854	40.93	49.11
60	30.	5.4772	21.91	27.39	32.86	135	67.5	8.2158	41.08	49.30
61	30.5	5.5227	22.09	27.61	33.14	136	68.	8.2462	41.23	49.48
62	31.	5.5678	22.27	27.84	33.41	137	68.5	8.2765	41.38	49.66
63	31.5	5.6125	22.45	28.06	33.67	138	69.	8.3066	41.53	49.84
64	32.	5.6569	22.63	28.28	33.94	139	69.5	8.3367	41.68	50.02
65	32.5	5.7009	22.80	28.50	34.21	140	70.	8.3666	41.83	50.20
66	33.	5.7446	22.98	28.72	34.47	141	70.5	8.3964	41.98	50.38
67	33.5	5.7879	23.15	28.94	34.73	142	71.	8.4261	42.13	50.56
68	34.	5.8310	23.32	29.15	34.99	143	71.5	8.4558	42.28	50.73
69	34.5	5.8737	23.49	29.37	35.24	144	72.	8.4853	42.43	50.91
70	35.	5.9161	23.66	29.58	35.50	145	72.5	8.5147	42.57	51.09
71	35.5	5.9582	23.83	29.79	35.75	146	73.	8.5440	42.72	51.26
72	36.	6.	24.	30.	36.	147	73.5	8.5732	42.87	51.44
73	36.5	6.0415	24.17	30.21	36.25	148	74.	8.6023	43.01	51.61
74	37.	6.0828	24.33	30.41	36.50	149	74.5	8.6313	43.16	51.79
75	37.5	6.1237	24.49	30.62	36.74	150	75.	8.6603	43.30	51.96

THREE PLY.

No. of yarn to be twist'd.	No. of twisted yarn.	Sq. root of No. twisted yarn.	Square root multiplied by			No. of yarn to be twist'd.	No. of twisted yarn.	Sq. root of No. twisted yarn.	Square root multiplied by	
			4	5	6				5	6
1	.33	.5774	2.31	2.89	3.46	76	25.33	5.0332	25.17	30.20
2	.67	.8165	3.27	4.08	4.90	77	25.67	5.0662	25.33	30.40
3	1.	1.	4.	5.	6.	78	26.	5.0990	25.50	30.59
4	1.33	1.1547	4.62	5.77	6.93	79	26.33	5.1316	25.66	30.79
5	1.67	1.2910	5.16	6.45	7.75	**80**	26.67	5.1640	25.82	30.98
6	2.	1.4142	5.66	7.07	8.49	81	27.	5.1962	25.98	31.18
7	2.33	1.5275	6.11	7.64	9.17	82	27.33	5.2281	26.14	31.37
8	2.67	1.6330	6.53	8.16	9.80	83	27.67	5.2599	26.30	31.56
9	3.	1.7321	6.93	8.66	10.39	84	28.	5.2915	26.46	31.75
10	3.33	1.8257	7.30	9.13	10.95	85	28.33	5.3229	26.61	31.94
11	3.67	1.9149	7.66	9.57	11.49	86	28.67	5.3541	26.77	32.12
12	4.	2.	8.	10.	12.	87	29.	5.3852	26.93	32.31
13	4.33	2.0817	8.33	10.41	12.49	88	29.33	5.4160	27.08	32.50
14	4.67	2.1602	8.64	10.80	12.96	89	29.67	5.4467	27.23	32.68
15	5.	2.2361	8.94	11.18	13.42	**90**	30.	5.4772	27.39	32.86
16	5.33	2.3094	9.24	11.55	13.86	91	30.33	5.5076	27.54	33.05
17	5.67	2.3805	9.52	11.90	14.28	92	30.67	5.5377	27.69	33.23
18	6.	2.4495	9.80	12.25	14.70	93	31.	5.5678	27.84	33.41
19	6.33	2.5166	10.07	12.58	15.10	94	31.33	5.5976	27.99	33.59
20	6.67	2.5820	10.33	12.91	15.49	95	31.67	5.6273	28.14	33.76
21	7.	2.6458	10.58	13.23	15.87	96	32.	5.6569	28.28	33.94
22	7.33	2.7080	10.83	13.54	16.25	97	32.33	5.6862	28.43	34.12
23	7.67	2.7689	11.08	13.84	16.61	98	32.67	5.7155	28.58	34.29
24	8.	2.8284	11.31	14.14	16.97	99	33.	5.7446	28.72	34.47
25	8.33	2.8868	11.55	14.43	17.32	**100**	33.33	5.7735	28.87	34.64
26	8.67	2.9439	11.76	14.72	17.66	101	33.67	5.8023	29.01	34.81
27	9.	3.	12.	15.	18.	102	34.	5.8310	29.15	34.99
28	9.33	3.0551	12.22	15.28	18.33	103	34.33	5.8595	29.30	35.16
29	9.67	3.1091	12.44	15.55	18.65	104	34.67	5.8878	29.44	35.33
30	10.	3.1623	12.65	15.81	18.97	105	35.	5.9161	29.58	35.50
31	10.33	3.2145	12.86	16.07	19.29	106	35.33	5.9442	29.72	35.67
32	10.67	3.2659	13.06	16.33	19.60	107	35.67	5.9722	29.86	35.83
33	11.	3.3166	13.27	16.58	19.90	108	36.	6.	30.	36.
34	11.33	3.3665	13.47	16.83	20.20	109	36.33	6.0277	30.14	36.17
35	11.67	3.4157	13.66	17.08	20.49	**110**	36.67	6.0553	30.28	36.33
36	12.	3.4641	13.86	17.32	20.78	111	37.	6.0828	30.41	36.50
37	12.33	3.5119	14.05	17.56	21.07	112	37.33	6.1101	30.55	36.66
38	12.67	3.5590	14.24	17.80	21.35	113	37.67	6.1374	30.69	36.83
39	13.	3.6056	14.42	18.03	21.63	114	38.	6.1644	30.82	36.99
40	13.33	3.6515	14.61	18.26	21.91	115	38.33	6.1914	30.96	37.15
41	13.67	3.6969	14.79	18.48	22.18	116	38.67	6.2183	31.09	37.31
42	14.	3.7417	14.97	18.71	22.45	117	39.	6.2450	31.22	37.47
43	14.33	3.7859	15.14	18.93	22.72	118	39.33	6.2716	31.36	37.63
44	14.67	3.8297	15.32	19.15	22.98	119	39.67	6.2981	31.49	37.79
45	15.	3.8730	15.49	19.36	23.24	**120**	40.	6.3246	31.62	37.95
46	15.33	3.9158	15.66	19.58	23.49	121	40.33	6.3509	31.75	38.11
47	15.67	3.9582	15.83	19.79	23.75	122	40.67	6.3770	31.89	38.26
48	16.	4.	16.	20.	24.	123	41.	6.4031	32.02	38.42
49	16.33	4.0415	16.17	20.21	24.25	124	41.33	6.4291	32.15	38.57
50	16.67	4.0825	16.33	20.41	24.49	125	41.67	6.4550	32.27	38.73
51	17.	4.1231	16.49	20.62	24.74	126	42.	6.4807	32.40	38.88
52	17.33	4.1633	16.65	20.82	24.98	127	42.33	6.5064	32.53	39.04
53	17.67	4.2032	16.81	21.02	25.22	128	42.67	6.5320	32.66	39.19
54	18.	4.2426	16.97	21.21	25.46	129	43.	6.5574	32.79	39.34
55	18.33	4.2817	17.13	21.41	25.69	**130**	43.33	6.5828	32.91	39.50
56	18.67	4.3205	17.28	21.60	25.92	131	43.67	6.6081	33.04	39.65
57	19.	4.3589	17.44	21.79	26.15	132	44.	6.6332	33.17	39.80
58	19.33	4.3970	17.59	21.98	26.38	133	44.33	6.6583	33.29	39.95
59	19.67	4.4347	17.74	22.17	26.61	134	44.67	6.6833	33.42	40.10
60	20.	4.4721	17.89	22.36	26.83	135	45.	6.7082	33.54	40.25
61	20.33	4.5092	18.04	22.55	27.06	136	45.33	6.7330	33.67	40.40
62	20.67	4.5461	18.18	22.73	27.28	137	45.67	6.7577	33.79	40.55
63	21.	4.5826	18.33	22.91	27.50	138	46.	6.7823	33.91	40.69
64	21.33	4.6188	18.48	23.09	27.71	139	46.33	6.8069	34.03	40.84
65	21.67	4.6547	18.62	23.27	27.93	**140**	46.67	6.8313	34.16	40.99
66	22.	4.6904	18.76	23.45	28.14	141	47.	6.8557	34.28	41.13
67	22.33	4.7258	18.90	23.63	28.35	142	47.33	6.8799	34.40	41.28
68	22.67	4.7610	19.04	23.80	28.57	143	47.67	6.9041	34.52	41.42
69	23.	4.7958	19.18	23.98	28.77	144	48.	6.9282	34.64	41.57
70	23.33	4.8305	19.32	24.15	28.98	145	48.33	6.9522	34.76	41.71
71	23.67	4.8648	19.46	24.32	29.19	146	48.67	6.9762	34.88	41.86
72	24.	4.8990	19.60	24.49	29.39	147	49.	7.	35.	42.
73	24.33	4.9329	19.73	24.66	29.60	148	49.33	7.0238	35.12	42.14
74	24.67	4.9666	19.87	24.83	29.80	149	49.67	7.0475	35.24	42.28
75	25.	5.	20.	25.	30.	**150**	50.	7.0711	35.36	42.43

FOUR PLY.

No. of yarn to be twist'd.	No. of twisted yarn.	Sq. root of No. twisted yarn.	Square root multiplied by			No. of yarn to be twist'd.	No. of twisted yarn.	Sq. root of No. twisted yarn.	Square root multiplied by	
			4	5	6				5	6
1	.25	.5	2.	2.5	3.	76	19.	4.3589	21.79	26.15
2	.50	.7071	2.83	3.54	4.24	77	.25	4.3875	21.94	26.32
3	.75	.8660	3.46	4.33	5.20	78	.50	4.4159	22.08	26.50
4	1.	1.	4.	5.	6.	79	.75	4.4441	22.22	26.66
5	.25	1.1180	4.47	5.59	6.71	80	20.	4.4721	22.36	26.83
6	.50	1.2247	4.90	6.12	7.35	81	.25	4.5	22.5	27.
7	.75	1.3229	5.29	6.61	7.94	82	.50	4.5277	22.64	27.17
8	2.	1.4142	5.66	7.07	8.49	83	.75	4.5552	22.78	27.33
9	.25	1.5	6.	7.5	9.	84	21.	4.5826	22.91	27.50
10	.50	1.5811	6.32	7.91	9.49	85	.25	4.6098	23.05	27.66
11	.75	1.6583	6.63	8.29	9.95	86	.50	4.6368	23.18	27.82
12	3.	1.7321	6.93	8.66	10.39	87	.75	4.6637	23.32	27.98
13	.25	1.8028	7.21	9.01	10.82	88	22.	4.6904	23.45	28.14
14	.50	1.8708	7.48	9.35	11.22	89	.25	4.7170	23.58	28.30
15	.75	1.9365	7.75	9.68	11.62	90	.50	4.7434	23.72	28.46
16	4.	2.	8.	10.	12.	91	.75	4.7697	23.85	28.62
17	.25	2.0616	8.25	10.31	12.37	92	23.	4.7958	23.98	28.77
18	.50	2.1213	8.49	10.61	12.73	93	.25	4.8218	24.11	28.93
19	.75	2.1794	8.72	10.90	13.08	94	.50	4.8477	24.24	29.09
20	5.	2.2361	8.94	11.18	13.42	95	.75	4.8734	24.37	29.24
21	.25	2.2913	9.17	11.46	13.75	96	24.	4.8990	24.49	29.39
22	.50	2.3452	9.38	11.73	14.07	97	.25	4.9244	24.62	29.55
23	.75	2.3979	9.59	11.99	14.39	98	.50	4.9497	24.75	29.70
24	6.	2.4495	9.80	12.25	14.70	99	.75	4.9749	24.87	29.85
25	.25	2.5	10.	12.5	15.	100	25.	5.	25.	30.
26	.50	2.5495	10.20	12.75	15.30	101	.25	5.0249	25.12	30.15
27	.75	2.5981	10.39	12.99	15.59	102	.50	5.0498	25.25	30.30
28	7.	2.6458	10.58	13.23	15.87	103	.75	5.0744	25.37	30.45
29	.25	2.6926	10.77	13.46	16.16	104	26.	5.0990	25.50	30.59
30	.50	2.7386	10.95	13.69	16.43	105	.25	5.1235	25.62	30.74
31	.75	2.7839	11.14	13.92	16.70	106	.50	5.1478	25.74	30.89
32	8.	2.8284	11.31	14.14	16.97	107	.75	5.1720	25.86	31.03
33	.25	2.8723	11.49	14.36	17.23	108	27.	5.1962	25.98	31.18
34	.50	2.9155	11.66	14.58	17.49	109	.25	5.2202	26.10	31.32
35	.75	2.9580	11.83	14.79	17.75	110	.50	5.2440	26.22	31.46
36	9.	3.	12.	15.	18.	111	.75	5.2678	26.34	31.61
37	.25	3.0414	12.17	15.21	18.25	112	28.	5.2915	26.46	31.75
38	.50	3.0822	12.33	15.41	18.49	113	.25	5.3151	26.58	31.89
39	.75	3.1225	12.49	15.61	18.73	114	.50	5.3385	26.69	32.03
40	10.	3.1623	12.65	15.81	18.97	115	.75	5.3619	26.81	32.17
41	.25	3.2016	12.81	16.01	19.21	116	29.	5.3852	26.93	32.31
42	.50	3.2404	12.96	16.20	19.44	117	.25	5.4083	27.04	32.45
43	.75	3.2787	13.11	16.39	19.67	118	.50	5.4314	27.16	32.59
44	11.	3.3166	13.27	16.58	19.90	119	.75	5.4543	27.27	32.73
45	.25	3.3541	13.42	16.77	20.12	120	30.	5.4772	27.39	32.86
46	.50	3.3912	13.56	16.96	20.35	121	.25	5.5	27.5	33.
47	.75	3.4278	13.71	17.14	20.57	122	.50	5.5227	27.61	33.14
48	12.	3.4641	13.86	17.32	20.78	123	.75	5.5453	27.73	33.27
49	.25	3.5	14.	17.5	21.	124	31.	5.5678	27.84	33.41
50	.50	3.5355	14.14	17.68	21.21	125	.25	5.5902	27.95	33.54
51	.75	3.5707	14.28	17.85	21.42	126	.50	5.6125	28.06	33.67
52	13.	3.6056	14.42	18.03	21.63	127	.75	5.6347	28.17	33.81
53	.25	3.6401	14.56	18.20	21.84	128	32.	5.6569	28.28	33.94
54	.50	3.6742	14.70	18.37	22.05	129	.25	5.6789	28.39	34.07
55	.75	3.7081	14.83	18.54	22.25	130	.50	5.7009	28.50	34.21
56	14.	3.7417	14.97	18.71	22.45	131	.75	5.7228	28.61	34.34
57	.25	3.7749	15.10	18.87	22.65	132	33.	5.7446	28.72	34.47
58	.50	3.8079	15.23	19.04	22.85	133	.25	5.7663	28.83	34.60
59	.75	3.8406	15.36	19.20	23.04	134	.50	5.7879	28.94	34.73
60	15.	3.8730	15.49	19.37	23.24	135	.75	5.8095	29.05	34.86
61	.25	3.9051	15.62	19.53	23.43	136	34.	5.8310	29.15	34.99
62	.50	3.9370	15.75	19.69	23.62	137	.25	5.8524	29.26	35.11
63	.75	3.9686	15.88	19.84	23.81	138	.50	5.8737	29.37	35.24
64	16.	4.	16.	20.	24.	139	.75	5.8949	29.47	35.37
65	.25	4.0311	16.12	20.16	24.19	140	35.	5.9161	29.58	35.50
66	.50	4.0620	16.25	20.31	24.37	141	.25	5.9372	29.69	35.62
67	.75	4.0927	16.37	20.46	24.56	142	.50	5.9582	29.79	35.75
68	17.	4.1231	16.49	20.62	24.74	143	.75	5.9791	29.90	35.87
69	.25	4.1533	16.61	20.77	24.92	144	36.	6.	30.	36.
70	.50	4.1833	16.73	20.92	25.10	145	.25	6.0208	30.10	36.12
71	.75	4.2130	16.85	21.07	25.28	146	.50	6.0415	30.21	36.25
72	18.	4.2426	16.97	21.21	25.46	147	.75	6.0622	30.31	36.37
73	.25	4.2720	17.09	21.36	25.63	148	37.	6.0828	30.41	36.50
74	.50	4.3012	17.20	21.51	25.81	149	.25	6.1033	30.52	36.62
75	.75	4.3301	17.32	21.65	25.98	150	.50	6.1237	30.62	36.74

FIVE PLY.

No. of yarn to be twist'd.	No. of twisted yarn.	Sq. root of No. twisted yarn.	Square root multiplied by			No. of yarn to be twist'd.	No of twisted yarn.	Sq. root of No. twisted yarn.	Square root multiplied by	
			4	5	6				5	6
1	.2	.4472	1.79	2.24	2.68	76	15.2	3.8987	19.49	23.39
2	.4	.6325	2.53	3.16	3.79	77	.4	3.9243	19.62	23.55
3	.6	.7746	3.10	3.87	4.65	78	.6	3.9497	19.75	23.70
4	.8	.8944	3.58	4.47	5.37	79	.8	3.9749	19.87	23.85
5	1.	1.	4.	5.	6.	**80**	16.	4.	20.	24.
6	.2	1.0954	4.38	5.48	6.57	81	.2	4.0249	20.12	24.15
7	.4	1.1832	4.73	5.92	7.10	82	.4	4.0497	20.25	24.30
8	.6	1.2649	5.06	6.32	7.59	83	.6	4.0743	20.37	24.45
9	.8	1.3416	5.37	6.71	8.05	84	.8	4.0988	20.49	24.59
10	2.	1.4142	5.66	7.07	8.49	85	17.	4.1231	20.62	24.74
11	.2	1.4832	5.93	7.42	8.90	86	.2	4.1473	20.74	24.88
12	.4	1.5492	6.20	7.75	9.30	87	.4	4.1713	20.86	25.03
13	.6	1.6125	6.45	8.06	9.67	88	.6	4.1952	20.98	25.17
14	.8	1.6733	6.69	8.37	10.04	89	.8	4.2190	21.10	25.31
15	3.	1.7321	6.93	8.66	10.39	**90**	18.	4.2426	21.21	25.46
16	.2	1.7889	7.16	8.95	10.73	91	.2	4.2661	21.33	25.60
17	.4	1.8439	7.38	9.22	11.06	92	.4	4.2895	21.45	25.74
18	.6	1.8974	7.59	9.49	11.38	93	.6	4.3128	21.56	25.88
19	.8	1.9494	7.80	9.75	11.70	94	.8	4.3359	21.68	26.02
20	4.	2.	8.	10.	12.	95	19.	4.3589	21.79	26.15
21	.2	2.0494	8.20	10.25	12.30	96	.2	4.3818	21.91	26.29
22	.4	2.0976	8.39	10.49	12.59	97	.4	4.4045	22.02	26.43
23	.6	2.1448	8.58	10.72	12.87	98	.6	4.4272	22.14	26.56
24	.8	2.1909	8.76	10.95	13.15	99	.8	4.4497	22.25	26.70
25	5.	2.2361	8.94	11.18	13.42	**100**	20.	4.4721	22.36	26.83
26	.2	2.2804	9.12	11.40	13.68	101	.2	4.4944	22.47	26.97
27	.4	2.3238	9.30	11.62	13.94	102	.4	4.5166	22.58	27.10
28	.6	2.3664	9.47	11.83	14.20	103	.6	4.5387	22.69	27.23
29	.8	2.4083	9.63	12.04	14.45	104	.8	4.5607	22.80	27.36
30	6.	2.4495	9.80	12.25	14.70	105	21.	4.5826	22.91	27.50
31	.2	2.4900	9.96	12.45	14.94	106	.2	4.6043	23.02	27.63
32	.4	2.5298	10.12	12.65	15.18	107	.4	4.6260	23.13	27.76
33	.6	2.5690	10.28	12.85	15.41	108	.6	4.6476	23.24	27.89
34	.8	2.6077	10.43	13.04	15.65	109	.8	4.6690	23.35	28.01
35	7.	2.6458	10.58	13.23	15.87	**110**	22.	4.6904	23.45	28.14
36	.2	2.6833	10.73	13.42	16.10	111	.2	4.7117	23.56	28.27
37	.4	2.7203	10.88	13.60	16.32	112	.4	4.7329	23.66	28.40
38	.6	2.7568	11.03	13.78	16.54	113	.6	4.7539	23.77	28.52
39	.8	2.7928	11.17	13.96	16.76	114	.8	4.7749	23.87	28.65
40	8.	2.8284	11.31	14.14	16.97	115	23.	4.7958	23.98	28.77
41	.2	2.8636	11.45	14.32	17.18	116	.2	4.8166	24.08	28.90
42	.4	2.8983	11.59	14.49	17.39	117	.4	4.8374	24.19	29.02
43	.6	2.9326	11.73	14.66	17.60	118	.6	4.8580	24.29	29.15
44	.8	2.9665	11.87	14.83	17.80	119	.8	4.8785	24.39	29.27
45	9.	3.	12.	15.	18.	**120**	24.	4.8990	24.49	29.39
46	.2	3.0332	12.13	15.17	18.20	121	.2	4.9193	24.60	29.52
47	.4	3.0659	12.26	15.33	18.40	122	.4	4.9396	24.70	29.64
48	.6	3.0984	12.39	15.49	18.59	123	.6	4.9598	24.80	29.76
49	.8	3.1305	12.52	15.65	18.78	124	.8	4.9800	24.90	29.88
50	10.	3.1623	12.65	15.81	18.97	125	25.	5.	25.	30.
51	.2	3.1937	12.77	15.97	19.16	126	.2	5.0200	25.10	30.12
52	.4	3.2249	12.90	16.12	19.35	127	.4	5.0398	25.20	30.24
53	.6	3.2558	13.02	16.28	19.53	128	.6	5.0596	25.30	30.36
54	.8	3.2863	13.15	16.43	19.72	129	.8	5.0794	25.40	30.48
55	11.	3.3166	13.27	16.58	19.90	**130**	26.	5.0990	25.50	30.59
56	.2	3.3466	13.39	16.73	20.08	131	.2	5.1186	25.59	30.71
57	.4	3.3764	13.51	16.88	20.26	132	.4	5.1381	25.69	30.83
58	.6	3.4059	13.62	17.03	20.44	133	.6	5.1575	25.79	30.95
59	.8	3.4351	13.74	17.18	20.61	134	.8	5.1769	25.88	31.06
60	12.	3.4641	13.86	17.32	20.78	135	27.	5.1962	25.98	31.18
61	.2	3.4928	13.97	17.46	20.96	136	.2	5.2154	26.08	31.29
62	.4	3.5214	14.09	17.61	21.13	137	.4	5.2345	26.17	31.41
63	.6	3.5496	14.20	17.75	21.30	138	.6	5.2536	26.27	31.52
64	.8	3.5777	14.31	17.89	21.47	139	.8	5.2726	26.36	31.64
65	13.	3.6056	14.42	18.03	21.63	**140**	28.	5.2915	26.46	31.75
66	.2	3.6332	14.53	18.17	21.80	141	.2	5.3104	26.55	31.86
67	.4	3.6606	14.64	18.30	21.96	142	.4	5.3292	26.65	31.97
68	.6	3.6878	14.75	18.44	22.13	143	.6	5.3479	26.74	32.09
69	.8	3.7148	14.86	18.57	22.29	144	.8	5.3666	26.83	32.20
70	14.	3.7417	14.97	18.71	22.45	145	29.	5.3852	26.93	32.31
71	.2	3.7683	15.07	18.84	22.61	146	.2	5.4037	27.02	32.42
72	.4	3.7947	15.18	18.97	22.77	147	.4	5.4222	27.11	32.53
73	.6	3.8210	15.28	19.10	22.93	148	.6	5.4406	27.20	32.64
74	.8	3.8471	15.38	19.24	23.08	149	.8	5.4589	27.29	32.75
75	15.	3.8730	15.49	19.37	23.24	**150**	30.	5.4772	27.39	32.86

SIX PLY.

No. of yarn to be twist'd.	No. of twisted yarn.	Sq. root of No. twisted yarn.	Square root multiplied by			No. of yarn to be twist'd.	No. of twisted yarn.	Sq. root of No. twisted yarn.	Square root multiplied by	
			4	5	6				5	6
1	.17	.4082	1.63	2.04	2.45	76	12.67	3.5590	17.80	21.35
2	.33	.5774	2.31	2.89	3.46	77	.83	3.5824	17.91	21.49
3	.50	.7071	2.83	3.54	4.24	78	13.	3.6056	18.03	21.63
4	.67	.8165	3.27	4.08	4.90	79	.17	3.6286	18.14	21.77
5	.83	.9129	3.65	4.56	5.48	**80**	.33	3.6515	18.26	21.91
6	1.	1.	4.	5.	6.	81	.50	3.6742	18.37	22.05
7	.17	1.0801	4.32	5.40	6.48	82	.67	3.6969	18.48	22.18
8	.33	1.1547	4.62	5.77	6.93	83	.83	3.7192	18.60	22.32
9	.50	1.2247	4.90	6.12	7.35	84	14.	3.7417	18.71	22.45
10	.67	1.2910	5.16	6.45	7.75	85	.17	3.7639	18.82	22.58
11	.83	1.3540	5.42	6.77	8.12	86	.33	3.7859	18.93	22.72
12	2.	1.4142	5.66	7.07	8.49	87	.50	3.8079	19.04	22.85
13	.17	1.4720	5.89	7.36	8.83	88	.67	3.8297	19.15	22.98
14	.33	1.5275	6.11	7.64	9.17	89	.83	3.8514	19.26	23.11
15	.50	1.5811	6.32	7.91	9.49	**90**	15.	3.8730	19.36	23.24
16	.67	1.6330	6.53	8.16	9.80	91	.17	3.8944	19.47	23.37
17	.83	1.6833	6.73	8.42	10.10	92	.33	3.9158	19.58	23.49
18	3.	1.7321	6.93	8.66	10.39	93	.50	3.9370	19.69	23.62
19	.17	1.7795	7.12	8.90	10.68	94	.67	3.9582	19.79	23.75
20	.33	1.8257	7.30	9.13	10.95	95	.83	3.9791	19.90	23.87
21	.50	1.8708	7.48	9.35	11.22	96	16.	4.	20.	24.
22	.67	1.9149	7.66	9.57	11.49	97	.17	4.0208	20.10	24.12
23	.83	1.9579	7.83	9.79	11.75	98	.33	4.0415	20.21	24.25
24	4.	2.	8.	10.	12.	99	.50	4.0620	20.31	24.37
25	.17	2.0412	8.16	10.21	12.25	**100**	.67	4.0825	20.41	24.49
26	.33	2.0817	8.33	10.41	12.49	101	.83	4.1028	20.51	24.62
27	.50	2.1213	8.49	10.61	12.73	102	17.	4.1231	20.62	24.74
28	.67	2.1602	8.64	10.80	12.96	103	.17	4.1433	20.72	24.86
29	.83	2.1985	8.79	10.99	13.19	104	.33	4.1633	20.82	24.98
30	5.	2.2361	8.94	11.18	13.42	105	.50	4.1833	20.92	25.10
31	.17	2.2730	9.09	11.37	13.64	106	.67	4.2032	21.02	25.22
32	.33	2.3094	9.24	11.55	13.86	107	.83	4.2229	21.11	25.34
33	.50	2.3452	9.38	11.73	14.07	108	18.	4.2426	21.21	25.46
34	.67	2.3805	9.52	11.90	14.28	109	.17	4.2622	21.31	25.57
35	.83	2.4152	9.66	12.08	14.49	**110**	.33	4.2817	21.41	25.69
36	6.	2.4495	9.80	12.25	14.70	111	.50	4.3012	21.51	25.81
37	.17	2.4833	9.93	12.42	14.90	112	.67	4.3205	21.60	25.92
38	.33	2.5166	10.07	12.58	15.10	113	.83	4.3397	21.70	26.04
39	.50	2.5495	10.20	12.75	15.30	114	19.	4.3589	21.79	26.15
40	.67	2.5820	10.53	12.91	15.49	115	.17	4.3780	21.89	26.27
41	.83	2.6141	10.46	13.07	15.68	116	.33	4.3970	21.98	26.38
42	7.	2.6458	10.58	13.23	15.87	117	.50	4.4159	22.08	26.50
43	.17	2.6771	10.71	13.39	16.06	118	.67	4.4347	22.17	26.61
44	.33	2.7080	10.83	13.54	16.25	119	.83	4.4535	22.27	26.72
45	.50	2.7386	10.95	13.69	16.43	**120**	20.	4.4721	22.36	26.83
46	.67	2.7689	11.08	13.84	16.61	121	.17	4.4907	22.45	26.94
47	.83	2.7988	11.20	13.99	16.79	122	.33	4.5092	22.55	27.06
48	8.	2.8284	11.31	14.14	16.97	123	.50	4.5277	22.64	27.17
49	.17	2.8577	11.43	14.29	17.15	124	.67	4.5461	22.73	27.28
50	.33	2.8868	11.55	14.43	17.32	125	.83	4.5644	22.82	27.39
51	.50	2.9155	11.66	14.58	17.49	126	21.	4.5826	22.91	27.50
52	.67	2.9439	11.78	14.72	17.66	127	.17	4.6007	23.00	27.60
53	.83	2.9721	11.89	14.86	17.83	128	.33	4.6188	23.09	27.71
54	9.	3.	12.	15.	18.	129	.50	4.6368	23.18	27.82
55	.17	3.0277	12.11	15.14	18.17	**130**	.67	4.6547	23.27	27.93
56	.33	3.0551	12.22	15.28	18.33	131	.83	4.6726	23.36	28.04
57	.50	3.0822	12.33	15.41	18.49	132	22.	4.6904	23.45	28.14
58	.67	3.1091	12.44	15.55	18.65	133	.17	4.7081	23.54	28.25
59	.83	3.1358	12.54	15.68	18.81	134	.33	4.7258	23.63	28.35
60	10.	3.1623	12.65	15.81	18.97	135	.50	4.7434	23.72	28.46
61	.17	3.1885	12.75	15.94	19.13	136	.67	4.7610	23.80	28.57
62	.33	3.2145	12.86	16.07	19.29	137	.83	4.7784	23.89	28.67
63	.50	3.2404	12.96	16.20	19.44	138	23.	4.7958	23.98	28.77
64	.67	3.2659	13.06	16.33	19.60	139	.17	4.8132	24.07	28.88
65	.83	3.2914	13.17	16.46	19.75	**140**	.33	4.8305	24.15	28.98
66	11.	3.3166	13.27	16.58	19.90	141	.50	4.8477	24.24	29.09
67	.17	3.3417	13.37	16.71	20.05	142	.67	4.8648	24.32	29.19
68	.33	3.3665	13.47	16.83	20.20	143	.83	4.8819	24.41	29.29
69	.50	3.3912	13.56	16.96	20.35	144	24.	4.8990	24.49	29.39
70	.67	3.4157	13.66	17.08	20.49	145	.17	4.9160	24.58	29.50
71	.83	3.4400	13.76	17.20	20.64	146	.33	4.9329	24.66	29.60
72	12.	3.4641	13.86	17.32	20.78	147	.50	4.9497	24.75	29.70
73	.17	3.4881	13.95	17.44	20.93	148	.67	4.9666	24.83	29.80
74	.33	3.5119	14.05	17.56	21.07	149	.83	4.9833	24.92	29.90
75	.50	3.5355	14.14	17.68	21.21	**150**	25.	5.	25.	30.

WEAVING.

Our general comments on the weave-room will be found in our data relating to the Northrop loom, both in this book and in our loom catalogue entitled "Labor Saving Looms." The weave-room covers so many possible combinations in machine and product, that there are few general statements that may be made. Looms endeavor to perform so many unmechanical operations, that they do not fall within the ordinary class of machine, and the shop trained mechanic or engineering expert would find "fixing" an impossible immediate task, his varied experience in other lines being worthless in this special sphere. We are doing our best to eliminate the curious make-shifts which have been on duty for so long a time that they receive an almost superstitious reverence.

The weave-room presents the most notable instance of piece payment in the cotton mill system, and also the chief instance of personal responsibility for defect in product. The help are responsible for more strikes than in any other department outside the mule-room. Any invention or process that reduces the number of laborers employed in this section is worthy of investigation.

The fact that the weaver must rely on the efforts of another laborer, to keep the machinery up to its best efficiency, also complicates the problem of management. American cotton mills are continually forced into additional complications by the requirements of more varied weaves, the insistence of fashion calling for continual changes in patterns. The Jacquard motion, the Dobby and various other attachments are becoming common, and the skill and experience of the operative must necessarily assume a higher plane, in conformity to new requirements.

We make no attempt to touch upon the various points involved in fancy weaves, as the limits of the present volume are too narrow. Much of the necessary education, and by far the better part, must come from actual experience. Reference to the problems introduced by automatic weaving will be found elsewhere.

RULES AND INFORMATION FOR WEAVERS.

To find the number of yards of cloth to the pound avoirdupois:

Multiply its width in inches by the weight in grains of a piece containing 1 square inch; divide 194.44 by the product and the quotient will be the number of yards to the pound.

Example: Width of cloth, 30 inches; weight of 1 square inch, 1.5 grains. $\frac{194.44}{30 \times 1.5} = 4.32$ yards per pound.

To find the average number of yarn required to produce cloth of any desired weight, width and pick:

Add together the number of picks per inch of warp and filling; multiply their sum by the yards of cloth per pound, and this product by the width in inches; divide by 840, and the quotient will be the average number of yarn required. For any increase in weight by sizing, proportional allowance must be made in the yarn.

As the filling is taken up in crossing the warp, and the amount varies in different goods this rule is not exact, but will approximate near enough to furnish a basis for practical purposes.

Weight of a square yard of cloth when the weight of a square inch is given:

Weight of sq, in. ingrains.	1	2	3	4	5	6	7
Weight of sq. yd. in lbs.	.1851	.3703	.5554	.7406	.9257	1.1109	1.2960

To find the size of warp or filling in any piece of goods:

Take 8 or more threads of any known number, say 2 feet long, and tie the ends together; this makes a link, through which draw the same number of threads of the same length of the unknown number, and twist the two links thus made as you would twist a chain. A keen eye will detect any difference in the size of the two links. By adding to or taking from either link, they can be varied in size in proportion to the number of threads used, and brought to nearly equal each other. When as nearly as possible alike, the unknown number can be approximately determined by the proportionate number of strands in each link. Thus, if 28 is the known number, and if 7 strands of the unknown make an equal size link of 8 strands of the known, the number of the unknown will be $\frac{7}{8}$ of 28=24.5.

Cotton cloth is sold on a basis of a certain number of yards to the pound, with a certain number of picks or threads per inch in warp and filling.

Standard print cloths weigh seven yards to the pound, have 64 threads of warp and 64 picks of filling to the inch, and are called 64×64—seven-yard goods.

Loom reeds are numbered by the number of dents or splits to the inch.

The number of threads in a warp divided by the number of the reed multiplied by the width in inches, will give the number of threads in a dent.

Linens take their technical fineness from the number of hundred dents or splits in a loom reed thirty-seven inches wide. There are two threads to each dent. The following table, adapted from Barlow's "History of Weaving," gives the number of threads to the inch for each "count" of linen goods.

Hundreds.	Threads per inch.	Hundreds.	Threads per inch.	Hundreds.	Threads per inch.	Hundreds.	Threads per inch
5 00	27.03	12 00	64.86	19 00	102.7	26 00	140.5
6 00	32.43	13 00	70.27	20 00	108.1	27 00	145.9
7 00	37.84	14 00	75.68	21 00	113.5	28 00	151.4
8 00	43.24	15 00	81.08	22 00	118.9	29 00	156.8
9 00	48.65	16 00	86.49	23 00	124.3	30 00	162.2
10 00	54.05	17 00	91.89	24 00	129.7	31 00	167.6
11 00	59.46	18 00	97.30	25 00	135.1	32 00	173.0

Weight of warp or filling in one square yard:

The tables on pages 134-137 give the weight in decimal fractions of a pound of the quantity of common warp and weft or filling in one square yard of cloth for any number of yarn, from five to one hundred, and for any number of picks per inch from twenty to one hundred and eighty. Multiply the weight given in the tables by .525 for woolen, 1.5 for worsted, 2.8 for linen and .525 for silk, if the number of the silk represents the number of hundred yards per ounce.

Both warp and filling take up in weaving, by passing over and under alternate threads; therefore, one yard of warp or filling will fall a percentage short of making a yard of cloth. This percentage varies with each different size of yarn and number of picks per inch, and for other reasons; consequently, the tables have been made, giving the weights of straight yarn, to which must be added the take-up or shrinkage, to obtain the precise weight of a yard of cloth. It may be safe to say that from seven to eight per cent. is an average shrinkage on cotton goods. On some woolen cloths, the finishing processes reduce the weight so that the calculated weights are as near as may be to the weight of the finished goods.

Yarn is commonly numbered before it is slashed or sized; and in estimating the weight of finished cloth, the quantity of sizing added to the warp must be known.

Production in yards of a loom running constantly for ten hours:

The tables on pages 138-139 give the number of yards of cloth which can be woven per loom in one day of ten hours, if the loom runs constantly. If the quantity given in the tables is exceeded in the production of any loom, it shows that an error has been made in estimating the number of picks per inch or in the speed of the loom. The same errors might account for a falling short of the quantities in the table; but as no loom runs constantly, the difference between the actual production and the possible production, represents the quantity that might be woven during the time that the loom is stopped. The percentage of time of stoppage of a loom can be ascertained by dividing this difference by the possible production.

To find the yards per pound of goods, from small samples of cloth:

Sample one square inch; divide 5.40123 by the weight in grains of one square inch of cloth.

With sample four square inches; divide 21.60492 by the weight in grains of four square inches of cloth; the quotient in either case will be the yards per pound of 36 inch cloth. Other widths of cloth will be in proportion, and rules for samples of other sizes may be worked out from the rule for one inch sample.

To find the number, or count, of yarns, warp or filling, from short samples; say 3 inch lengths:

Set the weight of a delicate grain scale to .694 grains; place in pan 3 inch lengths of the yarn in question; the number of 3 inch pieces of yarn needed to balance scale will be the number or count of the yarn.

The following tables were prepared by Mr. Elias Richards of Lynchburg, Virginia, formerly of New Orleans, La.

No. of yarn.	Picks per inch.									
	20	21	22	23	24	25	26	27	28	29
5	.171	.180	.189	.197	.206	.214	.223	.231	.240	.249
6	.143	.150	.157	.164	.171	.179	.186	.193	.200	.207
7	.122	.129	.135	.141	.147	.153	.159	.165	.171	.178
8	.107	.112	.118	.123	.129	.134	.139	.145	.150	.155
9	.095	.100	.105	.110	.114	.119	.124	.129	.133	.138
10	.086	.090	.094	.099	.103	.107	.111	.116	.120	.124
11	.078	.082	.086	.090	.094	.097	.101	.105	.109	.113
12	.071	.075	.079	.082	.086	.089	.093	.096	.100	.104
13	.066	.069	.073	.076	.079	.082	.086	.089	.092	.096
14	.061	.064	.067	.070	.073	.077	.080	.083	.086	.089
15	.057	.060	.063	.066	.069	.071	.074	.077	.080	.083
16	.054	.056	.059	.062	.064	.067	.070	.072	.075	.078
17	.050	.053	.055	.058	.060	.063	.066	.068	.071	.073
18	.048	.050	.052	.055	.057	.060	.062	.064	.067	.069
19	.045	.047	.050	.052	.054	.056	.059	.061	.063	.065
20	.043	.045	.047	.049	.051	.054	.056	.058	.060	.062
21	.041	.043	.045	.047	.049	.051	.053	.055	.057	.059
22	.039	.041	.043	.045	.047	.049	.051	.053	.055	.056
23	.037	.039	.041	.043	.045	.047	.048	.050	.052	.054
24	.036	.037	.039	.041	.043	.045	.046	.048	.050	.052
25	.034	.036	.038	.039	.041	.043	.045	.046	.048	.050
26	.033	.035	.036	.038	.040	.041	.043	.045	.046	.048
27	.032	.033	.035	.037	.038	.040	.041	.043	.044	.046
28	.031	.032	.034	.035	.037	.038	.040	.041	.043	.044
29	.030	.031	.032	.034	.035	.037	.038	.040	.041	.043
30	.029	.030	.031	.033	.034	.036	.037	.039	.040	.041
31	.028	.029	.030	.032	.033	.035	.036	.037	.039	.040
32	.027	.028	.029	.031	.032	.033	.035	.036	.037	.039
33	.026	.027	.029	.030	.031	.032	.034	.035	.036	.038
34	.025	.026	.028	.029	.030	.032	.033	.034	.035	.037
35	.024	.026	.027	.028	.029	.031	.032	.033	.034	.036
36	.024	.025	.026	.027	.029	.030	.031	.032	.033	.035
37	.023	.024	.025	.027	.028	.029	.030	.031	.032	.034
38	.023	.024	.025	.026	.027	.028	.029	.030	.032	.033
39	.022	.023	.024	.025	.026	.027	.029	.030	.031	.032
40	.021	.022	.024	.025	.026	.027	.028	.029	.030	.031
	30	31	32	33	34	35	36	37	38	39
5	.257	.266	.274	.283	.291	.300	.309	.317	.326	.334
6	.214	.221	.229	.236	.243	.250	.257	.264	.271	.279
7	.184	.190	.196	.202	.208	.214	.220	.227	.233	.239
8	.161	.166	.171	.177	.182	.187	.193	.197	.204	.209
9	.143	.148	.152	.157	.162	.167	.171	.176	.181	.186
10	.129	.133	.137	.141	.146	.150	.154	.159	.163	.167
11	.117	.121	.125	.129	.132	.136	.140	.144	.148	.152
12	.107	.111	.114	.118	.121	.125	.129	.132	.136	.139
13	.099	.102	.105	.109	.112	.115	.119	.122	.125	.129
14	.092	.095	.098	.101	.104	.107	.110	.113	.116	.119
15	.086	.089	.091	.094	.097	.100	.103	.106	.109	.111
16	.080	.083	.086	.088	.091	.094	.096	.099	.102	.104
17	.076	.078	.081	.083	.086	.088	.091	.093	.096	.098
18	.071	.074	.076	.079	.081	.083	.086	.088	.090	.093
19	.068	.070	.072	.074	.077	.079	.081	.083	.086	.088
20	.064	.066	.069	.071	.073	.075	.077	.079	.081	.084
21	.061	.063	.065	.067	.069	.071	.073	.076	.078	.080
22	.058	.060	.062	.064	.066	.068	.070	.072	.074	.076
23	.056	.058	.060	.061	.063	.065	.067	.069	.071	.073
24	.054	.055	.057	.059	.061	.062	.064	.066	.068	.070
25	.051	.053	.055	.057	.058	.060	.062	.063	.065	.067
26	.049	.051	.053	.054	.056	.058	.059	.061	.063	.064
27	.048	.049	.051	.052	.054	.056	.057	.059	.060	.062
28	.046	.047	.049	.051	.052	.054	.055	.057	.058	.060
29	.044	.046	.047	.049	.050	.052	.053	.055	.056	.058
30	.043	.044	.046	.047	.049	.050	.051	.053	.054	.056
31	.041	.043	.044	.046	.047	.048	.050	.051	.052	.054
32	.040	.042	.043	.044	.046	.047	.048	.050	.051	.052
33	.039	.040	.042	.043	.044	.045	.047	.048	.049	.051
34	.038	.039	.040	.042	.043	.044	.045	.047	.048	.049
35	.037	.038	.039	.040	.042	.043	.044	.045	.046	.048
36	.036	.037	.038	.039	.040	.042	.043	.044	.045	.046
37	.035	.036	.037	.038	.039	.041	.042	.043	.044	.045
38	.034	.035	.036	.037	.038	.039	.041	.042	.043	.044
39	.033	.034	.035	.036	.037	.038	.040	.041	.042	.043
40	.032	.033	.034	.035	.036	.037	.039	.040	.041	.042

No. of yarn.	Picks per inch.									
	40	41	42	43	44	45	46	47	48	49
10	.171	.176	.180	.184	.189	.193	.197	.201	.206	.210
11	.156	.160	.164	.168	.171	.175	.179	.183	.187	.191
12	.143	.146	.150	.154	.157	.161	.164	.168	.171	.175
13	.132	.135	.138	.142	.145	.148	.152	.155	.158	.162
14	.122	.126	.129	.132	.135	.138	.141	.144	.147	.150
15	.114	.117	.120	.123	.126	.129	.131	.134	.137	.140
16	.107	.110	.112	.115	.118	.121	.123	.126	.129	.131
17	.101	.103	.106	.108	.111	.113	.116	.118	.121	.124
18	.095	.098	.100	.102	.105	.107	.110	.112	.114	.117
19	.090	.092	.095	.097	.099	.102	.104	.106	.108	.110
20	.086	.088	.090	.092	.094	.096	.099	.101	.103	.105
21	.082	.084	.086	.088	.090	.092	.094	.096	.098	.100
22	.078	.080	.082	.084	.086	.088	.090	.092	.094	.095
23	.075	.076	.078	.080	.082	.084	.086	.088	.089	.091
24	.071	.073	.075	.077	.079	.080	.082	.084	.086	.087
25	.069	.070	.072	.074	.075	.077	.079	.081	.082	.084
26	.066	.068	.069	.071	.073	.074	.076	.077	.079	.081
27	.063	.065	.067	.068	.070	.071	.073	.075	.076	.078
28	.061	.063	.064	.066	.067	.069	.070	.072	.073	.075
29	.059	.061	.062	.064	.065	.067	.068	.069	.071	.072
30	.057	.059	.060	.061	.063	.064	.066	.067	.069	.070
31	.055	.057	.058	.059	.061	.062	.064	.065	.066	.068
32	.054	.055	.056	.058	.059	.060	.062	.063	.064	.066
33	.052	.053	.055	.056	.057	.058	.060	.061	.062	.064
34	.050	.052	.053	.054	.055	.057	.058	.059	.061	.062
35	.049	.050	.051	.053	.054	.055	.056	.058	.059	.060
36	.048	.049	.050	.051	.052	.054	.055	.056	.057	.058
37	.046	.047	.049	.050	.051	.052	.053	.054	.056	.057
38	.045	.046	.047	.048	.050	.051	.052	.053	.054	.055
39	.044	.045	.046	.047	.048	.049	.051	.052	.053	.054
40	.043	.044	.045	.046	.047	.048	.049	.050	.051	.052
41	.042	.043	.044	.045	.046	.047	.048	.049	.050	.051
42	.041	.042	.043	.044	.045	.046	.047	.048	.049	.050
43	.040	.041	.042	.043	.044	.045	.046	.047	.048	.049
44	.039	.040	.041	.042	.043	.044	.045	.046	.047	.048
45	.038	.039	.040	.041	.042	.043	.044	.045	.046	.047
	50	51	52	53	54	55	56	57	58	59
10	.214	.219	.223	.227	.231	.236	.240	.244	.249	.253
11	.195	.199	.203	.206	.210	.214	.218	.222	.226	.230
12	.179	.182	.186	.189	.193	.196	.200	.204	.207	.211
13	.165	.168	.171	.175	.178	.181	.185	.188	.191	.195
14	.153	.156	.159	.162	.165	.168	.171	.174	.178	.181
15	.143	.146	.149	.151	.154	.157	.160	.163	.166	.169
16	.134	.137	.139	.142	.145	.147	.150	.153	.155	.158
17	.126	.129	.131	.134	.136	.139	.141	.144	.146	.149
18	.119	.121	.124	.126	.129	.131	.133	.136	.138	.140
19	.113	.115	.117	.120	.122	.124	.126	.129	.131	.133
20	.107	.109	.111	.114	.116	.118	.120	.122	.124	.126
21	.102	.104	.106	.108	.110	.112	.114	.116	.118	.120
22	.097	.099	.101	.103	.105	.107	.109	.111	.113	.115
23	.093	.095	.097	.099	.101	.102	.104	.106	.108	.110
24	.089	.091	.093	.095	.096	.098	.100	.102	.104	.105
25	.086	.087	.089	.091	.093	.094	.096	.098	.099	.101
26	.082	.084	.086	.087	.089	.091	.092	.094	.096	.097
27	.079	.081	.083	.084	.086	.087	.089	.090	.092	.094
28	.077	.078	.080	.081	.083	.084	.086	.087	.089	.090
29	.074	.075	.077	.078	.080	.081	.083	.084	.086	.087
30	.071	.073	.074	.076	.077	.079	.080	.081	.083	.084
31	.069	.071	.072	.073	.075	.076	.077	.079	.080	.082
32	.067	.068	.070	.071	.072	.074	.075	.076	.078	.079
33	.065	.066	.068	.069	.070	.071	.073	.074	.075	.077
34	.063	.064	.066	.067	.068	.069	.071	.072	.073	.074
35	.061	.062	.064	.065	.066	.067	.069	.070	.071	.072
36	.060	.061	.062	.063	.064	.065	.067	.068	.069	.070
37	.058	.059	.060	.061	.063	.064	.065	.066	.067	.068
38	.056	.058	.059	.060	.061	.062	.063	.064	.065	.067
39	.055	.056	.057	.058	.059	.060	.062	.063	.064	.065
40	.054	.055	.056	.057	.058	.059	.060	.061	.062	.063
41	.052	.053	.054	.055	.056	.057	.059	.060	.061	.062
42	.051	.052	.053	.054	.055	.056	.057	.058	.059	.060
43	.050	.051	.052	.053	.054	.055	.056	.057	.058	.059
44	.049	.050	.051	.052	.053	.054	.055	.056	.056	.057
45	.048	.049	.050	.050	.051	.052	.053	.054	.055	.056

No. of yarn.	Picks per inch.										
	60	62	64	66	68	70	72	74	76	78	80
15	.171	.177	.183	.189	.194	.200	.206	.211	.217	.223	.229
16	.161	.166	.171	.177	.182	.187	.193	.197	.204	.209	.214
17	.151	.156	.161	.166	.171	.176	.182	.187	.192	.197	.202
18	.143	.148	.152	.157	.162	.167	.171	.176	.181	.186	.190
19	.135	.140	.144	.149	.153	.158	.162	.167	.171	.176	.180
20	.129	.133	.137	.141	.146	.150	.154	.159	.163	.167	.171
21	.122	.127	.131	.135	.139	.143	.147	.151	.155	.159	.163
22	.117	.121	.125	.129	.132	.136	.140	.144	.148	.152	.156
23	.112	.116	.119	.123	.127	.130	.134	.138	.142	.145	.149
24	.107	.111	.114	.118	.121	.125	.129	.132	.136	.139	.143
25	.103	.106	.110	.113	.117	.120	.123	.127	.130	.134	.137
26	.099	.102	.105	.109	.112	.115	.119	.122	.125	.129	.132
27	.095	.098	.102	.105	.108	.111	.114	.117	.121	.124	.127
28	.092	.095	.098	.101	.104	.107	.110	.113	.116	.119	.122
29	.089	.092	.095	.098	.100	.103	.106	.109	.112	.115	.118
30	.086	.089	.091	.094	.097	.100	.103	.106	.109	.111	.114
31	.083	.086	.088	.091	.094	.097	.100	.102	.105	.108	.111
32	.080	.083	.086	.088	.091	.094	.096	.099	.102	.104	.107
33	.078	.081	.083	.086	.088	.091	.094	.096	.099	.101	.104
34	.076	.078	.081	.083	.086	.088	.091	.093	.096	.098	.101
35	.073	.076	.078	.081	.083	.086	.088	.091	.093	.096	.098
36	.071	.074	.076	.079	.081	.083	.086	.088	.090	.093	.095
37	.069	.072	.074	.076	.079	.081	.083	.086	.088	.090	.093
38	.068	.070	.072	.074	.077	.079	.081	.083	.086	.088	.090
39	.066	.068	.070	.073	.075	.077	.079	.081	.084	.086	.088
40	.064	.066	.069	.071	.073	.075	.077	.079	.081	.084	.086
41	.063	.065	.067	.069	.071	.073	.075	.077	.079	.082	.084
42	.061	.063	.065	.067	.069	.071	.073	.076	.078	.080	.082
43	.060	.062	.064	.066	.068	.070	.072	.074	.076	.078	.080
44	.058	.060	.062	.064	.066	.068	.070	.072	.074	.076	.078
45	.057	.059	.061	.063	.065	.067	.069	.070	.072	.074	.076
46	.056	.058	.060	.061	.063	.065	.067	.069	.071	.073	.075
47	.055	.057	.058	.060	.062	.064	.066	.067	.069	.071	.073
48	.054	.055	.057	.059	.061	.062	.064	.066	.068	.070	.071
49	.052	.054	.056	.058	.059	.061	.063	.065	.066	.068	.070
50	.051	.053	.055	.057	.058	.060	.062	.063	.065	.067	.069

No. of yarn.	80	82	84	86	88	90	92	94	96	98	100
20	.171	.176	.180	.184	.189	.193	.197	.201	.206	.210	.214
21	.163	.167	.171	.176	.180	.184	.188	.192	.196	.200	.204
22	.156	.160	.164	.168	.171	.175	.179	.183	.187	.191	.195
23	.149	.153	.157	.160	.164	.168	.171	.175	.179	.183	.186
24	.143	.146	.150	.154	.157	.161	.164	.168	.171	.175	.179
25	.137	.141	.144	.147	.151	.154	.158	.161	.165	.168	.171
26	.132	.135	.138	.142	.145	.148	.152	.155	.158	.162	.165
27	.127	.130	.133	.137	.140	.143	.146	.149	.152	.156	.159
28	.122	.126	.129	.132	.135	.138	.141	.144	.147	.150	.153
29	.118	.121	.124	.127	.130	.133	.136	.139	.142	.145	.148
30	.114	.117	.120	.123	.126	.129	.131	.134	.137	.140	.143
31	.111	.113	.116	.119	.122	.124	.127	.130	.133	.135	.138
32	.107	.110	.112	.115	.118	.121	.123	.126	.129	.131	.134
33	.104	.107	.109	.112	.114	.117	.119	.122	.125	.127	.130
34	.101	.103	.106	.108	.111	.113	.116	.118	.121	.124	.126
35	.098	.100	.103	.105	.108	.110	.113	.115	.118	.120	.122
36	.095	.098	.100	.102	.105	.107	.110	.112	.114	.117	.119
37	.093	.095	.097	.100	.102	.104	.107	.109	.111	.114	.116
38	.090	.092	.095	.097	.099	.102	.104	.106	.108	.110	.113
39	.088	.090	.092	.095	.097	.099	.101	.103	.105	.107	.110
40	.086	.088	.090	.092	.094	.096	.099	.101	.103	.105	.107
41	.084	.086	.088	.090	.092	.094	.096	.098	.100	.102	.105
42	.082	.084	.086	.088	.090	.092	.094	.096	.098	.100	.102
43	.080	.082	.084	.086	.088	.090	.092	.094	.096	.098	.100
44	.078	.080	.082	.084	.086	.088	.090	.092	.094	.095	.097
45	.076	.078	.080	.082	.084	.086	.088	.090	.091	.093	.095
46	.075	.076	.078	.080	.082	.084	.086	.088	.089	.091	.093
47	.073	.075	.077	.078	.080	.082	.084	.086	.088	.089	.091
48	.071	.073	.075	.077	.079	.080	.082	.084	.086	.087	.089
49	.070	.072	.073	.075	.077	.079	.080	.082	.084	.086	.087
50	.069	.070	.072	.074	.075	.077	.079	.081	.082	.084	.086
51	.067	.069	.071	.072	.074	.076	.077	.079	.081	.082	.084
52	.066	.068	.069	.071	.073	.074	.076	.077	.079	.081	.082
53	.065	.066	.068	.070	.071	.073	.074	.076	.078	.079	.081
54	.063	.065	.067	.068	.070	.071	.073	.075	.076	.078	.079
55	.062	.064	.065	.067	.069	.070	.072	.073	.075	.076	.078

No. of yarn.	Picks per inch.										
	100	**102**	**104**	**106**	**108**	**110**	**112**	**114**	**116**	**118**	**120**
30	.143	.146	.149	.151	.154	.157	.160	.163	.166	.169	.171
31	.138	.141	.144	.147	.149	.152	.155	.158	.160	.163	.166
32	.134	.137	.139	.142	.145	.147	.150	.153	.155	.158	.161
33	.130	.133	.135	.138	.140	.143	.145	.148	.151	.153	.156
34	.126	.129	.131	.134	.136	.139	.141	.144	.146	.149	.151
35	.122	.125	.127	.130	.132	.135	.137	.140	.142	.144	.147
36	.119	.121	.124	.126	.129	.131	.133	.136	.138	.140	.143
37	.116	.118	.120	.123	.125	.127	.130	.132	.134	.137	.139
38	.113	.115	.117	.120	.122	.124	.126	.129	.131	.133	.135
39	.110	.112	.114	.116	.119	.121	.123	.125	.127	.130	.132
40	.107	.109	.111	.114	.116	.118	.120	.122	.124	.126	.129
42	.102	.104	.106	.108	.110	.112	.114	.116	.118	.120	.122
44	.097	.099	.101	.103	.105	.107	.109	.111	.113	.115	.117
46	.093	.095	.097	.099	.101	.102	.104	.106	.108	.110	.112
48	.089	.091	.093	.095	.096	.098	.100	.102	.104	.105	.107
50	.086	.087	.089	.091	.093	.094	.096	.098	.099	.101	.103
52	.082	.084	.086	.087	.089	.091	.092	.094	.096	.097	.099
54	.079	.081	.083	.084	.086	.087	.089	.090	.092	.094	.095
56	.077	.078	.080	.081	.083	.084	.086	.087	.089	.090	.092
58	.074	.075	.077	.078	.080	.081	.083	.084	.086	.087	.089
60	.071	.073	.074	.076	.077	.079	.080	.081	.083	.084	.086
62	.069	.071	.072	.073	.075	.076	.077	.079	.080	.082	.083
64	.067	.068	.070	.071	.072	.074	.075	.076	.078	.079	.080
66	.065	.066	.068	.069	.070	.071	.073	.074	.075	.077	.078
68	.063	.064	.066	.067	.068	.069	.071	.072	.073	.074	.076
70	.061	.062	.064	.065	.066	.067	.069	.070	.071	.072	.073
	120	**122**	**124**	**126**	**128**	**130**	**132**	**134**	**136**	**138**	**140**
40	.129	.131	.133	.135	.137	.139	.141	.144	.146	.148	.150
42	.122	.124	.127	.129	.131	.133	.135	.137	.139	.141	.143
44	.117	.119	.121	.123	.125	.127	.129	.131	.132	.134	.136
46	.112	.114	.116	.117	.119	.121	.123	.125	.127	.129	.130
48	.107	.109	.111	.112	.114	.116	.118	.120	.121	.123	.125
50	.103	.105	.106	.108	.110	.111	.113	.115	.117	.118	.120
52	.099	.101	.102	.104	.105	.107	.109	.110	.112	.114	.115
54	.095	.097	.098	.100	.102	.103	.105	.106	.108	.109	.111
56	.092	.093	.095	.096	.098	.099	.101	.103	.104	.106	.107
58	.089	.090	.092	.093	.095	.096	.098	.099	.100	.102	.103
60	.086	.087	.089	.090	.091	.093	.094	.096	.097	.099	.100
62	.083	.084	.086	.087	.088	.090	.091	.093	.094	.095	.097
64	.080	.082	.083	.084	.086	.087	.088	.090	.091	.092	.094
66	.078	.079	.081	.082	.083	.084	.086	.087	.088	.090	.091
68	.076	.077	.078	.079	.081	.082	.083	.084	.086	.087	.088
70	.073	.075	.076	.077	.078	.080	.081	.082	.083	.084	.086
72	.071	.073	.074	.075	.076	.077	.079	.080	.081	.082	.083
74	.069	.071	.072	.073	.074	.075	.076	.078	.079	.080	.081
76	.068	.069	.070	.071	.072	.073	.074	.076	.077	.078	.079
78	.066	.067	.068	.069	.070	.071	.073	.074	.075	.076	.077
80	.064	.065	.066	.067	.069	.070	.071	.072	.073	.074	.075
	140	**142**	**144**	**146**	**148**	**150**	**152**	**154**	**156**	**158**	**160**
50	.120	.122	.123	.125	.127	.129	.130	.132	.134	.135	.137
52	.115	.117	.119	.120	.122	.124	.125	.127	.129	.130	.132
54	.111	.113	.114	.116	.117	.119	.121	.122	.124	.125	.127
56	.107	.109	.110	.112	.113	.115	.116	.118	.119	.121	.122
58	.103	.105	.106	.108	.109	.111	.112	.114	.115	.117	.118
60	.100	.101	.103	.104	.106	.107	.109	.110	.111	.113	.114
65	.092	.094	.095	.096	.098	.099	.100	.102	.103	.104	.105
70	.086	.087	.088	.089	.091	.092	.093	.094	.096	.097	.098
75	.080	.081	.082	.083	.085	.086	.087	.088	.089	.090	.092
80	.075	.076	.077	.078	.079	.080	.081	.083	.084	.085	.086
85	.071	.072	073	.074	.075	.076	.077	.078	.079	.080	.081
	160	**162**	**164**	**166**	**168**	**170**	**172**	**174**	**176**	**178**	**180**
60	.114	.116	.117	.119	.120	.121	.123	.124	.126	.127	.129
65	.105	.106	.108	.109	.111	.112	.113	.115	.116	.117	.119
70	.098	.099	.100	.102	.103	.104	.105	.107	.108	.109	.110
75	.092	.093	.094	.095	.096	.097	.098	.099	.101	.102	.103
80	.086	.087	.088	.089	.090	.091	.092	.093	.094	.095	.096
85	.081	.082	.083	.084	.085	.086	.087	.088	.089	090	.091
90	.076	.077	.078	.079	.080	.081	.082	.083	.084	.085	.086
95	.072	.073	.074	.075	.076	.076	.077	.078	.079	.080	.081
100	.069	.070	.070	.071	.072	.073	074	.075	.075	.076	.077

Picks per inch.	Picks per minute.										
	100	**105**	**110**	**115**	**120**	**125**	**130**	**135**	**140**	**145**	**150**
20	83.3	87.5	91.7	95.8	100.0	104.2	108.3	112.5	116.7	120.8	125.0
22	75.8	79.5	83.3	87.1	90.9	94.7	98.5	102.3	106.1	109.8	113.6
24	69.4	72.9	76.4	79.9	83.3	86.8	90.3	93.7	97.2	100.7	104.2
26	64.1	67.3	70.5	73.7	76.9	80.1	83.3	86.5	89.7	92.9	96.2
28	59.5	62.5	65.5	68.5	71.4	74.4	77.4	80.4	83.3	86.3	89.3
30	55.6	58.3	61.1	63.9	66.7	69.4	72.2	75.0	77.8	80.6	83.3
32	52.1	54.7	57.3	59.9	62.5	65.1	67.7	70.3	72.9	75.5	78.1
34	49.0	51.5	53.9	56.4	58.8	61.3	63.7	66.2	68.6	71.1	73.5
36	46.3	48.6	50.9	53.2	55.6	57.9	60.2	62.5	64.8	67.1	69.4
38	43.9	46.1	48.2	50.4	52.6	54.8	57.0	59.2	61.4	63.6	65.8
40	41.7	43.7	45.8	47.9	50.0	52.1	54.2	56.3	58.3	60.4	62.5
42	39.7	41.7	43.7	45.6	47.6	49.6	51.6	53.6	55.6	57.5	59.5
44	37.9	39.8	41.7	43.6	45.5	47.3	49.2	51.1	53.0	54.9	56.8
46	36.2	38.0	39.9	41.7	43.5	45.3	47.1	48.9	50.7	52.5	54.3
48	34.7	36.5	38.2	39.9	41.7	43.4	45.1	46.9	48.6	50.3	52.1
50	33.3	35.0	36.7	38.3	40.0	41.7	43.3	45.0	46.7	48.3	50.0
52	32.1	33.7	35.3	36.9	38.5	40.1	41.7	43.3	44.9	46.5	48.1
54	30.9	32.4	34.0	35.5	37.0	38.6	40.1	41.7	43.2	44.8	46.3
56	29.8	31.3	32.7	34.2	35.7	37.2	38.7	40.2	41.7	43.2	44.6
58	28.7	30.2	31.6	33.0	34.5	35.9	37.4	38.8	40.2	41.7	43.1
60	27.8	29.2	30.6	31.9	33.3	34.7	36.1	37.5	38.9	40.3	41.7
62	26.9	28.2	29.6	30.9	32.3	33.6	34.9	36.3	37.6	39.0	40.3
64	26.0	27.3	28.6	29.9	31.3	32.6	33.9	35.2	36.5	37.8	39.1
66	25.3	26.5	27.8	29.0	30.3	31.6	32.8	34.1	35.4	36.6	37.9
68	24.5	25.7	27.0	28.2	29.4	30.6	31.9	33.1	34.3	35.5	36.8
70	23.8	25.0	26.2	27.4	28.6	29.8	31.0	32.1	33.3	34.5	35.7
72	23.1	24.3	25.5	26.6	27.8	28.9	30.1	31.3	32.4	33.6	34.7
74	22.5	23.6	24.8	25.9	27.0	28.2	29.3	30.4	31.5	32.7	33.8
76	21.9	23.0	24.1	25.2	26.3	27.4	28.5	29.6	30.7	31.8	32.9
78	21.4	22.4	23.5	24.6	25.6	26.7	27.8	28.8	29.9	31.0	32.1
80	20.8	21.9	22.9	24.0	25.0	26.0	27.1	28.1	29.2	30.2	31.3
82	20.3	21.3	22.4	23.4	24.4	25.4	26.4	27.4	28.5	29.5	30.5
84	19.8	20.8	21.8	22.8	23.8	24.8	25.8	26.8	27.8	28.8	29.8
86	19.4	20.3	21.3	22.3	23.3	24.2	25.2	26.2	27.1	28.1	29.1
88	18.9	19.9	20.8	21.8	22.7	23.7	24.6	25.6	26.5	27.5	28.4
90	18.5	19.4	20.4	21.3	22.2	23.1	24.1	25.0	25.9	26.9	27.8
92	18.1	19.0	19.9	20.8	21.7	22.6	23.6	24.5	25.4	26.3	27.2
94	17.7	18.6	19.5	20.4	21.3	22.2	23.0	23.9	24.8	25.7	26.6
96	17.4	18.2	19.1	20.0	20.8	21.7	22.6	23.4	24.3	25.2	26.0
98	17.0	17.9	18.7	19.6	20.4	21.3	22.1	23.0	23.8	24.7	25.5
100	16.7	17.5	18.3	19.2	20.0	20.8	21.7	22.5	23.3	24.2	25.0
102	16.3	17.2	18.0	18.8	19.6	20.4	21.2	22.1	22.9	23.7	24.5
104	16.0	16.8	17.6	18.4	19.2	20.0	20.8	21.6	22.4	23.2	24.0
106	15.7	16.5	17.3	18.1	18.9	19.7	20.4	21.2	22.0	22.8	23.6
108	15.4	16.2	17.0	17.7	18.5	19.3	20.1	20.8	21.6	22.4	23.1
110	15.2	15.9	16.7	17.4	18.2	18.9	19.7	20.5	21.2	22.0	22.7
112	14.9	15.6	16.4	17.1	17.9	18.6	19.3	20.1	20.8	21.6	22.3
114	14.6	15.4	16.1	16.8	17.5	18.3	19.0	19.7	20.5	21.2	21.9
116	14.4	15.1	15.8	16.5	17.2	18.0	18.7	19.4	20.1	20.8	21.6
118	14.1	14.8	15.5	16.2	16.9	17.7	18.4	19.1	19.8	20.5	21.2
120	13.9	14.6	15.3	16.0	16.7	17.4	18.1	18.7	19.4	20.1	20.8
122	13.7	14.3	15.0	15.7	16.4	17.1	17.8	18.4	19.1	19.8	20.4
124	13.4	14.1	14.8	15.5	16.1	16.8	17.5	18.1	18.8	19.5	20.1
126	13.2	13.9	14.6	15.2	15.9	16.5	17.2	17.9	18.5	19.2	19.8
128	13.0	13.7	14.3	15.0	15.6	16.3	16.9	17.6	18.2	18.9	19.5
130	12.8	13.5	14.1	14.7	15.4	16.0	16.7	17.3	17.9	18.6	19.2
134	12.4	13.1	13.7	14.3	14.9	15.5	16.2	16.8	17.4	18.0	18.7
136	12.3	12.9	13.5	14.1	14.7	15.3	15.9	16.5	17.2	17.8	18.4
140	11.9	12.5	13.1	13.7	14.3	14.9	15.5	16.1	16.7	17.3	17.9
144	11.6	12.2	12.7	13.3	13.9	14.5	15.0	15.6	16.2	16.8	17.4
146	11.4	12.0	12.6	13.1	13.7	14.3	14.8	15.4	16.0	16.6	17.1
150	11.1	11.7	12.2	12.8	13.3	13.9	14.4	15.0	15.6	16.1	16.7
154	10.8	11.4	11.9	12.4	13.0	13.5	14.1	14.6	15.2	15.7	16.2
156	10.7	11.2	11.8	12.3	12.8	13.4	13.9	14.4	15.0	15.5	16.0
160	10.4	10.9	11.5	12.0	12.5	13.0	13.5	14.1	14.6	15.1	15.6
164	10.2	10.7	11.2	11.7	12.2	12.7	13.2	13.7	14.2	14.7	15.2
166	10.0	10.5	11.0	11.5	12.0	12.6	13.1	13.5	14.1	14.6	15.1
170	9.8	10.3	10.8	11.3	11.8	12.3	12.7	13.2	13.7	14.2	14.7
174	9.6	10.1	10.5	11.0	11.5	12.0	12.5	12.9	13.4	13.9	14.4
176	9.5	9.9	10.4	10.9	11.4	11.8	12.3	12.8	13.3	13.7	14.2
180	9.3	9.7	10.2	10.6	11.1	11.6	12.0	12.5	13.0	13.4	13.9

Picks per inch.	Picks per minute.										
	155	160	165	170	175	180	185	190	195	200	205
20	129.2	133.3	137.5	141.7	145.8	150.0	154.2	158.3	162.5	166.7	170.8
22	117.4	121.2	125.0	128.8	132.6	136.4	140.2	143.9	147.7	151.5	155.3
24	107.6	111.1	114.6	118.1	121.5	125.0	128.5	131.9	135.4	138.9	142.4
26	99.4	102.6	105.8	109.0	112.2	115.4	118.6	121.8	125.0	128.2	131.4
28	92.3	95.2	98.2	101.2	104.2	107.1	110.1	113.1	116.1	119.0	122.0
30	86.1	88.9	91.7	94.4	97.2	100.0	102.8	105.5	108.3	111.1	113.9
32	80.7	83.3	85.9	88.5	91.1	93.7	96.4	99.0	101.6	104.2	106.8
34	76.0	78.4	80.9	83.3	85.8	88.2	90.7	93.1	95.6	98.0	100.5
36	71.8	74.1	76.4	78.7	81.0	83.3	85.6	88.0	90.3	92.6	94.9
38	68.0	70.2	72.4	74.6	76.8	78.9	81.1	83.3	85.5	87.7	89.9
40	64.6	66.7	68.7	70.8	72.9	75.0	77.1	79.2	81.3	83.3	85.4
42	61.5	63.5	65.5	67.5	69.4	71.4	73.4	75.4	77.4	79.4	81.3
44	58.7	60.6	62.5	64.4	66.3	68.2	70.1	72.0	73.9	75.8	77.7
46	56.2	58.0	59.8	61.6	63.4	65.2	67.0	68.8	70.7	72.5	74.3
48	53.8	55.6	57.3	59.0	60.8	62.5	64.2	66.0	67.7	69.4	71.2
50	51.7	53.3	55.0	56.7	58.3	60.0	61.7	63.3	65.0	66.7	68.3
52	49.7	51.3	52.9	54.5	56.1	57.7	59.3	60.9	62.5	64.1	65.7
54	47.8	49.4	50.9	52.5	54.0	55.6	57.1	58.6	60.2	61.7	63.3
56	46.1	47.6	49.1	50.6	52.1	53.6	55.1	56.5	58.0	59.5	61.0
58	44.5	46.0	47.4	48.8	50.3	51.7	53.2	54.6	56.0	57.5	58.9
60	43.1	44.4	45.8	47.2	48.6	50.0	51.4	52.8	54.2	55.6	56.9
62	41.7	43.0	44.4	45.7	47.0	48.4	49.7	51.1	52.4	53.8	55.1
64	40.4	41.7	43.0	44.3	45.6	46.9	48.2	49.5	50.8	52.1	53.4
66	39.1	40.4	41.7	42.9	44.2	45.5	46.7	48.0	49.2	50.5	51.8
68	38.0	39.2	40.4	41.7	42.9	44.1	45.3	46.6	47.8	49.0	50.2
70	36.9	38.1	39.3	40.5	41.7	42.9	44.0	45.2	46.4	47.6	48.8
72	35.9	37.0	38.2	39.4	40.5	41.7	42.8	44.0	45.1	46.3	47.5
74	34.9	36.0	37.2	38.3	39.4	40.5	41.7	42.8	43.9	45.0	46.2
76	34.0	35.1	36.2	37.3	38.4	39.5	40.6	41.7	42.8	43.9	45.0
78	33.1	34.2	35.3	36.3	37.4	38.5	39.5	40.6	41.7	42.7	43.8
80	32.3	33.3	34.4	35.4	36.5	37.5	38.5	39.6	40.6	41.7	42.7
82	31.5	32.5	33.5	34.6	35.6	36.6	37.6	38.6	39.6	40.7	41.7
84	30.8	31.7	32.7	33.7	34.7	35.7	36.6	37.7	38.7	39.7	40.7
86	30.0	31.0	32.0	32.9	33.9	34.9	35.8	36.8	37.8	38.8	39.7
88	29.4	30.3	31.3	32.2	33.1	34.1	35.0	36.0	36.9	37.9	38.8
90	28.7	29.6	30.6	31.5	32.4	33.3	34.3	35.2	36.1	37.0	38.0
92	28.1	29.0	29.9	30.8	31.7	32.6	33.5	34.4	35.3	36.2	37.1
94	27.5	28.4	29.3	30.1	31.0	31.9	32.8	33.7	34.6	35.5	36.3
96	26.9	27.8	28.6	29.5	30.4	31.3	32.1	33.0	33.9	34.7	35.6
98	26.4	27.2	28.1	28.9	29.8	30.6	31.5	32.3	33.2	34.0	34.9
100	25.8	26.7	27.5	28.3	29.2	30.0	30.8	31.7	32.5	33.3	34.4
102	25.3	26.1	27.0	27.8	28.6	29.4	30.2	31.0	31.9	32.7	33.5
104	24.8	25.6	26.4	27.2	28.0	28.8	29.6	30.4	31.3	32.1	32.9
106	24.4	25.2	25.9	26.7	27.5	28.3	29.1	29.9	30.7	31.4	32.2
108	23.9	24.7	25.5	26.2	27.0	27.8	28.5	29.3	30.1	30.9	31.6
110	23.5	24.2	25.0	25.8	26.5	27.3	28.0	28.8	29.5	30.3	31.1
112	23.1	23.8	24.6	25.3	26.0	26.8	27.5	28.3	29.0	29.8	30.5
114	22.7	23.4	24.1	24.9	25.6	26.3	27.0	27.8	28.5	29.2	30.0
116	22.3	23.0	23.7	24.4	25.1	25.9	26.6	27.3	28.0	28.7	29.5
118	21.9	22.6	23.3	24.0	24.7	25.4	26.1	26.8	27.5	28.2	29.0
120	21.5	22.2	22.9	23.6	24.3	25.0	25.7	26.4	27.1	27.8	28.5
122	21.2	21.9	22.5	23.2	23.9	24.6	25.3	26.0	26.6	27.3	28.0
124	20.8	21.5	22.2	22.8	23.5	24.2	24.9	25.5	26.2	26.9	27.6
126	20.5	21.2	21.8	22.5	23.1	23.8	24.5	25.1	25.8	26.5	27.1
128	20.2	20.8	21.5	22.1	22.8	23.4	24.1	24.7	25.4	26.0	26.7
130	19.9	20.5	21.2	21.8	22.4	23.1	23.7	24.4	25.0	25.6	26.3
134	19.3	19.9	20.5	21.1	21.8	22.4	23.0	23.6	24.3	24.9	25.5
136	19.0	19.6	20.2	20.8	21.4	22.1	22.7	23.3	23.9	24.5	25.1
140	18.5	19.0	19.6	20.2	20.8	21.4	22.0	22.6	23.2	23.8	24.4
144	17.9	18.5	19.1	19.7	20.3	20.8	21.4	22.0	22.6	23.1	23.7
146	17.7	18.3	18.8	19.4	20.0	20.5	21.1	21.7	22.3	22.8	23.4
150	17.2	17.8	18.3	18.9	19.4	20.0	20.6	21.1	21.7	22.2	22.8
154	16.8	17.3	17.9	18.4	18.9	19.5	20.0	20.6	21.1	21.6	22.2
156	16.6	17.1	17.6	18.2	18.7	19.2	19.8	20.3	20.8	21.4	21.9
160	16.1	16.7	17.2	17.7	18.2	18.7	19.3	19.8	20.3	20.8	21.4
164	15.8	16.3	16.8	17.3	17.8	18.3	18.8	19.3	19.8	20.3	20.8
166	15.6	16.1	16.6	17.1	17.6	18.1	18.6	19.1	19.6	20.1	20.6
170	15.2	15.7	16.2	16.7	17.2	17.6	18.1	18.6	19.1	19.6	20.1
174	14.8	15.4	15.8	16.3	16.8	17.2	17.7	18.2	18.7	19.2	19.6
176	14.7	15.2	15.6	16.1	16.6	17.0	17.5	18.0	18.5	18.9	19.4
180	14.4	14.8	15.3	15.7	16.2	16.7	17.1	17.6	18.1	18.5	19.0

REED TABLE.

		PLAIN CLOTH.			FOR DRILLS.		
Ends per Inch.	Ends in Cloth.	Dents per Inch.	Two Ends per Reed Dent. Total Dents.	Width of Reed or Spread.	Dents in Inch.	Three Ends per Reed Dent. Total Dents.	Width of Reed or Inches Spread.
32	1176	14.67	576	39.25	10.16	392	38.58
34	1248	15.59	612	39.25	10.79	416	38.55
36	1320	16.51	648	39.25	11.42	440	38.52
38	1392	17.42	684	39.25	12.06	464	38.47
40	1464	18.34	720	39.25	12.69	488	38.47
42	1536	19.26	756	39.25	13.33	512	38.40
44	1608	20.17	792	39.25	13.96	536	38.37
46	1680	21.09	828	39.25	14.60	560	38.35
48	1752	22.01	864	39.25	15.23	584	38.34
50	1824	22.93	900	39.25	15.87	608	38.33
52	1896	23.85	936	39.25	16.50	632	38.32
54	1968	24.77	972	39.25	17.14	656	38.27
56	2040	25.68	1008	39.25	17.77	680	38.26
58	2112	26.60	1044	39.25	18.41	704	38.24
60	2184	27.51	1080	39.25	19.04	728	38.23
62	2256	28.43	1116	39.25	19.68	752	38.20
64	2328	29.35	1152	39.25	20.32	776	38.19
66	2400	30.22	1188	39.25	20.95	800	38.18
68	2472	31.18	1224	39.25	21.58	824	38.18
70	2544	32.10	1260	39.25	22.22	848	38.17
72	2616	33.02	1296	39.25	22.85	872	38.16
74	2688	33.94	1332	39.25	23.49	896	38.14
76	2760	34.85	1368	39.25	24.12	920	38.14
78	2832	35.77	1404	39.25	24.76	944	38.13
80	2904	36.69	1440	39.25	25.39	968	38.12
82	2976	37.60	1476	39.25	26.03	992	38.12
84	3048	38.52	1512	39.25	26.66	1016	38.12
86	3120	39.44	1548	39.25	27.30	1040	38.09
88	3192	40.35	1584	39.25	27.94	1064	38.08
90	3264	41.27	1620	39.25	28.58	1088	38.07
92	3336	42.19	1656	39.25	29.22	1112	38.06
94	3408	43.11	1692	39.25	29.86	1136	38.05
96	3480	44.02	1728	39.25	30.50	1160	38.03
98	3552	44.92	1764	39.25	31.14	1184	38.02
100	3624	45.85	1800	39.25	31.78	1208	38.00

This table is made out for cloth 36″ wide—all other widths of cloth, proportion must be made. Twenty-four ends are allowed in every case for selvage.

For two harness plain, eyes on each harness = Total dents.
For three harness drill, eyes on each harness = Total dents.

TABLE TO FACILITATE THE CONVERSION OF YARDS TO THE POUND TO THEIR DECIMAL EQUIVALENT.

YDS. TO LB.	EQUIVA-LENT.	YDS. TO LB.	EQUIVA-LENT.	YDS. TO LB.	EQUIVA-LENT.	YDS. TO LB.	EQUIVA-LENT.	YDS. TO LB.	EQUIVA-LENT.	YDS. TO LB.	EQUIVA-LENT.	YDS. TO LB.	EQUIVA-LENT.	YDS. TO LB.	EQUIVA-LENT.
1.00	1.0000	2.00	.5000	3.00	.3333	4.00	.2500	5.00	.2000	6.00	.1667	7.00	.1429	8.00	.1250
.05	.9524	.05	.4878	.05	.3279	.05	.2469	.05	.1980	.05	.1653	.05	.1418	.05	.1242
.10	.9091	.10	.4762	.10	.3226	.10	.2439	.10	.1961	.10	.1639	.10	.1408	.10	.1235
.15	.8696	.15	.4651	.15	.3175	.15	.2410	.15	.1942	.15	.1626	.15	.1399	.15	.1227
.20	.8333	.20	.4545	.20	.3125	.20	.2381	.20	.1923	.20	.1613	.20	.1389	.20	.1220
.25	.8000	.25	.4444	.25	.3077	.25	.2353	.25	.1905	.25	.1600	.25	.1379	.25	.1212
.30	.7692	.30	.4348	.30	.3030	.30	.2326	.30	.1887	.30	.1587	.30	.1370	.30	.1205
.35	.7407	.35	.4255	.35	.2985	.35	.2299	.35	.1869	.35	.1575	.35	.1361	.35	.1198
.40	.7143	.40	.4167	.40	.2941	.40	.2273	.40	.1852	.40	.1562	.40	.1351	.40	.1190
.45	.6897	.45	.4082	.45	.2899	.45	.2247	.45	.1835	.45	.1550	.45	.1342	.45	.1183
.50	.6667	.50	.4000	.50	.2857	.50	.2222	.50	.1818	.50	.1538	.50	.1333	.50	.1176
.55	.6452	.55	.3922	.55	.2817	.55	.2198	.55	.1802	.55	.1527	.55	.1325	.55	.1170
.60	.6250	.60	.3846	.60	.2778	.60	.2174	.60	.1786	.60	.1515	.60	.1316	.60	.1163
.65	.6061	.65	.3774	.65	.2740	.65	.2151	.65	.1770	.65	.1504	.65	.1307	.65	.1156
.70	.5882	.70	.3704	.70	.2703	.70	.2128	.70	.1754	.70	.1493	.70	.1299	.70	.1149
.75	.5714	.75	.3636	.75	.2667	.75	.2105	.75	.1739	.75	.1481	.75	.1290	.75	.1143
.80	.5556	.80	.3571	.80	.2632	.80	.2083	.80	.1724	.80	.1471	.80	.1282	.80	.1136
.85	.5405	.85	.3509	.85	.2597	.85	.2062	.85	.1709	.85	.1460	.85	.1274	.85	.1130
.90	.5263	.90	.3448	.90	.2564	.90	.2041	.90	.1695	.90	.1449	.90	.1266	.90	.1124
.95	.5128	.95	.3390	.95	.2532	.95	.2020	.95	.1681	.95	.1439	.95	.1258	.95	.1117

The following rules and tables are made possible by the system of numbering cotton yarns in this country. This system establishes as a unit :

One pound of yarn measuring 840 yards, or one hank, is number 1 ; and further it provides that the yarn number, or count, is an indication of the number of hanks in one pound avoirdupois.

The factors entering into cloth calculations are six in number, viz :

Width;
Sley, or warp threads per inch;
Picks, or filling threads per inch;
Number, or count of warp yarn;
Number, or count of filling yarn;
Weight of cloth; this weight may be in yards per pound, ounces per yard, or pounds per yard expressed decimally.

The following tables are intended to enable any person having given the width and four of the other elements of a piece of cloth, to find the sixth by a simple calculation ; also to construct a piece of cloth of any required width, weight, sley and picks.

Allowance has been made in the tables for contraction of warp and filling in the process of weaving and for the sizing of the warp.

The tables show print cloth 28 inches wide, and sheetings, drills, etc., 32, 36, 40, 54 and 64 inches wide. Other widths of print cloth construction may be figured from the 28 inch column, and other widths of sheetings, etc., from either of the other columns.

The examples illustrating the several rules are, for the sake of uniformity, all based upon standard 28 inch print cloth.

The makeup of such cloth is,

Width	=	28 inches.
Sley	=	64
Picks	=	64
Warp number	=	28^s.
Filling number	=	36^s.
Weight	=	7 yards per lb.
1 yard weighs		.142857 lbs.

FIRST.

Having given the width, sley, picks, filling number and weight in yards per pound, to find the warp number required:

Rule. Divide the constant for sley by the weight of warp in one yard in pounds; the quotient will be the warp number.

Example.

Opposite 64, the number of picks in 28 inch column, find constant for picks = 2.25. Divide 2.25 by 36, the filling number = .0625, the weight of filling in decimal fraction of one pound.

From the weight of one yard of cloth	=	.142857
Subtract the weight of filling in one yard	=	.06250
Leaves the weight of warp in one yard	=	.080357

Opposite the sley in 28 inch column find the constant for sley = 2.25. Divide 2.25 by .080357, the weight of warp, and the quotient is 28 or the warp yarn number required.

SECOND.

Having given the width, sley, picks, warp number and weight of one yard of cloth, to find the filling number required:

Rule. Divide the constant for picks by the weight of filling in pounds in one yard; the quotient will be the filling number.

Example.

Opposite 64 picks in 28 inch column find constant for sley = 2.25. Divide 2.25 by .0625, the weight of filling in one yard of cloth as found in first problem and the quotient is 36, the filling number.

THIRD.

Having given the width, picks, warp number, filling number and weight of one yard of cloth, to find the sley:

Rule. Divide the constant for picks by the filling number to find the weight of filling in one yard of cloth. From the weight of one yard of cloth deduct the weight of filling; the remainder equals weight of warp in one yard; multiply this weight by the warp number to find the sley constant. Opposite the sley constant in 28 inch column will be the sley required.

Example.

Opposite 64 the number of picks in 28 inch column find pick constant 2.25. Divide by 36 the filling number equals .0625 the weight of filling. From the weight of one yard of cloth .142857 subtract .0625, the weight of filling in one yard. The remainder .080357 equals weight of warp in one yard; multiply by 28, the warp number, gives the sley constant 2.25. Opposite 2.25 in 28 inch column is found 64, the sley required.

FOURTH.

Given the width, sley, warp number, filling number and weight of one yard of cloth, to find the required picks:

RULE. Divide the sley constant by the warp number to obtain the weight of warp in one yard of cloth. Substract weight of warp from weight of one yard of cloth to obtain weight of filling; multiply weight of filling by filling number to obtain constant for picks. Opposite constant for picks will be found the required number of picks.

Example.

Opposite 64 the sley under 28 inch find sley constant 2.25. Divided by 28, the warp number, equals .080357 the weight of warp in one yard of cloth.

From total weight of one yard of cloth	.142857
Subtract weight of warp	.080357
Leaves weight of filling	.0625

Multiply by the filling number 36 equals 2.25 the filling constant. Opposite 2.25 in 28 inch column is 64, the number of picks required.

FIFTH.

Given the width, sley, picks, warp number, and filling number, to find the weight of one yard of cloth, the weight each of warp and filling and the number of yards in one pound of cloth:

RULE. Divide the sley constant by the warp number to find the weight of warp.

Divide the filling constant by the filling number to find the weight of filling. Add the two for total weight of one yard. Divide one pound by the fractional weight of one yard and the quotient is the number of yards per pound.

Example.

Opposite the sley 64 in 28 inch column, find the sley constant 2.25; divided by warp number 28 gives weight of warp .080357.

Opposite the number of picks 64 find pick constant 2.25.

Divided by the filling number equals weight of filling in one yard of cloth .0625.

Add	.080357,	weight of warp to
	.0625,	weight of filling
equals	.142857,	weight of one yard of cloth.

One pound divided by weight of one yard of cloth .142857, equals 7, the number of yards to the pound.

To find the weight of one yard in ounces multiply .142857, the weight of one yard in pounds, by 16 the number of ounces in one pound, equals 2.285712 ounces in one yard, or divide 16 by 7, the yards per pound, gives the same result.

SIXTH.

Given the width, sley and warp number, to find the weight of warp yarn in one yard of cloth :

RULE. Divide the constant for sley by the warp number and the quotient will be the weight of warp in one yard of cloth expressed in decimal fraction of one pound.

Example.

Opposite the sley 64 find the sley constant 2.25. Divided by 28, the warp number, equals .080357 lbs., the weight of warp in one yard of cloth.

SEVENTH.

Given the width, picks and filling number, to find the weight of filling in one yard of cloth :

RULE. Divide the constant for picks by the filling number and the quotient will be the weight of filling in one yard of cloth expressed in decimal fraction of one pound.

Example.

Opposite the picks 64 find the constant for picks 2.25. Divided by 36, the filling number, equals .0625 lbs., the weight of filling in one yard of cloth.

EIGHTH.

Given the weight of both warp and filling in one yard of cloth as found by problems six and seven, to find the weight of one yard of cloth :

RULE. Add the weight of warp to the weight of filling and their sum equals the weight of one yard of cloth. One divided by this sum equals the number of yards to the pound.

Example.

Weight of warp, problem six,	.080357
Weight of filling, problem seven,	.0625
Weight of one yard of cloth,	.142857

$$\frac{1.}{.142857} = 7 \text{ the number of yards per pound.}$$

NINTH.

Given the width, sley and weight of warp yarn, to find the number :

RULE. Divide the sley constant by the weight of warp in one yard of cloth ; the quotient will be the warp number.

Example.

Opposite the sley 64 find sley constant 2.25. Divide 2.25 by weight of warp yarn in one yard, .080357 lbs., equals 28, the number.

TENTH.

Given the width, picks and weight of filling yarn, to find the number.

RULE. Divide the constant for filling by the weight of filling in one yard of cloth ; the quotient will be the filling number.

Example.

Opposite the picks 64 find constant for picks, 2.25. Divide 2.25 by weight of filling in one yard of cloth .0625 lbs., equals 36, the number.

ELEVENTH.

Given the width, weight of warp and warp number, to find the sley required.

RULE. Multiply the weight of warp yarn in one yard of cloth by the warp number ; the product will be the sley constant. Opposite the sley constant the actual sley required will be found in the proper column.

Example.

Width 28 inches ; .080357 lbs. the weight of warp multiplied by 28, the number gives 2.25 the sley constant. Opposite 2.25 in 28 inch column is 64 the required sley.

TWELFTH.

Given the width, weight of filling yarn and filling number, to find the picks per inch.

RULE. Multiply the weight of filling yarn by the filling number; the product will be the constant for filling. Opposite filling constant the number of picks required will be found in the proper column.

Example.

Width 28 inches; weight of filling yarn .0625 lbs. multiplied by 36, the filling number, equals 2.25 the filling constant. Opposite 2.25 in 28 inch column is 64, the number of picks per inch.

THIRTEENTH.

Given the width, sley, picks and weight, to find the average number of yarn.

RULE. Add the sley constant to the pick constant and multiply by the number of yards per pound.

Example.

Opposite sley in 28 inch column find sley constant 2.25. Opposite picks per inch find pick constant 2.25; these added equal 4.50. Multiply by 7 the number of yards per pound equals 31.5, the average number required.

SUMMARY.

1. Sley constant means the figure found in table under the given width and opposite the actual sley.

2. Filling constant means the figure found in table under the given width and opposite the actual picks per inch.

3. Sley constant divided by warp yarn number equals weight of warp per yard in pounds.

4. Pick constant divided by filling yarn number equals weight of filling per yard in pounds.

5. Sley constant divided by weight of warp in one yard of cloth equals warp yarn number.

6. Pick constant divided by weight of filling in one yard of cloth equals filling yarn number.

7. Warp yarn number multiplied by weight of warp in one yard equals sley constant.

8. Filling yarn number multiplied by weight of filling in one yard equals filling constant.

9. Warp constant plus filling constant multiplied by yards per pound equals average numbers of yarn in cloth.

10. As stated at the opening of this article, allowances for contraction of warp and filling and for sizing of the warp are covered by the figures in the tables of sley and pick constants.

CONSTANTS FOR SLEY OR PICKS, WITH ALLOWANCES MADE FOR CONTRACTION AND SIZING.

Sley or Picks.	Print Cloth, Etc.	Sheetings, Shirtings, Drills, Twills, Etc.				
	28 Inch	32 Inch	36 Inch	40 Inch	54 Inch	64 Inch
1	.03516	.04280	.04815	.0535	.07222	.08560
2	.07031	.08560	.09630	.1070	.14445	.17120
3	.10547	.12840	.14445	.1605	.21667	.25680
4	.14062	.17120	.19260	.2140	.28890	.34240
5	.17578	.21400	.24075	.2675	.36112	.42800
6	.21094	.25680	.28890	.3210	.43335	.51360
7	.24609	.29960	.33705	.3745	.50557	.59920
8	.28125	.34240	.38520	.4280	.57780	.68480
9	.31641	.38520	.43335	.4815	.65002	.77040
10	.35156	.42800	.48150	.5350	.72225	.85600
11	.38672	.47080	.52965	.5885	.79447	.94160
12	.42187	.51360	.57780	.6420	.86670	1.02720
13	.45703	.55640	.62595	.6955	.93892	1.11280
14	.49219	.59920	.67410	.7490	1.01115	1.19840
15	.52734	.64200	.72225	.8025	1.08337	1.28400
16	.56250	.68480	.77040	.8560	1.15560	1.36960
17	.59766	.72760	.81855	.9095	1.22782	1.45520
18	.63281	.77040	.86670	.9630	1.30005	1.54080
19	.66797	.81320	.91485	1.0165	1.37227	1.62640
20	.70312	.85600	.96300	1.0700	1.44450	1.71200
21	.73828	.89880	1.01115	1.1235	1.51672	1.79760
22	.77344	.94160	1.05930	1.1770	1.58895	1.88320
23	.80859	.98440	1.10745	1.2305	1.66117	1.96880
24	.84375	1.02720	1.15560	1.2840	1.73340	2.05440
25	.87890	1.07000	1.20375	1.3375	1.80562	2.14000
26	.91406	1.11280	1.25190	1.3910	1.87785	2.22560
27	.94922	1.15560	1.30005	1.4445	1.95007	2.31120
28	.98437	1.19840	1.34820	1.4980	2.02230	2.39680
29	1.01953	1.24120	1.39635	1.5515	2.09452	2.48240
30	1.05469	1.28400	1.44450	1.6050	2.16675	2.56800
31	1.08984	1.32680	1.49265	1.6585	2.23897	2.65360
32	1.12500	1.36960	1.54080	1.7120	2.31120	2.73920
33	1.16016	1.41240	1.58895	1.7655	2.38342	2.82480
34	1.19531	1.45520	1.63710	1.8190	2.45565	2.91040
35	1.23047	1.49800	1.68525	1.8725	2.52787	2.99600
36	1.26562	1.54080	1.73340	1.9260	2.60010	3.08160
37	1.30078	1.58360	1.78155	1.9795	2.67232	3.16720
38	1.33593	1.62640	1.82970	2.0330	2.74455	3.25280
39	1.37109	1.66920	1.87785	2.0865	2.81677	3.33840
40	1.40625	1.71200	1.92600	2.1400	2.88900	3.42400
41	1.44141	1.75480	1.97415	2.1935	2.96122	3.50960
42	1.47656	1.79760	2.02230	2.2470	3.03345	3.59520
43	1.51172	1.84040	2.07045	2.3005	3.10567	3.68080
44	1.54687	1.88320	2.11860	2.3540	3.17790	3.76640
45	1.58203	1.92600	2.16675	2.4075	3.25012	3.85200
46	1.61718	1.96880	2.21490	2.4610	3.32235	3.93760
47	1.65234	2.01160	2.26305	2.5145	3.39457	4.02320
48	1.68750	2.05440	2.31120	2.5680	3.46680	4.10880
49	1.72265	2.09720	2.35935	2.6215	3.53902	4.19440
50	1.75781	2.14000	2.40750	2.6750	3.61125	4.28000

CONSTANTS FOR SLEY OR PICKS, WITH ALLOWANCES MADE FOR CONTRACTION AND SIZING.

SLEY OR PICKS.	Print Cloth, Etc.	SHEETINGS, SHIRTINGS, DRILLS. TWILLS, ETC.				
	28 Inch	32 Inch	36 Inch	40 Inch	54 Inch	64 Inch
51	1.79297	2.18280	2.45565	2.7285	3.68347	4.36560
52	1.82812	2.22560	2.50380	2.7820	3.75570	4.45120
53	1.86328	2.26840	2.55195	2.8355	3.82792	4.53680
54	1.89843	2.31120	2.60010	2.8890	3.90015	4.62240
55	1.93359	2.35400	2.64825	2.9425	3.97237	4.70800
56	1.96875	2.39680	2.69640	2.9960	4.04460	4.79360
57	2.00390	2.43960	2.74455	3.0495	4.11682	4.87920
58	2.03906	2.48240	2.79270	3.1030	4.18905	4.96480
59	2.07422	2.52520	2.84085	3.1565	4.26127	5.05040
60	2.10937	2.56800	2.88900	3.2100	4.33350	5.13600
61	2.14453	2.61080	2.93715	3.2635	4.40572	5.22160
62	2.17968	2.65360	2.98530	3.3170	4.47795	5.30720
63	2.21484	2.69640	3.03345	3.3705	4.55017	5.39280
64	2.25000	2.73920	3.08160	3.4240	4.62240	5.47840
65	2.28515	2.78200	3.12975	3.4775	4.69462	5.56400
66	2.32031	2.82480	3.17790	3.5310	4.76685	5.64960
67	2.35547	2.86760	3.22605	3.5845	4.83907	5.73520
68	2.39062	2.91040	3.27420	3.6380	4.91130	5.82080
69	2.42578	2.95320	3.32235	3.6915	4.98352	5.90640
70	2.46093	2.99600	3.37050	3.7450	5.05575	5.99200
71	2.49609	3.03880	3.41865	3.7985	5.12797	6.07760
72	2.53125	3.08160	3.46680	3.8520	5.20020	6.16320
73	2.56640	3.12440	3.51495	3.9055	5.27242	6.24880
74	2.60156	3.16720	3.56310	3.9590	5.34465	6.33440
75	2.63672	3.21000	3.61125	4.0125	5.41687	6.42000
76	2.67187	3.25280	3.65940	4.0660	5.48910	6.50560
77	2.70703	3.29560	3.70755	4.1195	5.56132	6.59120
78	2.74219	3.33840	3.75570	4.1730	5.63355	6.67680
79	2.77734	3.38120	3.80385	4.2265	5.70577	6.76240
80	2.81250	3.42400	3.85200	4.2800	5.77800	6.84800
81	2.84765	3.46680	3.90015	4.3335	5.85022	6.93360
82	2.88281	3.50960	3.94830	4.3870	5.92245	7.01920
83	2.91797	3.55240	3.99645	4.4405	5.99467	7.10480
84	2.95312	3.59520	4.04460	4.4940	6.06690	7.19040
85	2.98828	3.63800	4.09275	4.5475	6.13912	7.27600
86	3.02343	3.68080	4.14090	4.6010	6.21135	7.36160
87	3.05859	3.72360	4.18905	4.6545	6.28357	7.44720
88	3.09375	3.76640	4.23720	4.7080	6.35580	7.53280
89	3.12890	3.80920	4.28535	4.7615	6.42802	7.61840
90	3.16406	3.85200	4.33350	4.8150	6.50025	7.70400
91	3.19922	3.89480	4.38165	4.8685	6.57247	7.78960
92	3.23437	3.93760	4.42980	4.9220	6.64470	7.87520
93	3.26953	3.98040	4.47795	4.9755	6.71692	7.96080
94	3.30468	4.02320	4.52610	5.0290	6.78915	8.04640
95	3.33984	4.06600	4.57425	5.0825	6.86137	8.13200
96	3.37500	4.10880	4.62240	5.1360	6.93360	8.21760
97	3.41016	4.15160	4.67055	5.1895	7.00582	8.30320
98	3.44531	4.19440	4.71870	5.2430	7.07805	8.38880
99	3.48047	4.23720	4.76685	5.2965	7.15027	8.47440
100	3.51562	4.28000	4.81500	5.3500	7.22250	8.56000

Mills running on specialties where there are frequent changes in cloth construction, sometimes have parties in charge who are familiar with the slide rule and who prefer to figure such problems with this piece of apparatus. In such cases the special cloth calculating slide rule patented by Mr. Arnold Schaer of Warren, Rhode Island, will be found helpful.

LOOM PRODUCTION.

To find the production of a loom running at any number of picks per minute for a day of ten hours, or for a week of sixty hours, weaving cloth of any number of picks per inch:

RULE. Multiply the number of picks per minute by 100 and divide by the number of picks per inch multiplied by 6; the quotient will be the yards per ten hours theoretical product, without any allowance for stops.

Example.

Print cloth loom 190 picks per minute, 64 picks per inch.

$$\frac{\overset{95}{\cancel{190}} \times \overset{\overset{25}{\cancel{50}}}{\cancel{100}}}{\underset{\underset{16}{\cancel{32}}}{\cancel{64}} \times \underset{3}{\cancel{6}}} = \frac{2375}{48} = 49.47 = \text{yards per 10 hours.}$$

For a week of 60 hours.

RULE. Multiply the number of picks per minute by 100 and divide by the number of picks per inch.

Example.

Conditions as before.

$$\frac{\overset{95}{\cancel{190}} \times \overset{25}{\cancel{100}}}{\underset{\underset{8}{\cancel{16}}}{\cancel{64}}} = \frac{2375}{8} = 296.875 = \text{yards per 60 hours.}$$

With Northrop Automatic Looms the product is much nearer the theoretical or one hundred per cent. efficiency than with common looms, which must stop every time the filling runs out or breaks. By operating Northrop looms without weavers through the noon hour and a certain amount of time at morning or night, the percentage of product may be increased to considerably more than one hundred, the basis of one hundred per cent. being in all cases the schedule mill hours; i. e. bell hours.

After establishing a standard as a proper percentage to attain, the rule can be changed in both the above cases to conform to the individual mill requirements by using the standard percentage, as a whole number, instead of 100, in the numerator.

Example.

Print cloth as before; standard, say 85 per cent.

$$\frac{\overset{95}{\cancel{190}} \times 85}{64 \times \underset{3}{\cancel{6}}} = \frac{8075}{192} = 42.05 = \text{yards per 10 hours.}$$

Proof.

Yards based on 100 per cent =	49.47
Less 15 per cent =	7.42
85 per cent =	42.05

RULE. Multiply the number of picks per minute by the standard percentage required and divide by the number of picks per inch multiplied by 6. The quotient will be the production in yards per day of ten hours, with allowance made for loss by stops or gain by running automatic looms more than bell hours without weavers.

For weekly production:

Multiply the number of picks per minute by the standard percentage required and divide by the number of picks per inch.

Example.

Print cloth as before; Northrop automatic looms standard, say 106 per cent.

$$\frac{\overset{95}{\cancel{190}} \times \overset{53}{\cancel{106}}}{\underset{\underset{16}{\cancel{32}}}{\cancel{64}}} = \frac{5035}{16} = 314.68 = \text{yards in 60 hours.}$$

Proof.

Yards per 60 hours 100 per cent. basis =	296.87
Add 6 per cent. =	17.81
106 per cent. as before =	314.68

CLOTH STRUCTURAL TABLES.

To make a cloth of heavier or lighter weight, coarser or finer pick or sley, or coarser or finer yarns than a given cloth, while retaining all the essential qualities of the given cloth ; or, to make a range of cloths of various sleys, picks, warp and filling numbers, all of which shall have the same essential structural qualities as the given cloth and appear as the given cloth would if magnified or diminished.

These tables are based upon the fact that yarns are in proportion to each other as the squares of their diameters.

Murphy in "The Art of Weaving," 7th edition, 1842, page 428, says : "If a piece of cloth is woven in any sett of reed, as for instance, a 1200 on 37 inches, and that the diameters of the warp threads and the small spaces between them are of exactly the same size. Then if we have another piece of cloth of the same texture, woven, for example, in an 1800 reed, the diameters of the warp threads being also equal to the intervening spaces, then these two sizes of cloth are said to be of the same fabric, although the one is a third finer than the other ; so that when the diameters of the threads are greater than the spaces, the fabric is proportionally stouter, and the reverse when they are smaller. Now the method of determining the several grists of yarn that will preserve this uniformity of fabric through the different setts of reed depends on the following analogy :

As the square of any given reed is
To the grists of yarn that suits that reed,
So is the square of any other sett of reed
To its respective grist for the same fabric.

The reason of this rule will evidently appear by considering the threads of warp as so many cylinders of equal length or altitude and the reed as the scale which measures the space in which a given number of these threads are contained ; therefore the solidities of the threads in one sett of reed will be to those in any other sett of reed as their bases or as the squares of their diameters, by problem 11, book 12 of Euclid."

HOW TO USE.

In the first colum of these tables are the yarn numbers, warp or filling proceeding from 1 to 40 by half numbers.

The other columns headed "Sley or Picks," contain a tabular number, the use of which is shown in the accompanying examples.

FIRST—Warp and filling alike, sley and picks alike in a given cloth, to make a similar cloth, the warp and filling numbers of the required cloth being given. To find sley and picks.

Example.	Sley.	Warp No.	Picks.	Filling No.
Given cloth,	48	16	48	16
Required cloth,		20		20

Opposite 16, the warp and filling number of the given cloth, under 48 sley and picks, find the tabular number 21.5836.

Opposite 20, warp and filling number of required cloth, find the nearest tabular number to above, viz., 21.6376.

At the top of the column containing this tabular number is 54, the required sley and picks.

SECOND—Warp and filling alike, sley and picks alike in a given cloth, to make a similar cloth, the sley and picks of the required cloth being given. To find the required warp and filling numbers.

Example.	Sley.	Warp No.	Picks.	Filling No.
Given cloth,	48	16	48	16
Required cloth,	56		56	

Opposite 16, the warp and filling number of the given cloth, under 48, the given sley and picks, find 21.5836, the tabular number.

Under 56, the reed and picks of the required cloth, find 21.6394, the nearest tabular number to 21.5836.

Opposite this tabular number, in the column marked "Yarn Nos." is 21.5, the yarn numbers required.

THIRD—Warp and filling different numbers, sley and picks different in a given cloth, to make a similar cloth, the warp number only of the required cloth being given. To find sley, picks and filling number for required cloth.

Example.	Sley.	Warp No.	Picks.	Filling No.
Given cloth,	48	20	52	24
Required cloth,		25		

Opposite 20 warp, under 48 sley, find 20.6145, tabular number.

Opposite 25 warp, (required warp number), find 20.6685, (nearest tabular number).

Above this tabular number is the required sley, 54.

Opposite 24 filling number, under 48 sley (of given cloth), find tabular number 19.8227.

Under 54 sley (as found) opposite 19.8049 (nearest tabular number to above), find 30.5, the required filling number.

Opposite 24, filling number, under 52 picks of given cloth, find tabular number 20.5180.

Opposite 30.5 find 20.5740 (the nearest tabular number to above).

Above this tabular number is 59, the required picks.

FOURTH—Warp and sley different, filling and warp numbers different in a given cloth, to make a similar cloth, having picks only given. To find the required warp, sley and filling numbers.

Example.	Sley.	Warp No.	Picks.	Filling No.
Given cloth,	48	20	52	24
Required cloth,			59	

Opposite 24 filling number, under 52 picks (of given cloth), find 20.5180, tabular number.

Under 59 picks (of required cloth) find 20.5740 (nearest tabular number to above).

Opposite this tabular number is 30.5, the required filling number.

Opposite 24 filling, under 48 sley, is 19.8227, tabular number.

Opposite 30.5 (filling number as found) find 19.8049, tabular number.

Above this is 54, the required sley.

Opposite 20 warp number, under 48 sley (of given cloth), find 20.6145, tabular number.

Under 54, the sley as found, find 20.6685 (nearest tabular number).

Opposite this is 25, the required warp number.

FIFTH—Warp and filling different, sley and picks different in given cloth, to make a similar cloth, having sley only given. To find picks, warp and filling numbers.

Example.	Sley.	Warp No.	Picks.	Filling No.
Given cloth,	48	20	52	24
Required cloth,	54			

Opposite 20 (given warp number) under 48 (given sley) find 20.6145, tabular number.

Under 54, the required sley, opposite 20.6685 (nearest tabular number) find 25, the required warp number.

Under 48 sley, opposite 24 filling (of required cloth) find 19.8227, tabular number.

Under 54 (the required sley) find 19.8049, nearest tabular number.

Opposite this number is 30.5, the filling number required.

Opposite 24 filling, under 52 picks, find 20.5180.

Opposite 30.5 find 20.5740, the nearest tabular number to above, and above this is 59, the required picks.

SIXTH—To make a range of cloths equal to a given cloth, the sley only for the required cloth being given. To find warp number, filling number and picks per inch.

Example.	Sley.	Warp No.	Picks.	Filling No.
Given cloth.	48	20	52	24

Required cloth to have sley, 50, 52, 54, 56, 58, 60 threads to the inch.

Opposite 24 filling and under 48 sley of given cloth find tabular number 19.8227.

Opposite nearest tabular numbers, under the respective sley numbers of the required cloth, find the filling numbers.

Sley.	Nearest Tabular No.	Filling No.
50	19.8297	26
52	19.8485	28
54	19.8049	30.5
56	19.8450	32.5
58	19.8279	35
60	19.8227	37.5

Opposite 24 filling number, under 52 picks, find tabular number 20.5180.

Opposite respective filling numbers of required cloth as found, find nearest tabular numbers.

Above these are the required picks, viz., 54, 56, 59, 61, 63, 65.

Opposite 20, warp number, under 48 sley of given cloth, find 20.6145, tabular number.

Under the various sleys of given cloth find nearest tabular numbers.

Sley.	Nearest Tabular No.
50	20.6550
52	20.6094
54	20.5825
56	20.6502
58	20.6446
60	20.6494

Opposite these tabular numbers are the warp numbers 21.5, 23.5, 25.5, 27, 29, 31.

NOTE—The warp and filling numbers or the sley and picks in the table can be multiplied or divided by any number if the same proportion is maintained throughout a problem. Thus 20 yarn number will answer for 10 or 40, that is 20 divided or multiplied by two. 40 sley for 20 sley or 80 sley.

When another value is assigned it must be maintained throughout.

Nos. Yarn.	SLEY OR PICKS.									
	20	21	22	23	24	25	26	27	28	29
1	26.0206	26.4444	26.8485	27.2346	27.6042	27.9588	28.2995	28.6273	28.9432	29.2480
.5	24.2597	24.6835	25.0876	25.4737	25.8433	26.1979	26.5386	26.8664	27.1823	27.4871
2	23.0103	23.4341	23.8382	24.2243	24.5939	24.9485	25.2892	25.6170	25.9329	26.2377
.5	22.0412	22.4650	22.8691	23.2552	23.6248	23.9794	24.3201	24.6479	24.9638	25.2686
3	21.2494	21.6732	22.0773	22.4634	22.8330	23.1876	23.5283	23.8561	24.1720	24.4768
.5	20.5799	21.0037	21.4078	21.7939	22.1635	22.5181	22.8588	23.1866	23.5025	23.8073
4	20.0000	20.4238	20.8279	21.2140	21.5836	21.9382	22.2789	22.6067	22.9226	23.2274
.5	19.4885	19.9123	20.3164	20.7025	21.0721	21.4267	21.7674	22.0952	22.4111	22.7159
5	19.0309	19.4547	19.8588	20.2449	20.6145	20.9691	21.3098	21.6376	21.9535	22.2583
.5	18.6170	19.0408	19.4449	19.8310	20.2006	20.5552	20.8959	21.2237	21.5396	21.8444
6	18.2391	18.6629	19.0670	19.4531	19.8227	20.1773	20.5180	20.8458	21.1617	21.4665
.5	17.8915	18.3153	18.7194	19.1055	19.4751	19.8297	20.1704	20.4982	20.8141	21.1189
7	17.5696	17.9934	18.3975	18.7836	19.1532	19.5078	19.8485	20.1763	20.4922	20.7970
.5	17.2700	17.6938	18.0979	18.4840	18.8536	19.2082	19.5489	19.8767	20.1926	20.4974
8	16.9897	17.4135	17.8176	18.1937	18.5733	18.9279	19.2686	19.5964	19.9123	20.2171
.5	16.7264	17.1502	17.5543	17.9404	18.3100	18.6646	19.0053	19.3331	19.6490	19.9538
9	16.4782	16.9020	17.3061	17.6922	18.0618	18.4164	18.7571	19.0849	19.4008	19.7056
.5	16.2434	16.6672	17.0713	17.4574	17.8270	18.1816	18.5223	18.8501	19.1660	19.4708
10	16.0206	16.4444	16.8485	17.2346	17.6042	17.9588	18.2995	18.6273	18.9432	19.2480
.5	15.8087	16.2325	16.6366	17.0227	17.3923	17.7469	18.0876	18.4154	18.7313	19.0361
11	15.6067	16.0305	16.4346	16.8207	17.1903	17.5449	17.8856	18.2134	18.5293	18.8341
.5	15.4136	15.8374	16.2415	16.6276	16.9972	17.3518	17.6925	18.0203	18.3362	18.6410
12	15.2288	15.6526	16.0567	16.4428	16.8124	17.1670	17.5077	17.8355	18.1514	18.4562
.5	15.0515	15.4753	15.8794	16.2655	16.6351	16.9897	17.3304	17.6582	17.9741	18.2789
13	14.8812	15.3050	15.7091	16.0952	16.4648	16.8194	17.1601	17.4879	17.8038	18.1086
.5	14.7173	15.1411	15.5452	15.9313	16.3009	16.6555	16.9962	17.3240	17.6399	17.9447
14	14.5593	14.9831	15.3872	15.7733	16.1429	16.4975	16.8382	17.1660	17.4819	17.7867
.5	14.4069	14.8307	15.2348	15.6209	15.9905	16.3451	16.6858	17.0136	17.3295	17.5343
15	14.2597	14.6835	15.0876	15.4737	15.8433	16.1979	16.5386	16.8664	17.1823	17.4871
.5	14.1173	14.5411	14.9452	15.3313	15.7009	16.0555	16.3962	16.7240	17.0399	17.3447
16	13.9794	14.5032	14.8073	15.1934	15.5630	15.9176	16.2562	16.5861	16.9020	17.2068
.5	13.8458	14.2696	14.6737	15.0598	15.4294	15.7840	16.1247	16.4425	16.7684	17.0732
17	13.7161	14.1399	14.5430	14.9301	15.2997	15.6543	15.9950	16.3228	16.6387	16.9435
.5	13.5902	14.4040	14.4181	14.8042	15.1738	15.5284	15.8691	16.1969	16.5128	16.8176
18	13.4679	13.8917	14.2958	14.6819	15.0515	15.4061	15.7468	16.0746	16.3905	16.6953
.5	13.2589	13.6827	14.0868	14.4729	14.8425	15.1971	15.5378	15.8656	16.1815	16.4863
19	13.2331	13.6569	14.0610	14.4471	14.8167	15.1713	15.5120	15.8398	16.1557	16.4605
.5	13.1203	13.5441	13.9482	14.3343	14.7039	15.0585	15.3992	15.7270	16.0429	16.3447
20	13.0103	13.4341	13.8382	14.2243	14.5939	14.9485	15.2892	15.6170	15.9329	16.2377
.5	12.9031	13.3269	13.7310	14.1171	14.4867	14.8413	15.1820	15.5098	15.8257	16.1305
21	12.7984	13.2222	13.6263	14.0124	14.3820	14.7356	15.0773	15.4051	15.7210	16.0258
.5	12.6962	13.1200	13.5241	13.9102	14.2798	14.6344	14.9751	15.3029	15.6188	15.9236
22	12.5964	13.0202	13.4243	13.8104	14.1800	14.5346	14.8753	15.2031	15.5190	15.8238
.5	12.4988	12.9226	13.3267	13.7128	14.0824	14.4370	14.7777	15.1055	15.4214	15.7262
23	12.4033	12.8271	13.2312	13.6173	13.9869	14.3415	14.6822	15.0100	15.3259	15.6307
.5	12.3099	12.7337	13.1378	13.5239	13.8935	14.2481	14.5888	14.9166	15.2325	15.5373
24	12.2185	12.6423	13.0464	13.4325	13.8021	14.1567	14.4974	14.8252	15.1411	15.4459
.5	12.1289	12.5527	12.9568	13.3429	13.7125	14.0671	14.4078	14.7356	15.0515	15.3563
25	12.0412	12.4650	12.8691	13.2552	13.6248	13.9794	14.3201	14.6479	14.9638	15.2686
.5	11.9552	12.3790	12.7831	13.1692	13.5388	13.8934	14.2341	14.5619	14.8778	15.1826
26	11.8709	12.2947	12.6988	13.0849	13.4545	13.8091	14.1498	14.4776	14.7935	15.0983
.5	11.7811	12.2049	12.6090	12.9951	13.3647	13.7193	14.0600	14.3878	14.7037	15.0085
27	11.7070	12.1308	12.5349	12.9210	13.2906	13.6452	13.9859	14.3137	14.6296	14.9344
.5	11.6273	12.0511	12.4552	12.8413	13.2109	13.5655	13.9062	14.2340	14.5499	14.8547
28	11.5490	11.9728	12.3769	12.7630	13.1326	13.4872	13.8279	14.1557	14.4716	14.7764
.5	11.4722	11.8960	12.3001	12.6862	13.0558	13.4104	13.7511	14.0789	14.3948	14.6996
29	11.3966	11.8204	12.2245	12.6106	12.9802	13.3348	13.6755	14.0033	14.3192	14.6240
.5	11.3224	11.7462	12.1503	12.5364	12.9060	13.2606	13.6013	13.9291	14.2450	14.5498
30	11.2494	11.6732	12.0773	12.4634	12.8330	13.1876	13.5283	13.8561	14.1720	14.4768
.5	11.1776	11.6014	12.0055	12.3916	12.7612	13.1158	13.4565	13.7843	14.1002	14.4050
31	11.1070	11.5308	11.9349	12.3210	12.6906	13.0452	13.3859	13.7137	14.0296	14.3344
.5	11.0375	11.4613	11.8654	12.2515	12.6211	12.9757	13.3164	13.6442	13.9601	14.2649
32	10.9691	11.3929	11.7970	12.1831	12.5527	12.9073	13.2480	13.5758	13.8917	14.1965
.5	10.9018	11.3256	11.7297	12.1158	12.4854	12.8400	13.1807	13.5085	13.8244	14.1292
33	10.8355	11.2593	11.6634	12.0495	12.4191	12.7737	13.1144	13.4422	13.7581	14.0629
.5	10.7702	11.1940	11.5981	11.9842	12.3538	12.7084	13.0491	13.3769	13.6928	13.9976
34	10.7058	11.1296	11.5337	11.9198	12.2894	12.6440	12.9847	13.3125	13.6284	13.9332
.5	10.6424	11.0662	11.4703	11.8564	12.2260	12.5806	12.9213	13.2491	13.5650	13.8698
35	10.5799	11.0037	11.4078	11.7939	12.1635	12.5181	12.8588	13.1866	13.5025	13.8073
.5	10.5183	10.9421	11.3462	11.7323	12.1019	12.4565	12.7972	13.1250	13.4409	13.7457
36	10.4576	10.8814	11.2855	11.6716	12.0412	12.3958	12.7365	13.0643	13.3802	13.6850
.5	10.3977	10.8215	11.2256	11.6117	11.9813	12.3359	12.6766	13.0044	13.3203	13.6251
37	10.3386	10.7624	11.1665	11.5526	11.9222	12.2768	12.6175	12.9453	13.2612	13.5660
.5	10.2803	10.7041	11.1082	11.4943	11.8639	12.2185	12.5592	12.8870	13.2029	13.5077
38	10.2288	10.6466	11.0507	11.4368	11.8064	12.1610	12.5017	12.8295	13.1454	13.4502
.5	10.1660	10.5898	10.9939	11.3800	11.7496	12.1042	12.4449	12.7727	13.0886	13.3934
39	10.1100	10.5338	10.9379	11.3240	11.6936	12.0482	12.3889	12.7167	13.0326	13.3374
.5	10.0546	10.4784	10.8825	11.2686	11.6382	11.9928	12.3335	12.6613	12.9772	13.2820
40	10.0000	10.4238	10.8279	11.2140	11.5836	11.9382	12.2789	12.6067	12.9226	13.2274

Nos. Yarn.	SLEY OR PICKS.									
	30	31	32	33	34	35	36	37	38	39
1	29.5424	29.8272	30.1030	30.3703	30.6296	30.8814	31.1261	31.3640	31.5957	31.8213
.5	27.7815	28.0663	28.3421	28.6094	28.8687	29.1205	29.3652	29.6031	29.8348	30.0504
2	26.5321	26.8169	27.0927	27.3600	27.6193	27.8711	28.1158	28.3537	28.5854	28.8110
.5	25.5630	25.8478	26.1326	26.3909	26.6502	26.9020	27.1467	27.3846	27.6163	27.8449
3	24.7712	25.0560	25.3318	25.5991	25.8584	26.1102	26.3549	26.5928	26.8245	27.0501
.5	24.1017	24.3865	24.6623	24.9296	25.1889	25.4407	25.6854	25.9233	26.1550	26.3806
4	23.5218	23.8066	24.0824	24.3497	24.6090	24.8608	25.1055	25.3434	25.5751	25.8007
.5	23.0103	23.2951	23.5709	23.8382	24.0975	24.3493	24.5940	24.8319	25.0636	25.2892
5	22.5527	22.8375	23.1133	23.3806	23.6399	23.8917	24.1364	24.3743	24.6060	24.8316
.5	22.1388	22.4236	22.6994	22.9667	23.2260	23.4778	23.7225	23.9604	24.1921	24.4177
6	21.7609	22.0457	22.3215	22.5888	22.8481	23.0999	23.3446	23.5825	23.8142	24.0398
.5	21.4133	21.6981	21.9739	22.2412	22.5005	22.7523	22.9970	23.2349	23.4666	23.6922
7	21.0914	21.3762	21.6520	21.9193	22.1786	22.4304	22.6751	22.9130	23.1447	23.3702
.5	20.7918	21.0766	21.3524	21.6197	21.8790	22.1308	22.3755	22.6134	22.8451	23.0707
8	20.5115	20.7963	21.0721	21.3394	21.5987	21.8505	22.0952	22.3331	22.5648	22.7904
.5	20.2482	20.5330	20.8088	21.0761	21.3354	21.5872	21.8319	22.0698	22.3015	22.5271
9	20.0000	20.2848	20.5606	20.8279	21.0872	21.3390	21.5837	21.8216	22.0533	22.2789
.5	19.7652	20.0500	20.3258	20.5931	20.8524	21.1042	21.3489	21.5868	21.8185	22.0441
10	19.5424	19.8272	20.1030	20.3703	20.6296	20.8814	21.1261	21.3640	21.5957	21.8213
.5	19.3305	19.6153	19.8911	20.3584	20.4177	20.6695	20.9142	21.1521	21.3838	21.6094
11	19.1285	19.4133	19.6891	19.9564	20.2157	20.4675	20.7122	20.9501	21.1818	21.4074
.5	18.9354	19.2202	19.4960	19.7633	20.0226	20.2744	20.5191	20.7570	20.9887	21.2143
12	18.7506	19.0354	19.3112	19.5785	19.8378	20.0896	20.3343	20.5722	20.8039	21.0295
.5	18.5733	18.8581	19.1339	19.4012	19.6605	19.9123	20.1517	20.3949	20.6266	20.8522
13	18.4030	18.6878	18.9636	19.2309	19.4902	19.7420	19.9867	20.2246	20.4563	20.6819
.5	18.2391	18.5239	18.7997	19.0670	19.3263	19.5781	19.8228	20.0607	20.2924	20.5180
14	18.0811	18.3659	18.6417	18.9090	19.1683	19.4201	19.6648	19.9027	20.1344	20.3600
.5	17.9287	18.2135	18.4893	18.7566	19.0159	19.2677	19.5124	19.7503	19.9820	20.2076
15	17.7815	18.0663	18.3421	18.6094	18.8687	19.1205	19.3652	19.6031	19.8348	20.0604
.5	17.6391	17.9239	18.1997	18.4670	18.7263	18.9781	19.2228	19.4607	19.6924	19.9180
16	17.5012	17.7860	18.0618	18.3291	18.5884	18.8402	19.0849	19.3228	19.5545	19.7801
.5	17.3676	17.6524	17.9282	18.1955	18.4548	18.7066	18.9513	19.1892	19.4209	19.6465
17	17.2379	17.5227	17.7985	18.0658	18.3251	18.5769	18.8216	18.9595	19.2912	19.5168
.5	17.1120	17.3968	17.6726	17.9399	18.1992	18.4510	18.6957	18.9336	19.1653	19.3909
18	16.9897	17.2745	17.5503	17.8176	18.0769	18.3287	18.5734	18.8113	19.0430	19.2686
.5	16.7807	17.0655	17.3413	17.6086	17.8679	18.1197	18.3644	18.6023	18.8340	19.0596
19	16.7549	17.0397	17.3155	17.5828	17.8421	18.0939	18.3386	18.5765	18.8082	19.0338
.5	16.6421	16.9269	17.2027	17.4700	17.7293	17.9811	18.2258	18.4637	18.6954	18.9210
20	16.5321	16.8169	17.0927	17.3600	17.6193	17.8711	18.1158	18.3537	18.5854	18.8110
.5	16.4249	16.7097	16.9855	17.2528	17.5121	17.7639	18.0086	18.2465	18.4782	18.7038
21	16.3202	16.6050	16.8808	17.1481	17.4074	17.6592	17.9039	18.1418	18.3735	18.5991
.5	16.2180	16.5028	16.7786	17.0459	17.3052	17.5570	17.8017	18.0396	18.2713	18.4969
22	16.1182	16.4030	16.6788	16.9461	17.2054	17.4572	17.7019	17.9398	18.1715	18.3971
.5	16.0206	16.3054	16.5812	16.8485	17.1078	17.3596	17.6043	17.8422	18.0739	18.2995
23	15.9251	16.2099	16.4857	16.7530	17.0123	17.2641	17.5088	17.7467	17.9784	18.2040
.5	15.8317	16.1165	16.3923	16.6596	16.9189	17.1707	17.4154	17.6533	17.8850	18.1106
24	15.7403	16.0251	16.3009	16.5682	16.8275	17.0793	17.3240	17.5619	17.7936	18.0192
.5	15.6507	15.9355	16.2113	16.4786	16.7379	16.9897	17.2344	17.4723	17.7040	17.9296
25	15.5630	15.8478	16.1236	16.3909	16.6502	16.9020	17.1467	17.3846	17.6163	17.8419
.5	15.4770	15.7618	16.0376	16.3049	16.5642	16.8160	17.0607	17.2986	17.5303	17.7559
26	15.3927	15.6775	15.9533	16.2206	16.4799	16.7317	16.9764	17.2143	17.4460	17.6716
.5	15.3029	15.5877	15.8635	16.1308	16.3901	16.6419	16.8866	17.1245	17.3562	17.5818
27	15.2288	15.5136	15.7894	16.0567	16.3160	16.5678	16.8125	17.0504	17.2821	17.5077
.5	15.1491	15.4339	15.7097	15.9770	16.2363	16.4881	16.7328	16.9707	17.2024	17.4280
28	15.0708	15.3556	15.6314	15.8987	16.1580	16.4098	16.6545	16.8924	17.1241	17.3497
.5	14.9940	15.2788	15.5546	15.8219	16.0812	16.3330	16.5977	16.8356	17.0673	17.2929
29	14.9184	15.2032	15.4790	15.7463	16.0056	16.2574	16.5021	16.7400	16.9717	17.1973
.5	14.8442	15.1290	15.4048	15.6721	15.9314	16.1832	16.4279	16.6658	16.8975	17.1231
30	14.7712	15.0560	15.3318	15.5991	15.8584	16.1102	16.3549	16.5928	16.8245	17.0501
.5	14.6994	14.9842	15.2600	15.5273	15.7866	16.0384	16.2831	16.5210	16.7527	16.9783
31	14.6268	14.9136	15.1894	15.4567	15.7160	15.9678	16.2125	16.4504	16.6821	16.9077
.5	14.5593	14.8441	15.1199	15.3872	15.6465	15.8983	16.1430	16.3809	16.6126	16.8382
32	14.4909	14.7757	15.0515	15.3188	15.5781	15.8299	16.0746	16.3125	16.5442	16.7698
.5	14.4236	14.7084	14.9842	15.2515	15.5108	15.7626	16.0073	16.2452	16.4769	16.7025
33	14.3573	14.6421	14.9179	15.1852	15.4445	15.6963	15.9410	16.1789	16.4106	16.6362
.5	14.2920	14.5768	14.8526	15.1199	15.3792	15.6310	15.8757	16.1136	16.3453	16.5709
34	14.2276	14.5124	14.7882	15.0555	15.3148	15.5666	15.8113	16.0492	16.2809	16.5065
5.	14.1642	14.4490	14.7248	14.9921	15.2514	15.5032	15.7479	15.9858	16.2175	16.4431
35	14.1017	14.3865	14.6623	14.9296	15.1889	15.4407	15.6854	15.9233	16.1550	16.3806
.5	14.0401	14.3249	14.6007	14.8680	15.1273	15.3791	15.6238	15.8617	16.0934	16.3190
36	13.9794	14.2642	14.5400	14.8073	15.0666	15.3184	15.5631	15.8010	16.0327	16.2583
.5	13.9195	14.2043	14.4801	14.7474	15.0067	15.2585	15.5032	15.7411	15.9728	16.1984
37	13.8604	14.1452	14.4210	14.6883	14.9476	15.1994	15.4441	15.6820	15.9137	16.1393
.5	13.8021	14.0869	14.3627	14.6300	14.8893	15.1411	15.3858	15.6237	15.8554	16.0810
38	13.7446	14.0294	14.3052	14.5725	14.8318	15.0836	15.3283	15.5662	15.7979	16.0235
.5	13.6878	13.9726	14.2484	14.5157	14.7750	15.0268	15.2715	15.5094	15.7411	15.9667
39	13.6318	13.9166	14.1924	14.4597	14.7190	14.9708	15.2155	15.4534	15.6851	15.9107
.5	13.5764	13.8612	14.1370	14.4043	14.6636	14.9154	15.1601	15.3980	15.6297	15.8553
40	13.5218	13.8066	14.0824	14.3497	14.6090	14.8608	15.1055	15.3434	15.5751	15.8007

Nos. Yarn.	SLEY OR PICKS.									
	40	41	42	43	44	45	46	47	48	49
1	32.0412	32.2557	32.4650	32.6694	32.8691	33.0643	33.2552	33.4420	33.6248	33.8039
.5	30.2803	30.4948	30.7041	30.9085	31.1082	31.3034	31.4943	31.6811	31.8639	32.0430
2	29.0309	29.2454	29.4547	29.6591	29.8588	30.0540	30.2449	30.4317	30.6145	30.7936
.5	28.0618	28.2763	28.4856	28.6900	28.8897	29.0849	29.2758	29.4626	29.6454	29.8245
3	27.2700	27.4845	27.6936	27.8982	28.0979	28.2931	28.4840	28.6708	28.8536	29.0327
.5	26.6005	26.8150	27.0243	27.2287	27.4284	27.6236	27.8145	28.0013	28.1841	28.3632
4	26.0206	26.2351	26.4444	26.6488	26.8485	27.0437	27.2346	27.4214	27.6042	27.7833
.5	25.5091	25.7236	25.9329	26.1373	26.3370	26.5322	26.7231	26.9099	27.0927	27.2718
5	25.0515	25.2660	25.4753	25.6797	25.8794	26.0746	26.2655	26.4523	26.6351	26.8142
.5	24.6376	24.8501	25.0614	25.2658	25.4655	25.6607	25.8516	26.0384	26.2212	26.4003
6	24.2597	24.4742	24.6845	24.8879	25.0876	25.2828	25.4737	25.6605	25.8433	26.0224
.5	23.9121	24.1266	24.3349	24.5403	24.7400	24.9352	25.1261	25.3129	25.4957	25.6748
7	23.5902	23.8047	24.0140	24.2184	24.4181	24.6133	24.8042	24.9910	25.1738	25.3529
.5	23.2906	23.5051	23.7144	23.9188	24.1185	24.3137	24.5046	24.6914	24.8742	25.0533
8	23.0103	23.2248	23.4341	23.6385	23.8382	24.0334	24.2243	24.4111	24.5939	24.7730
.5	22.7470	22.9615	23.1708	23.3752	23.5749	23.7701	23.9610	24.1478	24.3306	24.5097
9	22.4988	22.7133	22.9226	23.1270	23.3267	23.5219	23.7128	23.8996	24.0824	24.2615
.5	22.2640	22.4785	22.6878	22.8922	23.0919	23.2871	23.4780	23.6648	23.8476	24.0267
10	22.0412	22.2557	22.4650	22.6694	22.8691	23.0643	23.2552	23.4420	23.6248	23.8039
.5	21.8293	22.0438	22.2531	22.4575	22.6572	22.8524	23.0433	23.2301	23.4129	23.5920
11	21.6273	21.8418	22.0511	22.2553	22.4552	22.6504	22.8413	23.0281	23.2109	23.3900
.5	21.4342	21.6487	21.8580	22.0624	22.2621	22.4573	22.6482	22.8350	23.0178	23.1969
12	21.2494	21.4639	21.6732	21.8776	22.0773	22.2725	22.4634	22.6502	22.8330	23.0121
.5	21.0721	21.2866	21.4959	21.7003	21.9000	22.0952	22.2861	22.4729	22.6557	22.8348
13	20.9018	21.1163	21.3256	21.5300	21.7297	21.9249	22.1158	22.3026	22.4854	22.6645
.5	20.7379	20.9524	21.1617	21.3661	21.5658	21.7610	21.9519	22.1387	22.3215	22.5006
14	20.5799	20.7944	21.0037	21.2081	21.4078	21.6030	21.7939	21.9807	22.1635	22.3426
.5	20.4275	20.6420	20.8513	21.0557	21.2554	21.4506	21.6415	21.8283	22.0111	22.1902
15	20.2803	20.4948	20.7001	20.9085	21.1082	21.3034	21.4943	21.6811	21.8639	22.0430
.5	20.1379	20.3524	20.5617	20.7661	20.9658	21.1610	21.3519	21.5387	21.7215	21.9006
16	20.0000	20.2145	20.4238	20.6282	20.8279	21.0231	21.2140	21.4008	21.5836	21.7627
.5	19.8664	20.0809	20.2902	20.4946	20.6943	20.8895	21.0804	21.2672	21.4500	21.6291
17	19.7367	19.9512	20.1605	20.3649	20.5646	20.7598	20.9507	21.1375	21.3203	21.4994
.5	19.6108	19.8253	20.0346	20.2390	20.4387	20.6339	20.8248	21.0116	21.1944	21.3735
18	19.4885	19.7030	19.9123	20.1167	20.3164	20.5116	20.7025	20.8893	21.0721	21.2512
.5	19.2795	19.4940	19.7033	19.9077	20.1074	20.3026	20.4935	20.6803	20.8631	21.0422
19	19.2537	19.4682	19 6775	19.8819	20.0816	20.2768	20.4677	20.6545	20.8373	21.0164
.5	19.1409	19.3554	19.5647	19.7691	19.9688	20.1640	20.3549	20.5417	20.7245	20.9036
20	19.0309	19.2454	19.4547	19.6591	19.8588	20.0540	20.2449	20.4317	20.6145	20.7936
.5	18.9237	19.1382	19.3475	19.5519	19.7516	19.9468	20.1377	20.3245	20.5073	20.6864
21	18.8190	19.0335	19.2428	19.4472	19.6469	19.8421	20.0330	20.2198	20.4026	20.5817
.5	18.7068	18.9313	19.1406	19.3450	19.5447	19.7399	19.9308	20.1176	20.3004	20.4795
22	18.6170	18.8315	19.0408	19.2452	19.4449	19.6401	19.8310	20.0178	20.2006	20.3797
.5	18.5194	18.7339	18.9432	19.1476	19.3473	19.5425	19.7334	19.9202	20.1030	20.2821
23	18.4239	18.6384	18.8477	19.0521	19.2518	19.4470	19.6379	19.8247	20.0075	20.1866
.5	18.3305	18.5450	18.7543	18.9587	19.1584	19.3536	19.5445	19.7313	19.9141	20.0932
24	18.2391	18.4536	18.6629	18.8673	19.0670	19.2622	19.4531	19.6399	19.8227	20.0018
.5	18.1495	18.3640	18.5733	18.7777	18.9774	19.1726	19.3635	19.5503	19.7331	19.9122
25	18.0618	18.2763	18.4856	18.6900	18.8897	19.0849	19.2758	19.4626	19.6454	19.8245
.5	17.9758	18.1903	18.3996	18.6040	18.8037	18.9989	19.1898	19.3766	19.5594	19.7385
26	17.8915	18.1060	18.3153	18.5197	18.7194	18.9146	19.1055	19.2923	19.4751	19.6542
.5	17.8017	18.0162	18.2255	18.4299	18.6296	18.8248	19.0157	19.2025	19.3853	19.5644
27	17.7276	17.9421	18.1514	18.3558	18.5555	18.7507	18.9416	19.1284	19.3112	19.4903
.5	17.6479	17.8624	18.0717	18.2761	18.4758	18.6710	18.8619	19.0487	19.2315	19.4406
28	17.5696	17.7841	17.9934	18.1978	18.3975	18.5927	18.7836	18.9704	19.1532	19.3323
.5	17.4928	17.7073	17.9166	18.1210	18.3207	18.5159	18.7068	18.8936	19.0764	19.2555
29	17.4172	17.6317	17.8410	18.0454	18.2451	18.4403	18.6312	18.8180	19.0008	19.1799
.5	17.3430	17.5575	17.7668	17.9712	18.1709	18.3661	18.5570	18.7438	18.9266	19.1057
30	17.2700	17.4845	17.6938	17.8982	18.0979	18.2931	18.4840	18.6708	18.8536	19.0327
.5	17.1982	17.4127	17.6220	17.8264	18.0261	18.2213	18.4122	18.5990	18.7818	18.9609
31	17.1276	17.3421	17.5514	17.7558	17.9555	18.1507	18.3416	18.5284	18.7112	18.8903
.5	17.0581	17.2726	17.4819	17.6863	17.8860	18.0812	18.2721	18.4589	18.6417	18.8208
32	16.9897	17.2042	17.4135	17.6179	17.8176	18.0128	18.2037	18.3905	18.5733	18.7524
.5	16.9224	17.1369	17.3462	17.5506	17.7503	17.9455	18.1364	18.3232	18.5060	18.6851
33	16.8561	17.0706	17.2799	17.4843	17.6840	17.8792	18.0701	18.2569	18.4397	18.6188
.5	16.7908	17.0053	17.2146	17.4190	17.6187	17.8139	18.0048	18.1916	18.3744	18.5537
34	16.7264	16.9409	17.1502	17.3546	17.5543	17.7495	17.9404	18.1272	18.3100	18.4891
.5	16.6630	16.8775	17.0868	17.2912	17.4909	17.6861	17.8770	18.0638	18.2466	18.4257
35	16.6005	16.8150	17.0243	17.2287	17.4284	17.6236	17.8145	18.0013	18.1841	18.3632
.5	16.5389	16.7534	16.9627	17.1671	17.3668	17.5620	17.7529	17.9397	18.1225	18.3016
36	16.4782	16.6927	16.9020	17.1064	17.3061	17.5013	17.6922	17.8790	18.0618	18.2409
.5	16.4183	16.6328	16.8421	17.0465	17.2462	17.4414	17.6323	17.8191	18.0019	18.1810
37	16.3592	16.5737	16.7830	16.9874	17.1871	17.3823	17.5732	17.7600	17.9428	18.1219
.5	16.3009	16.5154	16.7247	16.9291	17.1288	17.3240	17.5149	17.7017	17.8845	18.0636
38	16.2434	16.4579	16.6672	16.8716	17.0713	17.2665	17.4574	17.6442	17.8270	18.0061
.5	16.1866	16.4011	16.6104	16.8148	17.0145	17.2097	17.4006	17.5874	17.7702	17.9493
39	16.1306	16.3451	16.5344	16.7588	16.9585	17.1537	17.3446	17.5314	17.7142	17.8933
.5	16.0752	16.2897	16.4990	16.7034	16.9031	17.0983	17.2892	17.4760	17.6588	17.8379
40	16.0206	16.2351	16.4444	16.6488	16.8485	17.0437	17.2346	17.4214	17.6042	17.7833

Nos. Yarn.	SLEY OR PICKS.									
	50	51	52	53	54	55	56	57	58	59
1	33.9794	34.1514	34.3201	34.4855	34.6479	34.8073	34.9638	35.1175	35.2686	35.4170
.5	32.2185	32.3905	32.5592	32.7246	32.8870	33.0464	33.2029	33.3566	33.5077	33.6561
2	30.9691	31.1411	31.3098	31.4752	31.6376	31.7970	31.9535	32.1072	32.2583	32.4067
.5	30.0000	30.1720	30.3407	30.5061	30.6685	30.8279	30.9844	31.1381	31.2892	31.4376
3	29.2082	29.3802	29.5489	29.7143	29.8767	30.0361	30.1926	30.3463	30.4974	30.6458
.5	28.5387	28.7107	28.8794	29.0448	29.2072	29.3666	29.5231	29.6768	29.8279	29.9763
4	27.9588	28.1308	28.2995	28.4649	28.6273	28.7867	28.9432	29.0969	29.2480	29.3964
.5	27.4473	27.6193	27.7880	27.9534	28.1158	28.2752	28.4317	28.5854	28.7365	28.8849
5	26.9897	27.1617	27.3304	27.4958	27.6582	27.8176	27.9741	28.1278	28.2789	28.4273
.5	26.5758	26.7478	26.9165	27.0819	27.2443	27.4037	27.5602	27.7139	27.8650	28.0034
6	26.1979	26.3699	26.5386	26.7040	26.8664	27.0258	27.1823	27.3360	27.4871	27.6355
.5	25.8503	26.0223	26.1910	26.3564	26.5188	26.6782	26.8347	26.9884	27.1395	27.2879
7	25.5284	25.7004	25.8691	26.0345	26.1969	26.3563	26.5128	26.6665	26.8176	26.9660
.5	25.2288	25.4008	25.5695	25.7349	25.8973	26.0567	26.2132	26.3669	26.5180	26.6664
8	24.9485	25.1205	25.2892	25.4546	25.6170	25.7764	25.9329	26.0866	26.2377	26.3861
.5	24.6852	24.8572	25.0259	25.1913	25.3537	25.5131	25.6696	25.8233	25.9744	26.1228
9	24.4390	24.6090	24.7777	24.9431	25.1055	25.2649	25.4214	25.5751	25.7262	25.8746
.5	24.2022	24.3742	24.5429	24.7083	24.8707	25.0301	25.1866	25.3403	25.4914	25.6398
10	23.9794	24.1514	24.3201	24.4855	24.6479	24.8073	24.9638	25.1175	25.2686	25.4170
.5	23.7675	23.9395	24.1082	24.2736	24.4360	24.5954	24.7519	24.9056	25.0567	25.2051
11	23.5655	23.7375	23.9062	24.0716	24.2340	24.3934	24.5499	24.7036	24.8547	25.0031
.5	23.3724	23.5444	23.7131	23.8785	24.0409	24.2003	24.3568	24.5105	24.6616	24.8100
12	23.1876	23.3596	23.5283	23.6937	23.8561	24.0155	24.1720	24.3257	24.4768	24.6252
.5	23.0103	23.1823	23.3510	23.5164	23.6788	23.8382	23.9947	24.1484	24.2995	24.4479
13	22.8400	23.0120	23.1807	23.3461	23.5085	23.6679	23.8244	23.9781	24.1292	24.2776
.5	22.6761	22.8481	23.0168	23.1822	23.3446	23.5040	23.6605	23.8142	23.9653	24.1137
14	22.5181	22.6901	22.8588	23.0242	23.1866	23.3460	23.5025	23.6562	23.8073	23.9557
.5	22.3657	22.5377	22.7064	22.8718	23.0342	23.1936	23.3501	23.5038	23.6549	23.8033
15	22.2185	22.3905	22.5592	22.7246	22.8870	23.0464	23.2029	23.3566	23.5077	23.6561
.5	22.0761	22.2481	22.4168	22.5822	22.7446	22.9040	23.0605	23.2142	23.3653	23.5137
16	21.9382	22.1102	22.2789	22.4443	22.6067	22.7661	22.9226	23.0763	23.2274	23.3758
.5	21.8046	21.9766	22.1453	22.3107	22.4731	22.6325	22.7890	22.9427	23.0938	23.2422
17	21.6749	21.8469	22.0156	22.1810	22.3434	22.5028	22.6593	22.8130	22.9641	23.1125
.5	21.5490	21.7210	21.8897	22.0551	22.2175	22.3769	22.5334	22.6871	22.8382	22.9866
18	21.4267	21.5987	21.7674	21.9328	22.0952	22.2546	22.4111	22.5648	22.7159	22.8643
.5	21.2177	21.3897	21.5584	21.7238	21.8862	22.0456	22.2021	22.3558	22.5069	22.6553
19	21.1919	21.3639	21.5326	21.6980	21.8604	22.0198	22.1763	22.3300	22.4811	22.6295
.5	21.0791	21.2511	21.4198	21.5852	21.7476	21.9070	22.0635	22.2172	22.3683	22.5167
20	20.9691	21.1411	21.3098	21.4752	21.6376	21.7970	21.9535	22.1072	22.2583	22.4067
.5	20.8619	21.0339	21.2026	21.3680	21.5304	21.6898	21.8463	22.0000	22.1511	22.2995
21	20.7572	20.9292	21.0979	21.2633	21.4257	21.5851	21.7416	21.8953	22.0464	22.1948
.5	20.6550	20.8270	20.9957	21.1611	21.3235	21.4829	21.6394	21.7931	21.9442	22.0926
22	20.5552	20.7272	20.8959	21.0613	21.2237	21.3831	21.5396	21.6933	21.8444	21.9928
.5	20.4576	20.6296	20.7983	20.9637	21.1261	21.2855	21.4420	21.5957	21.7468	21.8952
23	20.3621	20.5341	20.7028	20.8682	21.0306	21.1900	21.3465	21.5002	21.6513	21.7997
.5	20.2687	20.4407	20.6094	20.7748	20.9372	21.0966	21.2531	21.4068	21.5579	21.7063
24	20.1773	20.3493	20.5180	20.6834	20.8458	21.0052	21.1617	21.3154	21.4665	21.6149
.5	20.0877	20.2597	20.4284	20.5938	20.7562	20.9156	21.0721	21.2258	21.3769	21.5253
25	20.0000	20.1720	20.3407	20.5061	20.6685	20.8279	20.9844	21.1381	21.2892	21.4376
.5	19.9140	20.0860	20.2547	20.4201	20.5825	20.7419	20.8984	21.0521	21.2032	21.3516
26	19.8297	20.0017	20.1704	20.3358	20.4982	20.6576	20.8141	20.9678	21.1189	21.2673
.5	19.7399	19.9119	20.0806	20.2460	20.4084	20.5678	20.7243	20.8780	21.0291	21.1775
27	19.6658	19.8378	20.0065	20.1719	20.3343	20.4937	20.6502	20.8039	20.9550	21.1034
.5	19.5861	19.7581	19.9268	20.0922	20.2546	20.4140	20.5705	20.7242	20.8753	21.0237
28	19.5078	19.6798	19.8485	20.0139	20.1763	20.3357	20.4922	20.6459	20.7970	20.9454
.5	19.4310	19.6030	19.7717	19.9371	20.0995	20.2589	20.4154	20.5691	20.7202	20.8686
29	19.3554	19.5274	19.6961	19.8615	20.0239	20.1833	20.3398	20.4935	20.6446	20.7930
.5	19.2812	19.4532	19.6219	19.7873	19.9497	20.1091	20.2656	20.4193	20.5704	20.7188
30	19.2082	19.3802	19.5489	19.7143	19.8767	20.0361	20.1926	20.3463	20.4974	20.6458
.5	19.1364	19.3084	19.4771	19.6425	19.8049	19.9643	20.1208	20.2745	20.4256	20.5740
31	19.0658	19.2378	19.4065	19.5719	19.7343	19.8937	20.0502	20.2039	20.3550	20.5034
.5	18.9963	19.1683	19.3370	19.5024	19.6648	19.8242	19.9807	20.1344	20.2855	20.4339
32	18.9279	19.0999	19.2686	19.4340	19.5964	19.7558	19.9123	20.0660	20.2171	20.3655
.5	18.8606	19.0326	19.2013	19.3667	19.5291	19.6885	19.8450	19.9987	20.1498	20.2982
33	18.7943	18.9663	19.1350	19.3004	19.4628	19.6222	19.7787	19.9324	20.0835	20.2319
.5	18.7290	18.9010	19.0697	19.2351	19.3975	19.5569	19.7134	19.8671	20.0182	20.1666
34	18.6646	18.8366	19.0053	19.1707	19.3331	19.4925	19.6490	19.8027	19.9538	20.1022
.5	18.6012	18.7732	18.9419	19.1073	19.2697	19.4291	19.5856	19.7393	19.8904	20.0388
35	18.5387	18.7107	18.8794	19.0448	19.2072	19.3666	19.5231	19.6768	19.8279	19.9763
.5	18.4771	18.6491	18.8178	18.9832	19.1456	19.3050	19.4615	19.6152	19.7663	19.9147
36	18.4164	18.5884	18.7571	18.9225	19.0849	19.2443	19.4008	19.5545	19.7056	19.8540
.5	18.3565	18.5285	18.6972	18.8626	19.0250	19.1844	19.3409	19.4946	19.6457	19.7941
37	18.2974	18.4694	18.6381	18.8035	18.9659	19.1253	19.2818	19.4355	19.5866	19.7350
.5	18.2391	18.4111	18.5798	18.7452	18.9076	19.0670	19.2235	19.3772	19.5283	19.6767
38	18.1816	18.3536	18.5223	18.6877	18.8501	19.0095	19.1660	19.3197	19.4708	19.6192
.5	18.1248	18.2968	18.4655	18.6309	18.7933	18.9527	19.1092	19.2629	19.4140	19.5624
39	18.0688	18.2408	18.4095	18.5749	18.7373	18.8967	19.0532	19.2069	19.3580	19.5064
.5	18.0134	18.1854	18.3541	18.5195	18.6819	18.8413	18.9978	19.1515	19.3026	19.4510
40	17.9588	18.1308	18.2995	18.4649	18.6273	18.7867	18.9432	19.0969	19.2480	19.3964

Nos. Yarn.	SLEY OR PICKS.									
	60	61	62	63	64	65	66	67	68	69
1	35.5630	35.7066	35.8478	35.9868	36.1236	36.2583	36.3909	36.5215	36.6502	36.7770
.5	33.8021	33.9457	34.0869	34.2259	34.3627	34.9774	34.6300	34.7606	34.7893	35.0161
2	32.5527	32.6963	32.8375	32.9765	33.1133	33.2480	33.3806	33.5112	33.6399	33.7667
.5	31.5836	31.7272	31.8694	32.0084	32.1442	32.2789	32.4115	32.5421	32.6708	32.7976
3	30.7918	30.9354	31.0766	31.2156	31.3524	31.4871	31.6197	31.7503	31.8790	32.0058
.5	30.1223	30.2659	30.4071	30.5461	30.6829	30.8176	30.9502	31.0808	31.2095	31.3363
4	29.5424	29.6860	29.8272	29.9662	30.1030	30.2377	30.3703	30.5009	30.6296	30.7564
.5	29.0309	29.1745	29.3157	29.4547	29.5915	29.7272	29.8588	29.9894	30.1171	30.2439
5	28.5733	28.7169	28.8581	28.9971	29.1339	29.2686	29.4012	29.5318	29.6605	29.7873
.5	28.1594	28.3030	28.4442	28.5832	28.7200	28.8547	28.9873	29.1183	29.2470	29.3738
6	27.7815	27.9251	28.0663	28.2053	28.3421	28.4768	28.6094	28.7400	28.8687	28.9955
.5	27.4339	27.5775	27.7187	27.8577	27.9945	28.1292	28.2618	28.3924	28.5211	28.6479
7	27.1120	27.2556	27.3968	27.5357	27.6726	27.8073	27.9399	28.0705	28.1992	28.3260
.5	26.8124	26.9560	27.0972	27.2362	27.3730	27.5077	27.6403	27.7709	27.8996	28.0264
8	26.5321	26.6757	26.8169	26.9559	27.0927	27.2274	27.3600	27.4906	27.6193	27.7461
.5	26.2688	26.4124	26.5536	26.6926	26.8294	26.9641	27.0967	27.2273	27.3560	27.4828
9	26.0206	26.1642	26.3054	26.4444	26.5812	26.7159	26.8485	26.9791	27.1078	27.2346
.5	25.7858	26.0294	26.1706	26.1796	26.3464	26.4811	26.6137	26.7443	26.8730	26.9998
10	25.5630	25.7066	25.8478	25.9868	26.1236	26.2583	26.3909	26.5215	26.6502	26.7770
.5	25.3511	25.4947	25.6359	25.7749	25.9117	26.0464	26.1790	26.3096	26.4383	26.5651
11	25.1491	25.2927	25.4339	25.5729	25.7097	25.8344	25.9770	26.1076	26.2363	26.3631
.5	24.9560	25.0996	25.2408	25.3798	25.5166	25.6513	25.7839	25.9145	26.0432	26.1700
12	24.7712	24.9148	25.0560	25.1950	25.3318	25.4665	25.5991	25.7297	25.8584	25.9852
.5	24.5939	24.7375	24.8787	25.0177	25.1545	25.2892	25.4218	25.5524	25.6811	25.8079
13	24.4236	24.5672	24.7084	24.8474	24.9842	25.1189	25.2515	25.3821	25.5108	25.6376
.5	24.2597	24.4033	24.5445	24.5835	24.8203	24.9550	25.0876	25.2182	25.3469	25.4737
14	24.1017	24.2453	24.3865	24.5255	24.6623	24.7970	24.9296	25.0602	25.1889	25.3157
.5	23.9493	24.0929	24.2341	24.3731	24.5099	24.6446	24.7772	24.9078	25.0365	25.1633
15	23.8021	23.9457	24.0869	24.2259	24.3627	24.4974	24.6300	24.7606	24.8893	25.0161
.5	23.6597	23.8033	23.9445	24.0835	24.2203	24.3550	24.4876	24.6182	24.7469	24.8737
16	23.5218	23.6654	23.8066	23.9466	24.0824	24.2071	24.3497	24.4803	24.6090	24.7358
.5	23.3882	23.5316	23.6728	23.8118	23.9488	24.0835	24.2161	24.3467	24.4754	24.6022
17	23.2585	23.4021	23.5433	23.6823	23.8291	23.9538	24.0864	24.2170	24.3457	24.4725
.5	23.1326	23.2762	23.4174	23.5564	23.6932	23.8279	23.9605	24.0911	24.2198	24.3466
18	23.0103	23.1539	23.2951	23.4341	23.5709	23.7058	23.8382	23.9688	24.0975	24.2243
.5	22.8013	22.9449	23.0861	23.2251	23.3619	23.4966	23.6292	23.7598	23.8885	24.0153
19	22.7755	22.9191	23.0603	23.1993	23.3361	23.4708	23.6034	23.7340	23.8627	23.9895
.5	22.6627	22.8063	22.9475	23.0865	23.2232	23.3570	23.4906	23.6212	23.7499	23.8767
20	22.5527	22.6963	22.8375	22.9765	23.1133	23.2470	23.3806	23.5112	23.6399	23.7667
.5	22.4455	22.5891	22.7303	22.8693	23.0061	23.1408	23.2734	23.4040	23.5327	23.6595
21	22.3408	22.4844	22.6256	22.7646	22.9014	23.0361	23.1687	23.2993	23.4280	23.5548
.5	22.2386	22.3822	22.5234	22.6624	22.7992	22.9339	23.0665	23.1971	23.3258	23.4526
22	22.1388	22.2824	22.4236	22.5626	22.6994	22.8341	22.9667	23.0973	23.2260	23.3528
.5	22.0412	22.1848	22.3260	22.4650	22.6018	22.7365	22.8691	22.9997	23.1284	23.2552
23	21.9457	22.0893	22.2305	22.3695	22.5063	22.6410	22.7736	22.9042	23.0329	23.1597
.5	21.8523	21.9959	22.1371	22.2761	22.4129	22.5476	22.6802	22.8108	22.9325	23.0663
24	21.7609	21.9045	22.0457	22.1847	22.3215	22.4562	22.5888	22.7194	22.8481	22.9749
.5	21.6713	21.8149	21.9551	22.0951	22.2319	22.3566	22.4992	22.6298	22.7585	22.8853
25	21.5836	21.7272	21.8684	22.0074	22.1442	22.2789	22.4115	22.5421	22.6708	22.7976
.5	21.4976	21.6412	21.7824	21.9214	22.0582	22.1929	22.3255	22.4561	22.5848	22.7116
26	21.4133	21.5569	21.6981	21.8371	21.9739	22.1086	22.2412	22.3718	22.5005	22.6273
.5	21.3235	21.4671	21.6083	21.7473	21.8841	22.0188	22.1514	22.2820	22.4107	22.5375
27	21.2494	21.3930	21.5342	21.6732	21.8100	21.9447	22.0773	22.2079	22.3366	22.4634
.5	21.1697	21.3133	21.4545	21.5935	21.7303	21.8650	21.9976	22.1282	22.2569	22.3837
28	21.0914	21.2350	21.3762	21.5152	21.6520	21.7867	21.9193	22.0499	22.1786	22.3054
.5	21.0146	21.1582	21.2994	21.4384	21.5752	21.7099	21.8425	21.9731	22.1018	22.2286
29	20.9390	21.0826	21.2238	21.3628	21.4996	21.6343	21.7669	21.8975	22.0262	22.1530
.5	20.8648	21.0084	21.1496	21.2886	21.4254	21.5601	21.6927	21.8233	21.9520	22.0788
30	20.7918	20.9354	21.0766	21.2156	21.3524	21.4871	21.6197	21.7503	21.8790	22.0058
.5	20.7200	20.8636	21.0048	21.1438	21.2806	21.4153	21.5479	21.6785	21.8072	21.9340
31	20.6494	20.7930	20.9342	21.0732	21.2100	21.3447	21.4773	21.6079	21.7366	21.8634
.5	20.5799	20.7235	20.8647	21.0037	21.1405	21.2752	21.4078	21.5384	21.6671	21.7939
32	20.5115	20.6551	20.7963	20.9353	21.0721	21.2068	21.3394	21.4700	21.5987	21.7255
.5	20.4442	20.5878	20.7290	20.8680	21.0048	21.1395	21.2721	21.4027	21.5314	21.6582
33	20.3779	20.5215	20.6627	20.8017	20.9385	21.0732	21.2058	21.3364	21.4651	21.5919
.5	20.3126	20.4562	20.5974	20.7364	20.8732	21.0079	21.1405	21.2711	21.3998	21.5266
34	20.2482	20.3918	20.5330	20.6720	20.8088	20.9435	21.0761	21.2067	21.3354	21.4622
.5	20.1848	20.3284	20.4696	20.6086	20.7454	20.8801	21.0127	21.1433	21.2720	21.3988
35	20.1223	20.2659	20.4071	20.5461	20.6829	20.8176	20.9502	21.0808	21.2095	21.3363
.5	20.0607	20.2043	20.3455	20.4845	20.6213	20.7560	20.8886	21.0192	21.1479	21.2747
36	20.0000	20.1436	20.2848	20.4238	20.5606	20.6953	20.8279	20.9585	21.0872	21.2140
.5	19.9401	20.0837	20.2249	20.3639	20.5007	20.6354	20.7680	20.8986	21.0273	21.1541
37	19.8810	20.0246	20.1558	20.3048	20.4416	20.5763	20.7089	20.8395	20.9682	21.0950
.5	19.8227	19.9663	20.1075	20.2465	20.3833	20.5180	20.6506	20.7812	20.9099	21.0367
38	19.7652	19.9088	20.0500	20.1890	20.3258	20.4605	20.5931	20.7237	20.8524	20.9792
.5	19.7084	19.8520	19.9932	20.1322	20.2690	20.4037	20.5363	20.6669	20.7956	20.9224
39	19.6524	19.7960	19.9372	20.0762	20.2130	20.3477	20.4803	20.6109	20.7396	20.8664
.5	19.5970	19.7406	19.8818	20.0208	20.1576	20.2923	20.4249	20.5555	20.6842	20.8110
40	19.5424	19.6860	19.8272	19.9662	20.1030	20.2377	20.3703	20.5009	20.6296	20.7564

Nos. Yarn.	SLEY OR PICKS.									
	70	71	72	73	74	75	76	77	78	79
1	36.9020	37.0252	37.1466	37.2665	37.3846	37.5012	37.6163	37.7298	37.8419	37.9525
.5	35.1411	35.2643	35.3857	35.5056	35.6237	35.7403	35.7554	35.9689	36.0810	36.191C
2	33.8917	34.0149	34.1363	34.2562	34.3743	34.4909	34.6060	34.7195	34.8306	34.9432
.5	32.9226	33.0458	33.1672	33.2871	33.4052	33.5218	33.6369	33.7504	33.8625	33.9731
3	32.1308	32.2540	32.3754	32.4953	32.6134	32.7300	32.8451	32.9586	33.0707	33.1813
.5	31.4613	31.5845	31.7059	31.8252	31.9439	32.0605	32.1756	32.2891	32.4012	32.5118
4	30.8814	31.0046	31.1260	31.2459	31.3640	31.4806	31.5957	31.7092	31.8213	31.9319
.5	30.3699	30.4931	30.6145	30.7344	30.8525	30.9691	31.0842	31.1977	31.3098	31.4204
5	29.9123	30.0355	30.1569	30.2768	30.3949	30.5115	30.6266	30.7401	30.8522	30.9628
.5	29.4984	29.6216	29.7430	29.8629	29.9810	30.0976	30.2127	30.3262	30.4383	30.5489
6	29.1205	29.2437	29 3651	29.4850	29.6031	29.7197	29.8348	29.9483	30.0604	30.1710
.5	28.7729	28.8961	29.0175	29.1374	29.2555	29.3721	29.4872	29.6007	29.7128	29.8234
7	28.4510	28.5742	28.6956	28.8155	28.9336	29.0502	29.1653	29.2788	29.3909	29.5015
.5	28.1514	28.2746	28.3960	28.5159	28.6340	28.7506	28.8657	28.9792	29.0913	29.2019
8	27.8711	27.9943	28.1157	28.2356	28.3537	28.4703	28.5854	28.6989	28.8110	28.9216
.5	27.6078	27.7310	27.8524	27.9723	28.0904	28.2070	28.3221	28.4356	28.5477	28.6583
9	27.3596	27.4828	27.6042	27.7241	27.8422	27.9588	28.0739	28.1874	28.2995	28.4101
.5	27.1248	27.2480	27.3694	27.4893	27.6074	27.7240	27.8391	27.9526	28.0647	28.1753
10	26.9020	27.0252	27.1466	27.2665	27.3446	27.5012	27.6163	27.7298	27.8419	27.9525
.5	26.6901	26.8133	26.9347	27.0546	27.1727	27.3893	27.4044	27.5179	27.6300	27.7406
11	26.4881	26.6113	26.7327	26.8526	26.9707	27.0873	27.2024	27.3159	27.4280	27.5386
.5	26.2950	26.4182	26.5396	26.6595	26.7776	26.8942	27.0093	27.1228	27.2349	27.3455
12	26.1102	26.2334	26.3548	26.4747	26.5928	26.7094	26.8245	26.9380	27.0501	27.1607
.5	25.9329	26.0561	26.1775	26.2974	26.4155	26.5321	26.6472	26.7607	26.8728	26.9834
13	25.7626	25.8858	26.0072	26.1271	26.2452	26.3618	26.4769	26.5904	26.7025	26.8131
.5	25.5987	25.7219	25.8433	25.9632	26.0813	26.1979	26.3130	26.4265	26.5386	26.6492
14	25.4407	25.5639	25.6853	25.8052	25.9233	26.0399	26.1550	26.2685	26.3806	26.4912
.5	25.2883	25.4115	25.5329	25.6528	25.7709	25.8875	26.0026	26.1161	26.2282	26.3388
15	25.1411	25.2643	25.3857	25.5056	25.6237	25.7403	25.8554	25.9689	26.0810	26.1916
.5	24.9987	25.1219	25.2433	25.3632	25.4813	25.5979	25.7130	25.8265	25.9386	26.0492
16	24.8608	24.9840	25.1054	25.2253	25.3434	25.4600	25.5751	25.6886	25.8007	25.9113
.5	24.7272	24.8504	24.9718	25.0917	25.2098	25.3264	25.4415	25.5550	25.5671	25.7777
17	24.5975	24.7207	24.8421	24.9620	25.0801	25.1967	25.3118	25.4253	25.5374	25.6480
.5	24.4716	24.5948	24.7162	24.8361	24.9542	25.0708	25.1859	25.2994	25.4115	25.5221
18	24.3493	24.4725	24.5939	24.7138	24.8319	24.9485	25.0636	25.1771	25.2892	25.3998
.5	24.1403	24.2635	24.3849	24.5048	24.6229	24.7395	24.8546	24.9681	25.0802	25.1908
19	24.1145	24.2377	24.3591	24.4790	24.5971	24.7137	24.8288	24.9423	25.0544	25.1650
.5	24.0017	24.1249	24.2463	24.3662	24.4843	24.6009	24.7160	24.8295	24.9416	25.0422
20	23.8917	24.0149	24.1363	24.2562	24.3743	24.4909	24.6060	24.7195	24.8316	24.9422
.5	23.7845	23.9077	24.0291	24.1490	24.2671	24.3837	24.4988	24.6123	24.7244	24.8350
21	23.6798	23.8030	23.9244	24.0443	24.1624	24.2790	24.3941	24.5976	24.6192	24.7303
.5	23.5776	23.7008	23.8222	23.9421	24.0602	24.1768	24.2919	24.4054	24.5175	24.6281
22	23.4778	23.6010	23.7224	23.8423	23.9604	24.0770	24.1921	24.3056	24.4177	24.5283
.5	23.3802	23.5034	23.6248	23.7447	23.8628	23.9794	24.0945	24.2080	24.3201	24.4307
23	23.2847	23.4079	23.5293	23.6492	23.7673	23.8839	23.9990	24.1125	24.2246	24.3352
.5	23.1913	23.3145	23.4359	23.5558	23.6739	23.7905	23.9056	24.0191	24.1312	24.2418
24	23.0999	23.2231	23.3445	23.4644	23.5825	23.6991	23.8142	23.9277	24.0398	24.1504
.5	23.0103	23.1335	23.2549	23.3748	23.4929	23.6095	23.7246	23.8381	23 9502	24.0606
25	22.9226	23.0458	23.1672	23.2871	23.4052	23.5218	23.6369	23.7504	23.8625	23.9731
.5	22.8366	22.9598	23.0812	23.2011	23.3292	23.4358	23.5509	23.6644	23.7765	23.8871
26	22.7523	22.8755	22.9969	23.1168	23.2349	23.3515	23.4666	23.5801	23.6922	23.8028
.5	22.6625	22.7857	22.9071	23.0270	23.1451	23.2617	23.3768	23.4903	23.6024	23.7130
27	22.5884	22.7116	22.8330	22.9529	23.0710	23.1876	23.3027	23.4152	23.5283	23.6389
.5	22.5087	22.6319	22.7333	22.8732	22.9913	23.1079	23.2230	23.3365	23.4486	23.5592
28	22.4304	22.5536	22.6750	22.7949	22.9130	23.0296	23.1447	23.2582	23.3703	23.4809
.5	22.3536	22.4768	22.5982	22.7181	22.8362	22.9528	23.0679	23.1814	23.2935	23.4041
29	22.2780	22.4012	22.5226	22.6425	22.7606	22.8772	22.9923	23.1058	23.2179	23.3285
.5	22.2038	22.3270	22.4484	22.5683	22.6864	22.8030	22.9181	23.0316	23.1437	23.2543
30	22.1308	22.2540	22.3754	22.4953	22.6134	22.7300	22.8451	22.9586	23.0707	23.1813
.5	22.0590	22.1822	22.3036	22.4235	22.5416	22.6582	22.7133	22.8868	22.9989	23.1095
31	21.9884	22.1116	22.2330	22.3529	22.4710	22.5876	22.7027	22.8162	22.9283	23.0389
.5	21.9189	22.0421	22.1635	22.2834	22.4015	22.5181	22.6332	22.7467	22.8588	22.9694
32	21.8505	21.9737	22.0951	22.2150	22.3331	22.4497	22.5648	22.6783	22.7904	22.9010
.5	21.7832	21.9064	22.0278	22.1477	22.2658	22.3824	22.4975	22.6110	22.7231	22.8337
33	21.7169	21.8401	21.9615	22.0814	22.1995	22.3161	22.4312	22.5447	22.6568	22.7674
.5	21.6516	21.7748	21.8962	22.0161	22.1342	22.2508	22.3659	22.4794	22.5915	22.7021
34	21.5872	21.7104	21.8318	21.9517	22.0698	22.1864	22.3015	22.4150	22.5271	22.6377
.5	21.5238	21.6470	21.7684	21.8823	22.0064	22.1230	22.2381	22.3516	22.4637	22.5743
35	21.4613	21.5845	21.7059	21.8258	21.9439	22.0605	22.1756	22.2881	22.4012	22.5118
.5	21.3997	21.5229	21.6443	21.7642	21.8823	21.9989	22.1140	22.2275	22.3396	22.4502
36	21.3390	21.4622	21.5836	21.7035	21.8216	21.9382	22.0533	22.1658	22.2789	22.3895
.5	21.2791	21.4023	21.5237	21.6436	21.7617	21.8783	21.9934	22.1069	22.2190	22.3296
37	21.2200	21.3432	21.4646	21.5845	21.7026	21.8192	21.9343	22.0478	22.1599	22.2705
.5	21.1617	21.2849	21.4063	21.5262	21.6443	21.7609	21.8760	21.9895	22.1016	22.2122
38	21.1042	21.2274	21.3488	21.4687	21.5868	21.7034	21.8185	21.9320	22.0441	22.1547
.5	21.0474	21.1706	21.2920	21.4119	21.5300	21.6466	21.7617	21.8752	21.9873	22.0979
39	20.9914	21.1146	21.2360	21.3559	21.4740	21.5906	21.7057	21.8192	21.9313	22.0419
.5	20.9360	21.0592	21.1806	21.3005	21.4186	21.5352	21.6503	21.7638	21.8759	21.9865
40	20.8814	21.0046	21.1260	21.2459	21.3640	21.4806	21.5957	21.7092	21.8213	21.9319

Nos. Yarn.	SLEY OR PICKS.									
	80	81	82	83	84	85	86	87	88	89
1	38.0618	38.1697	38.2763	38.3816	38.4856	38.5884	38.6900	38.7904	38.8897	38.9878
.5	36.3009	36.4088	36.5154	36.6207	36.7247	36.8275	36.9294	37.0295	37.1288	37.2269
2	35.0515	35.1594	35.2660	35.3713	35.4753	35.5781	35.6797	35.7801	35.8794	35.9775
.5	34.0824	34.1903	34.2969	34.4022	34.5062	34.6090	34.7186	34.8110	34.9103	35.0086
3	33.2906	33.3985	33.5051	33.6104	33.7144	33.8172	33.9188	34.0192	34.1185	34.2166
.5	32.6211	32.7290	32.8356	32.9409	33.0449	33.1477	33.2493	33.3497	33.4490	33.5471
4	32.0412	32.1491	32.2557	32.3610	32.4650	32.5678	32.6694	32.7698	32.8691	32.9672
.5	31.5297	31.6376	31.7442	31.8495	31.9535	32.0563	32.1579	32.2583	32.3576	32.4557
5	31.0721	31.1800	31.2866	31.3919	31.4959	31.5987	31.7003	31.8007	31.9000	31.9981
.5	30.6582	30.7661	30.8727	30.9780	31.0820	31.1848	31.2864	31.3869	31.4861	31.5842
6	30.2803	30.3882	30.4948	30.6001	30.7041	30.8069	30.9085	31.0089	31.1082	31.2063
.5	29.9327	30.0406	30.1472	30.2525	30.3565	30.4593	30.5609	30.6613	30.7606	30.8587
7	29.6108	29.7187	29.8253	29.9306	30.0346	30.1374	30.2390	30.3394	30.4387	30.6368
.5	29.3112	29.4191	29.5267	29.6310	29.7350	29.8378	29.9394	30.0398	30.1391	30.2372
8	29.0309	29.1388	29.2454	29.3507	29.4547	29.5575	29.6591	29.7695	29.8588	29.9569
.5	28.7676	28.8755	28.9821	29.0874	29.1914	29.2942	29.3958	29.4962	29.5955	29.6936
9	28.5194	28.6273	28.7339	28.8392	28.9432	29.0460	29.1476	29.2480	29.3473	29.4454
.5	28.2846	28.3925	28.4991	28.6044	28.7084	28.8112	28.9128	29.0132	29.1125	29.2106
10	28.0618	28.1697	28.2763	28.3876	28.4856	28.8497	28.6900	28.7904	28.8897	28.9878
.5	27.8499	27.9578	28.0644	28.1697	28.2737	28.3765	28.4781	28.5705	28.6778	28.7759
11	27.6479	27.7558	27.8624	27.9677	28.0717	28.1745	28.2761	28.3765	28.4758	28.5739
.5	27.4548	27.5627	27.6693	27.7746	27.8786	27.9814	28.0830	28.1834	28.2827	28.3808
12	27.2700	27.3779	27.4845	27.5898	27.6938	27.7966	27.8982	27.9986	28.0979	28.1960
.5	27.0927	27.2006	27.3072	27.4125	27.5165	27.6193	27.7209	27.8213	27.9206	28.0187
13	26.9224	27.0303	27.1369	27.2422	27.3462	27.3490	27.4506	27.5510	27.6503	27.7484
.5	26.7585	26.8664	26.9730	27.0783	27.1823	27.2851	27.3867	27.4871	27.5864	27.6845
14	26.6005	26.7084	26.8150	26.9203	27.0243	27.1271	27.2287	27.3291	27.4284	27.5265
.5	26.4481	26.5560	26.6626	26.7679	26.8719	26.9747	27.0763	27.1767	27.2760	27.3741
15	26.3009	26.4088	26.5154	26.6207	26.7247	26.8275	26.9291	27.0295	27.1288	27.2269
.5	26.1585	26.2664	26.3730	26.4783	26.5823	26.6851	26.7867	26.8871	26.9864	27.0845
16	26.0206	26.1285	26.2351	26.3404	26.4444	26.5472	26.6488	26.7492	26.8485	26.9466
.5	25.8870	25.9949	26.1028	26.2068	26.3108	26.4136	26.5152	26.6156	26.7149	26.8130
17	25.7573	25.8652	25.9731	26.0771	26.1811	26.2839	26.3855	26.4859	26.5852	26.6833
.5	25.6314	25.7393	25.8472	25.9512	26.0552	26.1580	26.2596	26.3600	26.4593	26.5574
18	25.5091	25.6170	25.7249	25.8289	25.9329	26.0357	26.1373	26.2378	26.3370	26.4351
.5	25.3001	25.4080	25.5159	25.6199	25.7239	25.8267	25.9283	26.0287	26.1280	26.2261
19	25.2743	25.3822	25.4901	25.5941	25.6981	25.8009	25.9025	26.0029	26.1022	26.2003
.5	25.1615	25.2694	25.3773	25.4813	25.5853	25.6881	25.7897	25.8901	25.9894	26.0875
20	25.0515	25.1594	25.2673	25.3713	25.4753	25.5781	25.6797	25.7801	25.8794	25.9775
.5	24.9443	25.0522	25.1588	25.2641	25.3681	25.4709	25.5725	25.6729	25.7722	25.8703
21	24.8396	24.9475	25.0541	25.1594	25.2634	25.3662	25.4678	25.5682	25.6675	25.7656
.5	24.7374	24.8453	24.9519	25.0572	25.1612	25.2640	25.3656	25.4660	25.5653	25.6634
22	24.6376	24.7455	24.8521	24.9574	25.0614	25.1642	25.2658	25.3662	25.4655	25.5636
.5	24.5400	24.6479	24.7545	24.8598	24.9638	25.0666	25.1682	25.2686	25.3679	25.4660
23	24.4445	24.5524	24.6590	24.7643	24.8683	24.9711	25.0727	25.1731	25.2724	25.3705
.5	24.3511	24.4590	24.5656	24.6709	24.7749	24.8777	24.9793	25.0797	25.1790	25.2771
24	24.2597	24.3676	24.4742	24.5795	24.6835	24.7863	24.8879	24.9883	25.0876	25.1857
.5	24.1701	24.2780	24.3846	24.4899	24.5939	24.6967	24.7983	24.8987	24.9980	25.0961
25	24.0824	24.1903	24.2969	24.4022	24.5062	24.6090	24.7106	24.8110	24.9103	25.0084
.5	23.9964	24.1043	24.2109	24.3162	24.4202	24.5230	24.6246	24.7250	24.8243	24.9224
26	23.9121	24.0200	24.1266	24.2319	24.3359	24.4387	24.5403	24.6407	24.7400	24.8381
.5	23.8223	23.9302	24.0368	24.1421	24.2461	24.3489	24.4505	24.5509	24.6502	24.7483
27	23.7482	23.8561	23.9627	24.0680	24.1720	24.2948	24.3764	24.4768	24.5761	24.6742
.5	23.6685	23.7764	23.8830	23.9883	24.0923	24.1951	24.2967	24.3971	24.4964	24.5945
28	23.5902	23.6981	23.8047	23.9100	24.0140	24.1168	24.2184	24.3188	24.4181	24.5162
.5	23.5134	23.6213	23.7279	23.8332	23.9372	24.0400	24.1416	24.2420	24.3413	24.4394
29	23.4378	23.5457	23.6523	23.7576	23.8616	23.9644	24.0660	24.1664	24.2657	24.3638
.5	23.3636	23.4715	23.5781	23.6834	23.7874	23.8902	23.9918	24.0922	24.1915	24.2896
30	23.2906	23.3985	23.5051	23.6104	23.7144	23.8172	23.9188	24.0192	24.1185	24.2166
.5	23.2188	23.3267	23.4333	23.5386	23.6426	23.7454	23.8470	23.9474	24.0467	24.1448
31	23.1482	23.2561	23.3627	23.4680	23.5720	23.6748	23.7764	23.8768	23.9761	24.0742
.5	23.0787	23.1866	23.2932	23.3985	23.5025	23.6053	23.7069	23.8073	23.9066	24.0047
32	23.0103	23.1182	23.2248	23.3301	23.4341	23.5369	23.6385	23.7389	23.8382	23.9363
.5	22.9430	23.0509	23.1575	23.2628	23.3668	23.4696	23.5712	23.6716	23.7709	23.8690
33	22.8767	22.9846	23.0912	23.1965	23.3005	23.4033	23.5049	23.6053	23.7046	23.8027
.5	22.8114	22.9193	23.0259	23.1312	23.2352	23.3380	23.4396	23.5400	23.6393	23.7374
34	22.7470	22.8549	22.9615	23.0668	23.1708	23.2736	23.3752	23.4756	23.5749	23.6730
.5	22.6836	22.7915	22.8981	23.0034	23.1074	23.2102	23.3118	23.4122	23.5115	23.6096
35	22.6211	22.7290	22.8356	22.9409	23.0449	23.1477	23.2493	23.3497	23.4490	23.5471
.5	22.5595	22.6674	22.7740	22.8793	22.9833	23.0861	23.1877	23.2881	23.3874	23.4855
36	22.4988	22.6067	22.7133	22.8186	22.9226	23.0254	23.1270	23.2274	23.3267	23.4248
.5	22.4389	22.5468	22.6534	22.7587	22.8627	22.9655	23.0671	23.1675	23.2668	23.3649
37	22.3798	22.4877	22.5943	22.6996	22.8036	22.9064	23.0080	23.1084	23.2077	23.3058
.5	22.3215	22.4294	22.5360	22.6413	22.7453	22.8481	22.9497	23.0501	23.1494	23.2475
38	22.2640	22.3719	22.4785	22.5838	22.6878	22.7906	22.8922	22.9926	23.0919	23.1900
·5	22.2072	22.3151	22.4217	22.5227	22.6310	22.7338	22.8354	22.9358	23.0351	23.1332
39	22.1512	22.2591	22.3657	22.4710	22.5750	22.6778	22.7794	22.8798	22.9791	23.0772
.5	22.0958	22.2037	22.3103	22.4156	22.5196	22.6224	22.7240	22.8244	22.9237	23.0218
40	22.0412	22.1491	22.2557	22.3610	22.4650	22.5678	22.6694	22.7698	22.8691	22.9672

Nos. Yarn.	SLEY OR PICKS.										
	90	91	92	93	94	95	96	97	98	99	100
1	39.0849	39.1808	39.2758	39.3697	39.4626	39.5545	39.6454	39.7354	39.8245	39.9127	40.0000
.5	37.3240	37.4199	37.5149	37.6088	37.7017	37.7936	37.8845	37.9745	38.0636	38.1518	38.2391
2	36.0746	36.1705	36.2655	36.3594	36.4523	36.5442	36.6351	36.7251	36.8142	36.9024	36.9897
.5	35.1055	35.2014	35.2964	35.3903	35.4832	35.5751	35.6660	35.7560	35.8451	35.9333	36.0206
3	34.3137	34.4096	34.5046	34.5985	34.6914	34.7833	34.8742	34.9642	35.0533	35.1415	35.2288
.5	33.6442	33.7401	33.8351	33.9290	34.0219	34.1138	34.2047	34.2947	34.3838	34.4720	34.5593
4	33.0643	33.1602	33.2552	33.3491	33.4420	33.5339	33.6248	33.7148	33.8039	33.8921	33.9794
.5	32.5528	32.6487	32.7437	32.8376	32.9305	33.0224	33.1133	33.2033	33.2924	33.3806	33.4679
5	32.0952	32.1911	32.2861	32.3800	32.4729	32.5648	32.6557	32.7457	32.8348	32.9230	33.0103
.5	31.6813	31.7772	31.8722	31.9661	32.0590	32.1509	32.2418	32.3318	32.4209	32.5091	32.5964
6	31.3034	31.3993	31.4943	31.5882	31.6811	31.7730	31.8639	31.9539	32.0430	32.1312	32.2185
.5	30.9558	31.0517	31.1467	31.2406	31.3335	31.4254	31.5163	31.6063	31.6954	31.7836	31.8709
7	30.6339	30.7298	30.8248	30.9187	31.0116	31.1035	31.1944	31.2844	31.3735	31.4617	31.5490
.5	30.3346	30.4302	30.5252	30.6191	30.7120	30.8039	30.8948	30.9848	31.0739	31.1621	31.2494
8	30.0540	30.1499	30.2449	30.3388	30.4317	30.5236	30.6145	30.7045	30.7936	30.8818	30.9691
.5	29.7907	29.8866	29.9816	30.0755	30.1684	30.2603	30.3512	30.4412	30.5303	30.6185	30.7058
9	29.5425	29.6384	29.7334	29.8273	29.9202	30.0121	30.1030	30.1930	30.2821	30.3703	30.4576
.5	29.3077	29.4036	29.4986	29.5925	29.6854	29.7773	29.8682	29.9582	30.0473	30.1355	30.2228
10	29.0849	29.1808	29.2758	29.3697	29.4626	29.5545	29.6454	29.7354	29.8245	29.9127	30.0000
.5	28.8730	28.9689	29.0639	29.1578	29.2507	29.3426	29.4335	29.5235	29.6126	29.7008	29.7881
11	28.6710	28.7669	28.8619	28.9558	29.0487	29.1406	29.2315	29.3215	29.4106	29.4988	29.5861
.5	28.4779	28.5738	28.6688	28.7627	28.8556	28.9475	29.0384	29.1284	29.2175	29.3057	29.3930
12	28.2931	28.3890	28.4840	28.5779	28.6708	28.7627	28.8536	28.9436	29.0327	29.1209	29.2082
.5	28.1158	28.2117	28.3067	28.4006	28.4935	28.5854	28.6763	28.7663	28.8554	28.9436	29.0309
13	27.9455	28.0414	28.1364	28.2303	28.3232	28.4151	28.5060	28.5960	28.6851	28.7733	28.8606
.5	27.7816	27.8775	27.9725	28.0664	28.1593	28.2512	28.3421	28.4321	28.5212	28.6094	28.6967
14	27.6236	27.7195	27.8145	27.9084	28.0013	28.0932	28.1841	28.2741	28.3632	28.4514	28.5387
.5	27.4712	27.5671	27.6621	27.7560	27.8489	27.9408	28.0317	28.1217	28.2108	28.2990	28.3863
15	27.3240	27.4199	27.5149	27.6088	27.7017	27.7936	27.8845	27.9745	28.0636	28.1518	28.2391
.5	27.1816	27.2775	27.3725	27.4664	27.5593	27.6512	27.7421	27.8321	27.9212	28.0094	28.0967
16	27.0437	27.1396	27.2346	27.3285	27.4214	27.5133	27.6042	27.6942	27.7833	27.8715	27.9588
.5	26.9101	27.0060	27.1010	27.1949	27.2878	27.3797	27.4706	27.5606	27.6497	27.7379	27.8252
17	26.7804	26.8763	26.9713	27.0652	27.1581	27.2500	27.3409	27.4309	27.5200	27.6082	27.6955
.5	26.6545	26.7504	26.8454	26.9393	27.0322	27.1241	27.2150	27.3050	27.3941	27.4823	27.5696
18	26.5322	26.6281	26.7231	26.8170	26.9099	27.0018	27.0927	27.1827	27.2718	27.3600	27.4473
.5	26.3232	26.4191	26.5141	26.6080	26.7009	26.7928	26.8837	26.9737	27.0628	27.1510	27.2383
19	26.2974	26.3933	26.4883	26.5822	26.6751	26.7670	26.8579	26.9479	27.0370	27.1252	27.2125
.5	26.1846	26.2805	26.3755	26.4694	26.5623	26.6542	26.7451	26.8351	26.9242	27.0124	27.0997
20	26.0746	26.1705	26.2655	26.3594	26.4523	26.5442	26.6351	26.7251	26.8142	26.9024	26.9897
.5	25.9674	26.0624	26.1583	26.2522	26.3451	26.4370	26.5279	26.6179	26.7070	26.7952	26.8825
21	25.8627	25.9577	26.0536	26.1475	26.2404	26.3323	26.4232	26.5132	26.6023	26.6905	26.7778
.5	25.7605	25.8555	25.9514	26.0453	26.1382	26.2301	26.3210	26.4110	26.5001	26.5883	26.6756
22	25.6607	25.7557	25.8516	25.9455	26.0384	26.1303	26.2212	26.3112	26.4003	26.4885	26.5758
.5	25.5631	25.6581	25.7540	25.8479	25.9408	26.0327	26.1236	26.2136	26.3027	26.3909	26.4782
23	25.4676	25.5626	25.6585	25.7524	25.8453	25.9372	26.0281	26.1181	26.2072	26.2954	26.3827
.5	25.3742	25.4692	25.5651	25.6590	25.7519	25.8438	25.9347	26.0247	26.1138	26.2020	26.2893
24	25.2828	25.3778	25.4737	25.5676	25.6605	25.7524	25.8433	25.9333	26.0224	26.1106	26.1979
.5	25.1932	25.2882	25.3841	25.4780	25.5709	25.6628	25.7537	25.8437	25.9328	26.0210	26.1083
25	25.1055	25.2005	25.2964	25.3903	25.4832	25.5751	25.6660	25.7560	25.8451	25.9333	26.0206
.5	25.0195	25.1145	25.2104	25.3043	25.3972	25.4891	25.5800	25.6700	25.7591	25.8473	25.9346
26	24.9352	25.0302	25.1261	25.2200	25.3129	25.4048	25.4957	25.5857	25.6748	25.7630	25.8503
.5	24.8454	24.9404	25.0363	25.1302	25.2231	25.3150	25.4059	25.4959	25.5850	25.6732	25.7605
27	24.7713	24.8663	24.9622	25.0561	25.1490	25.2409	25.3318	25.4218	25.5100	25.5992	25.6864
.5	24.6916	24.7866	24.8825	24.9764	25.0693	25.1612	25.2521	25.3421	25.4312	25.5194	25.6067
28	24.6133	24.7083	24.8042	24.8981	24.9910	25.0829	25.1738	25.2638	25.3529	25.4411	25.5284
.5	24.5365	24.6315	24.7274	24.8213	24.9142	25.0061	25.0970	25.1870	25.2761	25.3643	25.4516
29	24.4609	24.5559	24.6518	24.7457	24.8386	24.9305	25.0214	25.1114	25.2005	25.2887	25.3760
.5	24.3867	24.4817	24.5776	24.6715	24.7644	24.8563	24.9472	25.0372	25.1263	25.2145	25.3018
30	24.3137	24.4087	24.5046	24.5985	24.6914	24.7833	24.8742	24.9642	25.0533	25.1415	25.2288
.5	24.2419	24.3369	24.4328	24.5267	24.6196	24.7115	24.8024	24.8924	24.9815	25.0697	25.1570
31	24.1713	24.2663	24.3622	24.4561	24.5490	24.6409	24.7318	24.8218	24.9109	24.9991	25.0864
.5	24.1018	24.1968	24.2927	24.3866	24.4795	24.5714	24.6623	24.7523	24.8414	24.9296	25.0169
32	24.0334	24.1284	24.2243	24.3182	24.4111	24.5030	24.5939	24.6839	24.7730	24.8612	24.9485
.5	23.9661	24.0611	24.1570	24.2509	24.3438	24.4357	24.5266	24.6166	24.7057	24.7939	24.8812
33	23.8998	23.9948	24.0907	24.1846	24.2775	24.3694	24.4603	24.5503	24.6394	24.7276	24.8149
.5	23.8345	23.9295	24.0254	24.1193	24.2122	24.3041	24.3950	24.4850	24.5741	24.6623	24.7496
34	23.7701	23.8651	23.9610	24.0549	24.1478	24.2397	24.3306	24.4206	24.5097	24.5979	24.6852
.5	23.7067	23.8017	23.8976	23.9915	24.0844	24.1763	24.2672	24.3572	24.4463	24.5345	24.6218
35	23.6442	23.7392	23.8351	23.9290	24.0219	24.1138	24.2047	24.2947	24.3838	24.4720	24.5593
.5	23.5826	23.6776	23.7735	23.8674	23.9603	24.0522	24.1431	24.2331	24.3222	24.4104	24.4977
36	23.5219	23.6169	23.7128	23.8067	23.8996	23.9915	24.0824	24.1724	24.2615	24.3497	24.4370
.5	23.4620	23.5570	23.6529	23.7468	23.8397	23.9316	24.0225	24.1125	24.2016	24.2898	24.3771
37	23.4029	23.4979	23.5938	23.6877	23.7806	23.8725	23.9634	24.0534	24.1425	24.2307	24.3180
.5	23.3446	23.4396	23.5355	23.6294	23.7223	23.8142	23.9051	23.9951	24.0842	24.1724	24.2597
38	23.2871	23.3821	23.4780	23.5719	23.6648	23.7567	23.8476	23.9376	24.0267	24.1149	24.2022
.5	23.2303	23.3253	23.4212	23.5151	23.6080	23.6999	23.7908	23.8808	23.9699	24.0581	24.1454
39	23.1743	23.2693	23.3652	23.4591	23.5520	23.6439	23.7348	23.8248	23.9139	24.0021	24.0894
.5	23.1189	23.2139	23.3098	23.4037	23.4966	23.5885	23.6794	23.7694	23.8585	23.9467	24.0340
40	23.0643	23.1593	23.2552	23.3491	23.4420	23.5339	23.6248	23.7148	23.8039	23.8921	23.9794

The multiplication tables on the next two pages show at a glance products of numbers 1 to 100 multiplied by numbers 1 to 12 inclusive. To use the tables, find the number to be multiplied in the left hand column and follow its horizontal line until the product is reached in column directly under the multiplier.

Example: To multiply 46 by 9.

Find 46 in left hand column and under the column headed by 9 will be found the product 414, which is the answer.

For products of numbers not covered by the tables, subdivide the numbers into divisions that are found in the tables and multiply by sections as shown in the tables.

I. Example: To multiply 4326 by 97.

Note that 4326 is made up as follows

	4000
	300
	20
	6

Find 97×4 in table and add three ciphers	=	388,000
97×3 " " " " two "	=	29,100
97×2 " " " " one "	=	1,940
97×6 " "	=	582
added together	=	419,622 answer

II. Example: To multiply 1257 by 6709

Subdivide 1257=		1200
		57
Subdivide 6709=	6700	6000
	9	700
		9

1200×6700	=	8,040,000
1200× 9	=	10,800
57×6000	=	342,000
57× 700	=	39,900
57× 9	=	513
added together	=	8,433,213 answer

1	2	3	4	5	6	7	8	9	10	11	12
2	4	6	8	10	12	14	16	18	20	22	24
3	6	9	12	15	18	21	24	27	30	33	36
4	8	12	16	20	24	28	32	36	40	44	48
5	10	15	20	25	30	35	40	45	50	55	60
6	12	18	24	30	36	42	48	54	60	66	72
7	14	21	28	35	42	49	56	63	70	77	84
8	16	24	32	40	48	56	64	72	80	88	96
9	18	27	36	45	54	63	72	81	90	99	108
10	20	30	40	50	60	70	80	90	100	110	120
11	22	33	44	55	66	77	88	99	110	121	132
12	24	36	48	60	72	84	96	108	120	132	144
13	26	39	52	65	78	91	104	117	130	143	156
14	28	42	56	70	84	98	112	126	140	154	168
15	30	45	60	75	90	105	120	135	150	165	180
16	32	48	64	80	96	112	128	144	160	176	192
17	34	51	68	85	102	119	136	153	170	187	204
18	36	54	72	90	108	126	144	162	180	198	216
19	38	57	76	95	114	133	152	171	190	209	228
20	40	60	80	100	120	140	160	180	200	220	240
21	42	63	84	105	126	147	168	189	210	231	252
22	44	66	88	110	132	154	176	198	220	242	264
23	46	69	92	115	138	161	184	207	230	253	276
24	48	72	96	120	144	168	192	216	240	264	288
25	50	75	100	125	150	175	200	225	250	275	300
26	52	78	104	130	156	182	208	234	260	286	312
27	54	81	108	135	162	189	216	243	270	297	324
28	56	84	112	140	168	196	224	252	280	308	336
29	58	87	116	145	174	203	232	261	290	319	348
30	60	90	120	150	180	210	240	270	300	330	360
31	62	93	124	155	186	217	248	279	310	341	372
32	64	96	128	160	192	224	256	288	320	352	384
33	66	99	132	165	198	231	264	297	330	363	396
34	68	102	136	170	204	238	272	306	340	374	408
35	70	105	140	175	210	245	280	315	350	385	420
36	72	108	144	180	216	252	288	324	360	396	432
37	74	111	148	185	222	259	296	333	370	407	444
38	76	114	152	190	228	266	304	342	380	418	456
39	78	117	156	195	234	273	312	351	390	429	468
40	80	120	160	200	240	280	320	360	400	440	480
41	82	123	164	205	246	287	328	369	410	451	492
42	84	126	168	210	252	294	336	378	420	462	504
43	86	129	172	215	258	301	344	387	430	473	516
44	88	132	176	220	264	308	352	396	440	484	528
45	90	135	180	225	270	315	360	405	450	495	540
46	92	138	184	230	276	322	368	414	460	506	552
47	94	141	188	235	282	329	376	423	470	517	564
48	96	144	192	240	288	336	384	432	480	528	576
49	98	147	196	245	294	343	392	441	490	539	588
50	100	150	200	250	300	350	400	450	500	550	600

1	2	3	4	5	6	7	8	9	10	11	12
51	102	153	204	255	306	357	408	459	510	561	612
52	104	156	208	260	312	364	416	468	520	572	624
53	106	159	212	265	318	371	424	477	530	583	636
54	108	162	216	270	324	378	432	486	540	594	648
55	110	165	220	275	330	385	440	495	550	605	660
56	112	168	224	280	336	392	448	504	560	616	672
57	114	171	228	285	342	399	456	513	570	627	684
58	116	174	232	290	348	406	464	522	580	638	696
59	118	177	236	295	354	413	472	531	590	649	708
60	120	180	240	300	360	420	480	540	600	660	720
61	122	183	244	305	366	427	488	549	610	671	732
62	124	186	248	310	372	434	496	558	620	682	744
63	126	189	252	315	378	441	504	567	630	693	756
64	128	192	256	320	384	448	512	576	640	704	768
65	130	195	260	325	390	455	520	585	650	715	780
66	132	198	264	330	396	462	528	594	660	726	792
67	134	201	268	335	402	469	536	603	670	737	804
68	136	204	272	340	408	476	544	612	680	748	816
69	138	207	276	345	414	483	552	621	690	759	828
70	140	210	280	350	420	490	560	630	700	770	840
71	142	213	284	355	426	497	568	639	710	781	852
72	144	216	288	360	432	504	576	648	720	792	864
73	146	219	292	365	438	511	584	657	730	803	876
74	148	222	296	370	444	518	592	666	740	814	888
75	150	225	300	375	450	525	600	675	750	825	900
76	152	228	304	380	456	532	608	684	760	836	912
77	154	231	308	385	462	539	616	693	770	847	924
78	156	234	312	390	468	546	624	702	780	858	936
79	158	237	316	395	474	553	632	711	790	869	948
80	160	240	320	400	480	560	640	720	800	880	960
81	162	243	324	405	486	567	648	729	810	891	972
82	164	246	328	410	492	574	656	738	820	902	984
83	166	249	332	415	498	581	664	747	830	913	996
84	168	252	336	420	504	588	672	756	840	924	1008
85	170	255	340	425	510	595	680	765	850	935	1020
86	172	258	344	430	516	602	688	774	860	946	1032
87	174	261	348	435	522	609	696	783	870	957	1044
88	176	264	352	440	528	616	704	792	880	968	1056
89	178	267	356	445	534	623	712	801	890	979	1068
90	180	270	360	450	540	630	720	810	900	990	1080
91	182	273	364	455	546	637	728	819	910	1001	1092
92	184	276	368	460	552	644	736	828	920	1012	1104
93	186	279	372	465	558	651	744	837	930	1023	1116
94	188	282	376	470	564	658	752	846	940	1034	1128
95	190	285	380	475	570	665	760	855	950	1045	1140
96	192	288	384	480	576	672	768	864	960	1056	1152
97	194	291	388	485	582	679	776	873	970	1067	1164
98	196	294	392	490	588	686	784	882	980	1078	1176
99	198	297	396	495	594	693	792	891	990	1089	1188
100	200	300	400	500	600	700	800	900	1000	1100	1200

COMMON FRACTIONS WRITTEN DECIMALLY.

1-64 =						.01563
2-64 =	1-32 =					.03125
3-64 =						.04688
4-64 =	2-32 =	1-16 =				.0625
5-64 =						.07813
6-64 =	3-32 =					.09375
7-64 =						.10938
8-64 =	4-32 =	2-16 =	1-8 =			.125
9-64 =						.14063
10-64 =	5-32 =					.15625
11-64 =						.17188
12-64 =	6-32 =	3-16 =				.1875
13-64 =						.20313
14-64 =	7-32 =					.21875
15-64 =						.23438
16-64 =	8-32 =	4-16 =	2-8 =	1-4 =		.25
17-64 =						.26563
18-64 =	9-32 =					.28125
19-64 =						.29688
20-64 =	10-32 =	5-16 =				.3125
21-64 =						.32813
22-64 =	11-32 =					.34375
23-64 =						.35938
24-64 =	12-32 =	6-16 =	3-8 =			.375
25-64 =						.39063
26-64 =	13-32 =					.40625
27-64 =						.42188
28-64 =	14-32 =	7-16 =				.4375
29-64 =						.45313
30-64 =	15-32 =					.46875
31-64 =						.48438
32-64 =	16-32 =	8-16 =	4-8 =	2-4 =	1-2 =	.5
33-64 =						.51563
34-64 =	17-32 =					.53125
35-64 =						.54688
36-64 =	18-32 =	9-16 =				.5625
37-64 =						.57813
38-64 =	19-32 =					.59375
39-64 =						.60938
40-64 =	20-32 =	10-16 =	5-8 =			.625

41-64 =	.64063
42-64 = 21-32 =	.65625
43-64 =	.67188
44-64 = 22-32 = 11-16 =	.6875
45-64 =	.7013
46-64 = 23-32 =	.71875
47-64 =	.73438
48-64 = 24-32 = 12-16 = 6-8 = 3-4 =	.75
49-64 =	.76563
50-64 = 25-32 =	.78125
51-64 =	.79688
52-64 = 26-32 = 13-16 =	.8125
53-64 =	.82813
54-64 = 27-32 =	.84375
55-64 =	.85938
56-64 = 28-32 = 14-16 = 7-8 =	.875
57-64 =	.89063
58-64 = 29-32 =	.90625
59-64 =	.92188
60-64 = 30-32 = 15-16 =	.9375
61-64 =	.95313
62-64 = 31-32 =	.96875
63-64 =	.98438
64-64 = 32-32 = 16-16 = 8-8 = 4-4 = 2-2 =	1.00000

1-12 =	.0833+
2-12 = 1-6 =	.1666+
3-12 = 1-4 =	.25
4-12 = 2-6 = 1-3 =	.3333+
5-12 =	.4166+
6-12 = 3-6 = 1-2 =	.5
7-12 =	.5833+
8-12 = 4-6 = 2-3 =	.6666+
9-12 = 3-4 =	.75
10-12 = 5-6 =	.8333+
11-12 =	.9166+
12-12 =	1.0000

OUR TYPES OF SPINDLES.

Since the publication of the last edition of our Textile Texts there have been no radical changes in the several types of our spinning spindles. Improvements in processes of manufacture and in tools and machinery are always under way and it is a safe statement that we make spindles that are more uniform, and superior in every respect to those made a few years ago.

All spindles now on the market are based upon inventions of Francis J. Rabbeth. He was the pioneer inventor of the self centering spindle which has now come into general use both in this country and abroad. His latest spindle with the centrifugal clutch drive has been well received and is being more and more generally adopted. We manufacture the well known Draper type of spindle and have steadily and continuously recommended it to the trade. We also manufacture the McMullan and the Whitin or gravity spindle whenever ordered by our customers and can recommend our products in this line as second to none in the quality of material and care in workmanship.

A spinning frame spindle is a shaft revolving at high speed to carry a bobbin. This shaft, acting under the influence of its driving band, rotates in a position determined by its bearings. In practice the center of gravity of the spindle and its load is not coincident with the geometric center. The centrifugal force of the offset center of gravity tends to cause the spindle to gyrate. An unbalanced load will cause this offset and may be carried to such an extent that the spindle cannot be run properly, thereby limiting its practical range of speed. Well made and well used bobbins will help very much to obviate this result. Within the control of the spindle maker are a number of factors that will keep the center of gravity where it should be. A straight, true spindle blade that will continue to remain straight and true is of great importance. Accurately built spindle bolsters and round whorls contribute to the smooth running and long life of a spindle. All these factors are determined by the quality of the material and workmanship put into a spindle by its maker.

The Draper Company has been most prominently identified with the development of the modern high speed spindle, and throughout its history has been its advocate and leading introducer. Years of use and millions of spindles in active operation have endorsed our well known Draper spindles, known in the trade as the D 2, D 5 and D 4.

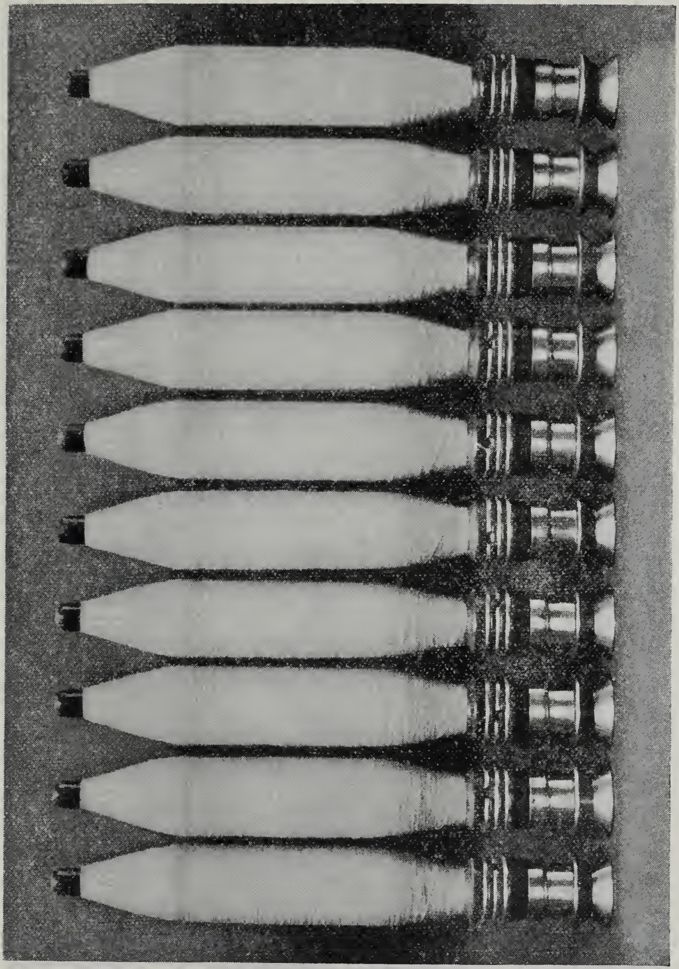
The most important recent development in spindles is the Rabbeth centrifugal bobbin clutch. This device has segments above the whorl so mounted that they are free to move outwardly under the influence of centrifugal force to grip the bobbin when the spindle is running at speed. The force so developed is enough to prevent the bobbin from slipping on the spindle. The great advantage of this device is that the bobbins will all stand at a uniform level on the spindles, giving completely filled bobbins, and on filling bobbins used on feeler looms a properly located feeler bunch. With the bobbins easily removable there is no excuse for the doffer bending spindle blades in doffing. In fact, blades under these circumstances can only be bent by inexcusable carelessness, while with the ordinary whorl and cup, the boy in his hurry can easily bend the spindle blade when the bobbin binds. The Rabbeth centrifugal clutch spindle used in conjunction with the Hastings bushed bobbin, gives the maximum of efficiency in spinning and weaving, and in the life of the bobbin. There is less slack yarn and less waste yarn. All bobbins shrink and swell more or less, especially those used for filling; but the clutch allows so loose a fit as to give more leeway in the dimension of the bobbin bore before reaming is necessary and there is no tendency whatever to split bobbins. We have over three millions of these spindles running, and from our present experience and observation we believe their merits will be universally recognized. A longer traverse means less frequent doffing, less work at the spooler with warp yarn, and less knots in the warp. With filling yarn it means less frequent changing of shuttles on common looms, less bobbins to place in the hoppers on Northrop looms and less defects in the cloth from changes of filling with either type of loom.

One important advantage of the Rabbeth patent centrifugal clutch spindle is readily seen in the contrast between the two sets of bobbins and spindles shown herewith.

The bobbins on the centrifugal clutch spindles were all taken from the same frame; those on the spindles without the clutch were all from another frame; both frames are in the same mill; spinning the same numbers of yarn; and in good condition.

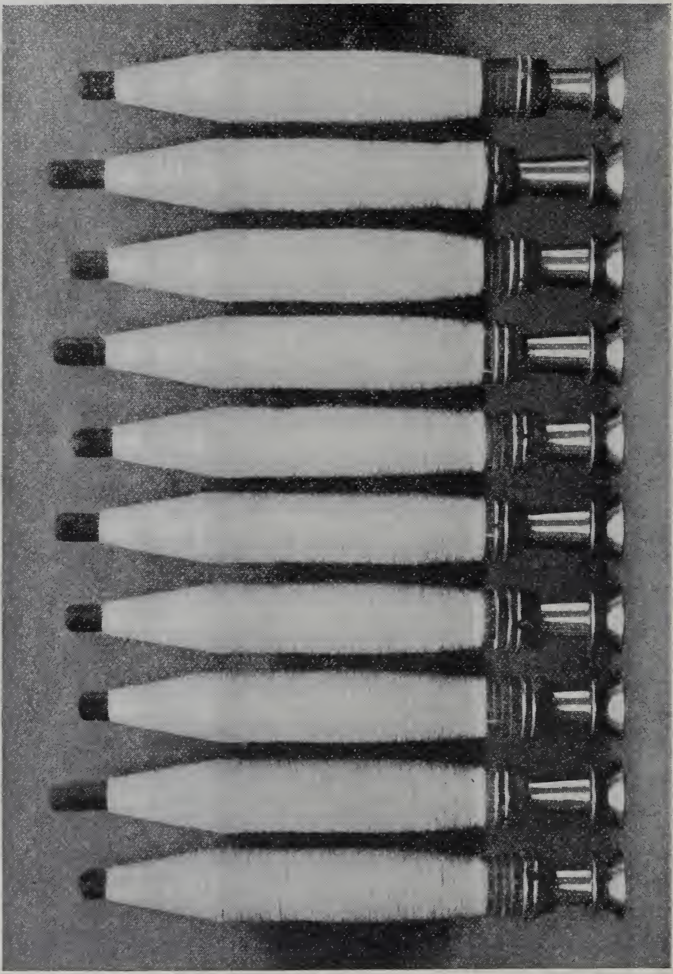
The centrifugal clutch bobbins stand at an absolutely uniform level on the spindles; the other bobbins vary in height, as is always the case, thereby reducing the available length of traverse and consequently the amount of yarn that can be carried.

The centrifugal clutch bobbins of same length average to contain fully ten per cent. more yarn than the bobbins on spindles without the centrifugal clutch, the spinning frames in each case being in good condition.



Ten bobbins spun under average mill conditions on a frame equipped with centrifugal clutch spindles.

Note that all bobbins rest on the top of spindle whorl at a uniform level.



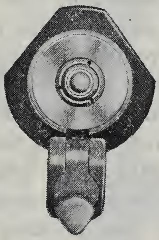
Ten bobbins spun under average mill conditions on a frame equipped with solid whorl spindles.

Note the variation in height of bobbins on the spindles.

While we show several illustrations of our spindles, we do not attempt to illustrate all the known modifications. There are so many different patterns of blades and bases that the combinations are almost endless. The blades are of different designs and different lengths. The whorls are furnished with different cups, with no cup at all, and with the centrifugal clutch. The bases are made with the old style snout, with brass oil-cap and steel retaining hook; also in the Draper spindle with Woodmancy base, and in the Model E base. The Model E base is in two patterns, one with round seat, the other with a double slabbed seat to avoid lifting rods.

Many customers prefer to have all of their spindles of this double slabbed pattern, although they are not so easily levelled by papering under the rim. The Model E, made under patent of Charles E. Lovejoy, is more convenient for oiling; it gives freedom for band knots to pass and is strengthened at former weak sections; the doffer guards will not break as easily as on the old base.

The bases for the centrifugal clutch spindle vary from the regular standard, since with the centrifugal clutch the bolster is set lower in the base, and the base is shortened at the top. On account of variations in patterns, care must be taken in ordering, to specify accurately just what is wanted, and if spindles are to duplicate old lots it is necessary to send a sample with the order.



Model E Base.

Double slabbed pattern, viewed from above.

We furnish repair parts for all types of spindle, whether originating in our works or not. As we have special tools for assembling, it is best to let us do as much of the assembling as possible.

THE 49 D SPINDLE.

The parts of the 49 D spindle, as illustrated, are not wholly sub-divided, since we do not sub-divide them in repairs; for instance, we sell the spindle blade with the whorl and cup attached, for these parts must be assembled on special machinery in order to have them concentric. The blade, as shown, is really in four parts, as it has blade, whorl, cup and also a brass collar forced on under the whorl, to prevent the throwing out of oil. The blade of the 49 D spindle differs somewhat in section from that of the Draper spindle, and we recommend our customers to order the regular Draper blade, as it will fit in the 49 D bolster and is of stronger section. Note that blades are made in two regular lengths, and with two patterns of top; that is, the longer traverse blade has a cylindrical top, and the shorter traverse blade has a tapering top. The short traverse blade is shown in the illustration. The cups are also made in two sizes, one for warp bobbins and the other for filling bobbins, the filling bobbins taking the larger cup.

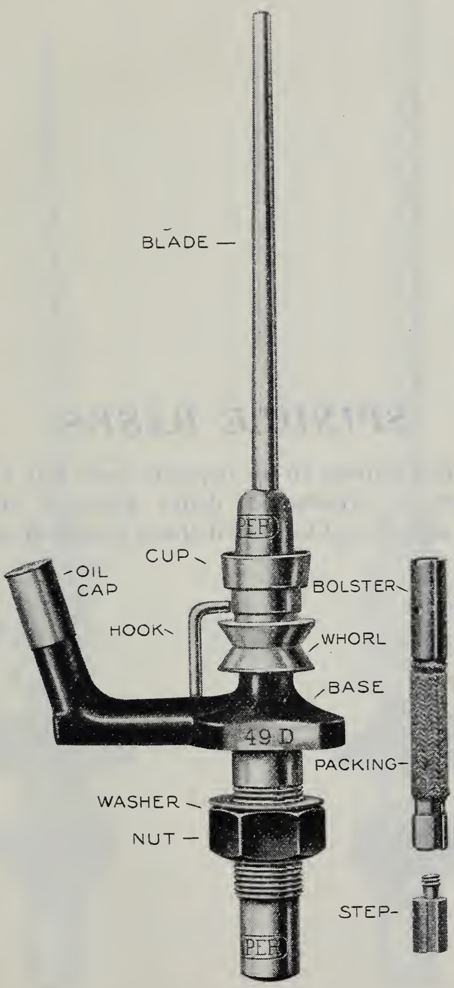
The filling spindle with large cup is designated as the 48 D spindle and it is a duplicate of the 49 D except in size of cup.

The whorls are made in several sizes, being usually either ¾, 13/16, or ⅞ inches in diameter at the band groove. The ¾ inch whorl is shown in the illustration. Since the taper on the whorls of the spindles made by different shops varies slightly, this introduces a variation which necessitates accurate knowledge of the spindle to be duplicated.

The 49 D base is usually supplied with the hook, although we sell the hooks separately; also the brass oil caps. Bases are always supplied with their retaining hooks in place. Nuts and washers are furnished separately. The bolster is usually supplied with the packing attached, though we can furnish packing in quantity desired. Steps sometimes wear sufficiently to need replacement, although they are carefully hardened.

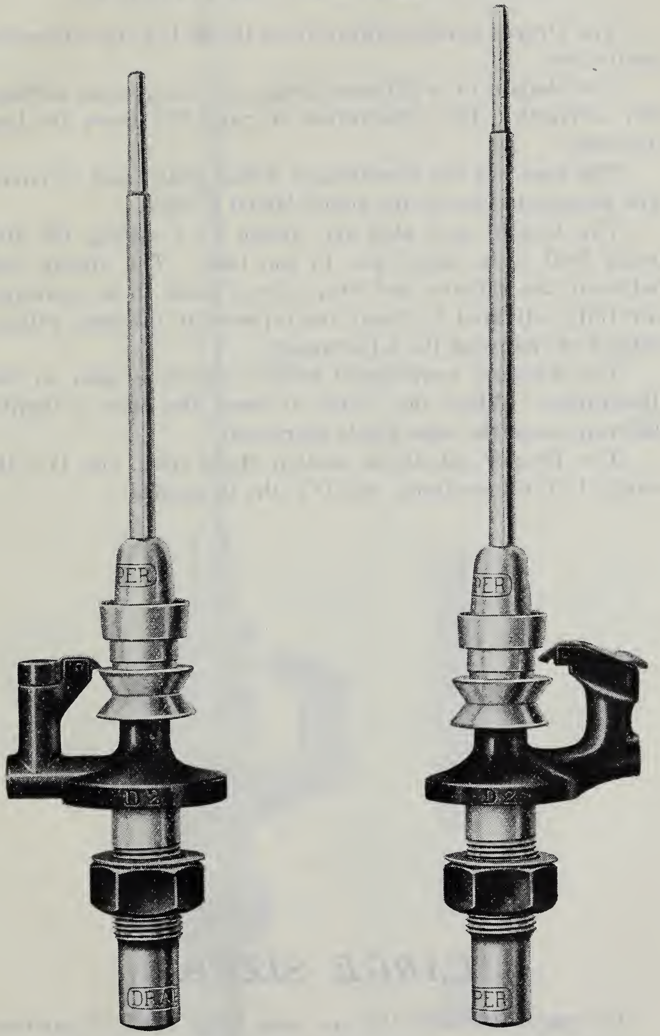
Note that our spindle whorls and bases are now all marked with the word "DRAPER" enclosed in a rectangle with rounded corners. This mark signifies that the piece so marked is made by Draper Company.

The 49 D type of spindle is made in three sizes, viz: 49 D, the small; D 91, the medium; and D 81, the large size.


BLADE
CUP
OIL
CAP
HOOK
BOLSTER
WHORL
BASE
49 D
PACKING
WASHER
NUT
STEP

SPINDLE BASES.

In the illustrations on the opposite page may be seen the earlier form of Woodmancy doffer guard in the Draper No. 2 base at left, and the round Model E base at right.



THE DRAPER SPINDLE.

The Draper spindle differs from the 49 D in the following particulars:

The blade is of a different design, giving greater stiffness and strength. The illustration on page 179 shows the long traverse.

The base has the Woodmancy doffer guard and oil cover. The illustration shows the round Model E style.

The bolster and step are united by a spring, the step being held by a single pin in the base. The spring lock between the bolster and step allows them to be removed, carefully adjusted by hand and replaced in the base without danger of changing the adjustment.

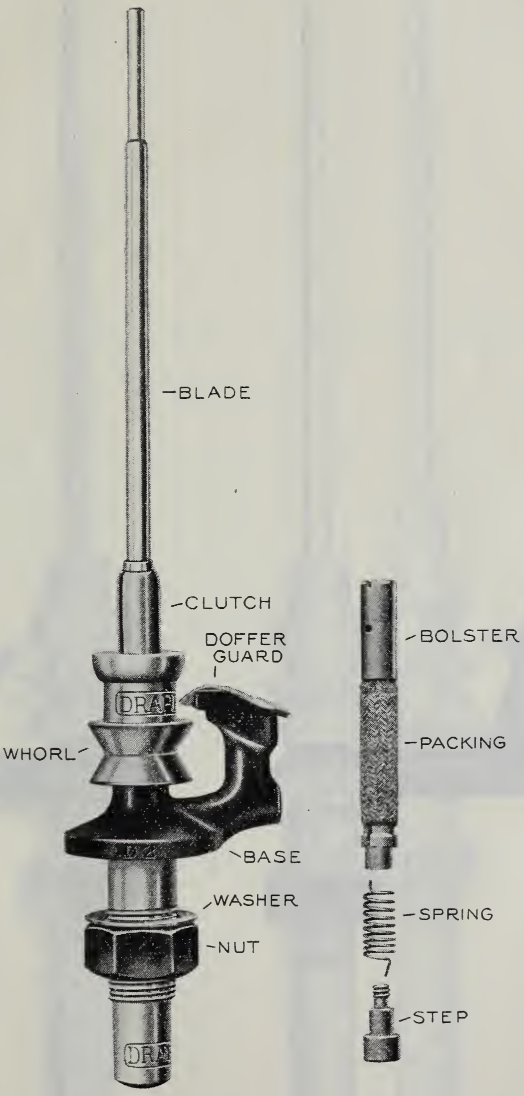
The Rabbeth centrifugal bobbin clutch is seen on this illustration. When the clutch is used the base is slightly different since the base top is shortened.

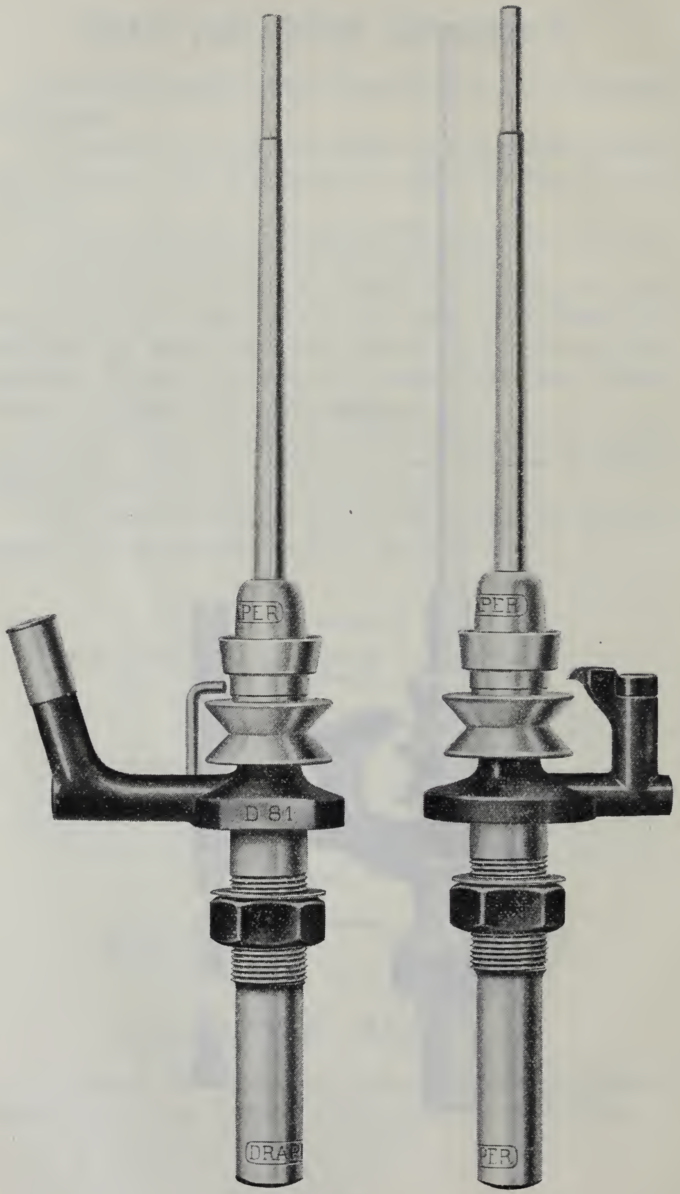
The Draper spindle is made in three sizes, viz: D 2, the small; D 5, the medium; and D 4, the large size.

LARGE SIZES.

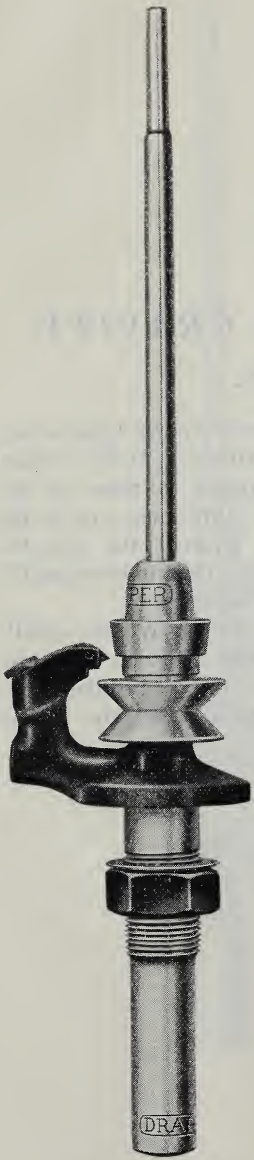
On pages 180 and 181 are seen large sizes of spinning spindles of various forms. They are in order as follows:

1 D 81 which is a large size 49 D.
2 D 4 which is a large size D 2.
3 D 4 in round Model E base.
4 D 4 centrifugal clutch type in round Model E base.

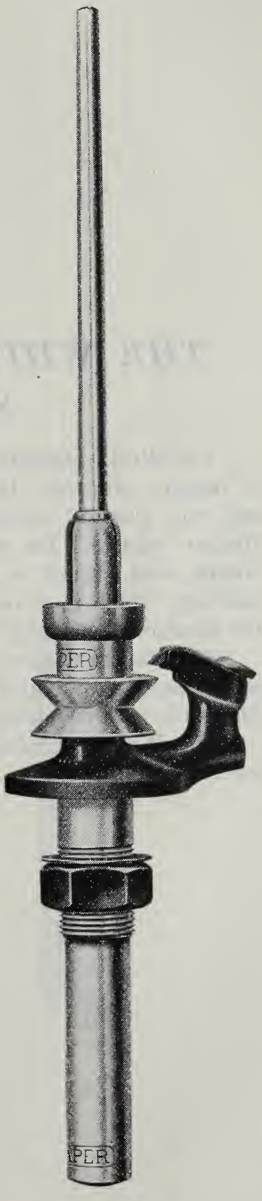

BLADE
CLUTCH
DOFFER GUARD
WHORL
BASE
WASHER
NUT
BOLSTER
PACKING
SPRING
STEP



1 2



3



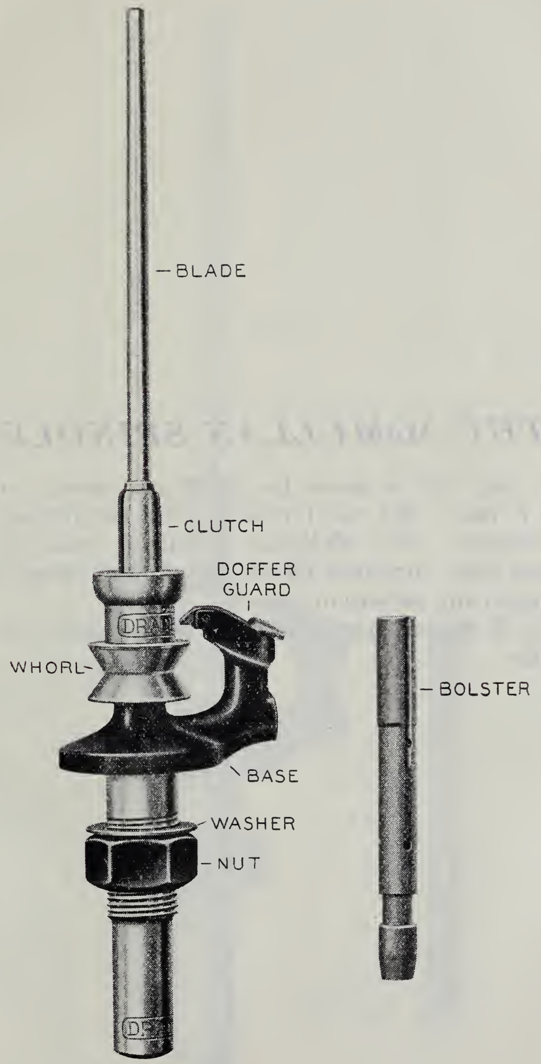
4

THE WHITIN, OR GRAVITY SPINDLE.

The Whitin spindle is one of the well known types which is largely ordered. It has the Woodmancy Doffer Guard and the general dimensions are similar to those of the Draper spindle. Its main points of difference are in the bobbin seat, which is usually made without the cup; the bearing, which is in one piece and cylindrical in bore; and in the absence of packing and means for adjustment.

The illustration on next page shows the Whitin spindle with centrifugal clutch in round Model E base. We also furnish it with or without centrifugal clutch in regular base.

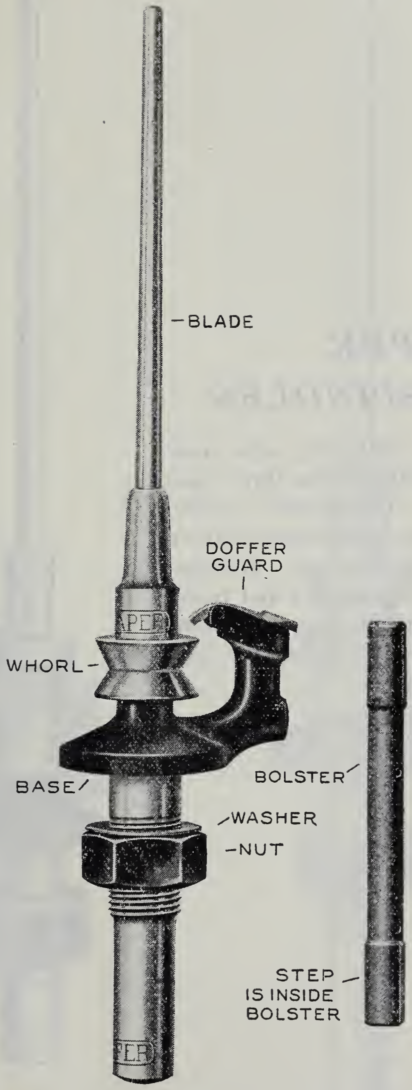
The Whitin spindle is made in three sizes, viz: small, medium and large.


BLADE
CLUTCH
DOFFER GUARD
WHORL
BASE
WASHER
NUT
BOLSTER

THE McMULLAN SPINDLE.

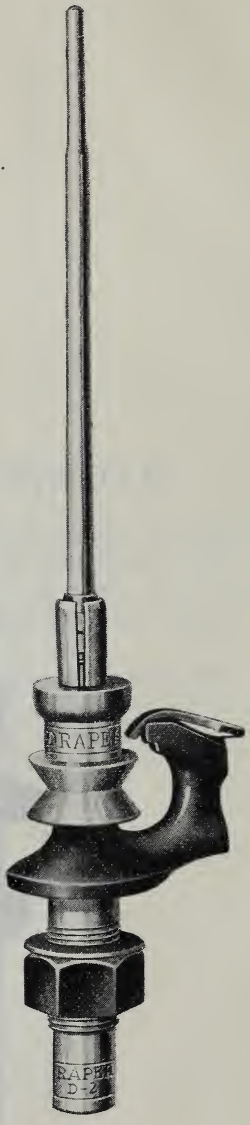
On page 185 is shown the McMullan spindle in round Model E base. We can furnish it with centrifugal clutch when desired. The McMullan spindle is made by us to duplicate those furnished by the Saco-Lowell shops, and we can furnish any pattern of base.

The McMullan spindle is made in two sizes, viz: small and large.


BLADE
DOFFER GUARD
WHORL
BASE
BOLSTER
WASHER
NUT
STEP IS INSIDE BOLSTER

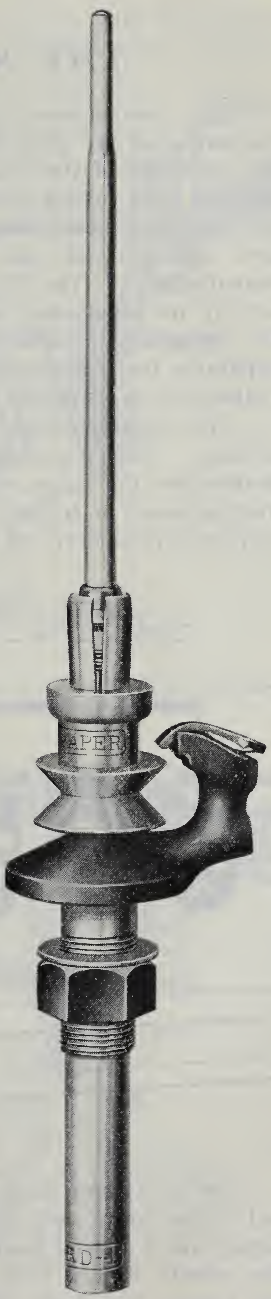
DRAPER SPINDLES.

The three following cuts show Draper spindles in the three sizes drawn in proportional scale. They are the construction that we recommend, and are provided with centrifugal clutch and round E model base with Lovejoy patent oil snout with blades for long traverse.



D 2

D 5



D 4

THE SEPARATOR.

The development of high speed spindles and the ballooning of the yarn due to increased spindle-speed led to the invention of the separator to keep the yarn on adjacent spindles from coming in contact and breaking down.

We have been closely identified with the introduction and adoption of the separator and are its largest manufacturer. The Rhoades-Chandler Separator brought out by us superseded our earlier Doyle type and is now the recognized standard. We recommend and furnish this separator for changing over old frames and also supply it to builders of new frames.

This separator can be turned either up or down for doffing. Our experience in supplying the trade has determined the shape and size of separator to use for the varying speed of spindle, gauge of ring, and number of yarn, and we have patterns to meet all conditions.

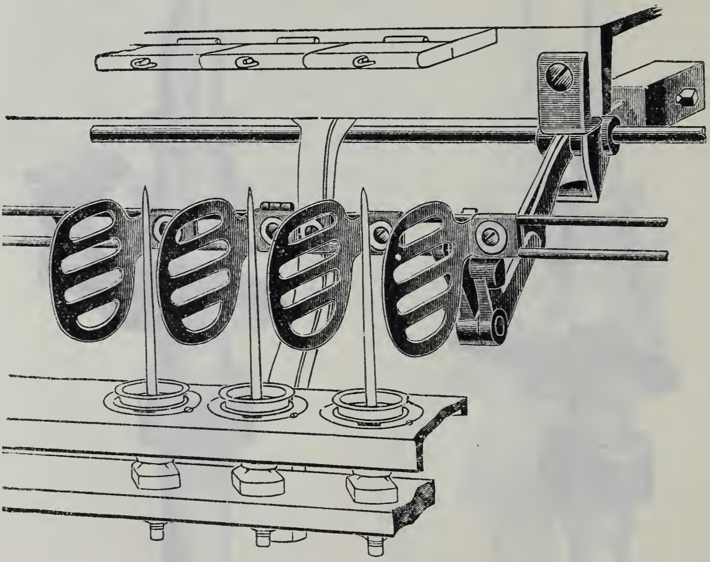


FIGURE 1.

The cuts show the position the blades occupy with the rail at the lower part of the traverse, Figure 1 showing the separators in normal position with the bobbins removed from the spindle, Figure 2 the blades turned down, and Figure 3 the blades turned up for doffing. In Figure 2 it will be noticed that one separator blade contacts with the samson of the frame. Such blades are provided with a special hinged support.

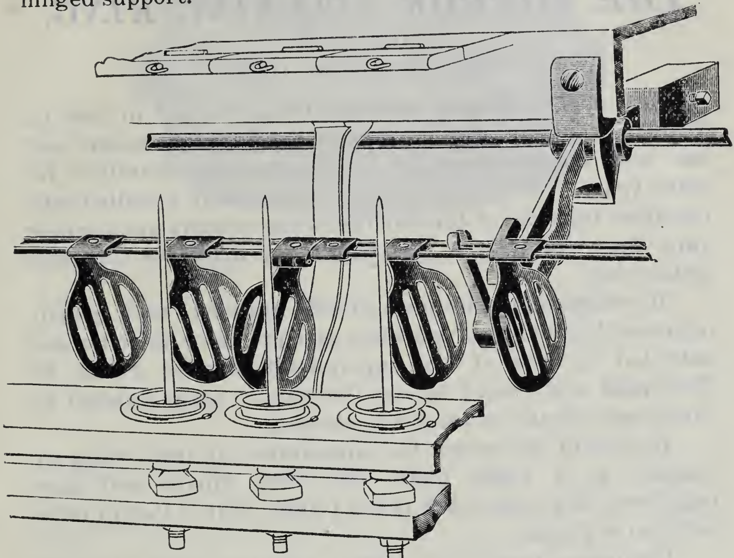


FIGURE 2.

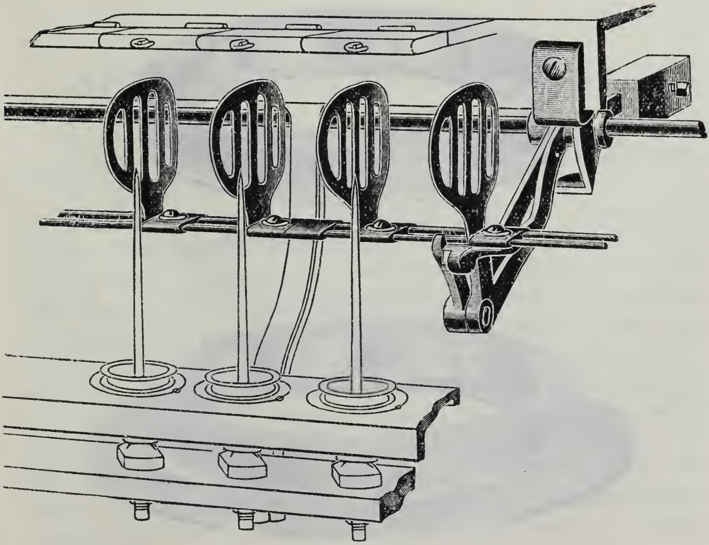


FIGURE 3.

THE MIRROR SPINNING RING.

TRADE MARK.

REG. U. S. PAT. OFF.

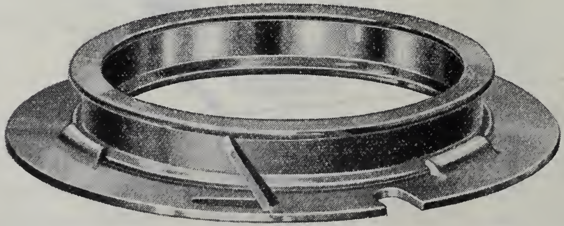
The double flanged spinning ring patented in 1869 by William T. Carroll was introduced by our predecessors and has been manufactured by us in increasing quantities for many years. While single flanged rings have a limited sale, the great majority of the spindles in this country are spinning yarn upon one of the two flanges of a Draper Company double ring.

In recent years the finish of our rings has been greatly improved by the use of machines and processes invented and patented by one of our superintendents, Mr. Frank H. Thompson and owned by our Company. Rings finished by this process make no trouble in starting.

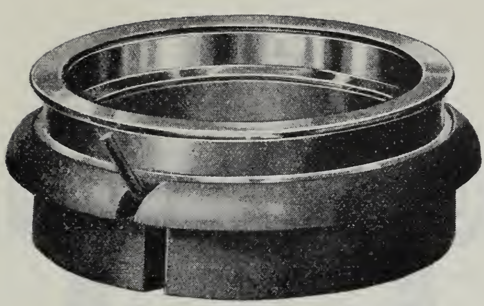
In view of the mirror-like appearance of these rings we adopted as a trade mark the word Mirror and have registered this trade mark in the United States Patent office and also in Canada.

Customers purchasing Mirror spinning rings may rest assured that they will obtain the best that can be furnished in shape, finish and durability.

RING WITHOUT HOLDER.



RING WITH PLATE HOLDER.



Ring With Cast Iron Holder
and Knight's Patent Traveler Clearer.

SPINNING RING FLANGES.

It has been customary ever since ring spinning was first introduced, to use the standard or number 2 width of flange for all classes of spinning, whether the ring was one and one-quarter inches in diameter, or two and one-quarter inches. This system worked well so long as ring spinning was confined to coarse and medium numbers of yarn, but with the introduction of finer ring-spun yarn, it has been found advisable to reduce the width of the flange so that the traveler can also be reduced in circle, and therefore use a wire with greater diameter without increasing the weight. A small circle traveler cannot be used on the ordinary width flange, as it will not stretch over without breaking. We have been selling the small or number 1 flange ring for years, our sales having increased rapidly. We recommend it especially for fine and medium numbers, and it is being used successfully for as large as two inch rings.

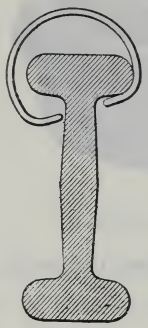


FIGURE 1

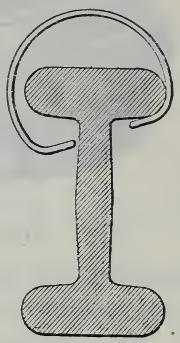


FIGURE 2

The above cuts are self-explanatory, being drawn on enlarged scale. The number 1 flange is shown in Figure 1 and is the narrow width to which we refer. The number 2 flange is shown in Figure 2 and is the old standard width. We sell the number 1 flange and number 2 flange rings at the same price.

RING WITH NUMBER 1 FLANGE

PRICES OF MIRROR SPINNING RINGS.

TRADE MARK REGISTERED IN U. S. PATENT OFFICE AND ALSO REGISTERED IN CANADA.

DIAMETER IN INCHES.	PRICES OF DOUBLE RINGS.	
	With either Cast Iron or Plate Holder.	Without Holder.
1	14 cents.	10 cents.
1 1-16	14 "	10 "
1 1-8	14 "	10 "
1 1-4	14 "	10 "
1 3-8	14 "	10 "
1 1-2	14 "	10 "
1 9-16	14 "	10 "
1 5-8	14 "	10 "
1 11-16	15 "	11 "
1 3-4	16 "	12 "
1 13-16	17 "	13 "
1 7-8	18 "	14 "
1 15-16	19 "	15 "
2	20 "	16 "
2 1-8	22 "	18 "
2 1-4	24 "	20 "

In lots of 5000 or more, taken in any one year, a discount of 10 per cent. will be allowed from the above prices.

For guaranteed round rings, add two cents each.

For burnished rings, add two cents each.

For traveler clearers with cast iron holders add one cent per ring.

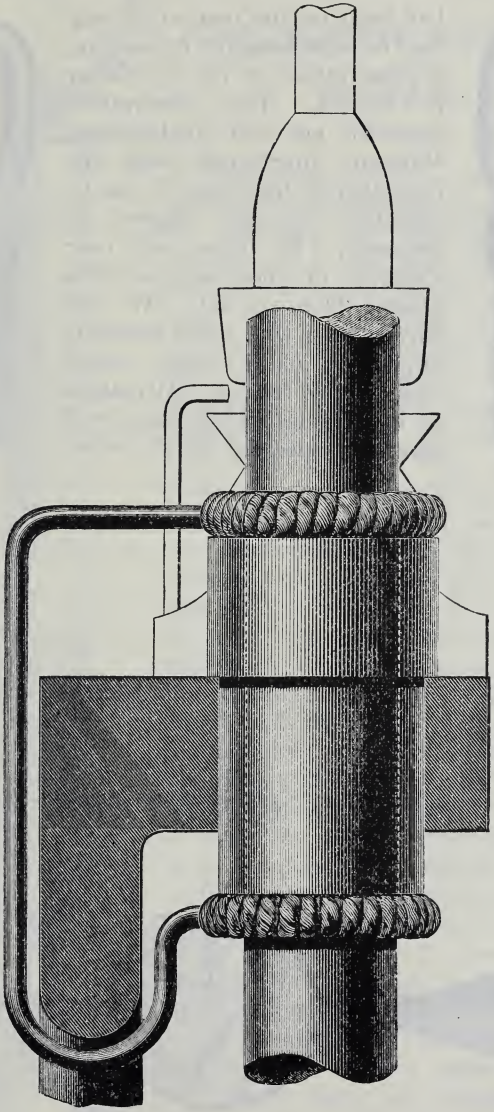
SHAW & FLINN'S LIFTING ROD CLEANER.

This simple and practical invention, which is shown in cut on opposite side full size for three-quarter inch lifting rod, is the result of a necessity for something that will prevent the frequent sticking of lifting rods.

Everyone familiar with the details of spinning cotton yarn knows that dirt and lint will adhere to the lifting rods and be carried into the bushings or guides set in the frames for the rods to work in; this accumulation of dirt will wear the rods, and sooner or later is liable to stop one or more on a frame.

This attachment is made of wire, covered where it passes around the lifting rod with a twisted and braided cord, which fits the rod closely, but not tight enough to cause undue friction; the elasticity of the wire and its covering prevents any liability of sticking on account of collection of dirt. The two parts or covered rings are formed at the ends of one piece of wire, which is bent to pass over the back side of the rail holding the bushing through which the rods run. In forming the cleaner, sufficient spring is given to the wire to cause the rings to fit closely to the top and bottom of the bushing.

The lifting rod cleaner has been in successful use for years. We recommend it as a cheap and convenient attachment, requiring but a moment to put on, effectually preventing wear and sticking of lifting rods, adding to the neatness of frames, and reducing the amount of oil required for lubricating the rods to the least possible quantity. With this device the rods will not require oiling more than once in two or three weeks.

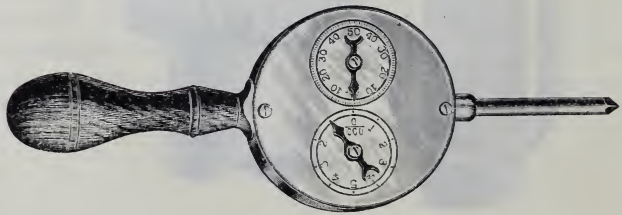


SHAW & FLINN'S LIFTING ROD CLEANER.

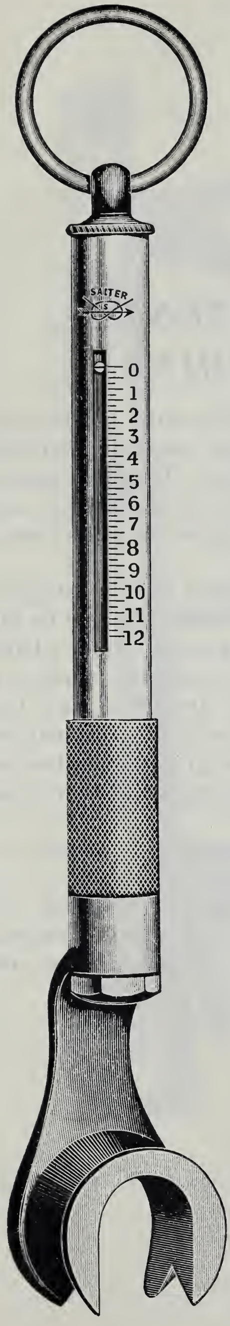
THE SPEAKMAN LEVER SCREW

has been on the market so long that no explanation of its working or dissertation on its superiority is needed. The illustrations herewith are self explanatory. Without interfering with the operation of the frame it can be adjusted to any degree of accuracy. We have sold over 4,000,000 of these screws since placing them on sale. We can furnish them with screw thread to duplicate old screws when changing old frames. All makers of new frames include these lever screws if specified on the order.

SPEED COUNTERS.



We are prepared to sell speed counters like the above. Connected with a piece of rubber tubing they are of great assistance in taking spindle speeds.



THE BAND TENSION SCALE.

This device is to the spinning room what an indicator is to the engine room. It multiplies the efficiency of the overseer, or second hand, although the results are shown at the coal pile, rather than in their immediate departments. It is important to the spinning room to have its bands adjusted to a uniform scale of tension, so that they will wear longer, and protect the weave room against slack yarn. The band scale absolutely determines the exact tension of any band, or number of bands.

To use the scale, the frame must be stopped, and if the spindle is of the old type with a hook, the hook must be turned. The whorl of the scale is then applied by its slot, under the whorl of the spindle, which will thereby be raised, and the band is slipped off the spindle whorl onto the band scale whorl. By drawing the lower whorl even with the spindle whorl, the tension is shown on the scale. New bands should pull from three to four pounds. It is a mistake to put them on at any higher tension. A spindle should run with a pull of one pound and if it does not turn freely with this tension, it either needs oiling or is too tight in its bearings.

The band tension scale can be made to earn its cost many times over in a very short time, by intelligent use. Send sample spindle with order. This is absolutely necessary as the whorl on the scale must be an exact duplicate of the whorl on the spindle.

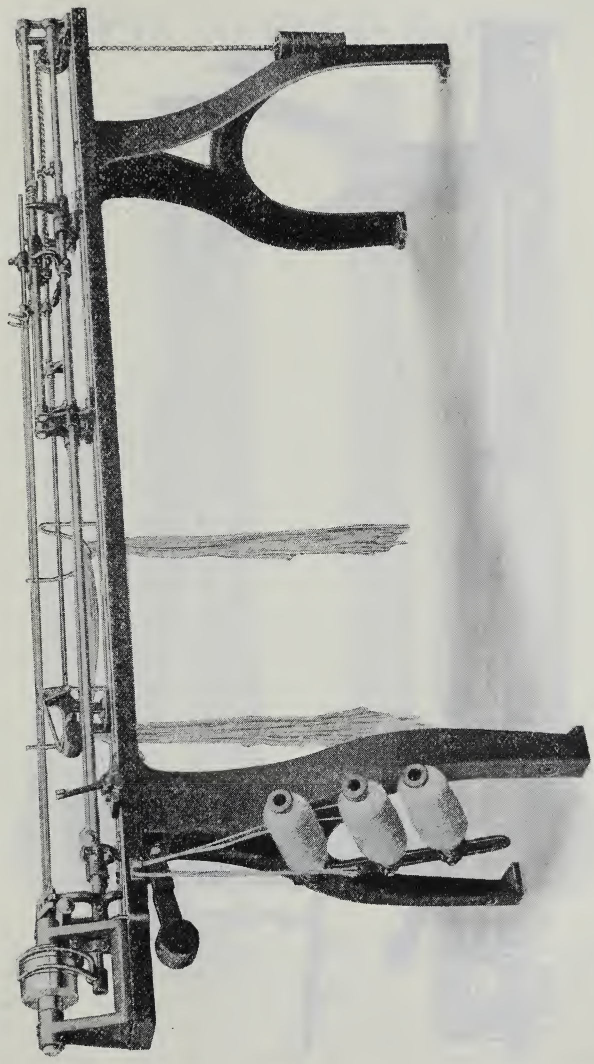
RHOADES PATENT BANDING MACHINE.

Our banding machine as now manufactured includes all the good features of the original Weeks machine combined with the Watters marking attachment, Rhoades patent improvement to prevent spattering the ink in marking, and Rhoades patent arrangement for making bands with reverse twist.

It is semi-automatic in action, changing from twisting to doubling, and stopping when the band is done. It can be set to obtain any desired amount of twist, making either a hard or a soft band. A marking attachment marks the bands at a uniform length to indicate where they are to be tied; the band hook slide has a graduated scale so that bands may be made to a predetermined length; by changing the position of the belt shipper, bands can readily be made with reverse twist.

At a speed of about 2000 revolutions per minute an operative can produce as high as 1500 bands per day.

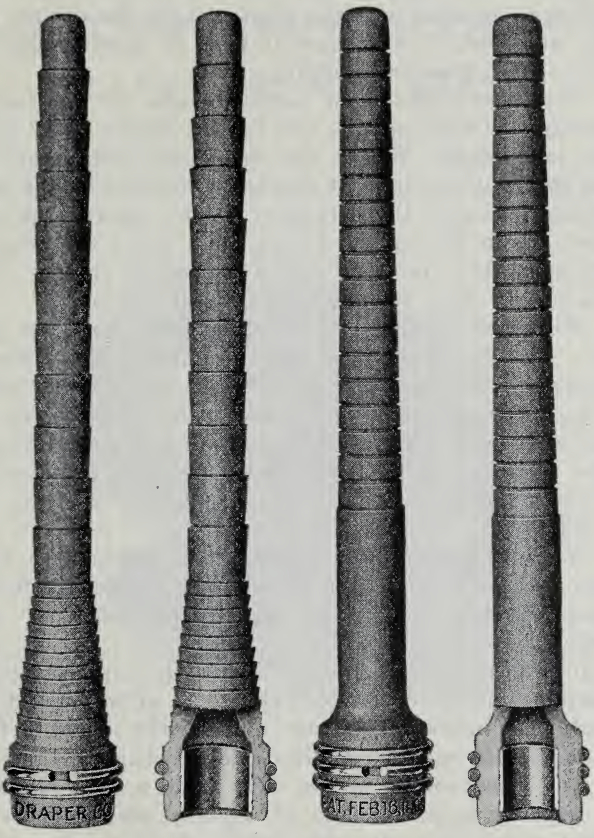
For years our machines have been the standard for making bands for spinning frames, spoolers and twisters. We carry them in stock both in Hopedale and Atlanta, and can fill orders promptly.



RHOADES PATENT BANDING MACHINE ADJUSTED FOR REGULAR TWIST.

RHOADES PATENT BANDING MACHINE ADJUSTED FOR REVERSE TWIST.

HASTINGS PATENT METAL BUSHED BOBBIN.



For years the injury to filling bobbins by the various processes of conditioning yarn has been a source of annoyance to spinners and weavers and of expense to the mills. In the process of conditioning, the bobbins swell, reducing the size of the hole at the bottom, and causing them to stand at various heights on the spindles in the spinning frame; this calls for reaming to fit the spindles; after repeated reaming the wood is so reduced that on Northrop bobbins the heads contract in outside diameter and the rings following the surface of the wood become loose, or fail to fit the shuttle springs, thus ruining the bobbins.

The bobbins shown on page 201 were patented by Mr. Walter M. Hastings of Methuen, Mass. and the patent is owned by our Company. The important feature of its construction is the insertion of a metal bushing in the base of the bobbin, opposite the rings on the exterior. This bushing co-operates with the rings to hold the wood in place when subjected to extremes of heat or moisture and thus secures much greater durability.

Our illustrations show bobbins made for the Rabbeth Centrifugal Clutch spindle and for the Draper No. 2 spindle with solid whorl. Where the centrifugal clutch spindle is used the bobbins stand at absolutely uniform height on the spinning frame, as the bottom of bobbin rests on the top of whorl. With the spindle having solid whorl the height of bobbins on the frame is nearly the same, subject to the variations in shape of spindle whorls and bobbins.

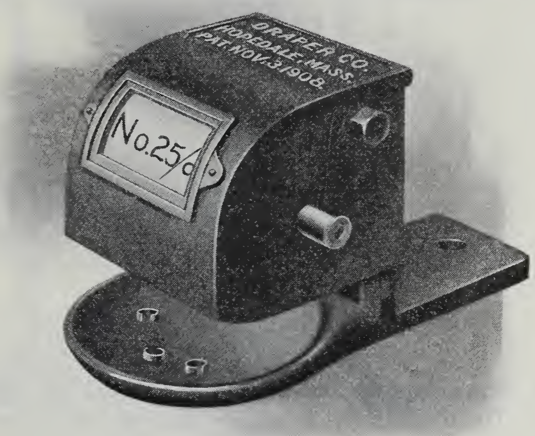
We began to introduce these bobbins about five years ago. The result of the early sample orders was so encouraging that several mills adopted this form of bobbin as their standard. There are now over 22,000,000 of such bobbins in daily use, demonstrating in a practical way our claim that this is the best Northrop loom bobbin on the market when viewed from the points of efficiency and economy.

We are prepared to furnish this bobbin with either feeler or cone for Northrop Looms, with any desired form of outside shape, and to fit centrifugal clutch or other standard patterns of spindles.

In ordering these bobbins for solid whorl spindles we call special attention to the following: As above stated, the whorls of spindles vary in size, and bobbins should be fitted to samples having the smallest size of whorl. In this case the only disadvantage is that they stand a little higher on the larger whorls; whereas if bobbins are fitted to the largest whorls they may ride loosely on the smaller whorls and thus make slack yarn.

Customers ordering bobbins for solid whorl spindles are requested to send a sample spindle with a file mark on whorl to locate bottom of bobbin.

DUCKWORTH'S PATENT TRAVELER MAGAZINE.



One of the regular expenses of operating ring spinning frames is the replacement of travelers. This expense, which amounts to a large sum in the aggregate, is due to two causes. First, the actual wear, and second, the loss of travelers which are never used at all. The number lost or thrown away is estimated by spinners to be fully as great as the number actually used. Observations in spinning rooms show travelers distributed the entire length of creel boards, also in the pockets of doffers and spinners and other convenient places from which they are later dropped to the floor or thrown away.

Travelers have a faculty of bunching together as shown in illustration, so that it is difficult, if not impossible, to separate them without loss.

The Duckworth Traveler Magazine takes a bunch of the travelers, and in regular operation drops them singly so that there is no excuse for losing travelers in handling.

An opening is provided for a label to indicate the size in use.

A comparison of the two illustrations tells the whole story. The magazine will pay for itself in a very short time.

THE MOSCROP PATENT SINGLE THREAD YARN-TESTING MACHINE.

THE MOSCROP PATENT SINGLE THREAD YARN-TESTING MACHINE ARRANGED FOR BELT DRIVE.

Notwithstanding the development in textile manufacturing during the past few years and the improvements in various machines used in cotton mills, one process of vital importance has been practically at a standstill, namely, the accurate testing of yarns.

In England, where mills are divided between spinners, and weavers or purchasers of yarn, tests to determine the standard of product are a recognized part of doing business, and the Moscrop Single Thread Testing Machine is used to settle the basis of buying and selling.

In this country it is equally important to ascertain the quality of the product even if yarns are both spun and woven in the same mill. The weaving value of warp yarn does not consist in the joint strength of a combined number of threads but in the regularity of the strength, and the weaveability of the single individual threads. Therefore a completely satisfactory test must take cognizance of the single individual threads.

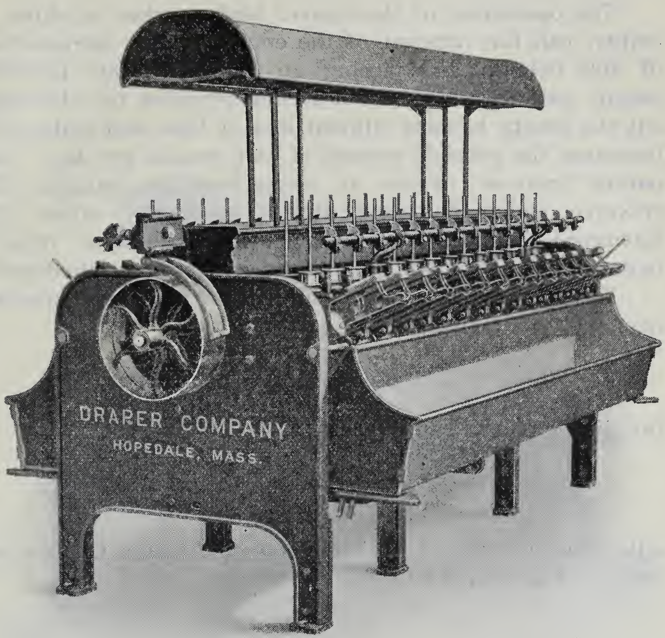
The Moscrop testing machine, for which we have the agency for the United States, can be used to determine the relative value of different lots of cotton, as well as the strength and regularity of the yarn as influenced by the spinning and other processes of manufacture. The fact that some threads may be very strong, and the average strength high, does not relieve the mill from the consequences of loss of production caused by frequent breakage of the weaker threads. Put in concrete form: if in a warp of 2000 threads, 1500 are of superior working quality while one in four, or 500 threads, are weak and irregular, the superiority of the three-fourths is of little consequence, as the production will be so seriously hindered by the stoppages to piece up the breaks in the faulty one-fourth.

The Moscrop machine is driven by power, either motor or belt as preferred, and takes six bobbins or cops of yarn at one time, seizes the yarn ends, winds off a certain length, and then breaks it through spring pull; the breaking strength being registered on a diagram paper.

The machine is provided with weights for testing the accuracy of the springs.

Hundreds of these machines have been sold in Great Britain and on the continent.

We shall be pleased to make tests of samples of yarns for our customers if desired.



E Model Spooler with Side Boxes.

SPOOLERS.

Since entering the field in the early seventies, our spooler has fixed the standard of quality in general design, effectiveness in operation and patented attachments furnished. We introduced the original Wade bobbin holder and the adjustable thread guide, both of which have been greatly improved by our own inventors in recent years. We made the first steel side boxes and top creels; the first all metal spooler; the first machine with adjustable feet for ends and sampsons, and the first single rail spooler.

The spooling of yarn involves a large amount of labor per machine, or in other words is an expensive process, and it is therefore important to adopt such construction as will improve the quality of the output or reduce its cost. Regularity of spindle speed is essential to obtaining a maximum product; slack bands are responsible for a large loss in production.

The operations of the spooler tender, when a bobbin is empty, call for removal of the empty bobbin; introduction of full bobbin; and piecing up the end. Our Rhoades patent self ejecting bobbin holder provides for throwing out the empty bobbins without loss of time and materially increases the possible amount of yarn spooled per day. Our patent traverse motion is convenient in changing the traverse and our patent thread guides of either the Lawrence, MacColl or Improved Northrop type remove imperfections from the yarn to the greatest possible degree.

We offer our customers four distinct models of spooler, namely:

E MODEL,

the pioneer single rail spooler.

H MODEL,

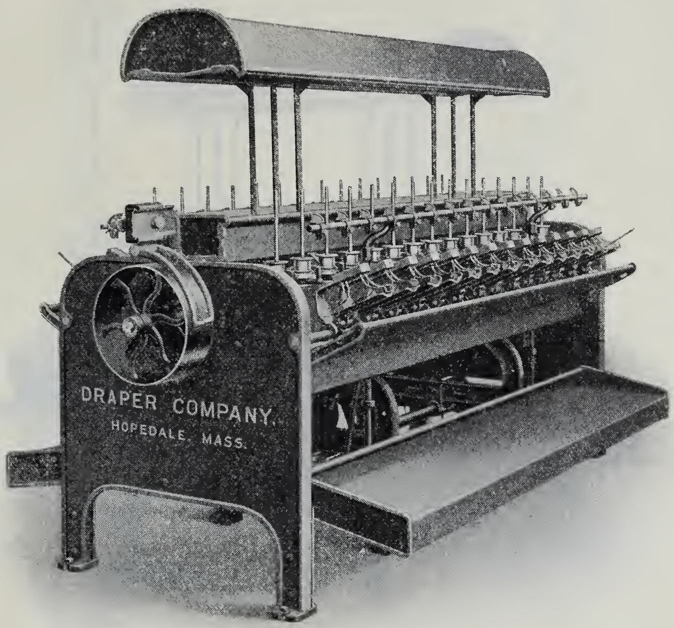
with Rhoades patent Traverse motion, Bobbin Chutes and side ejecting bobbin holders.

I MODEL,

with separate traveling belts for empty bobbins, side ejecting bobbin holders, and Rhoades patent traverse motion.

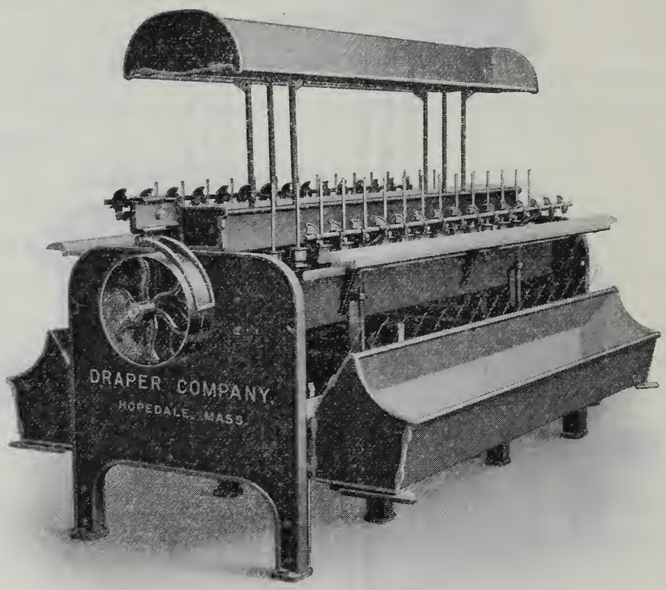
L MODEL,

with tape driven spindles, otherwise with improvements similar to I model.



E Model Spooler with Side Shelves.

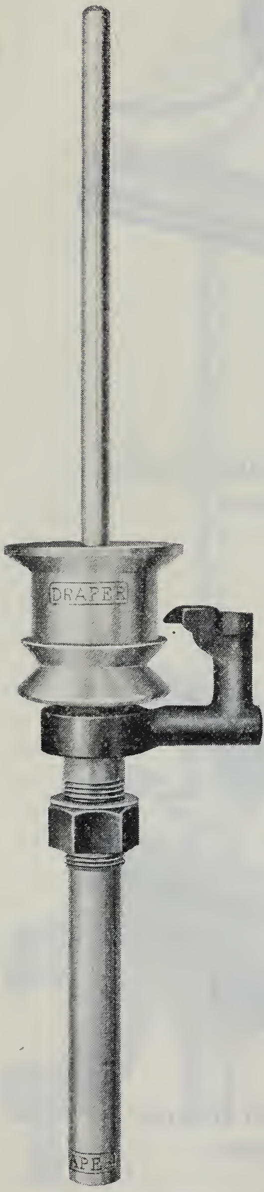
Our E Model Spooler is made entirely of metal; it is equipped either with side boxes as shown on page 207 or with side shelves for removable boxes as illustrated above; it may be provided with skewers and side friction strips for spooling from cops or bobbins with filling wind.



E Model Spooler

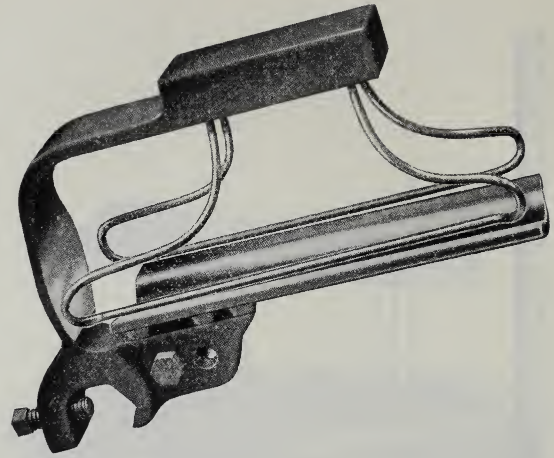
With Side Boxes and Friction Strips.

The traverse motion is of the lifting rod type; a change gear governs the speed to produce a faster or slower traverse; another gear determines the length of traverse. A patented compound rocker arm prevents breakage in case a spool gets under the traveling rocker.

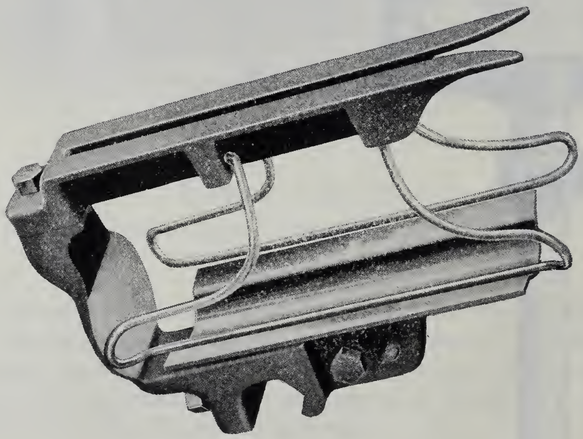


The spindle is of single rail pattern with Woodmancy retaining lock and oil cap. In banding the spindles, one band drives two spindles, one on each side of the machine.

Spooler Spindle.



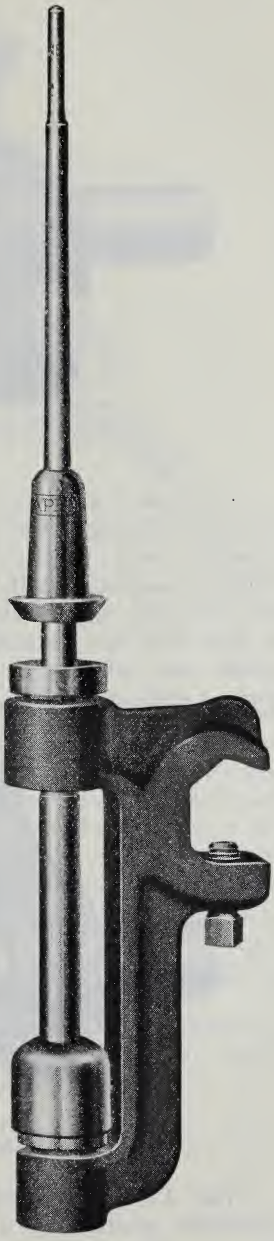
THE LAWRENCE PATENT BOBBIN HOLDER.
STANDARD PATTERN.



LAWRENCE PATENT BOBBIN HOLDER.
CENTRE DRAW PATTERN.

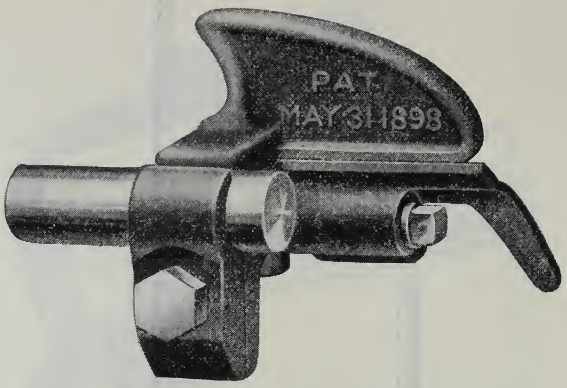
This spooler is equipped with the Lawrence patent bobbin holder of either the standard or centre draw pattern as the size of yarn may require.

SPOOLER END SPINDLE.



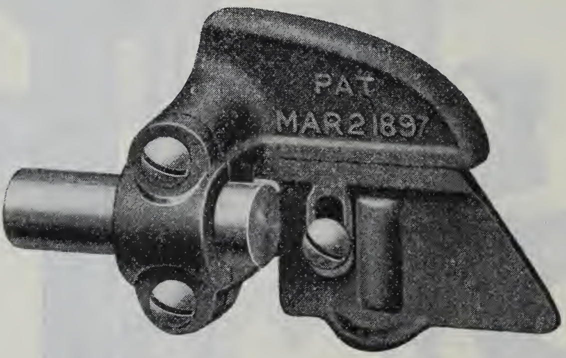
SPOOLER SIDE SPINDLE.

We also furnish side spindles instead of bobbin holders if desired. An end spindle for tangled yarn replaces one bobbin holder on each side of every machine.



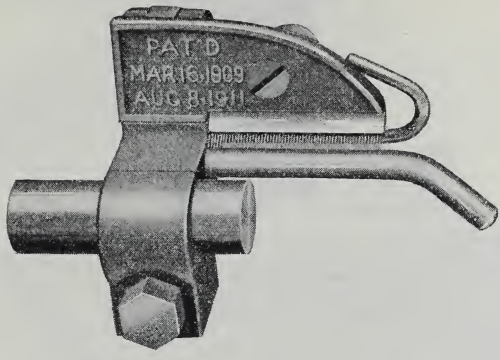
IMPROVED NORTHROP GUIDE.

In thread guides we furnish several patterns. The Improved Northrop Guide has the lower jaw mounted on an eccentric bolt which provides an accurate adjustment without loosening on the rod. If the slot becomes clogged the lower jaw may be slightly tipped thus exposing the edge so that lint may be removed. With all our spooler thread guides the rod may be turned to present a new wearing surface without changing adjustment of the guide jaws.



LAWRENCE GUIDE.

The Lawrence guide has the lower blade held in operative position by a concealed spring which is easily compressed when the jaw is opened for removal of lint. A separate screw adjustment provides for setting the jaw to give the right opening for the size of yarn to be spooled.



MacColl Guide.

The MacColl Guide works on a different principle from any other guide on the market. It does not scrape the yarn but the points of the teeth in the comb on the adjustable jaw catch loose slubs, bunches or imperfections that would pass through other guides; as it allows a larger opening in the setting, it will allow small piecings and knots which are unobjectionable to pass through. The teeth in the comb of the MacColl guide are usually 25 per inch for yarns up to 40^s; and 40 per inch for 40^s and finer. By the use of gauges similar to the illustration the guide can readily be adjusted to the size of yarn.

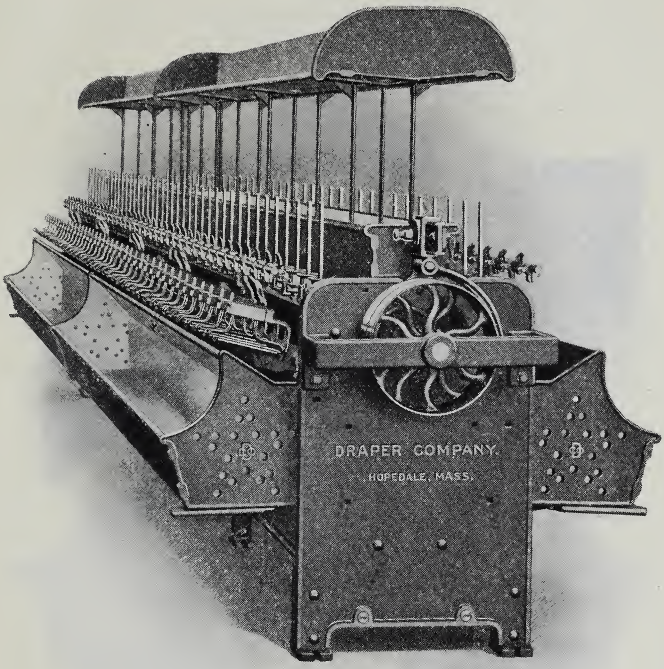
The standard lengths of jaws in our thread guides for upright spoolers are 1½ inches and 2 inches; all are made with longer jaws when desired for use on winders.

GAUGE FOR SETTING
MACCOLL THREAD GUIDES.

The following table shows the thickness of gauges in thousandths of an inch which we recommend for different numbers of yarn.

GAUGES FOR MACCOLL SPOOLER GUIDES.

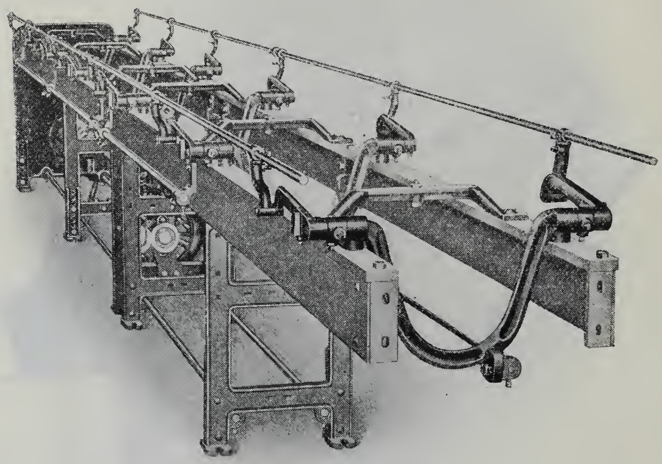
Yarn No.	Gauge.	Yarn No.	Gauge.
10	.044	60	.018
15	.040	65	.018
20	.036	70	.016
25	.032	75	.016
30	.028	80	.015
35	.024	85	.015
40	.022	90	.014
45	.022	95	.013
50	.020	100	.012
55	.020		



H Model Spooler.

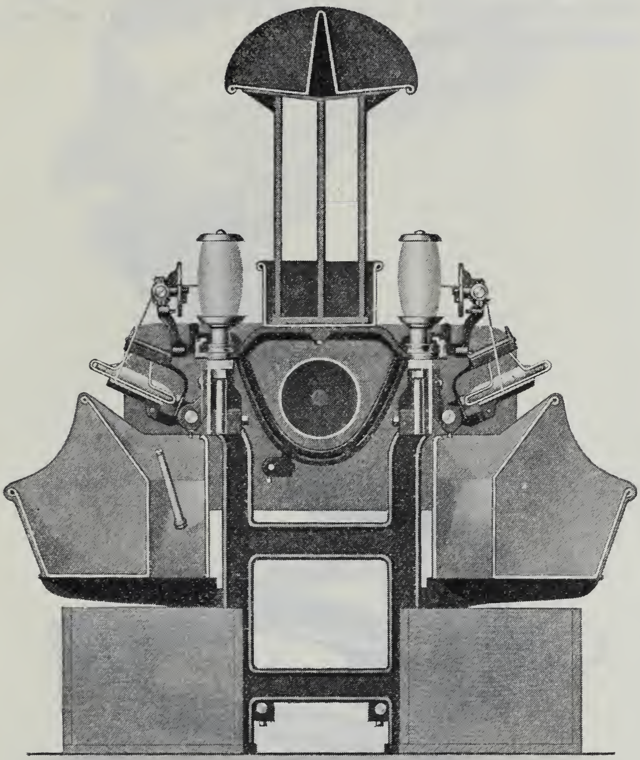
Our H Model spooler allows the empty bobbins to be dropped back of the side boxes where they pass into chutes from which by opening a slide they may be dropped into a box placed below. The construction is made clear by the sectional illustration.

The H Model spooler is made with Rhoades patent traverse motion which does away with lifting rods and their attendant troubles.



DETAIL OF PATENT TRAVERSE MOTION.

By imparting a lengthwise motion to the rods carrying the spooler thread guides, wear and clogging of the guides is reduced and there is less breakage of yarn. This motion is so arranged that changes in length of traverse of yarn on the spool may easily be made; a change of one tooth on the change gear varies the traverse $\frac{1}{8}$ inch.

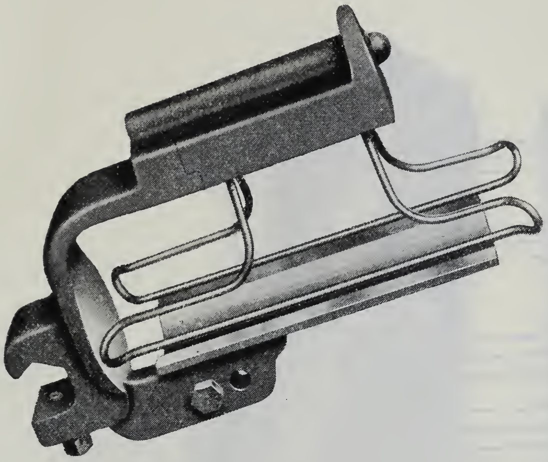


H Model Spooler.
Sectional View.

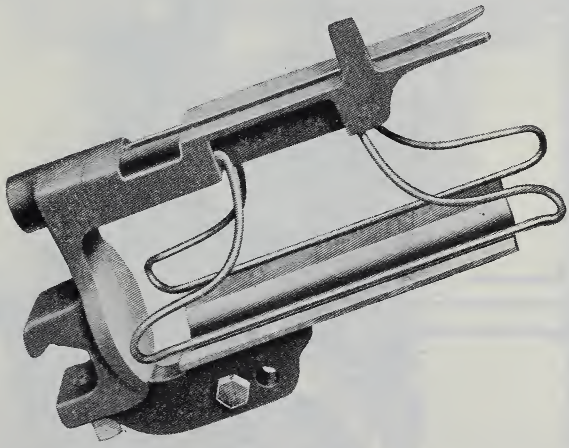
We furnish Rhoades patent side-ejecting bobbin holder which is used only on our chute, or belt spoolers. This bobbin holder saves time of the spooler tender in changing bobbins; a slight motion of the hand will empty several holders at the same time.

RHOADES PATENT SIDE-EJECTING BOBBIN HOLDER.

This bobbin holder is made with either standard or center draw as the size of yarn may require.

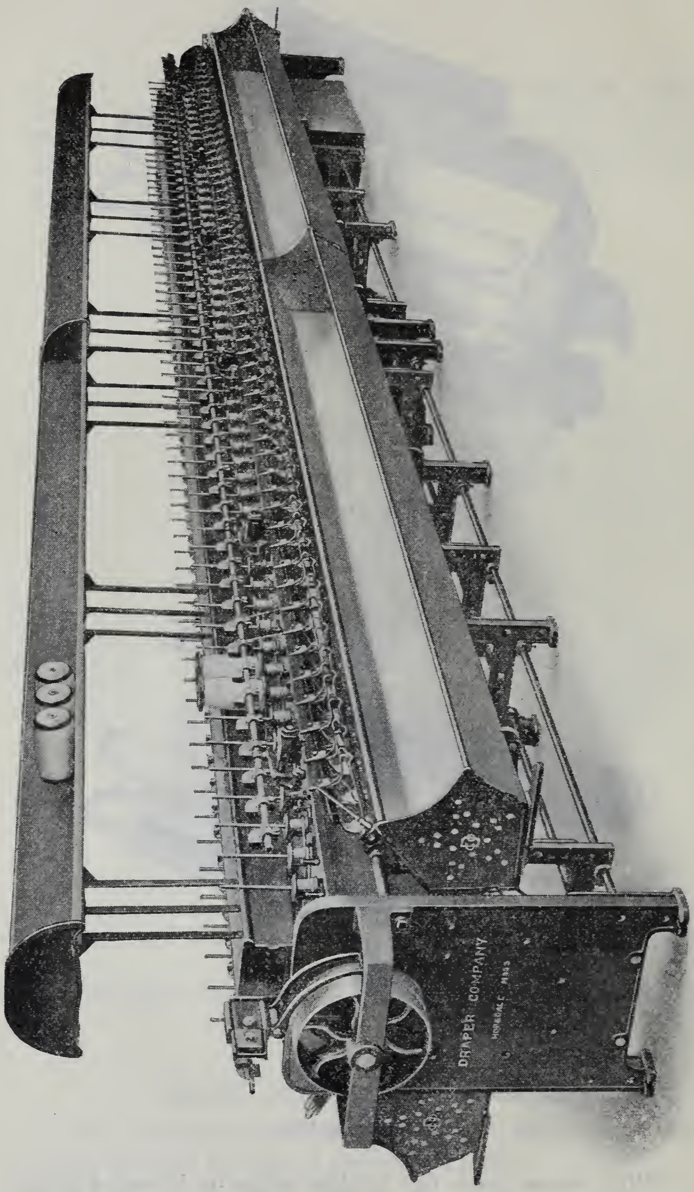


RHOADES PATENT BOBBIN HOLDER.
SIDE DRAW.

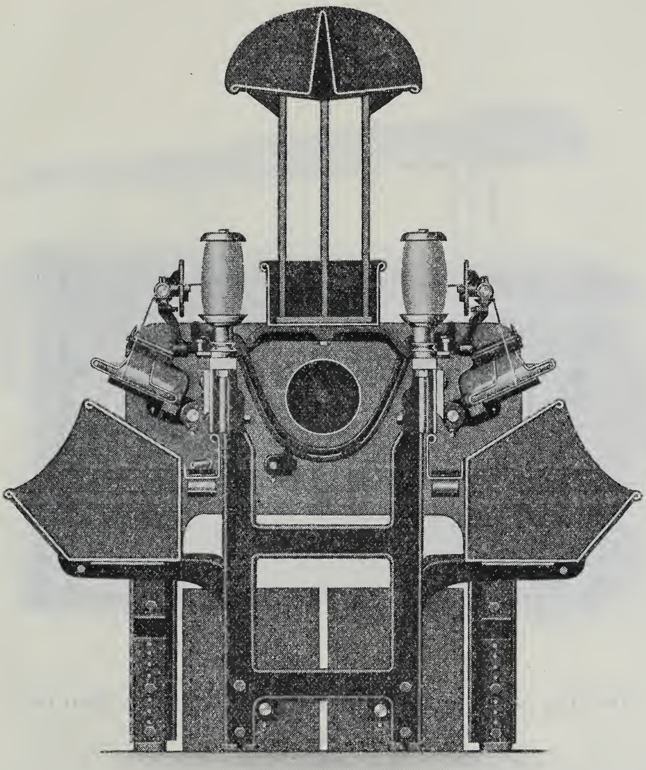


RHOADES PATENT BOBBIN HOLDER.
CENTER DRAW.

With coarse yarn this bobbin holder is threaded in the usual way, under the wire. With fine yarns it is threaded through the slot so as to reduce the strain on the yarn from the bobbin to the spool.



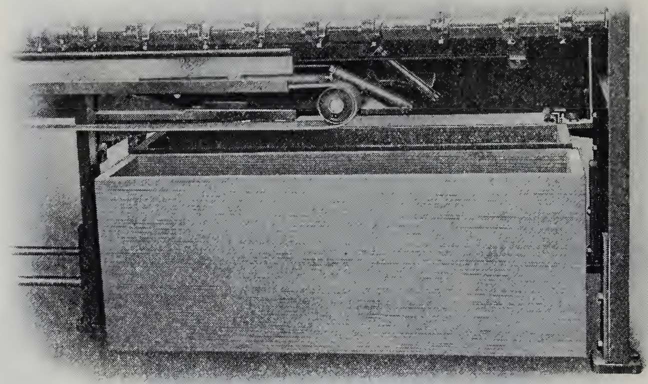
I Model Spooler.



I Model Spooler.

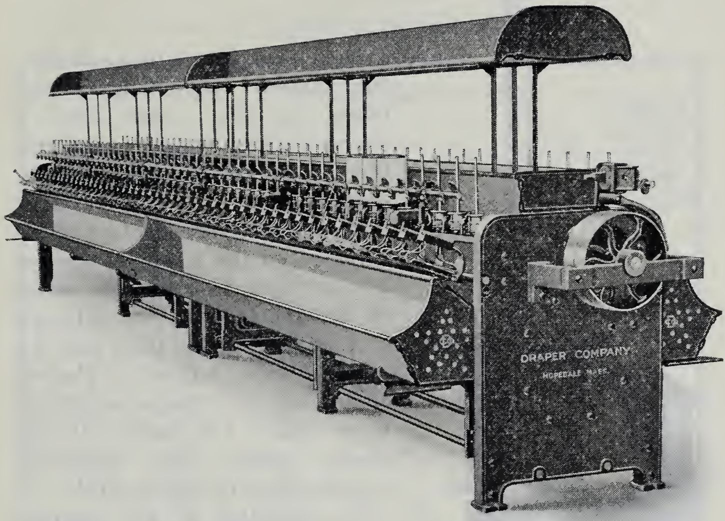
Sectional View.

The I Model Spooler has traveling belts which collect the empty bobbins in boxes at one end of the machine. Having two belts which keep the bobbins from each side of the machine separated, the responsibility for bad work may be readily placed where it belongs.



DETAIL OF SEPARATE BOXES AT DISCHARGE END OF TRAVELING BELTS.

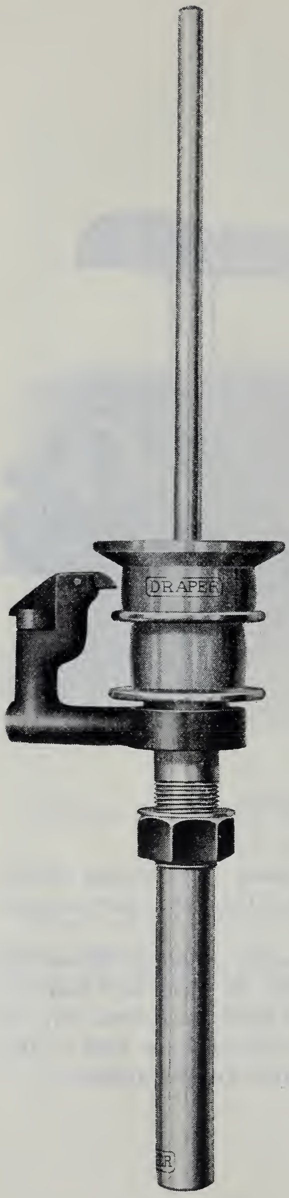
The bobbin holders and thread guides used on the I Model Spooler are the same as for the H model. The traverse motion is also the same.



L Model Spooler.

Our L Model Spooler is the latest construction on the market and has been newly designed from the start to meet the requirements of our customers.

Recognizing the fact that spooler spindles driven by bands in the usual way vary greatly in speed and that the bands are seldom, if ever, replaced until they come off, we have made a spooler spindle to be driven by a tape on the same general system as our tape-driven twister spindle.



Each tape drives four spindles; our patent equalizing device takes up the slack and a compensating weight regulates the tension on each group of four spindles.

By changing the location of the cylinder on the L Model Spooler we are able to keep the width of the machine at the old limit of four feet; at the same time we provide wider boxes and shelves on the top of the spooler, giving more room for both full and empty spools, an important consideration on coarse work.

The spindles in the machine stand two inches nearer the operative than in our other spoolers, making that distance less to reach in piecing up the ends; this renders the work of the spooler tender less tiresome and incidentally increases her efficiency.

TAPE-DRIVEN
SPOOLER SPINDLE.

PRODUCTION OF SPOOLERS.

Dimensions of Spool. Length between heads.	Dimensions of Spool. Diam. of heads.	Number of Yarn.	Revolutions per minute of the Cylinder, 200. Spindle, 750.	Cylinder, 220. Spindle, 825.	Cylinder, 240. Spindle, 900.	Number of Rabbeth spindles to 1 spooler spindle, running at 825 revolutions per minute.
			Pounds per spindle per week of 60 hours.			
		8	64.3	70.7	77.1	
		10	51.4	56.6	61.7	12
6	5	12	42.9	47.1	51.4	
		14	36.7	40.4	44.1	
		16	32.1	35.3	38.6	13
		18	28.6	31.4	34.3	
		20	25.7	28.3	30.9	
		22	23.4	25.7	28.1	14
		24	21.4	23.6	25.7	
5	4	26	19.8	21.8	23.7	
		28	18.4	20.2	22.0	15
		29	17.7	19.5	21.3	
		30	17.1	18.9	20.6	
		32	16.1	17.7	19.3	16
		34	15.1	16.6	18.1	
		36	14.3	15.7	17.1	
		38	13.5	14.9	16.2	17
4½	3½	40	12.9	14.1	15.4	18
		44	11.7	12.9	14.0	19
		50	10.3	11.3	12.3	20
		60	8.6	9.4	10.3	21
3½	3¼	70	7.3	8.1	8.8	23
		80	6.4	7.1	7.8	25

This table applies to spoolers with 6 inch cylinders and band driven spindles with 1½ inch whorls.

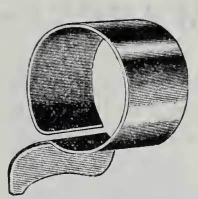
While our spoolers may be operated at as high speeds as those of any other make, we advise low speeds as they give less strain on the yarn.

DIMENSIONS OF SPOOLERS.

Gauge	3½	3¾	4	4¼	4½	4¾	5	5¼	5½	5¾	6	6½
Diam. head of spool.	2¾	3	3¼	3½	3¾	4	4¼	4½	4¾	5	5¼	5¾
No. of spindles.	Lengths in feet and inches.											
60	10 2½	10 9¾	11 5	12 ¼	12 7½	13 2¾	13 10	14 5¼	15 ½	15 7¾	16 3	17 5½
80	13 1½	13 11¼	14 9	15 6¾	16 4½	17 2¼	18 0	18 9¾	19 7½	20 5¼	21 3	22 10½
100	16 ½	17 ¾	18 1	19 1¼	20 1½	21 1¾	22 2	23 2¼	24 2½	25 2¾		
120		20 2¼	21 5	22 7¾	23 10½	25 1¼	26 4	27 6¾				
150				27 11½	29 6	31 ½						

Width, including side boxes, four feet.

To ascertain the length of a spooler multiply one-half the number of spindles less 1, by the gauge in inches, add 21 inches to the product and divide by 12; the quotient and remainder will be the length over all in feet and inches for a machine with pulleys having 2 inch face. If pulleys with more than 2 inch face are used, add to these figures for length twice the added width face of pulley. Example—with 2½ inch face pulleys add 1 inch.



THE BOURNE AND JOHNSON SPOOLER TENDERS' KNOT TRIMMER.

As a large share of the warp breaks at the loom are due to bad knots at the spooler, the making of perfect knots is important. A spooler's knot is usually so tied that the body of the knot is at one side of the yarn, whereas a weaver's knot is smaller in diameter and is central with the yarn; if the spooler's knot is slightly loose it projects still more, and if the ends are not cut short the protruding ends may cause warp breakage in the loom.

It is a matter of economy to educate the spooler tenders to make small knots with closely trimmed ends; in the knot tying process at the spooler there is but one thread of yarn involved and the labor of a cheap operative, while at the loom every warp break means the labor of a weaver at high wages and the stoppage of the entire loom product with perhaps several thousand warp threads.

Spooler knot tyers, partially automatic, are used by many cotton mills, but until they are made to tie weavers' knots and cut the yarn with short ends, there is still room for invention.

Meantime in mills where the knots are tied by hand, the Bourne and Johnson cutter which we have sold for years will be found a convenience to the spooler tender and to reduce warp breakage in the weave room.

WARPERS.

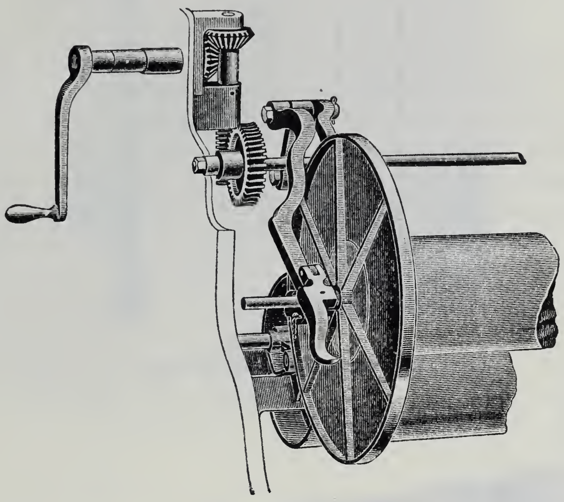
The warper occupies a position between the spooler and the slasher. The function of the machine is to wind a beam of yarn from a creel supplied with the number of spools that will give the desired number of ends of yarn on the beam. We began the manufacture of warpers some forty-five years ago, soon after the invention of the slasher. We have introduced practically all the improvements which are found on modern warpers, including the rise roll; the slow motion for starting; the small cylinder, which made possible a reduction in both height and width of the machine; the Hicks' cone drive which increased the production; the Walmsley stop motion; the Rhoades beam doffer; the best expansion combs; the glass creel step; the Straw breakage recorder, etc.

As warping is a relatively inexpensive process and an equipment of warpers for a mill represents but a small proportion of the total cost of its machinery, no mill can afford to operate warpers that do not contain the most improved devices. It is also important to purchase a sufficient number of warpers to handle the entire output with the machines running at moderate speed. In warping, as in spooling, high speeds increase the breakage of the yarn, thereby multiplying the number of knots; also the increased strain on the yarn due to high speeds reduces its elasticity.

Among the improvements which we strongly recommend are the following:

The Hicks' Cone Motion; this cone drive compensates for the difference in tension between the full and nearly empty spools; by increasing the speed of the warper when the spools are full and gradually reducing as they are emptied, the cone-motion without adding to the strain on the yarn will increase the net product of the warper about one-third. In equipping a new mill the reduced number of machines and saving in floor space is an important consideration. It is safe to figure that four cone warpers will do the work of five warpers without the cone drive.

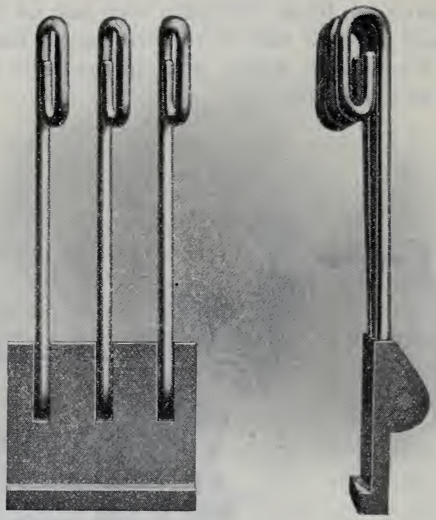
The Rhoades Beam Doffer; the use of this device makes it easy for one man to remove the full beam of warp and put in a new beam where, without the beam doffer, two men would be a necessity.



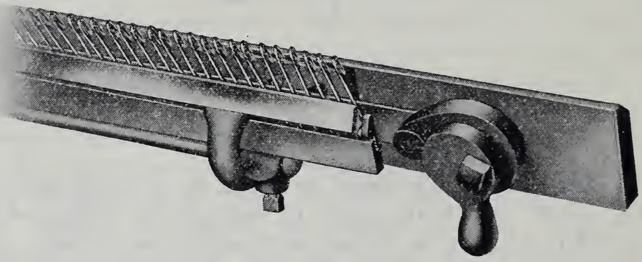
Beam Doffer.

The Small Cylinder; by using an eccentric drive we can allow the beam head to overlap the centre of the cylinder enabling us to use much larger beam heads. This feature as well as the beam doffer is shown in the above cut. By the use of the small cylinder the warper is made both lower and narrower so that the ends may be tied in with greater ease.

The Walmsley Stop Motion; this stop motion uses a hinged wire which relieves the yarn from weight as compared with the old drop wire system; our warper stop motions are provided with a locking bar and eccentric release which enable the removal of a group of wires at any point; the illustrations show the locking bar in position and also raised for removal of a section of drop-wires. The stop motion is furnished with two banks of drop wires for 450 ends or less; for more than 450 ends we recommend three banks.

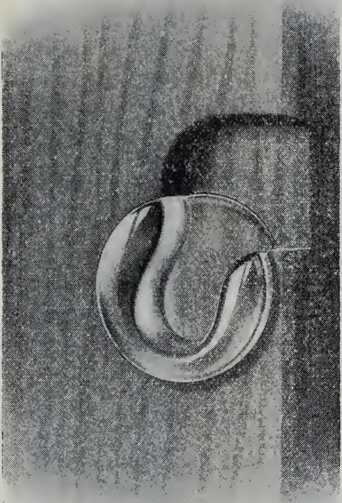


WALMSLEY DROP WIRES.

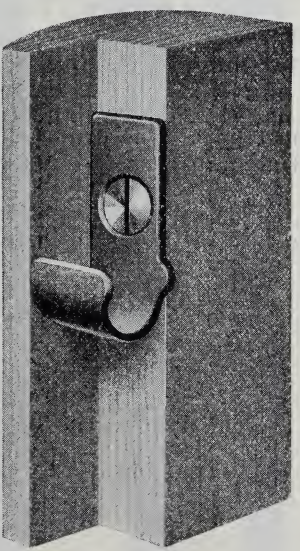


WALMSLEY WIRES LOCKED IN POSITION.

LOCKING BAR RAISED FOR REMOVAL OF WIRES.



In Creel Steps we furnish the patent glass steps which we recommend for yarns No. 40s and finer and for coarser numbers if tender or with large spools carrying a heavy load.



Our Iron Creel Steps are standard for ordinary numbers and conditions; the projection on the side of the step keeps the head of spool from rubbing against the creel.

FOR MEASURING we have substituted seamless drawn brass tubing for the tin rolls formerly used, as the tubing is much more uniform in circumference and more nearly round.

THE STRAW BREAKAGE RECORDER is furnished at a small additional charge when ordered and is a valuable attachment for detecting and recording the number of times a warper stops for broken threads; a dial with pointer shows this breakage at a glance.

OUR SLOW MOTION reduces the strain on the yarn in starting the warper.

OUR IMPROVED EXPANSION REEDS AND COMBS are so arranged as to allow freedom of movement; the round wires in our front combs present a smoother surface to the yarn than flat wires and the regular spacing winds the yarn so as to make a smoother beam.

We make several varieties of warper reeds and combs.

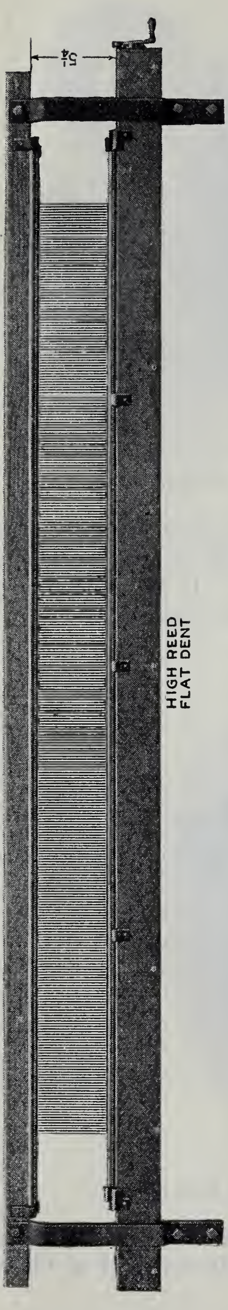
1st. The front comb, or comb next the beam. This is open on the top.

2nd. The lease comb. This is used when leasing motion is ordered.

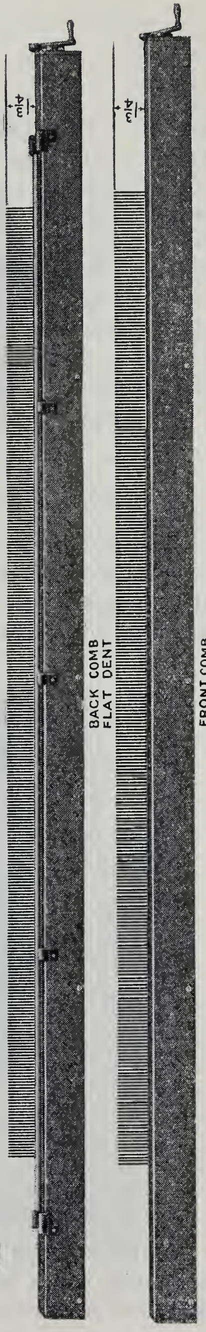
3rd. The back comb. This is similar to the front comb, but has in addition a V rod placed about 3 inches behind it to hold the ends from the upper half of the creel down between the wires.

4th. The back reed, which has a hand-rail directly over and covering the tops of the wires. We make two kinds of back reeds, the high and the low.

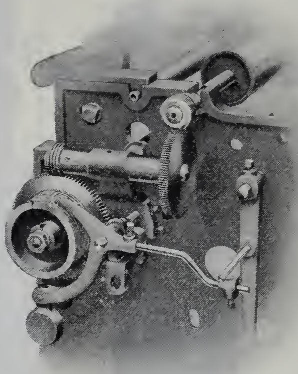
The maximum number of ends in a standard comb can be reduced 20 per cent. by the expansion apparatus.



HIGH AND LOW BACK REEDS.



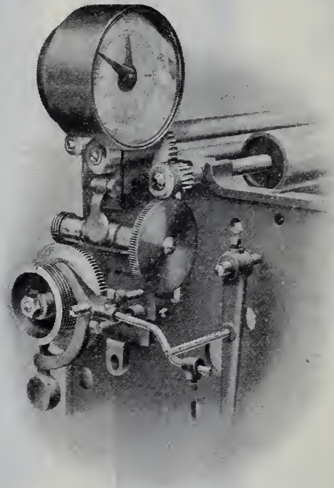
FRONT AND BACK COMBS.



No. 1 Warper Clock without Register.

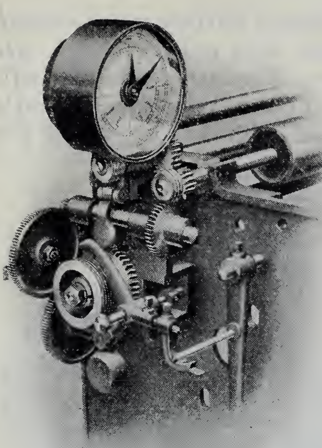
For clocks we illustrate those most frequently called for.

The No. 1 Clock is usually furnished to stop the warper at 10 wraps or less of 3,000 yards each. It may be built for wraps as low as 252 yards and as high as 5,000 yards.



No. 1 Warper Clock with Register.

The Register has a dial reading the total yards up to the maximum, which may be as low as 1,200 or as high as 12,000 yards.

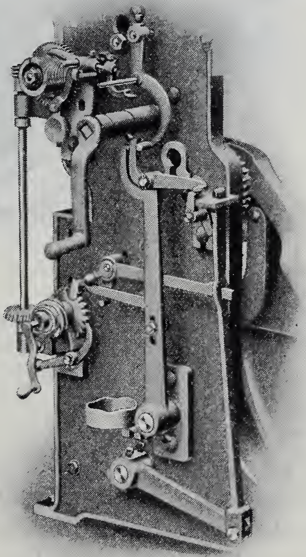


THE No. 3 OR CHANGE GEAR CLOCK may be arranged for as low as 20 yards and as high as 750 yards. This is used mostly on ball warpers and is more expensive than the simple wrap clock. It can be furnished with or without register.

No. 3 CHANGE GEAR WARPER CLOCK WITH REGISTER.

THE No. 5 CLOCK is used with warpers measuring from the cylinder.

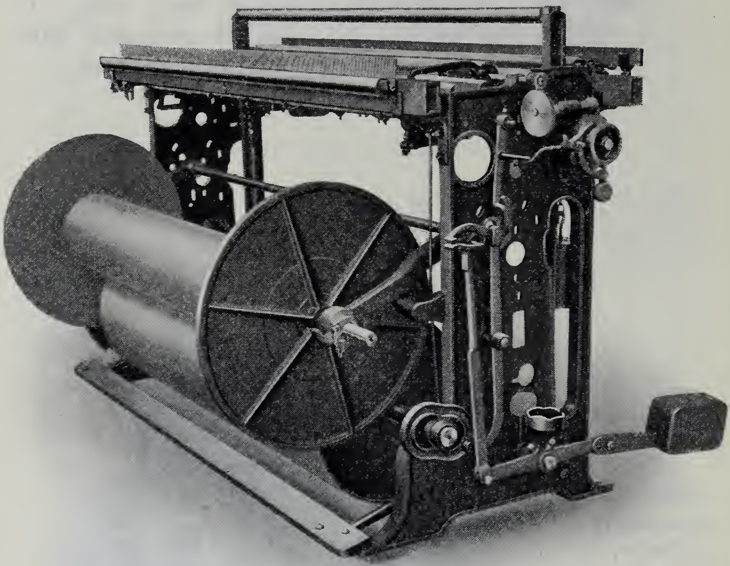
It is usually furnished to stop the warper at 10 wraps or less of 3,000 yards each. It may be built for wraps as low as 1,000 yards each and to any practical maximum requirement.



No. 5 WARPER CLOCK.

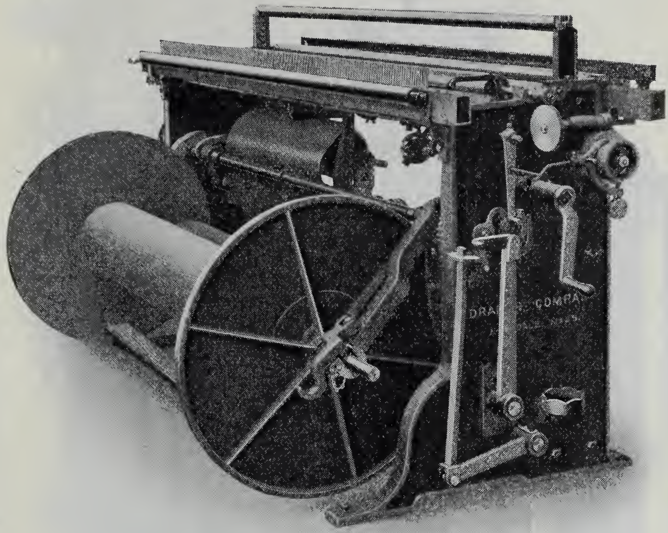
For fine yarns we make special warpers which measure from the cylinder and provided with roller bearings, thus reducing the strain on the yarn. For coarse yarns and mills where the maximum length on beam is important we make warpers which will take beams with as large as 32 inch heads.

Our standard warpers are as follows:



C MODEL WARPER.

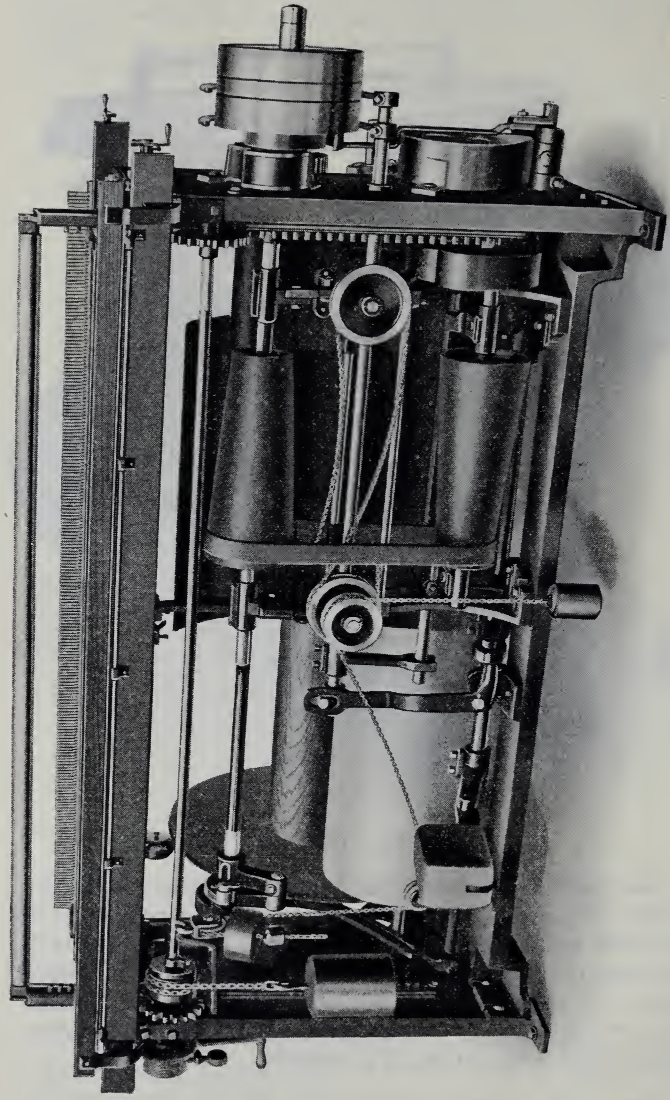
The C Model Warper can be furnished with 18 inch cylinder using beams with 24 inch heads or with 20 inch cylinder using beams with 26 inch heads; with or without cone motion; with or without beam doffer; measures from measuring roll; with plain or change gear clock; with or without register; with lease motion if so ordered.



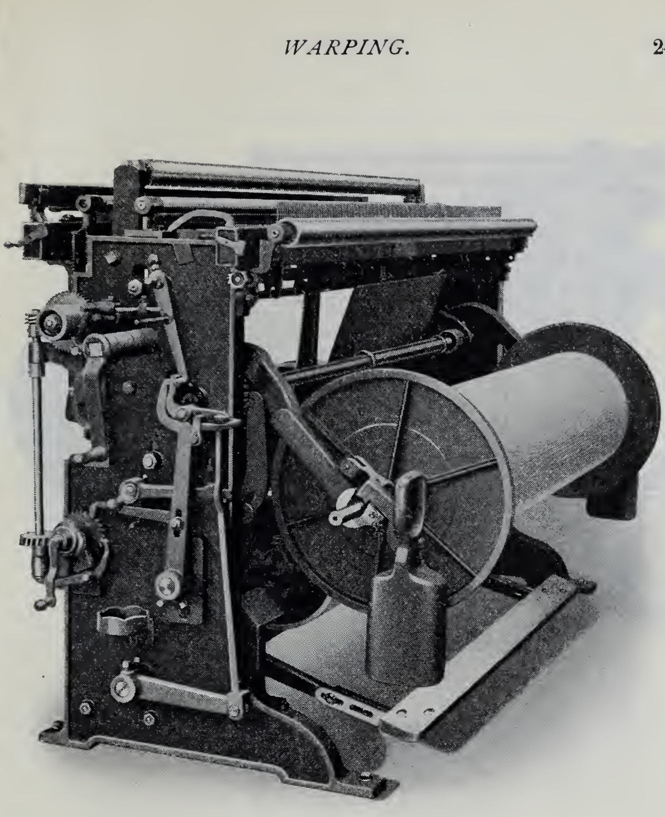
E Model Warper.

E MODEL WARPER.

See illustrations on this page and next. Has 12 inch low cylinder; measures from measuring roll; uses beams up to 26 inch heads with two banks of drop wires but is limited to 25 inch heads if stop motion with three banks of wires and lease motion are used; with or without cone motion and beam doffer; with plain or change gear clock; with or without register; with lease motion if so ordered.

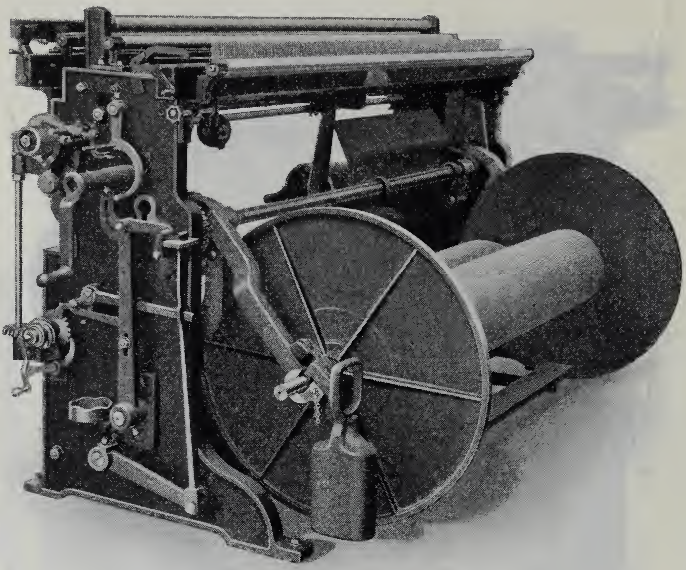


E Model Warper. Rear View Showing Cone Drive.



F Model Warper.

Special machine for fine yarns; measures from cylinder 32 inches in circumference; roller bearings for carrier rolls; takes beams with 24 inch heads if they have 9 inch or 12 inch barrels and drop wires in two banks; with three banks of drop wires and lease motion limited to 23 inch heads. Specially light beams and beam heads may be furnished with this warper; built with or without cone motion and beam doffer; lease motion if so ordered; has plain clock; may be constructed to measure from a measuring roll if desired in which case it is furnished with plain or change gear clock, and with or without register.

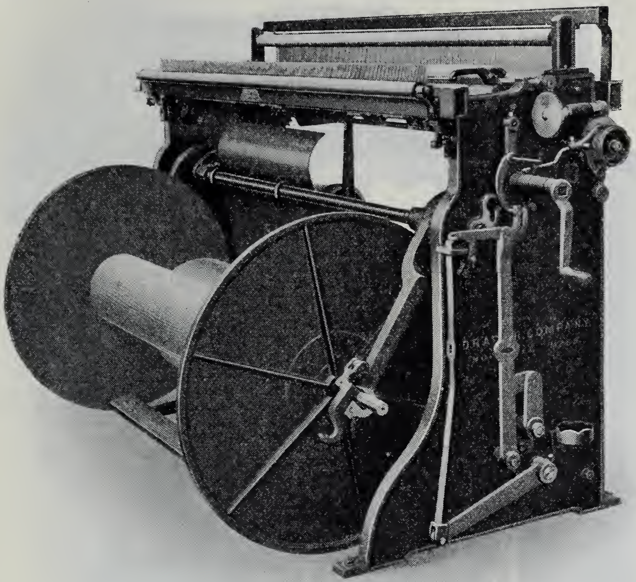


G Model Warper.

This model is similar to the F Model, but made for coarser yarns; measures from cylinder 41$\frac{1}{7}$ inches in circumference; takes beams with heads up to 28 inches having 9 inch barrels; built with or without cone motion and beam doffer; lease motion if so ordered; has plain clock.

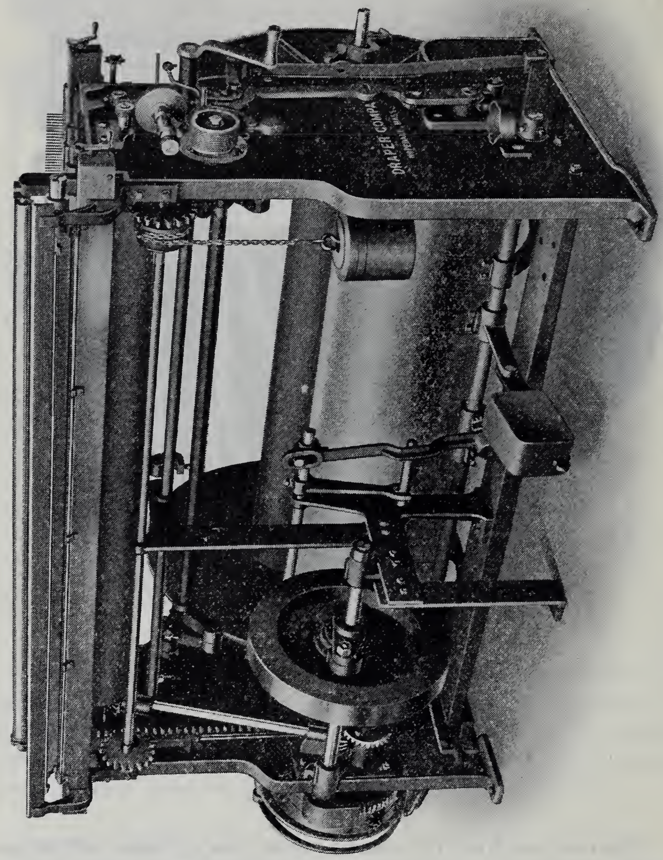
K Model Warper.

For same numbers of yarns as G Model; has low cylinder measuring 41$\frac{1}{7}$ inches; measures from measuring roll; takes beams with heads up to 28 inches having 9 inch barrels; built with or without cone motion and beam doffer; lease motion if so ordered; with plain or change gear clock; and with or without register.



I Model Warper.

Special machine for coarse yarns; low cylinder, 48 inches in circumference; measures from measuring roll; takes beams up to 32 inch heads with 9 inch barrels if with two banks of drop wires; with three banks of drop wires and lease motion limited to 30 inch beam heads; furnished with or without cone motion and beam doffer; with plain or change gear clock; with or without register; lease motion if so ordered.



L Model Warper.

For very heavy yarn; measures from measuring roll which roll also acts as a drawing roll to draw the yarn through the warper; uses same size of beam heads as I model; with or without beam doffer; no cone motion; with plain or change gear clock; with or without register; with lease motion if so ordered.

While we expect to furnish warpers such as our customers may order, we emphasize the importance of the machine measuring from cylinder on yarns 40s and finer; of the cone motion for all numbers; of the beam doffer for all warpers; and of the machines taking large beam heads for coarse yarns; also all of the warpers having low cylinders compared with the old style high cylinders which are not as convenient for the help.

The following will be found approximately correct, and convenient for reference.

Weight of yarn on a spool with barrel 1½ inches in diameter.

With 5	inch head and	6	inch traverse	1.9 lbs.
With 5	inch head and	5	inch traverse	1.6 lbs.
With 4	inch head and	5	inch traverse	1.0 lbs.
With 3½	inch head and	4½	inch traverse	0.7 lbs.

Weight of yarn on a beam 54¼ inches between heads and with a 9 inch barrel.

With 32	inch heads	670 lbs.
With 30	inch heads	580 lbs.
With 28	inch heads	500 lbs.
With 26	inch heads	420 lbs.
With 24	inch heads	350 lbs.
With 22	inch heads	285 lbs.
With 21	inch heads	255 lbs.

To find the number of pounds of yarn on a beam.

Rule: Multiply the sum of the diameters of the barrel and beam heads by the difference of their diameters, then multiply by .7854, and then multiply by the length between the heads, giving the cubic inches of yarn on the beam when full.

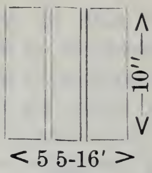
Example: With a beam 9″ barrel and 24″ head, and 54¼″ between heads:

$9+24\times 15\times .7854\times 54\frac{1}{4}=21090.935+$ cubic inches yarn in full beam.

$21090.935\div 60 = 351+$ (pounds).

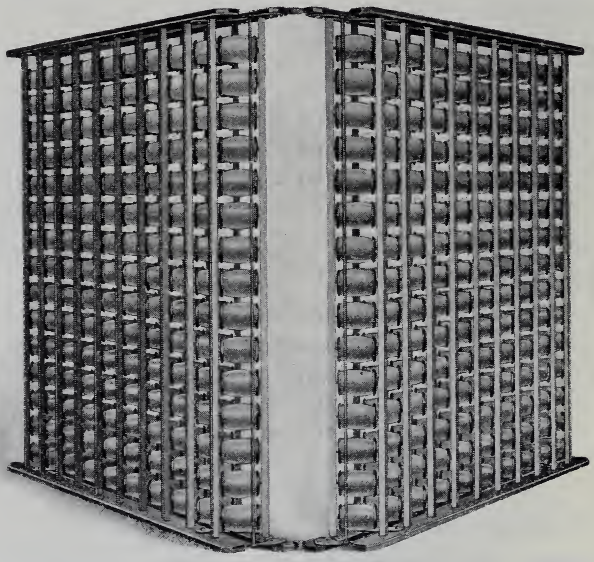
To obtain the length of the yarn on beam.

Rule: Multiply number of yarn by 840, which gives the number of yards in one pound, then multiply by number of pounds of yarn in beam. Divide the product by number of ends run in warper to find the length of warp. Where weights are used on the beam arms about 20 per cent. more yarn can be wound on.



Pulleys are *always* 10 inches in diameter.
Outer pulleys 2 inches face each.
Center pulley 1 1-8 inches face.
3-16" allowed for spaces between pulleys.

Pulley on counter shaft should be 6 in. face to cover loose and slow motion pulleys on Warper.



V Creel.

REGULAR SIZES OF V WARPER CREELS.

360	Spools,	12 x 15	512	Spools,	16 x 16
364	"	13 x 14	532	"	14 x 19
384	"	12 x 16	540	"	15 x 18
390	"	13 x 15	544	"	16 x 17
392	"	14 x 14	570	"	15 x 19
416	"	13 x 16	576	"	16 x 18
420	"	14 x 15	600	"	15 x 20
448	"	14 x 16	608	"	16 x 19
450	"	15 x 15	640	"	16 x 20
476	"	14 x 17	680	"	17 x 20
480	"	15 x 16	720	"	18 x 20
504	"	14 x 18	750	"	15 x 25
510	"	15 x 17	800	"	16 x 25

WARPER PRODUCTION.

The tables of warper production printed in our former catalogues have been based on the old standard 18-inch cylinder warper, requiring much figuring to adapt the tables to our later machines. We now not only build warpers with various sizes of cylinder, but we complicate the problem by adapting our cone drive to most of them; in fact we sell more with the cone drive than without. To present tables that would meet every possible variation in practice would require a book by itself, and we think it will be more convenient to have one theoretical table and give rules by which to determine any individual requirement. Since the hours of labor vary in different mill sections, our table is worked out on an hour basis. Our former table was based on the assumption that the warper would be stopped one-third of the time. Such an assumption cannot be generally applicable, however, since the time lost in running not only depends on the kind and quality of yarn warped, but also on the amount of help used in tying in ends, and the number of warpers given each operative. Our table is now based on a supposedly continuous run, allowing each to figure out the time actually lost in his own regular practice. If the speed of the mill is variable, allowance must be made and a proper average speed used in the calculations.

The following rules show how the table itself was prepared, and how to figure results without table.

To find the production of a warper at any given speed without the use of tables.

Rule: Multiply the number of the yarn warped by 840 to find the number of yards per pound. Divide the number of yards per hour at speed chosen by the number of yards per pound and the quotient equals the pounds per hour warped of one strand of yarn; multiply the pounds per hour of one strand by the number of ends in the warp to give the pounds per hour of the full warp based on continuous production.

Multiply the pounds per hour full product by the working hours per week making such allowance as may be determined for stops; this final product will be the actual pounds per week.

Example: Speed, 50 yards per minute, No. 20 yarn; 410 ends on beam; what is product per week of 58 hours assuming warper to run two-thirds of the time?

$20 \times 840 = 16{,}800 =$ number of yards of No. 20 yarn in one pound.

$50 \times 60 = 3{,}000 =$ yards per hour at speed of 50 yards per minute.

$3{,}000 \div 16{,}800 = .1786 =$ pounds per hour warped of one strand of yarn.

$.1786 \times 410 = 73.226 =$ pounds per hour of full warp.

$58 \times 2 = 116 \div 3 = 38.66 + =$ hours per week of warper run.

$73.226 \times 38.66 = 2830.9 + =$ pounds per week.

Answer.

TABLES OF WARPER PRODUCTION.

In pounds per hour for different numbers of yarn.

The figures given are for one strand.

Number of yarn.	YARDS PER MINUTE.						
	30	35	40	45	50	55	60
6	.3571	.4167	.4762	.5357	.5952	.6548	.7143
7	.3061	.3571	.4082	.4592	.5102	.5612	.6122
8	.2679	.3125	.3571	.4018	.4464	.4911	.5357
9	.2381	.2778	.3175	.3571	.3968	.4365	.4762
10	.2143	.2500	.2857	.3214	.3571	.3929	.4286
12	.1786	.2083	.2381	.2679	.2976	.3274	.3571
14	.1531	.1786	.2041	.2296	.2551	.2806	.3061
16	.1339	.1563	.1786	.2009	.2232	.2455	.2679
18	.1190	.1389	.1587	.1786	.1984	.2183	.2381
20	.1071	.1250	.1429	.1607	.1786	.1964	.2143
22	.0974	.1136	.1299	.1461	.1623	.1786	.1948
24	.0893	.1042	.1190	.1339	.1488	.1637	.1786
26	.0824	.0962	.1099	.1236	.1374	.1511	.1649
28	.0765	.0893	.1020	.1148	.1275	.1403	.1531
30	.0714	.0833	.0952	.1071	.1190	.1310	.1429
32	.0670	.0781	.0893	.1004	.1116	.1228	.1339
34	.0630	.0735	.0840	.0945	.1050	.1155	.1261
36	.0595	.0694	.0794	.0893	.0992	.1091	.1190
38	.0564	.0658	.0752	.0846	.0940	.1034	.1128
40	.0536	.0625	.0714	.0804	.0893	.0982	.1071
42	.0510	.0595	.0680	.0765	.0850	.0935	.1020
44	.0487	.0568	.0649	.0731	.0812	.0893	.0974
46	.0466	.0543	.0621	.0699	.0776	.0854	.0932
48	.0446	.0521	.0595	.0670	.0744	.0818	.0893
50	.0429	.0500	.0571	.0643	.0714	.0786	.0857
54	.0397	.0463	.0529	.0595	.0661	.0728	.0794
60	.0357	.0417	.0476	.0536	.0595	.0655	.0714
66	.0325	.0379	.0433	.0487	.0541	.0595	.0649
70	.0306	.0357	.0408	.0459	.0510	.0561	.0612
80	.0268	.0313	.0357	.0402	.0446	.0491	.0536
90	.0238	.0278	.0317	.0357	.0397	.0437	.0476
100	.0214	.0250	.0286	.0321	.0357	.0393	.0429

To use table apply the following rules.

To determine the product at another speed.

Rule: Look at table for answer given for the same yarn under first column. Divide by 30 and multiply by speed known.

Example: If speed is 52 yards per minute to ascertain the product of a single strand of No. 18 yarn.

Answer for No. 18 yarn under first column is .1190.

$.1190 \div 30 = .003966 +$

$.003966 \times 52 = .2062 +$ Answer.

To determine the product with any given number of ends on beam.

Rule: Multiply the product of single strand at known speed by number of ends.

Example: Given 410 ends on beam find the product per hour of continuous running with No. 18 yarn warped at speed of 52 yards per minute.

Find answer for single strand as before = .2062.

$.2062 \times 410 = 84.542$ Answer.

For week of 60 hours with warper running two-thirds of the time the product would be:

$60 \times 2 = 120 \div 3 = 40$

$40 \times 84.542 = 3381.68$ Answer.

To find the speed of driving pulley on warper to give any desired speed of winding.

First: For warper without cone drive.

Rule: Take assumed speed of winding and reduce it to inches per minute; divide this by circumference of warper cylinder in inches; multiply by known relation of cylinder speed to pulley speed.

Draper warpers have the following dimensions and pulley relations.

When without Cone Drive.

	Turns of pulley to one turn of cylinder.
C model 18 inch cylinder = 56.549 in. circumference	5.44
C model 20 inch cylinder = 62.832 in. circumference	5.44
E model 12 inch cylinder = 37.7 in. circumference	3.94
F model 32 in. circumference	5.
G and K models 41.143 in. circumference	4.63
I and L models 48 in. circumference	6.25

Example:

Assume 55 yards per minute as desired speed on an E model warper with 12 inch cylinder; what is speed of driving pulley?

$55 \times 36 = 1980$ = inches in 55 yards.

$12 \times 3.1416 = 37.7$ = inches in circumference of cylinder.

$1980 \div 37.7 = 52.52$.

Note relation of speeds gives 3.94 between cylinder and pulley on E model.

$52.52 \times 3.94 = 206.93$ = turns per minute of pulley.

Answer.

To find driving pulley speed when Warper is driven by Cone Pulleys.

Rule: Take assumed speed of winding and reduce it to inches per minute as before.

Divide this by circumference of warper cylinder in inches; multiply by known relation of cylinder speed to pulley speed at the position determined by the belt on the cone. As usually run the average relation would be properly used.

Draper warpers have the following relation of cones to cylinder.

C model, 18 and 20 inch cylinders 18 inch circumference = 56.549 in. 20 inch circumference = 62.832 in.	High Average Low	8.9 6.675 4.45
E model, 37.7 circumference	High Average Low	5.89 4.40 2.91
F model 32 in. circumference	High Average Low	8. 6. 4.
G and K models 41.143 circumference	High Average Low	6.66 5. 3.33
I model 48 in. circumference	High Average Low	8. 6. 4.

Example:

Assume 55 yards per minute as desired speed and E model warper as before.

55 × 36 = 1980 inches in 55 yards.

Circumference E model cylinder = 37.7 in.

1980 ÷ 37.7 = 52.52.

If warper is run with belt traveling equally on each side of the center of the cone the driving pulley will average to turn 4.40 times the cylinder rotations.

52.52 × 4.40 = 231.09 = speed of driving pulley on warper. Answer.

To find size of shaft pulley for given speed of warper pulley.

Rule: Take speed of rotation of warper pulley, multiply it by 10 (since warper pulley is 10 inches in diameter) and divide product by speed of shaft.

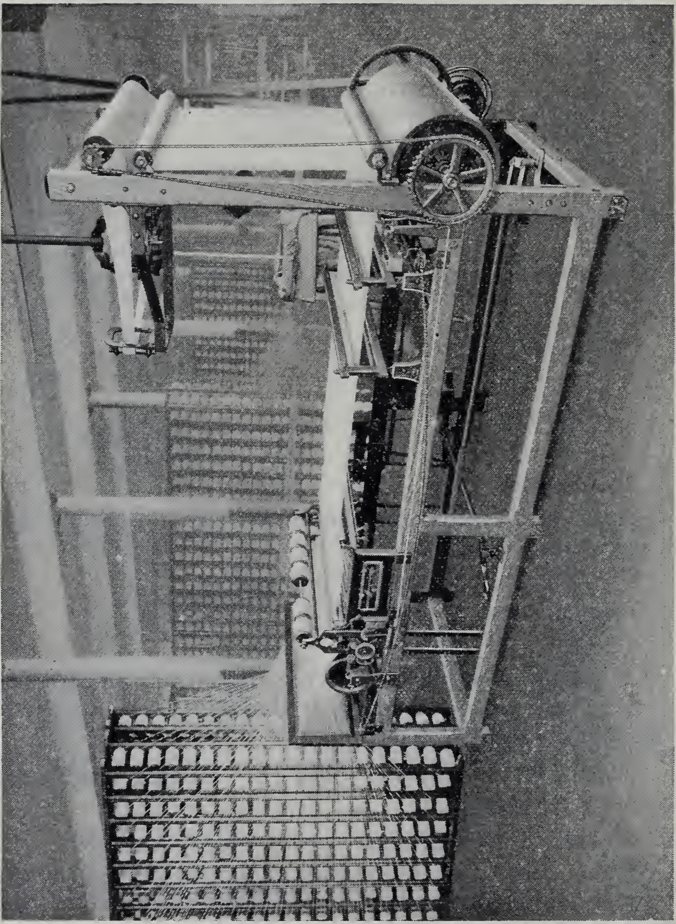
Example:

Suppose shaft rotates 200 times per minute.

Suppose speed of warper pulley is 231.09 as in above example; what is size of pulley needed on shaft?

231.09 × 10 = 2310.9 ÷ 200 = 11.5 + Answer.

Pulley on shaft should be 11.5 + inches in diameter. (It ought never to be less than 6 inches.)



WALCOTT CHAIN WARPER.

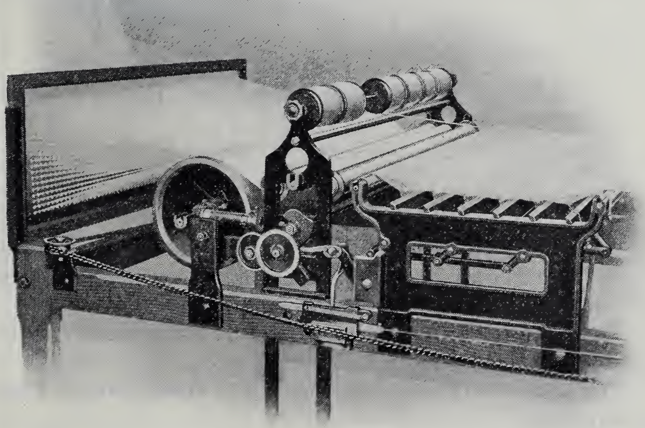
THE WALCOTT CHAIN WARPER.

This machine has for years been the acknowledged standard for producing long chains of 500 to 1,200 ends. Our experience has shown that the disadvantages in handling more than 1,200 ends in one creel due to the loss of product caused by the stops for piecing up ends, etc., more than offset the advantages, and we consider 1,200 ends the maximum limit for economy.

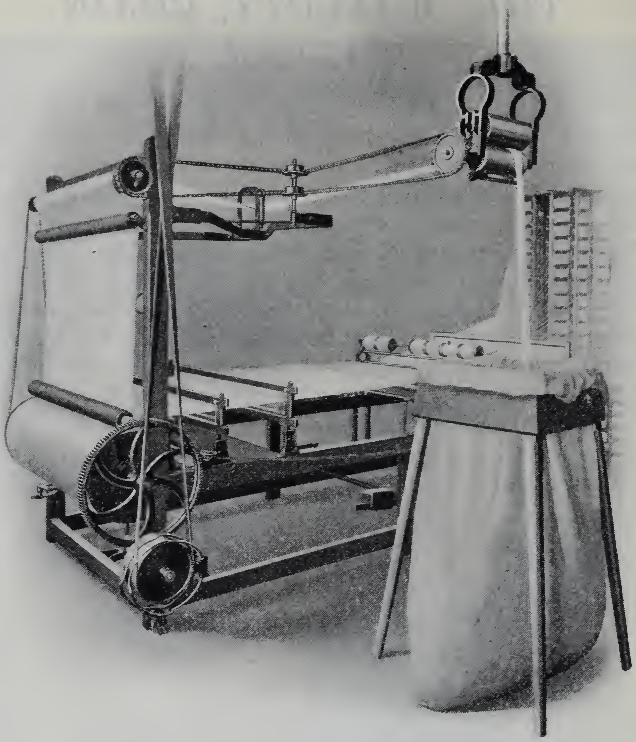
Our illustrations show a full view of the machine followed by detailed illustrations of each end. The machine shown is provided with the well known Walmsley stop motion.

We furnish a linking motion when ordered.

One of these warpers will do more and better work than three circular or upright warpers.



WALCOTT WARPER. HEAD END.



Walcott Warper. Delivery End.

See table on page 255 for arrangement of spools in creels for different numbers of ends and floor space required for creels with different sizes and numbers of spools.

The length of Walcott warper frame without stop motion is 10 feet; with stop motion 12 feet.

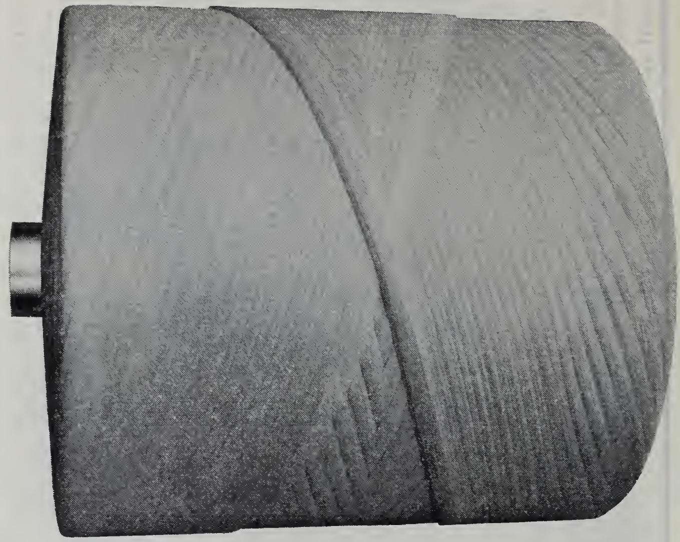
The space between holey board and creel is about 2 feet and 6 inches.

If skewers are used they should be $1\frac{1}{16}$ inches longer than spools.

Driving pulley is 10 inches diameter for a 2 inch belt.

DIMENSIONS OF CREELS FOR WALCOTT CHAIN WARPER.

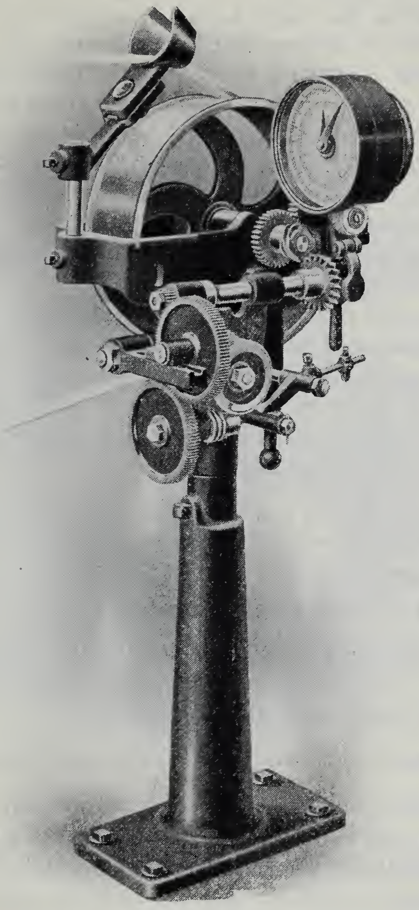
No. of Ends.	No. Spools High.	No. Spools Long.	7½″ RUN, to carry spools with 3½″ h'd, 4½″ traverse			8″ RUN, to carry spools with 4″ head, 5″ traverse.			8½″ RUN to carry spools with 4″ head, 6″ traverse.			9″ RUN, to carry spools with 5″ head, 6″ traverse.		
			L'gth	Width.	Height	L'gth.	Width.	Height	L'gth.	Width.	Height	L'gth.	Width.	Height.
1200	20	30	17′ 8″	15′ 1″	7′ 4¼″	18′ 9″	16′	8′ 2½″	19′ 11″	16′ 10″	8′ 2½″	21′	17′ 9″	9′ 10½″
1160	20	29	17′ 1″	14′ 8″	7′ 4¼″	18′ 2″	15′ 6″	8′ 2½″	19′ 3″	16′ 4″	8′ 2½″	20′ 4″	17′ 2″	9′ 10½″
1120	20	28	16′ 6″	14′ 2″	7′ 4¼″	17′ 7″	15′	8′ 2½″	18′ 7″	15′ 10″	8′ 2½″	19′ 8″	16′ 8″	9′ 10½″
1080	18	30	17′ 8″	15′ 1″	6′ 8″	18′ 9″	16′	7′ 5″	19′ 11″	16′ 10″	7′ 5″	21′	17′ 9″	8′ 11″
1044	18	29	17′ 1″	14′ 8″	6′ 8″	18′ 2″	15′ 6″	7′ 5″	19′ 3″	16′ 4″	7′ 5″	20′ 4″	17′ 2″	8′ 11″
1008	18	28	16′ 6″	14′ 2″	6′ 8″	17′ 7″	15′	7′ 5″	18′ 7″	15′ 10″	7′ 5″	19′ 8″	16′ 8″	8′ 11″
972	18	27	15′ 11″	13′ 9″	6′ 8″	16′ 11″	14′ 6″	7′ 5″	17′ 11″	15′ 4″	7′ 5″	18′ 11″	16′ 1″	8′ 11″
960	16	30	17′ 8″	15′ 1″	6′ 3½″	18′ 9″	16′	6′ 11½″	19′ 11″	16′ 10″	6′ 11½″	21′	17′ 9″	8′ 3½″
928	16	29	17′ 1″	14′ 8″	6′ 3½″	18′ 2″	15′ 6″	6′ 11½″	19′ 3″	16′ 4″	6′ 11½″	20′ 4″	17′ 2″	8′ 3½″
896	16	28	16′ 6″	14′ 2″	6′ 3½″	17′ 7″	15′	6′ 11½″	18′ 7″	15′ 10″	6′ 11½″	19′ 8″	16′ 8″	8′ 3½″
864	16	27	15′ 11″	13′ 9″	6′ 3½″	16′ 11″	14′ 6″	6′ 11½″	17′ 11″	15′ 4″	6′ 11½″	18′ 11″	16′ 1″	8′ 3½″
840	14	30	17′ 8″	15′ 1″	5′ 6½″	18′ 9″	16′	6′ 1½″	19′ 11″	16′ 10″	6′ 1½″	21′	17′ 9″	7′ 3½″
812	14	29	17′ 1″	14′ 8″	5′ 6½″	18′ 2″	15′ 6″	6′ 1½″	19′ 3″	16′ 4″	6′ 1½″	20′ 4″	17′ 2″	7′ 3½″
784	14	28	16′ 6″	14′ 2″	5′ 6½″	17′ 7″	15′	6′ 1½″	18′ 7″	15′ 10″	6′ 1½″	19′ 8″	16′ 8″	7′ 3½″
756	14	27	15′ 11″	13′ 9″	5′ 6½″	16′ 11″	14′ 6″	6′ 1½″	17′ 11″	15′ 4″	6′ 1½″	18′ 11″	16′ 1″	7′ 3½″
728	14	26	15′ 4″	13′ 3″	5′ 6½″	16′ 3″	14′ 1″	6′ 1½″	17′ 3″	14′ 9″	6′ 1½″	18′ 3″	15′ 6″	7′ 3½″
700	14	25	14′ 9″	12′ 10″	5′ 6½″	15′ 8″	13′ 7″	6′ 1½″	16′ 7″	14′ 3″	6′ 1½″	17′ 6″	15′	7′ 3½″
672	14	24	14′ 2″	12′ 4″	5′ 6½″	15′ 1″	13′ 1″	6′ 1½″	15′ 11″	13′ 9″	6′ 1½″	16′ 10″	14′ 5″	7′ 3½″
644	14	23	13′ 7″	11′ 11″	5′ 6½″	14′ 5″	12′ 7″	6′ 1½″	15′ 3″	13′ 3″	6′ 1½″	16′ 2″	13′ 11″	7′ 3½″
616	14	22	13′	11′ 6″	5′ 6½″	13′ 9″	12′ 1″	6′ 1½″	14′ 7″	12′ 9″	6′ 1½″	15′ 5″	13′ 4″	7′ 3½″
588	14	21	12′ 5″	11′	5′ 6½″	13′ 2″	11′ 7″	6′ 1½″	13′ 11″	12′ 3″	6′ 1½″	14′ 9″	12′ 10″	7′ 3½″



RHOADES PATENT CYLINDRICAL BALL OF YARN.

BALL WARPERS AND BALLING MACHINES.

For mills that desire to use the chain warping process rather than beam warping, we furnish machines that wind the warps in a cylindrical ball with square ends as shown in the above illustration. Where the warps are shipped in a ball it is of advantage to the shipper to put up the yarn in an attractive form with ends that do not bulge and with carefully laid courses. Our Mr. Rhoades by a modification of the thread of the balling machine traverse-screw has succeeded in laying the courses so as to make such a package and we have patented the cylindrical ball of yarn as so wound.



Our Balling Machine is provided with a patent measuring arrangement with the clock and register on the floor stand which measures direct from the pulley; this pulley has large contact surface with the chain of yarn which is less liable to slip and the measuring is more accurate and the balls therefore more uniform in length than when measured by a measuring roll. The clock is arranged to stop the warper so that a thread lease can be taken at any point in the chain that may be desired. Two short balls may be wound at one time in place of one large ball by a modification of the worm and connecting parts.

Our arrangement on the warper for holding bitting spools enables the ready insertion or removal of a spool on the same size of skewer that is used in the creel.

The ball is wound by contact with two rolls directly connected with the warper which give ample driving power.

STRAW'S LEASING MOTION is more simple and effective than any other of which we have knowledge. We can equip the warper with a pin leasing motion if desired.

We furnish either IRON or GLASS CREEL STEPS in the warper creels as may best meet the requirements of the mills.

We use the WALMSLEY STOP MOTION on our ball warpers same as shown and described in the article on beam warpers; also the same range of REEDS and COMBS and with the same limits as to numbers of ends, expansion and contraction.

Our LEASING COMBS are made with open tops the same as our other expansion combs.

For illustrations and description of ball warper devices which are the same as used on our beam warpers refer to preceding pages, viz:—

IRON and GLASS CREEL STEPS, page 233.

WALMSLEY STOP MOTION and DROP WIRES, pages 231 and 232.

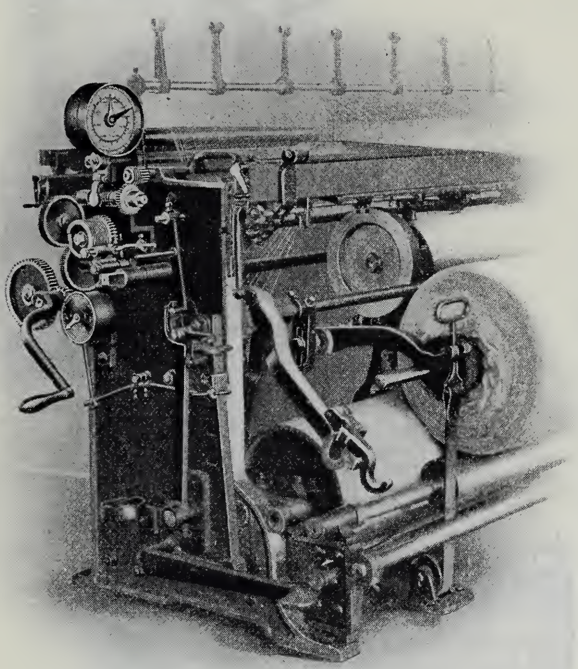
REEDS and COMBS, pages 234 and 235.

WARPER CLOCKS and REGISTERS, pages 236 and 237.

We make two distinct types of ball warper.

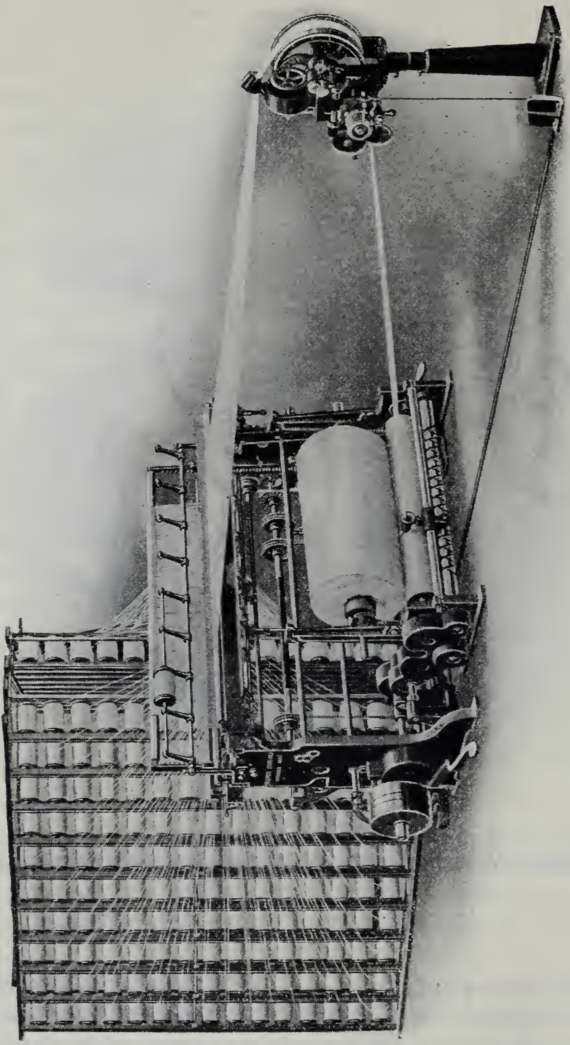
In one the balling machine is applied to a beam warper and constitutes an alternative arrangement; in the other the warper has no cylinder and the balling mechanism is an integral part of the machine with no provision for beam warping.

We can, if desired, furnish balling machines arranged to run the yarn up over a pulley, where it is important to save floor space but we do not consider this as desirable as the standard construction shown and described in the following pages.



E Model Warper with E Model Balling Machine.

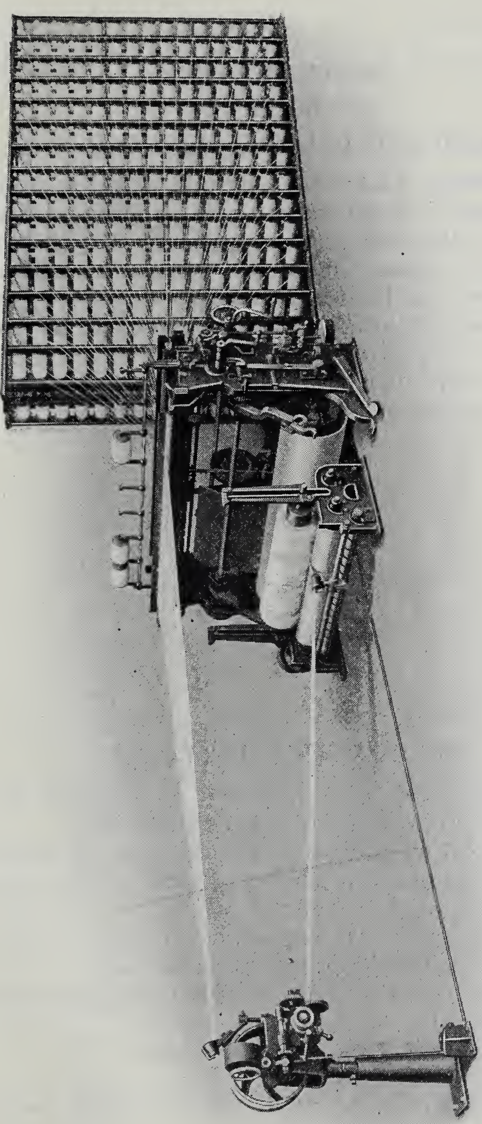
This balling machine can only be applied to our "E" model warper; it is bolted to the warper; it has but one driving roll and the cylinder of the warper takes the place of the second roll; it cannot be used in a warper without a cylinder; has change gear clock and register located on floor stand; also has a measuring roll with plain clock on warper side for beam warping for which the machine is adapted. Can be furnished with change gear clock and register on warper side as shown, and in this case a plain floor stand without clock is used; can be arranged to wind either one or two balls, and for any regular length of traverse.



G Model Ball Warper without Cylinder.

This machine is adapted for ball warping only, the cylinder being omitted from the warper; clock and register are located on floor stand. This is our standard ball warper, and can be built to wind one or two balls as preferred, and of any regular length of traverse.

This balling arrangement can also be applied to our standard C, E, F, I and K model warpers.



G Model Warper with G Model Balling Machine.

G MODEL WARPER WITH G MODEL BALLING MACHINE.

The G Model Balling Machine is shown on page 261 applied to our G model warper with cylinder, making it adaptable to either ball or beam warping. When used for ball warping the measurements are obtained from clock and register on floor stand; for beam warping a clock is furnished on warper side measuring from cylinder. This balling machine can be applied to our C, E, F, I, K and L models in similar manner. Can be arranged to wind one or two balls as ordered, and for any regular length of traverse.

WEIGHT OF CHAIN WARPS.

To find the weight of a warp chain, the number of ends, the length in yards and the number of the yarn being known.

Rule: Point off decimally two places in the number of ends and two places in the number of yards (or four places in the number of yards); multiply one by the other and the product by the constant for the given number of yarn; the result will be the number of pounds in the chain.

Example: Given a chain of 5000 yards containing 400 ends of No. 24 yarn.

$50.00 \times 4.00 = 200. \times .496 = 99.2$ lbs. = Answer.

Proof.

$840 \times 24 = 20160$ = yards per lb. $\div 400 = 50.4$ = yds. per lb. of 400 ends.

$5000 \div 50.4 = 99.2$ = lbs. in 5000 yards as before.

To figure constant, divide 11.904762 by the number of the yarn.

TABLE OF CONSTANTS FOR FIGURING THE WEIGHT OF NUMBERS 1 TO 100 WARP YARNS IN THE CHAIN.

No. Yarn.	Constant.	No. Yarn.	Constant.	No. Yarn.	Constant.
1	11.904762	35	.34	69	.1725
2	5.952	36	.3307	70	.17
3	3.968	37	.3218	71	.1677
4	2.976	38	.3133	72	.1654
5	2.3808	39	.3053	73	.1631
6	1.984	40	.2976	74	.1609
7	1.7006	41	.2904	75	.1587
8	1.488	42	.2835	76	.1567
9	1.3228	43	.2769	77	.1546
10	1.19	44	.2706	78	.1526
11	1.0822	45	.2645	79	.1507
12	.992	46	.2588	80	.1488
13	.9158	47	.2533	81	.147
14	.8503	48	.248	82	.1452
15	.7936	49	.2429	83	.1434
16	.744	50	.238	84	.1417
17	.7003	51	.2334	85	.14
18	.6614	52	.229	86	.1384
19	.6265	53	.2246	87	.1368
20	.5952	54	.2205	88	.1353
21	.5669	55	.2164	89	.1338
22	.5411	56	.2126	90	.1323
23	.5176	57	.2089	91	.1308
24	.496	58	.2053	92	.1294
25	.4761	59	.2018	93	.128
26	.4579	60	.1984	94	.1267
27	.4409	61	.1951	95	.1253
28	.4252	62	.192	96	.124
29	.4105	63	.189	97	.1227
30	.3968	64	.186	98	.1215
31	.384	65	.1832	99	.1203
32	.372	66	.1804	100	.119
33	.3608	67	.1777		
34	.3501	68	.1751		

Change Gears for Balling Machine Clock.

This table to be used with Rhoades' Clocks on all models of Warpers.

Yards per Lease.	Top Gear.	Bottom Gear.	No. of Wraps.	Yards per Lease.	Top Gear.	Bottom Gear.	No. of Wraps.	Yards per Lease.	Top Gear.	Bottom Gear.	No. of Wraps.	Yards per Lease.	Top Gear.	Bottom Gear.	No. of Wraps.	Yards per Lease.	Top Gear.	Bottom Gear.	No. of Wraps.	Yards per Lease.	Top Gear.	Bottom Gear.	No. of Wraps.
20	100	20	1	74	100	74	1	141	100	47	3	220	30	66	1	308	25	77	1	408	100	68	6
21	100	21	1	75	100	75	1	142	50	71	1	222	100	37	6	310	30	93	1	410	20	82	1
22	100	22	1	76	100	76	1	144	50	72	1	224	50	56	2	312	25	78	1	413	100	59	7
23	100	23	1	77	100	77	1	145	40	58	1	225	32	72	1	315	100	63	5	414	100	69	6
24	100	24	1	78	100	78	1	146	50	73	1	228	50	57	2	316	25	79	1	415	20	83	1
25	100	25	1	79	100	79	1	147	100	49	3	230	30	69	1	318	100	53	6	416	100	52	8
26	100	26	1	80	100	80	1	148	50	74	1	231	100	77	3	320	25	80	1	420	20	84	1
27	100	27	1	81	100	81	1	150	40	60	1	232	50	58	2	322	100	46	7	423	100	47	9
28	100	28	1	82	100	82	1	152	50	76	1	234	100	78	3	324	25	81	1	424	100	53	8
29	100	29	1	83	100	83	1	153	100	51	3	235	100	47	5	325	24	78	1	425	20	85	1
30	100	30	1	84	50	42	1	154	50	77	1	236	50	59	2	328	25	82	1	427	100	61	7
31	100	31	1	85	100	85	1	155	40	62	1	237	100	79	3	330	30	99	1	430	20	86	1
32	100	32	1	86	50	43	1	156	50	78	1	240	30	72	1	332	25	83	1	432	100	72	6
33	100	33	1	87	100	87	1	158	50	79	1	243	100	81	3	333	100	37	9	435	20	87	1
34	100	34	1	88	50	44	1	159	100	53	3	244	50	61	2	335	100	67	5	438	100	73	6
35	100	35	1	89	100	89	1	160	40	64	1	245	100	49	5	336	25	84	1	440	20	88	1
36	100	36	1	90	50	45	1	161	100	23	7	246	100	82	3	340	25	85	1	441	100	49	9
37	100	37	1	91	100	91	1	162	50	81	1	248	50	62	2	342	100	57	6	444	100	74	6
38	100	38	1	92	50	46	1	164	50	82	1	249	100	83	3	343	100	49	7	445	20	89	1
39	100	39	1	93	100	93	1	165	40	66	1	250	30	75	1	344	25	86	1	448	100	56	8
40	100	40	1	94	50	47	1	166	50	83	1	252	50	63	2	345	100	69	5	450	20	90	1
41	100	41	1	95	60	57	1	168	50	84	1	255	100	51	5	348	100	58	6	455	20	91	1
42	100	42	1	96	50	48	1	170	40	68	1	256	50	64	2	350	24	84	1	456	100	76	6
43	100	43	1	97	100	97	1	172	50	86	1	258	100	86	3	351	100	39	9	459	100	51	9
44	100	44	1	98	50	49	1	174	50	87	1	259	100	37	7	352	25	88	1	460	20	92	1
45	100	45	1	99	100	99	1	175	40	70	1	260	30	78	1	354	100	59	6	462	100	77	6
46	100	46	1	100	50	50	1	176	50	88	1	261	100	87	3	355	100	71	5	464	100	58	8
47	100	47	1	102	50	51	1	178	50	89	1	264	50	66	2	356	25	89	1	465	20	93	1
48	100	48	1	104	50	52	1	180	40	72	1	265	100	53	5	357	100	51	7	468	100	78	6
49	100	49	1	105	60	63	1	182	50	91	1	267	100	89	3	360	25	90	1	469	100	67	7
50	100	50	1	106	50	53	1	183	100	61	3	268	25	67	1	364	25	91	1	470	20	94	1
51	100	51	1	108	50	54	1	184	50	92	1	270	30	81	1	365	20	73	1	472	100	59	8
52	100	52	1	110	50	55	1	185	40	74	1	272	25	68	1	366	100	61	6	474	100	79	6
53	100	53	1	111	100	37	3	186	100	62	3	273	100	39	7	368	25	92	1	475	20	95	1
54	100	54	1	112	50	56	1	188	50	94	1	275	24	66	1	369	100	41	9	477	100	53	9
55	100	55	1	114	50	57	1	189	100	27	7	276	25	69	1	370	20	74	1	480	100	80	6
56	100	56	1	115	40	46	1	190	40	76	1	279	100	31	9	371	100	53	7	483	100	69	7
57	100	57	1	116	50	58	1	192	50	96	1	280	25	70	1	372	25	93	1	485	20	97	1
58	100	58	1	118	50	59	1	195	40	78	1	282	100	47	6	375	24	90	1	486	100	81	6
59	100	59	1	120	45	54	1	196	50	98	1	284	25	71	1	376	25	94	1	488	100	61	8
60	100	60	1	122	50	61	1	198	50	99	1	285	100	57	5	378	100	63	6	490	20	98	1
61	100	61	1	123	100	41	3	200	50	100	1	287	100	41	7	380	20	76	1	492	100	82	6
62	100	62	1	124	50	62	1	201	100	67	3	288	25	72	1	384	25	96	1	495	20	99	1
63	100	63	1	125	48	60	1	203	100	29	7	290	30	87	1	385	100	55	7	496	100	62	8
64	100	64	1	126	50	63	1	204	50	51	2	291	100	97	3	387	100	43	9	497	100	71	7
65	100	65	1	128	50	64	1	205	40	82	1	292	25	73	1	388	25	97	1	498	100	83	6
66	100	66	1	129	100	43	3	207	100	69	3	294	50	49	3	390	20	78	1	500	20	100	1
67	100	67	1	130	50	65	1	208	50	52	2	295	100	59	5	392	25	98	1				
68	100	68	1	132	50	66	1	210	30	63	1	296	25	74	1	395	20	79	1				
69	100	69	1	134	50	67	1	212	50	53	2	297	100	99	3	396	25	99	1				
70	100	70	1	135	40	54	1	215	100	43	5	300	25	75	1	399	100	57	7				
71	100	71	1	136	50	68	1	216	50	54	2	304	25	76	1	400	20	80	1				
72	100	72	1	138	50	69	1	217	100	31	7	305	100	61	5	405	20	81	1				
73	100	73	1	140	40	56	1	219	100	73	3	306	100	51	6	406	100	58	7				

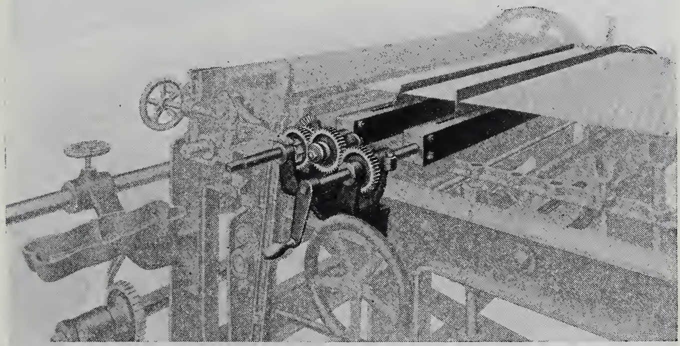
SLASHER COMBS.

In the process of slashing warp yarns it has been customary to use a single comb with upright teeth to divide the warp sheet evenly so that an even beam may be wound. This comb separates the threads into a series of groups; the threads of each group take a position one above another, so that each group is traveling in a vertical plane towards the beam.

As the beam and press rolls are in a horizontal position, the several groups of threads must change from a vertical to a horizontal plane when wound upon the beam.

In the old way this change is accomplished at random; some groups turn to one side, and some to the other; often they reverse. As a result of this lack of regularity, "slasher rolls," so-called, form in the beam of yarn which make trouble in the weave room. These slasher rolls cause "hitch-backs" and warp breakage which reduce the quantity and injure the quality of the cloth woven.

To obviate these troubles we offer the Morrill patent slasher comb, which is of greatest value on high sley and plain goods, and yarns with high twist; also the Rhoades' patent slasher comb which we recommend for low sley goods, stripes, colored work and for general use.



THE MORRILL SLASHER COMB.

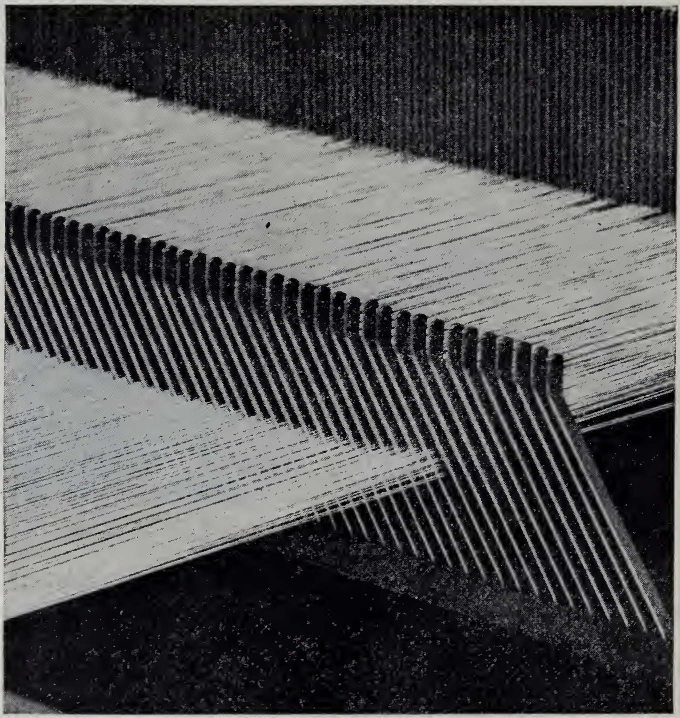
The Morrill Slasher Comb is so constructed that the threads are laid on the warp beam in regular sequence.

The improvement consists in placing a second comb having slanting teeth in front of the regular comb; this second comb also has its teeth offset horizontally with relation to the teeth in the back comb. The slanting of the teeth in the front comb and their offset with relation to the vertical teeth in the back comb give the groups of threads a quarter turn and hold them firmly so they will not change their relation either to adjacent threads, or to adjacent groups of threads.

As the warp threads cannot roll or turn over upon each other, "slasher rolls" and "draws" are eliminated. By their use the operator can strike in the warps and thus save time over counting in the ends.

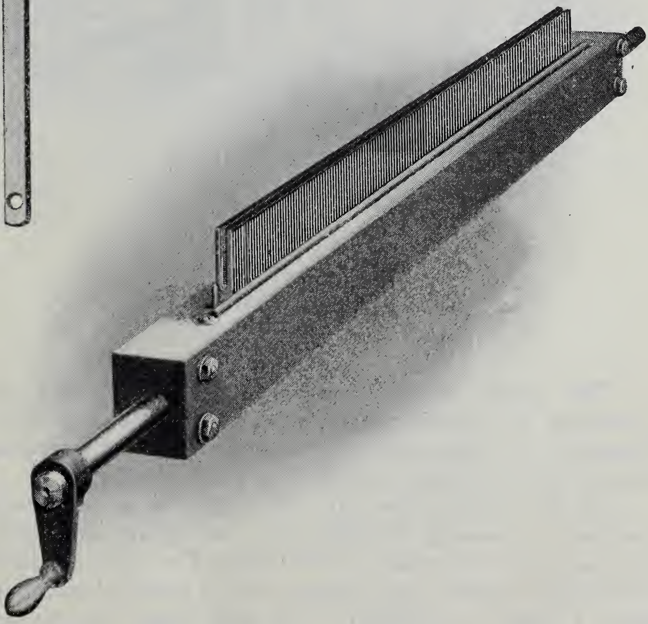
The combs are made adjustable in the usual manner; the application to the slasher is simple; the device is easy to operate and does not interfere with the working of the slasher. The two combs are so connected that both may be operated as one, or each adjusted separately, as may be required.

These combs have been in use for several years; they have shown an improvement in the preparation of the warps in all cases; in a test at one mill ten per cent. more cloth was produced in the weave room.

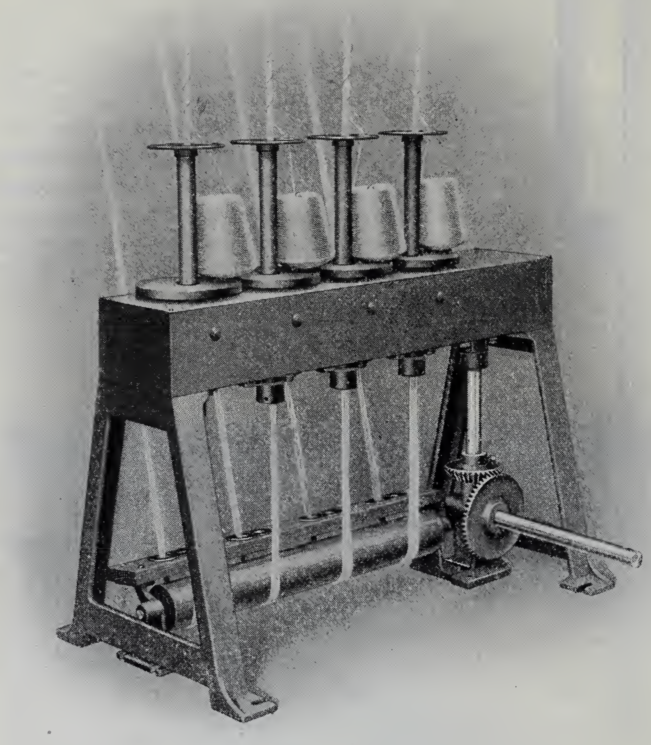


DETAILED VIEW OF MORRILL COMB.

THE RHOADES SLASHER COMB, the teeth of which have two prongs each where the warps run, doubles the number of separations in the warp and largely prevents the threads from sticking, rolling over and crossing; beams slashed where this comb is used run much better in the weave room and show an improvement in the quality of the cloth produced.



RHOADES PATENT DOUBLE-DENT SLASHER COMB.



STRAW'S WINDING MACHINE.

The Straw system and machines for applying and removing the binding yarn used on long chains in the bleachery or dye-house are among the most important improvements in their field that we have introduced.

By this system the yarns are kept in proper relative position in passing through the boiling-box and dyeing process and until ready to be beamed or quilled. In the unwinding machine the binding yarn is removed and wound upon a spool in condition to be used again for the same purpose, or to be utilized with similar yarn in the manufactured goods. The use of this system will make a saving of at least one-half the cost of beaming, while in the weave-room the improvement in the condition of the yarn will make an additional saving of as much more, besides insuring a better quality of product.

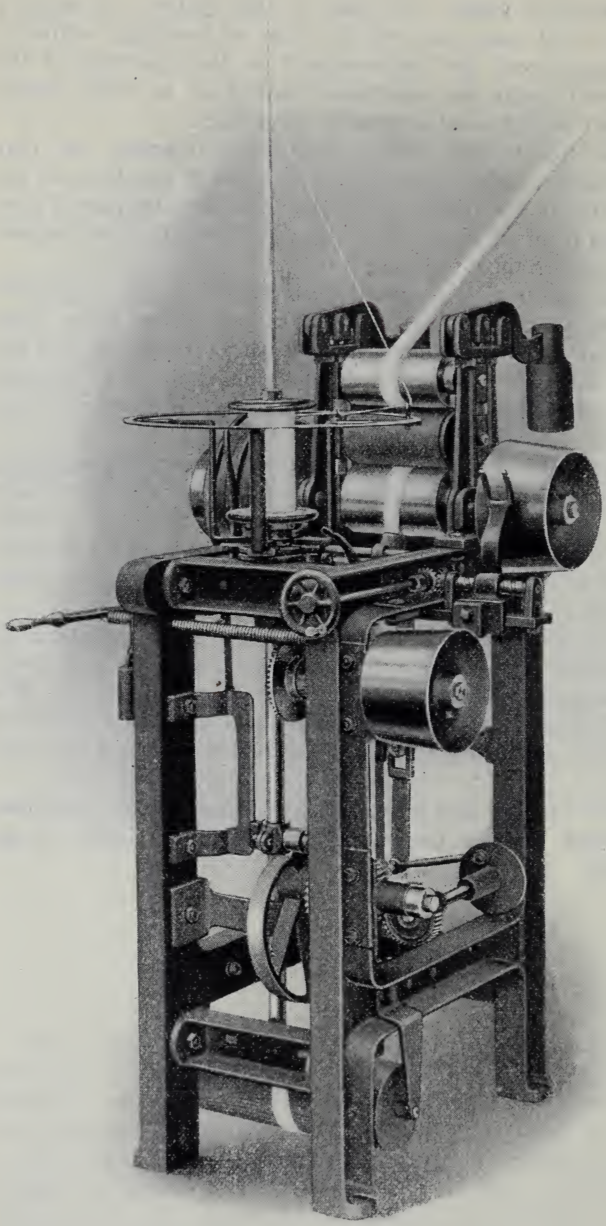
The illustration shows a winding machine of four spindles, but this number may be more or less to meet the conditions in each individual case. The binding yarn is seen in cones from which it is led to the point where it is wrapped around the chains of passing yarn.

The illustration of unwinding machine on page 270 shows its simplest form. After the wrapped chains have been bleached or colored and dried, the thread coiled around the chain must be unwrapped before the chains are rewound either onto beams for warp yarns or onto bobbins, if for filling.

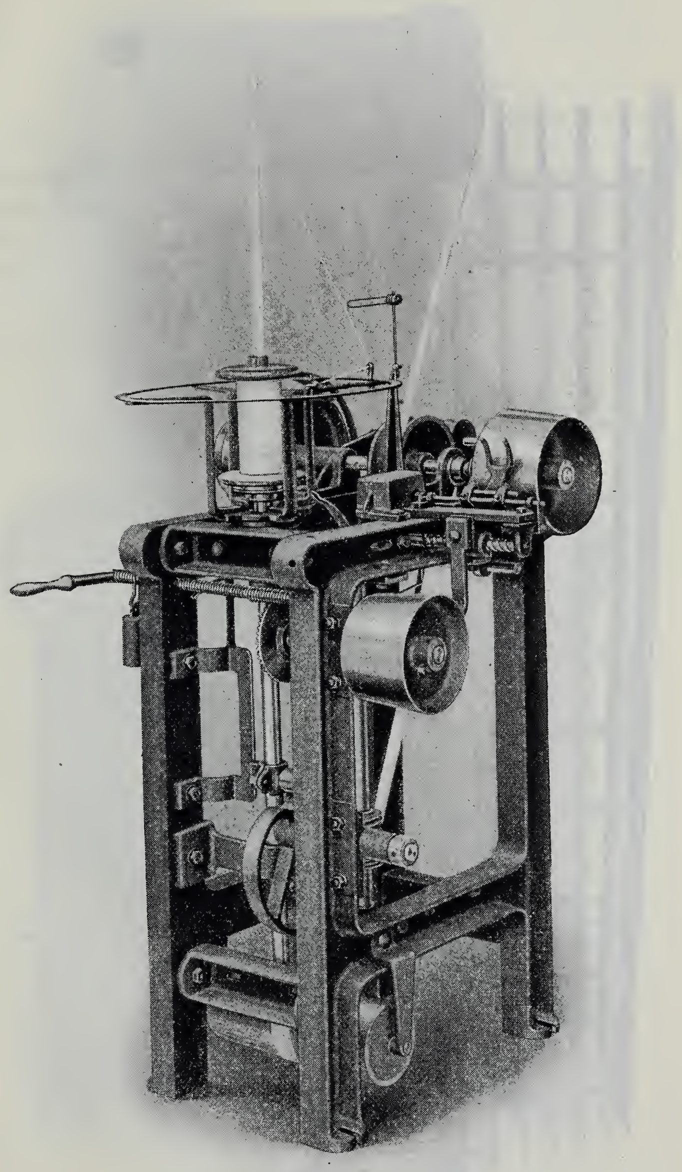
The unwinding machine as shown unwinds the wrapping yarn from the chain and winds it upon a large spool as seen in the centre of the machine. In case the ratio of the linear speed of the chain and the rotary speed of the flier becomes out of proportion the operative must change the relative speed so as to prevent breakage of the yarn, etc.

To avoid bad work and reduce the cost of operation the unwinding machine may be provided with an automatic regulating device as shown in illustration on page 271. The use of this device enables an operative to care for more machines and at the same time do better work and with less labor.

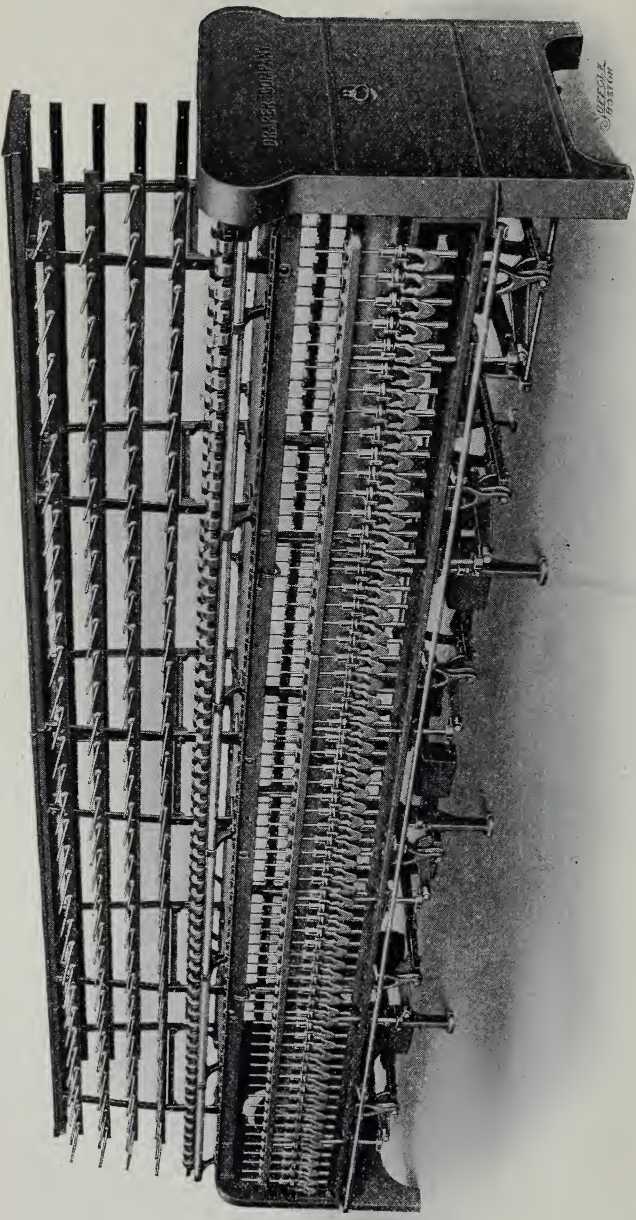
The winding and unwinding machines are in general use in nearly all the important colored goods mills of the country.



UNWINDING MACHINE
WITHOUT PATENT REGULATING DEVICE.



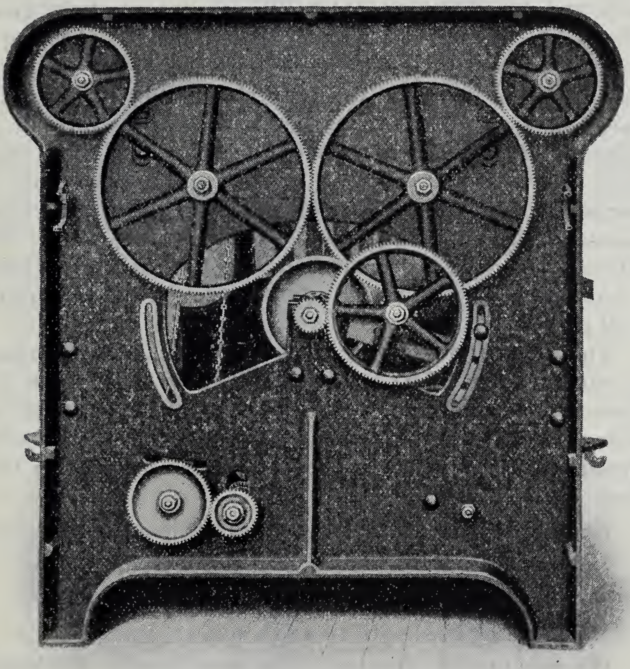
UNWINDING MACHINE
WITH CONNELLY PATENT REGULATING DEVICE.



G Model Twister.

TWISTERS.

Soon after the introduction of the Sawyer spindle, about forty years ago, recognizing the call for an improved machine, our predecessors designed and placed upon the market the first twister containing high speed spindles. This machine was in advance of the times in twister construction; the spindles weighed but one-half the weight of the old common spindles previously in use, and they turned off a greater product per spindle at a large saving in power. Since that time we have brought out many other



TWISTER. GEARED END WITH COVERS REMOVED.

improvements, including the Rabbeth spindle; the box rail construction for twister frame; the Hetherington spindle brake; the all-metal top and creel; the Smith stop motion; Rhoades' novelty yarn attachments; adjustable feet for sampsons; etc.

In the process of twisting it is desirable to use spindles adapted to as high speed as consistent with the character of the yarn to be twisted. This in turn calls for machines with plenty of material and designed with view of carrying the load with the least possible vibration.

Our twisters are very heavy; all joints in the frames are machined together; the sampsons have adjustable feet to accommodate variations in floor level; the gears in head end are all protected by covers held in place by automatic locking devices; the spindle rails are of heavy box pattern; the ring rails are provided with deep flanges making them rigid and are made in short sections with two lifting rods each; all gears on our twisters are machine cut, have wide faces and are interchangeable; we arrange our twist gears directly on the end of cylinder shaft, thereby securing a greater range with less changes, and the gears make less noise when in motion; the traverse motion is fitted for change gears so that the speed of the ring rail can be adjusted without changing the twist; by use of a lever clutch the worm of traverse motion can be thrown out of gear so that the ring rail may be lowered at any time when necessary; the spindles used in our twisters are of the Rabbeth type and are made in our own works, by machines of our special design which insure accuracy and uniformity in all particulars.

The illustrations of our number 105 spindle show details as usually made. The bolster is locked by a spline which enters a slot, and the step is held in place by a spring connection which can be readily changed in position when adjustment is necessary. These spindles are made in four sizes:—

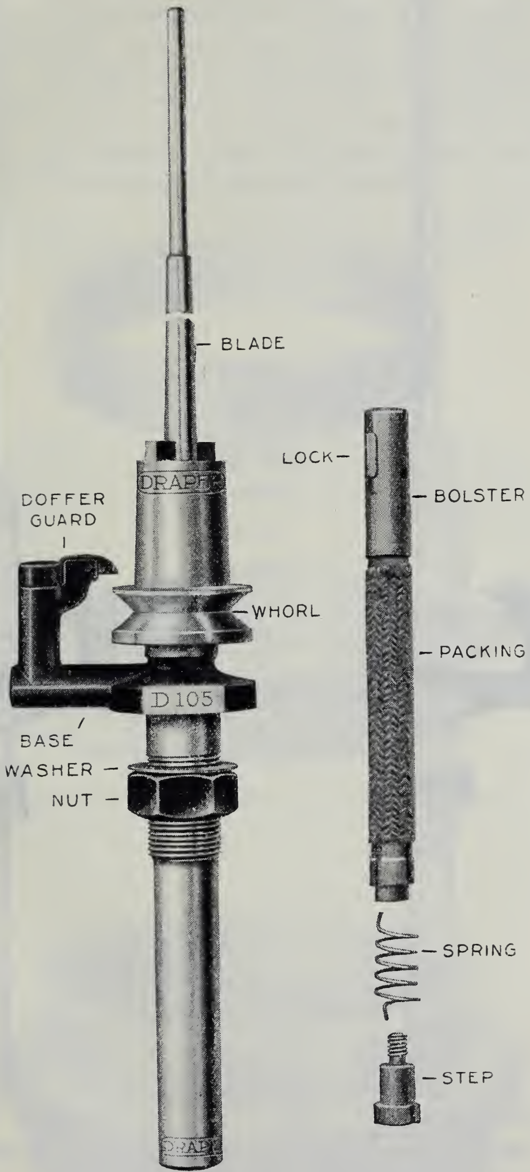
Number 105, used with rings up to and including 2½ inch.

Number 106, used with rings 2¾ to 3¼ inch.

Number 107, used with rings 3½ to 4 inch.

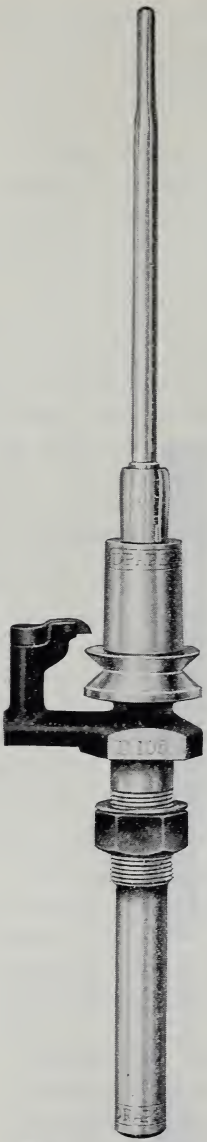
Number 108, used with rings 4¼ and 4½ inch.

We can furnish the number 105 spindle with centrifugal clutch bobbin drive, if desired.

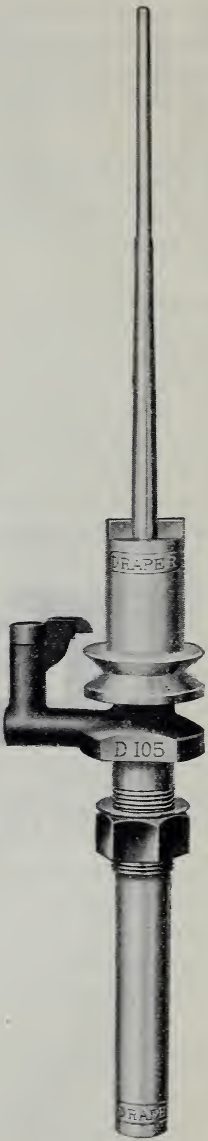


NUMBER 105 SPINDLE.

DRAPER 105 TWISTER SPINDLES WITH WHORLS FOR BAND DRIVE.

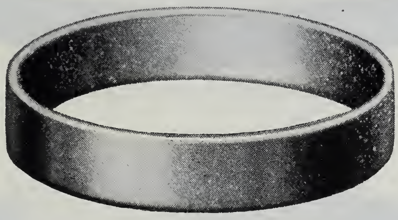


WITH PATENT CENTRIFUGAL CLUTCH.

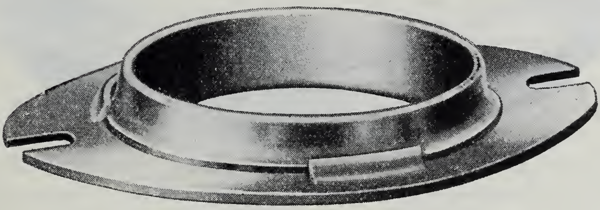


WITH SOLID WHORL.

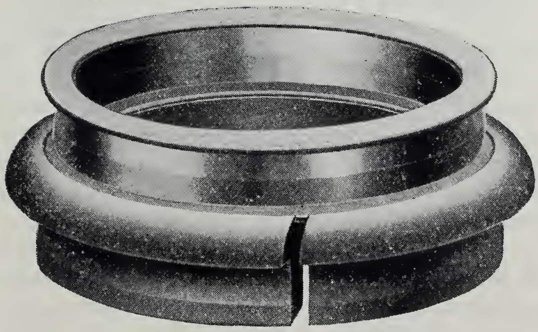
Our twister rings have the benefit of over forty years' experience in the manufacture of rings and in hardness, finish, uniformity and roundness are the best that can be produced. We illustrate the several types of rings used on our twisters. With vertical twister rings 3 inch diameter or more we recommend the Carter oiling device which lubricates the traveler below its contact with the yarn thereby allowing a material increase in speed.



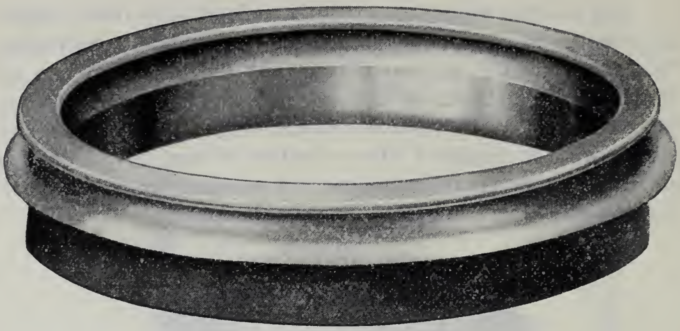
Band Ring.



Narrow Vertical Ring in Plate Holder.



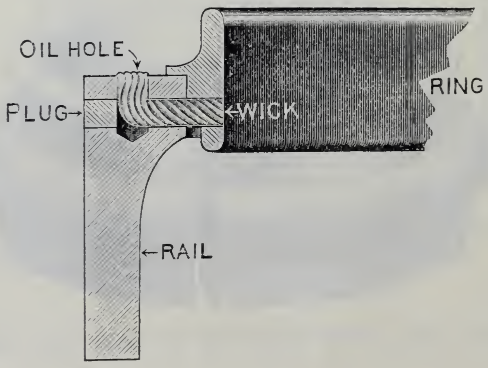
Double Ring with Flat Top in Cast Iron Holder.

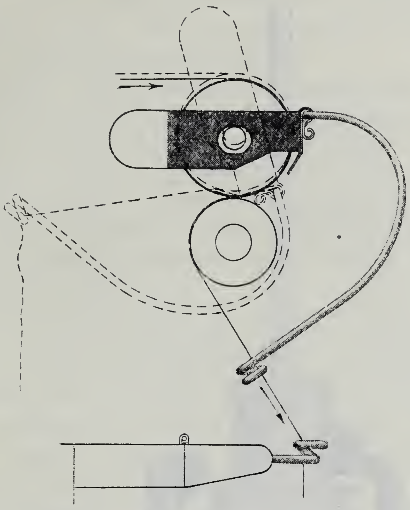


Single Ring with Flat Top.

Wide Vertical Ring.

Carter Oiling Device For Vertical Twister Rings.





THE SMITH STOP MOTION.

THE SMITH TWISTER STOP MOTION is the only practical device for the purpose that has ever been placed on the market. Its use on two-ply work eliminates waste; prevents roller laps; enables the help to tend more spindles; and in some cases allows the speed to be increased. If a band breaks on a spindle the stop motion will hold the end until the new band is applied.

Broken ends are held in place and do not lash around to break others. The stop motion does not unthread during the process of doffing.

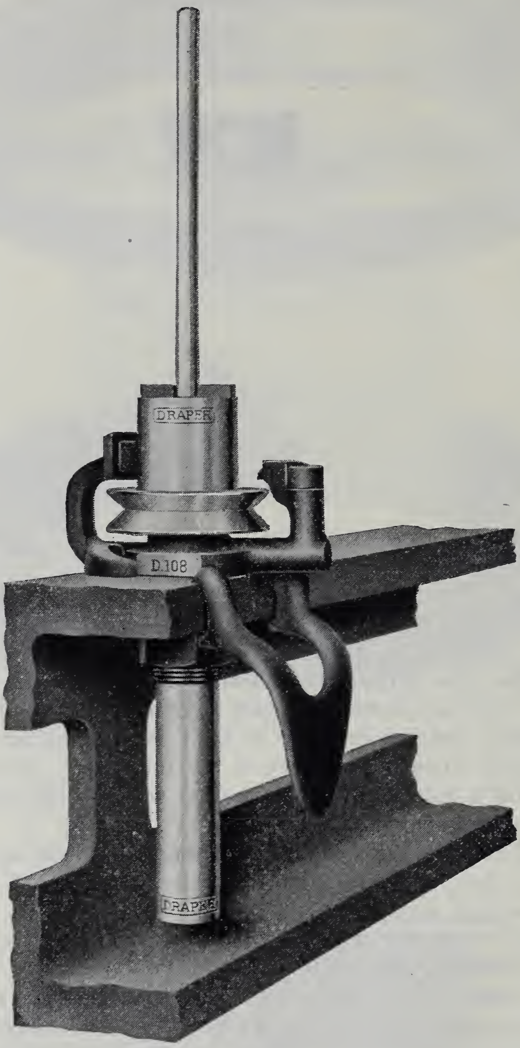
With more than two ply, it stops only when the entire thread breaks in front of the rolls.

The extension of sheet metal at the back makes a signal which indicates to the operator when an end is broken.

This stop motion is not recommended for wet twisting and can only be applied where a single line of top and bottom rolls is used, with the yarn delivered from the under side of the bottom roll, as shown in illustration.

The device is of much more value on worsted than on cotton yarn owing to the greater value of the waste saved.

We are prepared to furnish these stop motions for twisters of other make.



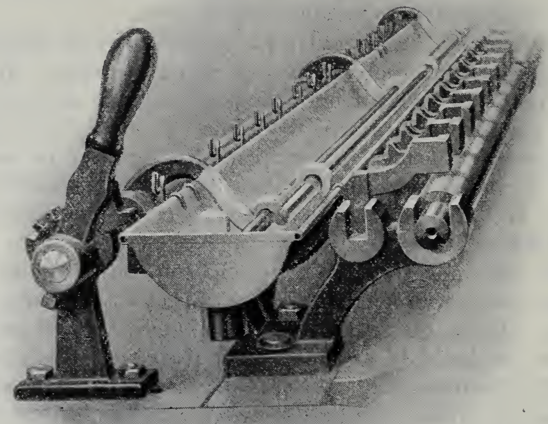
HEAVY TWISTER SPINDLE WITH BRAKE.

Our twister spindles may be provided with spindle brakes, which are important on the heavy spindles. We illustrate the number 108 spindle with brake as it would be mounted on the rail of the twister; the friction pad is lined with leather and pressure of the knee against the overhanging part of the brake quickly stops the spindle. The brake can be readily disconnected if desired. A guard rail is applied to the front of the twister to protect the brakes from injury by passing trucks.

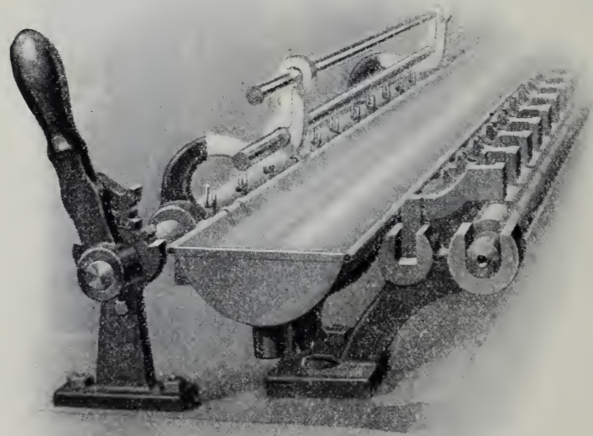
We usually build twisters to twist from horizontal spools located in creels at the top of the machines. We can make them to twist from beams if desired; also to twist from upright tubes or bobbins; in the last named arrangement Rhoades' patent combination step or bearing gives a choice between a glass step which reduces the friction and a cast iron step with more contact surface when more friction is needed.

For the novelty yarns which can be made on ring twisters we recommend Rhoades' patent attachments. By the use of change gears and cams a wide range of patterns may be produced in as many as four colors. They can be applied to outstanding twisters of our make. Our special circular in colors illustrates many of the designs which may be easily produced.

On wet twisters we provide brass water pans containing glass rods under which the yarn is drawn in the process of twisting. These glass rods are raised from the pan and thrown back out of the way by use of a lever, as shown in the illustrations. The water may be drawn from the pans through an outlet provided for that purpose.



Water Pan with Glass Rods in Working Position.



Water Pan with Glass Rods Thrown Back.

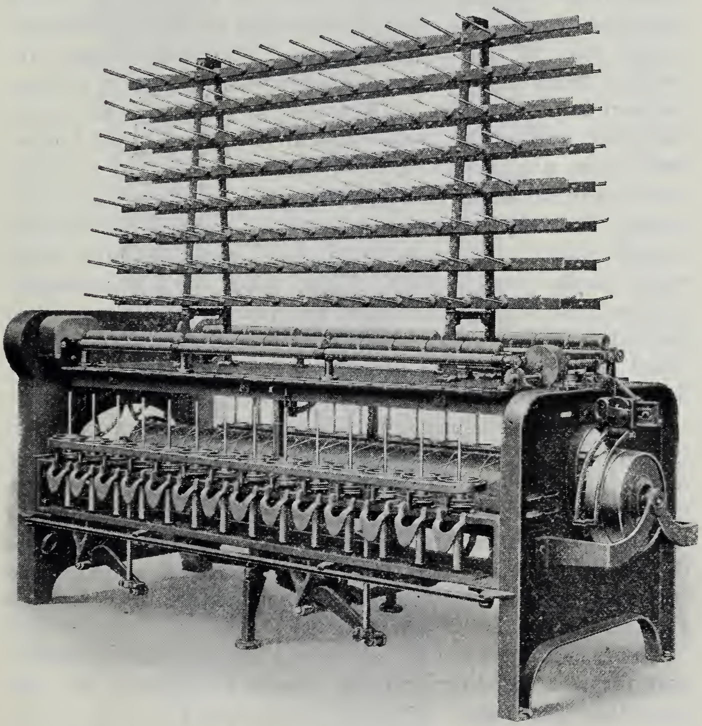
We offer two models of twister.

G MODEL

with spindles driven by round bands.

H MODEL

with spindles driven in groups of four each by flat tapes.



G Model Twister for Heavy Work.

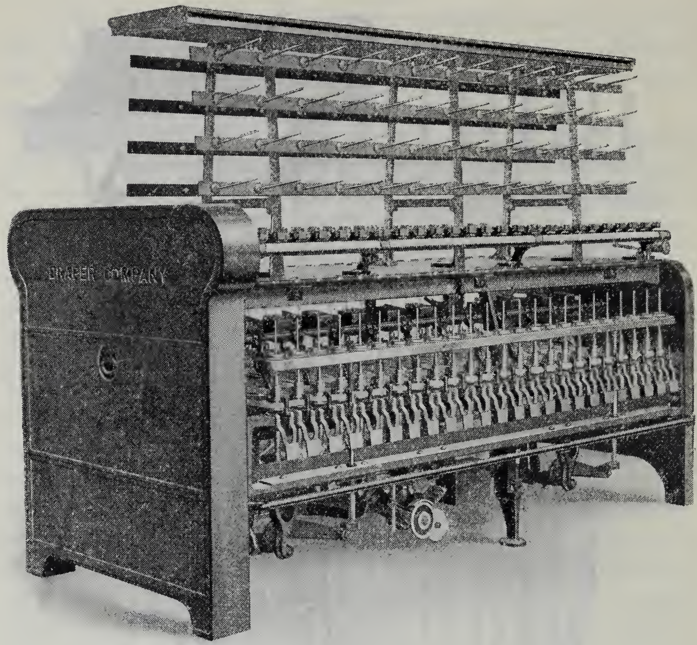
Our G Model Twister is the standard machine which has been on the market for several years. The illustration on page 285 shows a machine with small rings and that on page 283 the machine for heavy work.

This model has 8 inch cylinders; with outrigger bearing near pulleys; it measures 38 inches across the frame; it may be adapted for either wet or dry twisting; the rolls are either single line top and bottom, single line top and double line bottom, or both top and bottom double; we use the well known Rabbeth type of spindle illustrated on pages 275-6; knee brakes are recommended on the heavy spindle twisters, and may be furnished if desired on the lighter spindle machines; machines are usually arranged to twist from creels but may be built to twist from beams, or from vertical spools, if preferred; in the latter case Rhoades' patent friction arrangement is desirable with alternative glass steps for tender yarns; flat top rings of 2½ inches diameter or less are usually double rings in cast iron holders; larger than 2½ inch flat top are solid single rings; for vertical rings 2½ inches diameter or less the narrow vertical pattern in plate holder is used; larger sizes than 2½ inches diameter are in the wide vertical pattern without holder; band rings are also preferred in some cases on wet twisting; see ring illustrations on pages 277-8; the usual traverse is six inches, but may be longer or shorter if desired; the building motion may be for warp wind, two headed bobbins, warp wind single head bobbin, filling wind, or a combination motion that will build either; the number of ply may be as desired from two-ply up; the Smith stop motion, for which a small additional charge is made, is recommended on two-ply dry twisting; machines are equipped with wire-board lifters.

Machines are usually geared to drive both sides together, but may be geared independently if so ordered; the twister may have Rhoades' patent measuring device; all of our twisters may be equipped for making a wide range of novelty yarns in as high as four colors; an additional charge is made for these last two attachments; a special yarn traverse motion may also be furnished to traverse the yarn on the rolls.

The cuts on page 282 show our arrangement of water pan for wet twisting and the means for raising the rods from the water pan.

H Model Twister.



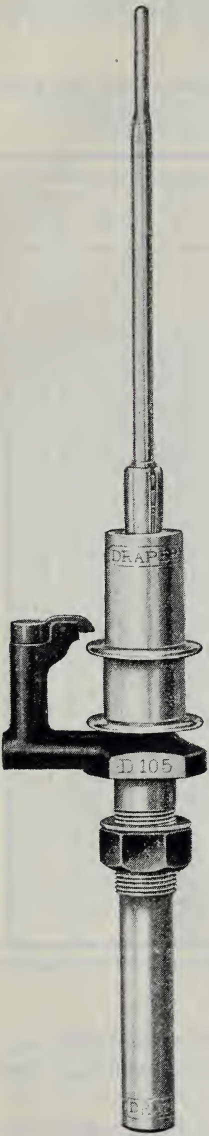
H MODEL TWISTER.

Our H MODEL TWISTER was designed primarily to meet the requirements of the worsted trade. For years worsted twisters had been equipped with spindles driven by flat bands or tapes; users of such machines claimed that they produced yarns of more uniform twist; that the tapes lasted much longer than round bands and that there was a saving of power in tape driven machines as compared with the band drive.

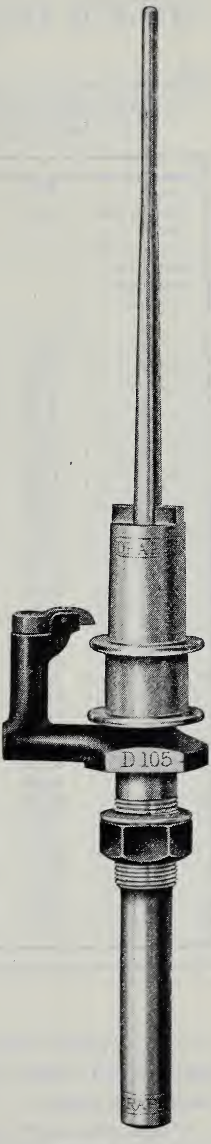
The machines previously constructed were so arranged in conveying the power from cylinder to spindles that it was necessary to have the machine much wider than with a band drive. As floor space is expensive we determined to build a twister that would at least be no wider than our standard machine. Our special arrangement includes a ten inch cylinder located away from the center of machine, and connected with the spindles in groups of four spindles each. A patented idler pulley in self oiling floating bearings is mounted between cylinder and spindles to take up the slack of the tape and with an adjustable weight to regulate the amount of tension.

The H Model twister measures the same in width and admits of the same options, range of sizes, etc., as on G Model twister; for details see page 284.

DRAPER
105
TWISTER
SPINDLES
WITH
WHORLS
FOR
TAPE
DRIVE.



WITH PATENT
CENTRIFUGAL
CLUTCH.



WITH SOLID
WHORL.

TABLE OF TWIST GEARS FOR DRAPER COMPANY'S TWISTER.

This table gives the number of teeth required in cylinder gears with a given stud gear to produce a theoretical twist with 8-inch cylinder and 1/8-inch band. No allowance is made for contraction.

Diameter of whorl . . .	2½	2¼	1¾	1¼	1⅛	1	⅞
Teeth in stud gear . . .	36	32	36	38	32	28	26
Teeth in cylinder gear.	TWIST.						
18	10.95	13.61	15.33	19.80	25.86	32.85	39.79
19	10.37	12.90	14.52	18.77	24.50	31.12	37.54
20	9.85	12.25	13.79	17.82	23.28	29.56	35.81
21	9.38	11.67	13.14	16.97	22.17	28.15	34.11
22	8.95	11.14	12.54	16.20	21.16	26.87	32.55
23	8.57	10.65	11.99	15.50	20.24	25.70	31.14
24	8.21	10.21	11.49	14.85	19.40	24.63	29.84
25	7.88	9.80	11.03	14.25	18.62	23.65	28.65
26	7.58	9.42	10.61	13.70	17.90	22.74	27.55
27	7.30	9.07	10.22	13.19	17.24	21.90	26.53
28	7.04	8.75	9.85	12.71	16.63	21.12	25.58
29	6.79	8.45	9.52	12.29	16.05	20.39	24.70
30	6.57	8.17	9.20	11.88	15.52	19.70	23.87
31	6.36	7.90	8.90	11.50	15.02	19.06	23.10
32	6.16	7.66	8.62	11.14	14.55	18.47	22.38
33	5.97	7.42	8.36	10.80	14.11	17.91	21.70
34	5.80	7.21	8.11	10.48	13.69	17.38	21.06
35	5.63	7.00	7.88	10.18	13.30	16.89	20.46
36	5.47	6.81	7.66	9.90	12.93	16.42	19.89
37	5.33	6.62	7.45	9.63	12.58	15.98	19.36
38	5.19	6.45	7.26	9.38	12.25	15.56	18.85
39	5.06	6.28	7.08	9.14	11.94	15.16	18.36
40	4.93	6.13	6.90	8.91	11.64	14.78	17.90
41	4.81	5.98	6.73	8.69	11.35	14.42	17.47
42	4.69	5.83	6.57	8.48	11.08	14.07	17.05
43	4.58	5.70	6.42	8.29	10.83	13.75	16.66
44	4.48	5.57	6.27	8.10	10.58	13.44	16.28
45	4.38	5.44	6.13	7.94	10.35	13.14	15.92
46	4.29	5.33	6.00	7.75	10.12	12.86	15.57
47	4.20	5.21	5.87	7.58	9.90	12.58	15.24
48	4.11	5.10	5.75	7.42	9.70	12.32	14.92
49	4.02	5.00	5.63	7.28	9.50	12.07	14.62
50	3.94	4.90	5.52	7.13	9.31	11.82	14.32
51	3.87	4.80	5.41	6.98	9.13	11.59	14.04
52	3.79	4.71	5.31	6.85	8.95	11.37	13.77

This table is figured for G model Twister with 1½ inch bottom roll, with a 90 tooth gear on the front roll and a 120 tooth jack gear.

The ordinary ranges of twist required are given in the table. If any twist not given is necessary it can be obtained within a small fraction of a turn by changing both stud and cylinder gears. All gears are interchangeable and have same size nut, requiring but one size of wrench to make any change.

TABLE OF TWIST GEARS FOR DRAPER COMPANY'S H MODEL TWISTER.

This table gives the number of teeth required in cylinder gears with a given stud gear to produce a theoretical twist with 10-inch cylinder and with tape 1-11 inch thick; no allowance is made for contraction.

Diameter of whorl . . .	$2\frac{1}{2}$	$2\frac{1}{4}$	$1\frac{3}{4}$	$1\frac{1}{4}$	$1\frac{1}{8}$	1	$\frac{7}{8}$
Teeth in stud gear . . .	36	32	36	38	32	28	26
Teeth in cylinder gear	TWIST.						
18	13.76	17.16	19.40	25.20	33.04	42.08	51.16
19	13.02	16.24	18.36	23.88	31.28	39.84	48.47
20	12.42	15.44	17.46	22.68	29.72	37.87	46.04
21	11.82	14.70	16.62	21.60	28.29	36.06	43.85
22	11.28	14.04	15.88	20.64	27.03	34.41	41.86
23	10.77	13.41	15.18	19.74	25.83	32.91	40.04
24	10.32	12.87	14.55	18.90	24.78	31.56	38.37
25	9.94	12.36	13.96	18.15	23.79	30.27	36.84
26	9.53	11.88	13.44	17.45	22.85	29.12	35.42
27	9.19	11.43	12.92	16.80	22.00	28.04	34.11
28	8.85	11.03	12.48	16.20	21.23	27.05	32.89
29	8.55	10.65	12.03	15.65	20.50	26.11	31.75
30	8.28	10.30	11.63	15.13	19.83	25.23	30.70
31	8.00	9.98	11.26	14.64	19.18	24.20	29.71
32	7.74	9.64	10.90	14.18	18.58	23.66	28.78
33	7.52	9.36	10.58	13.76	18.02	22.94	27.91
34	7.30	9.08	10.26	13.34	17.48	22.26	27.08
35	7.08	8.82	9.98	12.96	16.98	21.64	26.31
36	6.88	8.58	9.70	12.60	16.52	21.04	25.58
37	6.70	8.34	9.44	12.26	16.06	20.46	24.89
38	6.52	8.12	9.18	11.94	15.64	19.92	24.23
39	6.36	7.92	8.96	11.64	15.24	19.41	23.61
40	6.21	7.72	8.73	11.34	14.86	18.94	23.02
41	6.05	7.53	8.51	11.07	14.50	18.47	22.46
42	5.91	7.35	8.31	10.80	14.15	18.03	21.93
43	5.77	7.18	8.12	10.55	13.82	17.61	21.42
44	5.64	7.02	7.94	10.32	13.52	17.21	20.93
45	5.52	6.87	7.76	10.09	13.23	16.82	20.46
46	5.39	6.71	7.59	9.87	12.92	16.46	20.02
47	5.28	6.57	7.42	9.66	12.65	16.11	19.59
48	5.16	6.44	7.28	9.46	12.39	15.78	19.19
49	5.06	6.30	7.12	9.26	12.13	15.45	18.79
50	4.97	6.18	6.98	9.08	11.90	15.13	18.42
51	4.87	6.05	6.84	8.89	11.65	14.85	18.06
52	4.77	5.94	6.72	8.73	11.43	14.56	17.71

The above table is for H model twister only provided with $1\frac{1}{2}$ inch bottom roll, with a 90 tooth gear on the front roll and a 120 tooth jack gear. The table includes the ordinary ranges of twist. If any twist not given is necessary it can be obtained within a small fraction of a turn by changing both stud and cylinder gears. All gears are interchangeable and have the same size nut, requiring but one size of wrench to make any change.

TWIST FORMULÆ

For Our G Model Twister of Regular Construction.
See Opposite Page for Tables.

Roll Gear=90 Teeth. Jack Gear=120 Teeth.
Diameter of Cylinder=8 inches.
Diameter of Round Band=1/8 inch or .125. (usual size.)
Bottom Roll Diam.=1½ inches. Circum.=4.7124 inches.

Formulæ for Stud Gear Constants.

$$\frac{\text{T. in Roll Gear} \times \text{T. in Jack Gear} \times (\text{dia. of Cyl.} + \text{dia. of Band})}{\text{Circum. of Bottom Roll} \times \text{T. in Stud Gear}} = \text{Stud Gear Constant}$$

$$\frac{\text{Stud Gear Constant}}{(\text{dia. of Whorl} + \frac{1}{8}'') \times \text{T. in Cyl. Gear}} = \text{Twist per inch.}$$

$$\frac{\text{Stud Gear Constant}}{(\text{dia. of Whorl} + \frac{1}{8}'') \times \text{Twist per inch}} = \text{T. in Cyl. Gear.}$$

Examples, based on Stud Gear of 30 teeth, Cylinder Gear of 32 teeth and 1⅛″ diam. Whorl on Twister:

$$\frac{90 \times 120 \times 8.125}{4.7124 \times 30} = 620.703 \text{ Stud Gear Constant as per table.}$$

$$\frac{620.703}{1.25 \times 32} = 15.52 \text{ Turns Twist per inch.}$$

$$\frac{620.703}{1.25 \times 15.5} = 32 \text{ Teeth in Cyl. Gear.}$$

Formulæ for Whorl Constants.

$$\frac{\text{T. in Roll Gear} \times \text{T. in Jack Gear} \times (\text{dia. of Cyl.} + \text{dia. of Band})}{\text{Circum. of Bottom Roll} \times (\text{dia. of Whorl} + \text{dia. of Band})} = \text{Whorl Constant}$$

$$\frac{\text{Whorl Constant}}{\text{T. in Cyl. Gear} \times \text{T. in Stud Gear}} = \text{Twist per inch.}$$

$$\frac{\text{Whorl Constant}}{\text{T. in Stud Gear} \times \text{Twist per inch}} = \text{T. in Cyl. Gear.}$$

Examples, assuming 1⅛″ dia. Whorl on Twister:

$$\frac{90 \times 120 \times 8.125}{4.7124 \times 1.25} = 14897 \text{ Whorl Constant as per table.}$$

$$\frac{14897}{32 \times 30} = 15.52 \text{ Turns Twist per inch.}$$

$$\frac{14897}{30 \times 15.5} = 32 \text{ Teeth in Cyl. Gear.}$$

TABLE OF CONSTANTS FOR G MODEL TWISTER FOR USE WITH FORMULÆ TO DETERMINE THEORETICAL TWIST PER INCH OR NUMBER OF TEETH IN CYLINDER GEAR.

Teeth in Stud Gear.	Stud Gear Constants.	Teeth in Stud Gear.	Stud Gear Constants.
18	1034.504	61	305.264
19	980.057	62	300.340
20	931.054	63	295.573
21	886.718	64	290.954
22	846.413	65	286.478
23	809.612	66	282.138
24	775.879	67	277.927
25	744.843	68	273.840
26	716.196	69	269.871
27	689.670	70	266.016
28	665.039	71	262.269
29	642.106	72	258.626
30	620.703	73	255.083
31	600.680	74	251.636
32	581.911	75	248.281
33	564.275	76	245.014
34	547.679	77	241.832
35	532.031	78	238.732
36	517.252	79	235.710
37	503.273	80	232.764
38	490.028	81	229.890
39	477.464	82	227.086
40	465.527	83	224.350
41	454.173	84	221.680
42	443.359	85	219.072
43	433.048	86	216.524
44	423.206	87	214.035
45	413.802	88	211.603
46	404.806	89	209.226
47	396.193	90	206.901
48	387.939	91	204.627
49	380.022	92	202.403
50	372.422	93	200.227
51	365.119	94	198.097
52	358.098	95	196.011
53	351.341	96	193.970
54	344.835	97	191.970
55	338.565	98	190.011
56	332.519	99	188.092
57	326.686	100	186.211
58	321.053		
59	315.612		
60	310.351		

WHORL CONSTANTS.

Diam. of Whorl in Inches	Whorl Constants.
⅞	18621
1	16550
1⅛	14897
1¼	13542
1⅜	12414
1½	11459
1⅝	10641
1¾	9931
2	8763
2¼	7840
2½	7094
2¾	6477
3	5959

TWIST FORMULÆ

FOR OUR H MODEL TWISTER OF REGULAR CONSTRUCTION.
SEE OPPOSITE PAGE FOR TABLES.

Roll Gear=90 Teeth. Jack Gear=120 Teeth.
Diameter of Cylinder=10 inches.
Thickness of Flat Tape=$\frac{1}{11}$ inch or .09091. (usual thickness.)
Bottom Roll Diam.=1½ inches. Circum.=4.7124.

FORMULÆ FOR STUD GEAR CONSTANTS.

$$\frac{\text{T. in Roll Gear} \times \text{T in Jack Gear} \times (\text{dia. of Cyl.} + \text{th'k. of Tape})}{\text{Circum. of Bottom Roll} \times \text{T. in Stud Gear}} = \text{Stud Gear Constant}$$

$$\frac{\text{Stud Gear Constant}}{(\text{dia. of Whorl} + 1\text{-}11'') \times \text{T. in Cyl. Gear}} = \text{Twist per inch.}$$

$$\frac{\text{Stud Gear Constant}}{(\text{dia. of Whorl} + 1\text{-}11'') \times \text{Twist per inch}} = \text{T. in Cyl. Gear.}$$

EXAMPLES, based on Stud Gear of 30 teeth, Cylinder Gear of 32 teeth and 1⅛″ diam. Whorl on Twister:

$$\frac{90 \times 120 \times 10.09091}{4.7124 \times 30} = 770.887 \text{ Stud Gear Constant as per table.}$$

$$\frac{770.887}{1.21591 \times 32} = 19.81 \text{ Turns Twist per inch.}$$

$$\frac{770.887}{1.21591 \times 19.81} = 32 \text{ Teeth in Cyl. Gear.}$$

FORMULÆ FOR WHORL CONSTANTS.

$$\frac{\text{T. in Roll Gear} \times \text{T. in Jack Gear} \times (\text{dia. of Cyl.} + \text{th'k. of Tape})}{\text{Circum. of Bottom Roll} \times (\text{dia. of Whorl} + \text{th'k. of Tape})} = \text{Whorl Constant}$$

$$\frac{\text{Whorl Constant}}{\text{T. in Cyl. Gear} \times \text{T. in Stud Gear}} = \text{Twist per inch.}$$

$$\frac{\text{Whorl Constant}}{\text{T. in Stud Gear} \times \text{Twist per inch}} = \text{T. in Cyl. Gear.}$$

EXAMPLES, assuming 1⅛″ dia. Whorl on Twister:

$$\frac{90 \times 120 \times 10.09091}{4.7124 \times 1.21591} = 19020 \text{ Whorl Constant as per table.}$$

$$\frac{19020}{32 \times 30} = 19.81 \text{ Turns Twist per inch.}$$

$$\frac{19020}{30 \times 19.81} = 32 \text{ Teeth in Cyl. Gear.}$$

TABLE OF CONSTANTS FOR H MODEL TWISTER FOR USE WITH FORMULÆ TO DETERMINE THEORETICAL TWIST PER INCH, OR NUMBER OF TEETH IN CYLINDER GEAR.

Teeth in Stud Gear.	Stud Gear Constants.	Teeth in Stud Gear.	Stud Gear Constants.	Whorl Constants. Diam. of Whorl in Inches	Whorl Constants. Whorl Constants.
18	1284.811	61	379.124		
19	1217.190	62	373.009		
20	1156.330	63	367.089		
21	1101.267	64	361.353		
22	1051.209	65	355.793		
23	1005.504	66	350.403	7/8	23943
24	963.608	67	345.173	1	21199
25	925.064	68	340.097	1 1/8	19020
26	889.484	69	335.168	1 1/4	17247
27	856.541	70	330.380	1 3/8	15776
28	825.950	71	325.726	1 1/2	14537
29	797.469	72	321.202	1 5/8	13478
30	770.887	73	316.802	1 3/4	12563
31	746.019	74	312.521	2	11061
32	722.706	75	308.354	2 1/4	9879
33	700.806	76	304.297	2 1/2	8926
34	680.194	77	300.345		
35	660.760	78	296.494		
36	642.405	79	292.744		
37	625.043	80	289.082		
38	608.594	81	285.513		
39	592.989	82	282.031		
40	578.165	83	278.633		
41	564.063	84	275.316		
42	550.633	85	272.077		
43	537.828	86	268.914		
44	525.604	87	265.823		
45	513.924	88	262.802		
46	502.752	89	259.849		
47	492.055	90	256.962		
48	481.804	91	254.138		
49	471.971	92	251.376		
50	462.532	93	248.673		
51	453.462	94	246.027		
52	444.742	95	243.437		
53	436.351	96	240.902		
54	428.270	97	238.418		
55	420.483	98	235.985		
56	412.975	99	233.602		
57	405.729	100	231.266		
58	398.734				
59	391.976				
60	385.443				

PRODUCTION OF TWISTERS.

In preparing tables of production we have assumed the number of yarn after twisting to be one-half for 2-ply, one-fourth for 4-ply, etc., of the number before twisting; the twist is indicated by the number at the head of table by which the square root of the twisted yarn is multiplied. (See twist tables pages 125-129.) The figures given cover the usual sizes of ring and numbers of yarn. What we consider a fair allowance for loss from the theoretical production has been made.

In accordance with modern practice we have assumed the following conditions:

Traverse:—6 inches.

Bobbin head diameter:—Top ¼ inch less than ring diameter for rings larger than 2½ inches, and ½ inch less than ring diameter for rings 2½ and less. Bottom head ¼ inch less than diameter of ring in all cases.

Gauge of frame :—1 inch more than diameter of ring.

Roll speed is figured in proportion to the spindle speed and twist, on the basis that contraction in length due to twist is offset by the additional turns of the spindle that are necessary to wind the yarn on the bobbin.

Example: To find the roll speed, divide the spindle speed by the circumference of the bottom roll and then divide the result by the twist per inch.

As bottom roll is 1½ inches in diameter the circumference=3.1416×1.5=4.7124.

Spindle speed for No. 6 yarn is 4500÷4.7124=954.92.

If twist with multiplier 4 is used consult the twist table which gives 6.93 for the square root of 6 multiplied by 4.

954.92÷6.93=137.8 number of revolutions. The tables give 138 as the nearest equivalent.

Production is figured directly from the delivery of the front roll.

Taking the example of No. 6 yarn above, multiply the circumference—4.7124 inches by 138 the turns per minute =650.3112 inches of delivery per minute. 650.3112×600= 390186.72 inches of delivery per day. As there are 30,240 inches in a hank, 390186.72÷30,240=12.9 hanks per day ÷3 (the number of 6 two-ply)=4.3 pounds per day, the theoretical production of continuous running.

PER CENT. OF ALLOWANCE FOR STOPS IN TWISTING.

Number of Yarn.	2 Ply.	3 Ply.	4 Ply.	6 Ply.
6	14	15	17	20
7	14	15	16	18
8	13	14	15	17
9	13	14	15	16
10	12	13	14	15
12	12	13	14	15
14	11	12	13	14
16	11	12	13	14
18	10	11	12	13
20	10	11	12	13
22	9	10	11	12
24	9	10	11	12
26	9	9	10	11
28	8	9	10	11
30	8	9	9	10
32	8	8	9	10
34	7	8	9	9
36	7	8	8	9
38	7	7	8	9
40	6	7	8	8
42	6	7	7	8
44	6	6	7	8
46	5	6	7	7
48	5	6	6	7
50	5	5	6	7
60	5	5	6	6
70	4	5	5	6
80	4	5	5	6

In order to make a proper allowance for loss of time due to doffing, etc., it is necessary to find out what results are actually obtained and work out a systematic table. The above basis has been assumed for our own figures. The percentage varies with the ply and number of yarn, but not with the twist.

Taking the same problem as before, with the theoretical product of 4.3 pounds, the table would recommend a percentage reduction of 14 per cent. $4.3 \times .14 = .602$

$4.3 - .602 = 3.69$—Answer

Same as given in the Production tables.

TABLE SHOWING NUMBER OF POUNDS OF TWISTED YARN PRODUCED IN 10 HOURS—2 PLY.
FRONT ROLL 1½ IN. IN DIAMETER IN ALL CASES.

No. of Yarn to be Twisted.	Rev. of Spindle per Minute.	Dia. of Ring in Inches.	Dia. of Bobbin Barrel.	Weight of Yarn in Pounds on Bobbin.	Multiplier 3. Rev. per Minute of Roll.	Multiplier 3. Pounds per Spindle.	Multiplier 4. Rev. per Minute of Roll.	Multiplier 4. Pounds per Spindle.	Multiplier 5. Rev. per Minute of Roll.	Multiplier 5. Pounds per Spindle.	Multiplier 6. Rev. per Minute of Roll.	Multiplier 6. Pounds per Spindle.
6	4500	3	1¼	.42	184	4.92	138	3.69	110	2.94	92	2.47
7	4500				170	3.90	127	2.67	102	2.34	85	1.95
8	4500				159	3.22	119	2.41	95	1.93	79	1.60
9	4500				150	2.70	112	2.01	90	1.63	75	1.36
10	4500				142	2.33	107	1.76	85	1.40	71	1.17
12	5300	2½	1	.331	153	2.10	115	1.57	91	1.25	76	1.04
14	5300				141	1.67	106	1.25	85	1.01	70	.83
16	5300				132	1.37	99	1.02	79	.82	66	.68
18	5300				125	1.17	93	.87	75	.70	62	.58
20	5300				118	.99	89	.75	72	.61	59	.50
22	6000	2¼	1	.247	128	.99	96	.74	76	.59	64	.50
24	6000				122	.86	92	.65	73	.52	61	.43
26	6000				118	.77	88	.58	70	.46	58	.39
28	6000				113	.69	85	.52	68	.42	56	.34
30	6000				109	.62	82	.47	65	.37	54	.31
32	6000				106	.57	79	.42	63	.34	53	.28
34	6000				103	.52	76	.39	61	.31	51	.26
36	7000	2	7/8	.180	116	.56	87	.42	70	.34	58	.28
38	7000				114	.52	85	.39	68	.31	56	.26
40	7000				111	.49	83	.36	66	.29	55	.24
42	7000				108	.45	81	.34	64	.27	54	.23
44	7000				106	.42	79	.31	62	.25	52	.21
46	7000				104	.40	77	.30	61	.23	51	.19
48	7000				101	.37	75	.28	60	.22	50	.19
50	7500	1¾	7/8	.117	106	.38	79	.28	63	.22	53	.19
60	7500				97	.29	72	.21	58	.17	48	.14
70	8000				95	.24	71	.18	57	.15	47	.12
80	8000				89	.20	67	.15	53	.12	44	.10

Table Showing Number of Pounds of Twisted Yarn Produced in 10 Hours—3 Ply.
Front Roll 1½ In. in Diameter in all Cases.

No. of Yarn to be Twisted.	Rev. of Spindle per Minute.	Dia. of Ring in Inches.	Dia. of Bobbin Barrel.	Weight of Yarn in Pounds on Bobbin.	Multiplier 3.		Multiplier 4.		Multiplier 5.		Multiplier 6.	
					Rev. per Minute of Roll.	Pounds per Spindle.	Rev. per Minute of Roll.	Pounds per Spindle.	Rev. per Minute of Roll.	Pounds per Spindle.	Rev. per Minute of Roll.	Pounds per Spindle.
6	3700	3½	1¼	.645	185	7.35	139	5.52	111	4.40	93	3.69
7	3700				172	5.87	129	4.40	103	3.51	86	2.93
8	3700				161	4.87	120	3.62	96	2.86	80	2.41
9	3700				151	4.05	113	3.03	90	2.41	76	2.04
10	3700				144	3.51	108	2.64	86	2.10	71	1.73
12	4500	3	1¼	.420	159	3.23	119	2.42	96	1.95	80	1.63
14	4500				148	2.61	110	1.94	89	1.57	74	1.31
16	4500				138	2.13	103	1.59	83	1.28	69	1.06
18	4500				130	1.80	97	1.34	78	1.08	65	.90
20	4500				124	1.55	92	1.15	74	.91	62	.77
22	5300	2½	1	.331	139	1.59	104	1.19	83	.95	69	.78
24	5300				133	1.39	100	1.05	80	.84	66	.69
26	5300				128	1.25	96	.94	76	.75	64	.63
28	5300				123	1.12	92	.84	74	.67	62	.56
30	5300				119	1.01	89	.76	71	.60	59	.50
32	5300				115	.92	86	.69	69	.55	57	.45
34	5300				112	.85	83	.63	67	.51	56	.42
36	6000	2¼	1	.247	123	.88	92	.66	74	.53	61	.44
38	6000				120	.82	89	.61	72	.49	60	.41
40	6000				117	.76	87	.57	70	.46	58	.37
42	6000				114	.71	85	.53	68	.42	57	.35
44	6000				111	.67	83	.50	67	.40	56	.33
46	7000	2	⅞	.180	127	.73	95	.54	76	.44	63	.36
48	7000				124	.68	93	.51	74	.41	62	.34
50	7000				122	.65	91	.49	73	.39	61	.32
60	7000				111	.49	83	.37	66	.29	55	.24
70	8000	1¾	⅞	.117	117	.45	88	.33	71	.27	59	.22
80	8000				110	.37	82	.27	66	.22	55	.18

Table Showing Number of Pounds of Twisted Yarn Produced in 10 Hours—4 Ply.
Front Roll 1½ In. in Diameter in all Cases.

No. of Yarn to be Twisted.	Rev. of Spindle per Minute.	Dia. of Ring in Inches.	Dia. of Bobbin Barrel.	Weight of Yarn in Pounds on Bobbin.	Multiplier 3. Rev. per Minute of Roll.	Multiplier 3. Pounds per Spindle.	Multiplier 4. Rev. per Minute of Roll	Multiplier 4. Pounds per Spindle.	Multiplier 5. Rev. per Minute of Roll.	Multiplier 5. Pounds per Spindle.	Multiplier 6. Rev. per Minute of Roll.	Multiplier 6. Pounds per Spindle.
6	3000	4	1½	.855	174	9.00	130	6.72	104	5.38	87	4.50
7	3000				161	7.22	121	5.43	97	4.35	80	3.59
8	3000				150	5.96	113	4.49	90	3.58	75	2.98
9	3000				142	5.02	106	3.74	85	3.00	71	2.51
10	3000				135	4.34	101	3.25	81	2.61	67	2.16
12	3700	3½	1¼	.645	152	4.07	113	3.03	91	2.44	76	2.04
14	3700				140	3.25	105	2.47	84	1.95	70	1.63
16	3700				131	2.66	98	1.99	79	1.61	65	1.32
18	3700				124	2.27	93	1.70	74	1.35	62	1.13
20	3700				117	1.93	88	1.45	70	1.15	58	.95
22	4500	3	1¼	.420	136	2.06	102	1.54	81	1.22	68	1.03
24	4500				130	1.80	97	1.34	78	1.08	65	.90
26	4500				125	1.60	94	1.21	75	.96	62	.79
28	4500				120	1.44	91	1.09	72	.87	60	.72
30	4500				116	1.32	88	.99	70	.79	58	.66
32	4500				112	1.19	85	.90	68	.72	56	.59
34	4500				109	1.09	82	.82	66	.66	55	.55
36	5300	2½	1	.331	125	1.20	94	.90	75	.72	63	.60
38	5300				122	1.10	91	.82	73	.66	61	.55
40	5300				119	1.02	89	.77	71	.61	59	.51
42	5300				116	.96	87	.71	69	.57	58	.48
44	5300				113	.89	85	.67	68	.54	57	.45
46	7000	2	7/8	.180	146	1.12	110	.83	88	.67	73	.55
48	7000				143	1.04	107	.78	86	.63	72	.53
50	7000				140	1.00	105	.74	83	.58	70	.49
60	7000				128	.76	96	.56	77	.45	64	.37
70	8000	1¾	7/8	.117	135	.69	101	.51	81	.41	68	.34
80	8000				126	.56	95	.42	76	.34	64	.28

Table Showing Number of Pounds of Twisted Yarn Produced in 10 Hours—6 Ply.
Front Roll 1½ In. in Diameter in all Cases.

No. of Yarn to be Twisted.	Rev. of Spindle per Minute.	Dia. of Ring in Inches.	Dia. of Bobbin Barrel.	Weight of Yarn in Pounds on Bobbin.	Multiplier 3.		Multiplier 4.		Multiplier 5.		Multiplier 6.	
					Rev. per Minute of Roll.	Pounds per Spindle.	Rev. per Minute of Roll.	Pounds per Spindle.	Rev. per Minute of Roll.	Pounds per Spindle.	Rev. per Minute of Roll.	Pounds per Spindle.
6	2500	4½	1½	1.160	177	13.24	133	9.95	106	7.93	89	6.66
7	2500				164	10.84	123	8.13	98	6.48	82	5.42
8	2500				153	8.93	115	6.71	92	5.37	77	4.49
9	2500				145	7.59	109	5.71	87	4.56	72	3.77
10	2500				137	6.56	103	4.93	82	3.93	69	3.30
12	3000	4	1½	.855	150	5.96	113	4.49	90	3.58	75	2.98
14	3000				139	4.80	105	3.62	83	2.86	69	2.38
16	3000				130	3.93	98	2.96	78	2.36	65	1.97
18	3000				123	3.34	92	2.50	74	2.01	61	1.65
20	3000				116	2.83	87	2.12	70	1.71	58	1.42
22	3700	3½	1¼	.645	137	3.08	103	2.32	82	1.84	68	1.53
24	3700				131	2.70	98	2.02	79	1.63	65	1.34
26	3700				126	2.42	95	1.83	76	1.46	63	1.21
28	3700				121	2.16	91	1.63	73	1.30	61	1.09
30	3700				117	1.97	88	1.48	70	1.18	59	.99
32	3700				114	1.79	85	1.34	68	1.07	57	.90
34	3700				110	1.65	83	1.25	66	.99	55	.83
36	4500	3	1¼	.420	130	1.84	98	1.39	78	1.11	65	.92
38	4500				127	1.71	95	1.28	76	1.02	63	.87
40	4500				124	1.60	91	1.18	74	.96	62	.80
42	4500				121	1.49	90	1.11	72	.88	60	.73
44	4500				118	1.39	88	1.03	70	.82	59	.69
46	5300	2½	1	.331	136	1.54	102	1.15	81	.92	68	.77
48	5300				133	1.45	100	1.09	80	.87	66	.72
50	5300				130	1.36	98	1.02	78	.81	65	.68
60	5300				119	1.05	89	.78	71	.62	59	.52
70	6500	2	⅞	.180	135	1.02	101	.76	81	.61	67	.50
80	6500				126	.84	95	.62	76	.50	63	.42

DIMENSIONS OF G MODEL AND H MODEL TWISTERS.

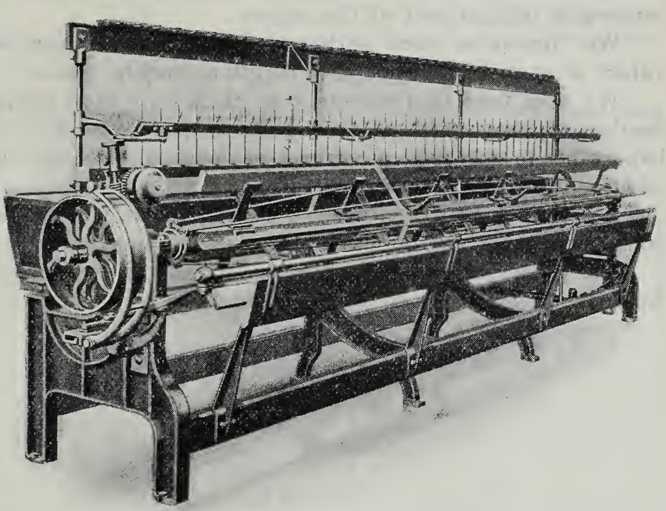
These are figured for $2\frac{1}{4}$ inch face pulleys. If other width pulleys are ordered, add to these figures for length, twice the extra width of pulley. Example—with $3\frac{3}{4}$ inch pulleys, add 3 inches.

Size of Ring	$1\frac{3}{4}$ in.	2 in.	$2\frac{1}{4}$ in.	$2\frac{1}{2}$ in.	3 in.	$3\frac{1}{2}$ in.	4 in.	$4\frac{1}{2}$ in.
Space between centres of spindles, or gauge	$2\frac{3}{4}$ in.	3 in.	$3\frac{1}{4}$ in.	$3\frac{1}{2}$ in.	4 in.	$4\frac{1}{2}$ in.	5 in.	$5\frac{1}{2}$ in.
* Total width	3 ft. $3\frac{1}{2}$ in.	3 ft. $3\frac{3}{4}$ in.	3 ft. 4 in.	3 ft. $4\frac{1}{4}$ in.	3 ft. $4\frac{3}{4}$ in.	3 ft. $5\frac{1}{4}$ in.	3 ft. $5\frac{3}{4}$ in.	3 ft. $6\frac{3}{8}$ in.
Number of Spindles.	LENGTH OF TWISTERS OVER ALL, IN FEET AND INCHES.							
240	29 6	32 0						
220	27 2½	29 6	31 9½					
200	24 11	27 0	29 1	31 2				
180	22 7½	24 6	26 4½	28 3	32 0			
160	20 4	22 0	23 8	25 4	28 8	32 0		
144	18 6	20 0	21 6	23 0	26 0	29 0	32 0	
140	18 0½	19 6	20 11½	22 5	25 4	28 3	31 2	
128	16 8	18 0	19 4	20 8	23 4	26 0	28 8	31 4
120	15 9	17 0	18 3	19 6	22 0	24 6	27 0	29 6
112	14 10	16 0	17 2	18 4	20 8	23 0	25 4	27 8
108	14 4½	15 6	16 7½	17 9	20 0	22 3	24 6	26 9
100	13 5½	14 6	15 6½	16 7	18 8	20 9	22 10	24 11
96	....	14 0	15 0	16 0	18 0	20 0	22 0	24 0
90	....	....	14 2¼	15 1½	17 0	18 10½	20 9	22 7½
84	....	....	....	14 3	16 0	17 9	19 6	21 3
80	....	....	....	13 8	15 4	17 0	18 8	20 4
72	....	....	....	....	14 0	15 6	17 0	18 6
64	....	....	....	....	....	14 0	15 4	16 8

To ascertain the length of Twister with $2\frac{1}{4}$ inch face pulleys and with any number of spindles: Multiply one-half the number of spindles by the distance between centres of spindles, add 24, and divide by 12; the quotient and remainder will be the total length in feet and inches.

Diameter of driving pulleys 8 to 20 inches.

* Width of Twister on floor 3 feet, 2 inches; the ring rails project beyond other parts. making total width as given above for all sizes at ring rail. The width of head end at level of front roll is 3 feet, 7 3-4 inches. This is the regular width.



Our Standard Reel.

We took up the manufacture of reels years ago as they naturally belonged in the group of machines comprising warpers, spoolers and twisters. Reels have been sold at such low prices that we have confined our efforts to making a superior machine without any attempt to compete with the low prices offered on an inferior article.

In construction, our machine is heavy and designed to be operated without excessive vibration. The shaft in the swift is of wood which is the best material for the purpose; truss rods give the swift added stiffness; the bearing on the driven end is hung in a ball and socket joint so that it cannot be strained in lifting the swift for removal of the yarn; the bearing on the opposite end is so protected as to prevent oiling the skeins while being removed; the releasing arms have metal bearings fitted in metal boxes.

Our traverse motion is geared and positive and may be arranged either for winding plain skeins or for the so-called Grant cross-wind.

The bobbin box has a waste box at each end.

We build the reels with dead spindles for cops or for bobbins with filling wind; with live spindles for warp wind bobbins; or for twister bobbins; each spindle is removable independent of the others.

We furnish a clock with gong to strike at each 840 yards; or at such other specified length as may be desired.

We also furnish a change gear clock with stop motion similar to that used on our ball warpers where it is important to measure a variety of lengths of skein; an additional charge is made for this clock.

We furnish swifts either 54, 60 or 72 inch. We do not make adjustable swifts, having found them unsatisfactory.

The gauge of our reels may be from 2 inch to 5 inch as desired.

REEL PRODUCTION.

Our reel production table is based upon the theoretical product if in continuous operation. As reels are stopped a very large percentage of the possible running time a deduction must be made to cover what is found to be the average loss from stoppage in each mill.

The table represents in pounds per spindle of single yarn, ten hours continuous product in the various numbers specified. The table starts with number 10 as the coarsest. For numbers 1 to 9 inclusive, take the products for 10 to 90 and multiply by 10.

Example: The product of a reel with 54 inch swift at 120 revolutions per minute on number 5 yarn would be the product of number 50 yarn (2.57 pounds) multiplied by 10= 25.7 pounds.

Reel Production Tables—Theoretical Continuous Result in Pounds per Spindle per Day of Ten Hours.

No. Yarn.	54 Inch Reel.				60 Inch Reel.				72 Inch Reel.			
	Revolutions per Minute.											
	120	130	140	150	120	130	140	150	110	120	130	140
10	12.85	13.92	15.00	16.07	14.28	15.47	16.66	17.85	15.71	17.14	18.57	20.00
11	11.68	12.65	13.63	14.60	12.98	14.06	15.14	16.22	14.28	15.58	16.88	18.18
12	10.70	11.60	12.50	13.39	11.90	12.89	13.88	14.87	13.09	14.28	15.47	16.66
13	9.89	10.70	11.53	12.36	10.98	11.90	12.81	13.73	12.08	13.18	14.28	15.38
14	9.17	9.94	10.71	11.47	10.20	11.05	11.90	12.75	11.22	12.24	13.26	14.28
15	8.57	9.28	10.00	10.71	9.50	10.31	11.10	11.90	10.47	11.42	12.38	13.33
16	8.03	8.70	9.38	10.04	8.92	9.66	10.41	11.15	9.81	10.71	11.60	12.50
17	7.56	8.19	8.83	9.45	8.40	9.10	9.80	10.50	9.24	10.08	10.92	11.76
18	7.14	7.74	8.34	8.93	7.93	8.59	9.25	9.91	8.72	9.52	10.31	11.11
19	6.76	7.33	7.90	8.46	7.52	8.14	8.77	9.40	8.27	9.02	9.77	10.52
20	6.42	6.96	7.50	8.04	7.14	7.74	8.33	8.93	7.86	8.57	9.28	10.00
21	6.12	6.63	7.15	7.65	6.80	7.37	7.94	8.50	7.49	8.16	8.84	9.52
22	5.84	6.33	6.82	7.30	6.49	7.03	7.57	8.12	7.15	7.80	8.44	9.10
23	5.59	6.05	6.53	6.99	6.21	6.73	7.25	7.77	6.83	7.45	8.07	8.70
24	5.35	5.30	6.25	6.70	5.95	6.45	6.94	7.43	6.55	7.15	7.74	8.33
25	5.14	5.57	6.00	6.43	5.71	6.19	6.67	7.14	6.28	6.86	7.43	8.00
26	4.94	5.36	5.77	6.18	5.49	5.95	6.40	6.87	6.04	6.60	7.15	7.70
27	4.76	5.16	5.55	5.95	5.29	5.73	6.17	6.61	5.82	6.35	6.88	7.41
28	4.59	4.97	5.36	5.74	5.10	5.53	5.95	6.38	5.61	6.13	6.63	7.15
29	4.43	4.80	5.17	5.54	4.92	5.33	5.75	6.15	5.42	5.91	6.41	6.90
30	4.28	4.64	5.00	5.35	4.76	5.15	5.55	5.95	5.21	5.72	6.19	6.67
40	3.21	3.48	3.74	4.01	3.57	3.87	4.16	4.47	3.93	4.29	4.64	5.00
50	2.57	2.78	3.00	3.21	2.86	3.10	3.33	3.57	3.14	3.43	3.71	4.00
60	2.14	2.32	2.50	2.68	2.39	2.58	2.78	2.98	2.62	2.86	3.10	3.34
70	1.83	1.99	2.14	2.29	2.04	2.21	2.38	2.55	2.24	2.45	2.65	2.86
80	1.60	1.74	1.87	2.01	1.78	1.93	2.08	2.23	1.96	2.14	2.32	2.50
90	1.42	1.55	1.67	1.78	1.59	1.72	1.85	1.98	1.74	1.90	2.06	2.22
100	1.28	1.39	1.50	1.60	1.42	1.54	1.66	1.78	1.57	1.71	1.85	2.00

DIMENSIONS OF YARN REELS.

Size of ring	1⅜	1½	1⅝	1¾	1⅞	2	2¼	2½	2¾	3	3¼	3½	3¾	4	4¼	4½
Outside diameter of bobbin or cop	1¼	1⅜	1½	1⅝	1¾	1⅞	2	2¼	2½	2¾	3	3¼	3½	3¾	4	4¼
Space between centres of spindles	2	2⅛	2¼	2⅜	2½	2⅝	2¾	3	3¼	3½	3¾	4	4¼	4½	4¾	5
Number of spindles.	LENGTH OF REELS OVER ALL, IN FEET AND INCHES.															
25	....	....	....	....	....	....	....	8 5	8 11	9 5	9 11	10 5	10 11	11 5	11 11	12 5
30	....	....	....	8 1⅞	8 5½	8 9⅛	9 0¾	9 8	10 3¼	10 10½	11 5¾	12 1	12 8½	13 3½	13 10½	14 6
35	....	8 5¼	8 9½	9 1¾	9 6	9 10¼	10 2½	10 11	11 7½	12 4	13 0½	13 9	14 5½	15 2		
40	8 11	9 3⅞	9 8¾	10 1⅝	10 6½	10 11⅜	11 4¼	12 2	12 11¾	13 9½	14 7¼	15 5				
45	9 9	10 2½	10 8	11 1½	11 7	12 0½	12 6	13 5	14 4	15 3						
50	10 7	11 1⅛	11 7¼	12 1⅜	12 7½	13 1⅝	13 7¾	14 8	15 8¼							
55	11 5	11 11¾	12 6½	13 1¼	13 8	14 2¾	14 9½									
60	12 3	12 10⅜	13 5¾	14 1⅛	14 8½	15 3⅞										
65	13 1	13 9¾	14 5	15 1												
70	13 11	14 7⅝														
75	14 9															

WIDTH OF REELS, IN FEET AND INCHES.

Size of skein	54″	60″	72″
Extreme width of reel	3 0	3 2	3 6

We recommend maximum length of reel not to exceed 15 ft. 6 in. Diameter of driving pulleys, 12 in., with 1¾ in. face.

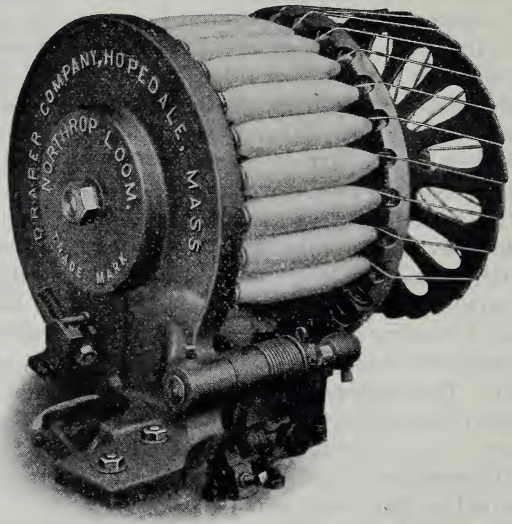
THE NORTHROP LOOM.

The Northrop loom, invented and developed by us, has been for a number of years our main product. Its inception, rapid development and manifest advantages are matters of common knowledge to the textile trade. In cotton we are prepared to furnish our automatic loom for everything woven with one shuttle except the heavier grades of duck, and in worsted and woolen we cover a large field of one shuttle weaves. Within its range the Northrop loom has reached the position of determining weaving costs. This cost averages one-half the cost on common looms. The controlling interests of a mill using common looms where the goods are in direct competition with Northrop Loom woven goods have to face the fact that they are asking their manufacturing department to carry the burden of a weaving cost double that of better equipped competitors; and weaving is by far the most expensive labor item in a cotton mill. Our contribution to the art of weaving—The Northrop Loom—has cut in half the cost of weaving.

Within the last few years a large number of important patented devices have been added to the loom which have materially enhanced its value. We are constantly adding to our knowledge by experiments which result in patented devices, a number of which have passed the practical test of mill conditions and have been adopted for our commercial product. The aggregate of these patents is large in number and added refinements keep us seventeen years ahead of the open art. A comparison of the loom we put out today with that of seventeen years ago furnishes evidence that during this period we have been active.

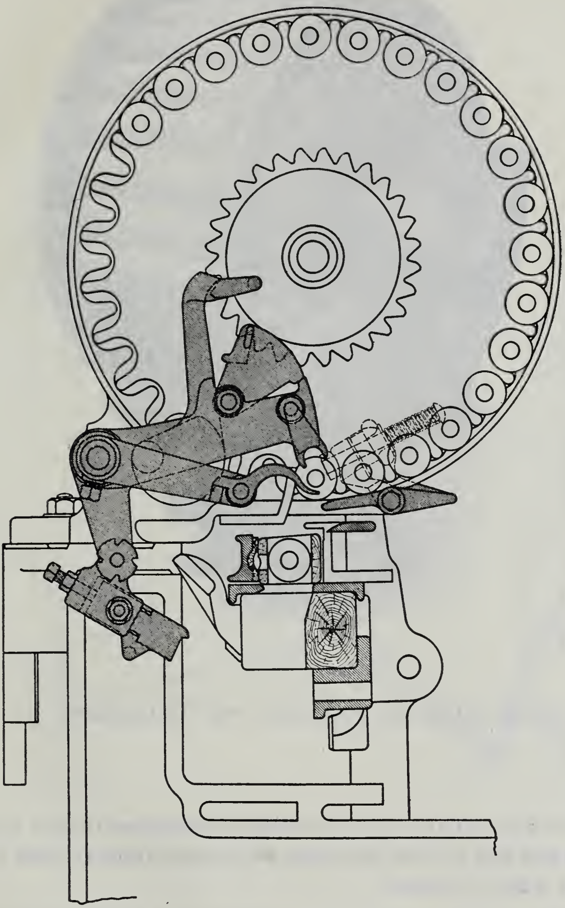
There has been an increase in the effectiveness of our loom by such improvements as cut gears, grinding the take-up roll and the use of lock washers. We now cut by machinery the gears on our looms. It adds to the cost and also adds to the value of the loom in smooth running and especially in the evenness of the take-up motion. This gives a better product as the cloth comes true to count in picks per inch. Grinding the take-up roll to a certain size is another contribution to better cloth. All of our loom-frames and girts are milled, the girts being milled to exact length so that the looms are uniform and the frames set up in correct alignment. Lock washers are another important improvement, in that the various parts of the loom, subject as it is to constant vibration caused by the beat-up of the lay and the picking of the shuttle, are securely locked in place.

Our three great additions to the art of weaving in the Northrop Loom are the changing of filling by changing the bobbin in the running shuttle to take care of the problem of replenishing the filling; the first practical and successful warp stop-motion to stop the loom upon the failure of a warp thread, and the filling feeler. The filling feeler is a natural result of perfecting the first two elements where the quality of goods permits no partial or double picks. It changes the filling in the running shuttle before the supply is completely exhausted, thus making perfect cloth.



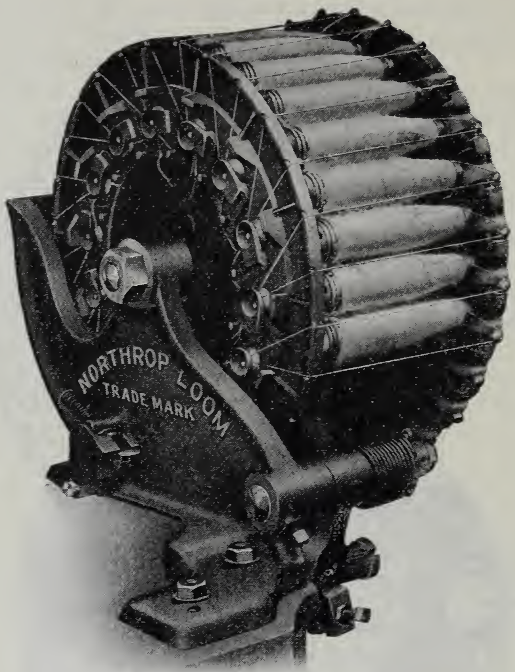
Number 3 Battery.

Taking up the first of our great improvements, the changing of the bobbin, the cut represents our standard No. 3 battery a number of features of which we control by patents. This is the same type 25-bobbin battery we have been using, having found it thoroughly satisfactory.



NUMBER 3 BATTERY FEEDING MECHANISM.

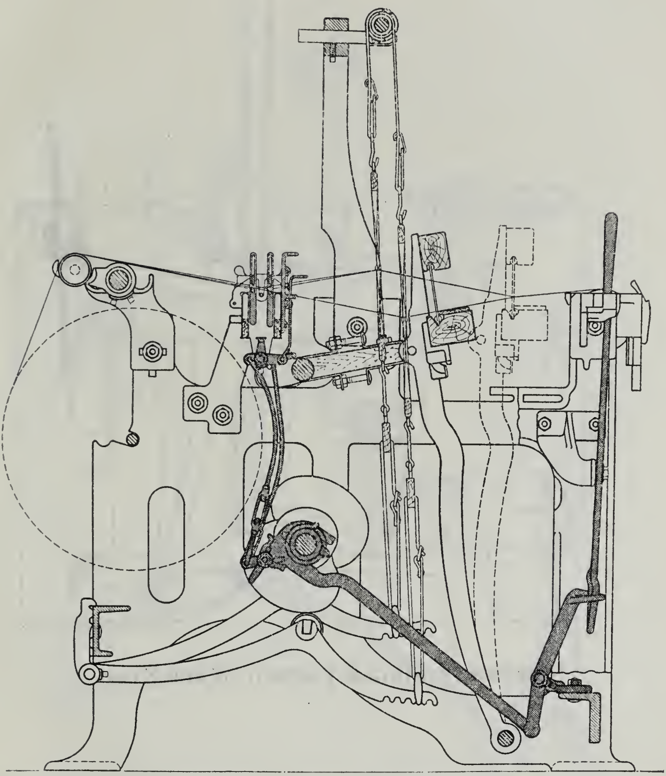
The feeding mechanism of our No. 3 battery shown is representative of the larger part of our battery feeds; the transferrer, transferrer-fork, top holder, and bobbin support are all of the usual type.



Number 14 Battery for Worsteds.

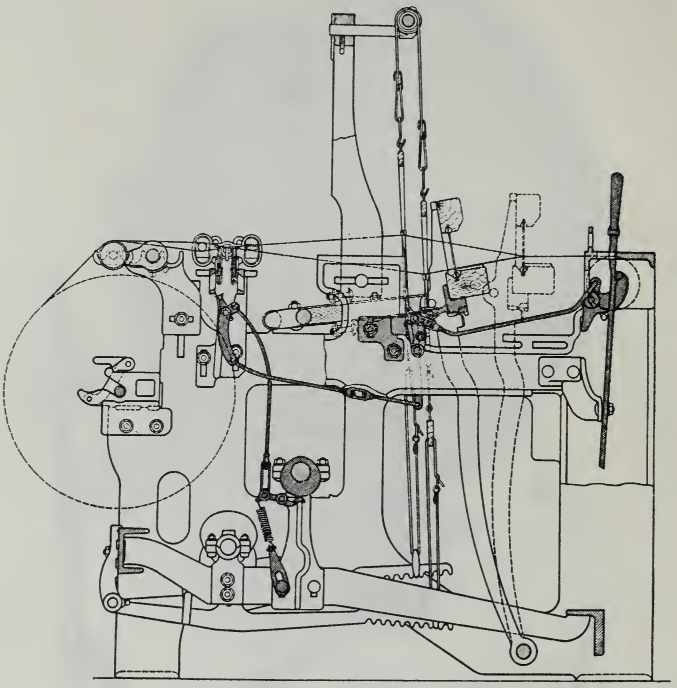
Our No. 14 battery for worsteds is designed to give a short filling end and is used on looms where the value of the filling is very high per pound.

The second great advance in the art of weaving we made on warp stop-motions; a motion on a loom which we were the first to reduce to practical conditions and introduce to the trade. We have a line of motions for the various conditions met in weaving. Highness of sley, breaking strength of warp and the capacity to stand relatively harsh usage by the harness motion all have to be considered. A certain number of ends per inch of 60s and of 8s present different warp stop problems, just as 60s and 8s are different yarns in the harness motion.



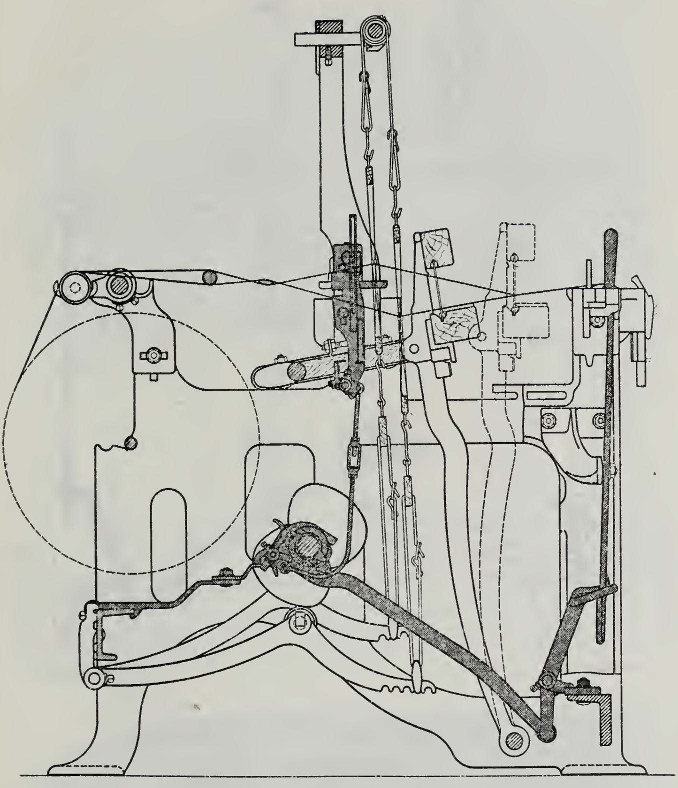
NUMBER 2 SINGLE-THREAD WARP STOP-MOTION.

Our No. 2 single thread warp stop-motion is used on low or medium sley and has the advantage of being a motion where it is easy to find the broken end. The No. 8 is like the No. 2 except it has three banks of drop wires to handle a slightly higher sley. We also make four-bank stop-motions of this type.



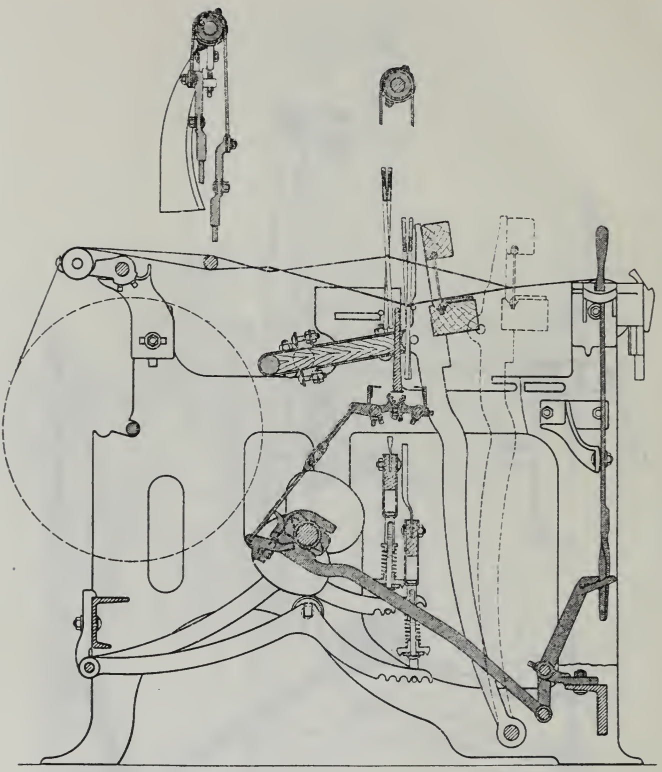
NUMBER 7 SINGLE-THREAD WARP-STOP.

The cut shows our No. 7 single thread warp stop-motion. This stop-motion has the advantage of reducing chafing of the warp threads because its short drop wires are hung on the under shed of the leased warp. The drop wires are short enough to prevent their coming in contact with any of the threads in the upper lease, and consequently while an end has to pass through its own drop wire in one bank it does not have to come in contact with any drop wire in the other bank. Thus the chafing coming from passing through another bank of drop wires is entirely avoided and at the same time the number of ends per inch while each end is passing through its drop wire is cut in two. This results in a material reduction of warp breakage.



TWINE HARNESS 1898 WARP STOP-MOTION.

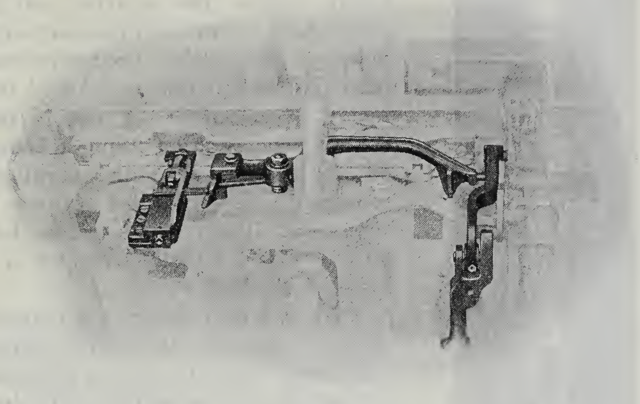
Certain weaves are so organized that more than one end can be drawn in one drop wire. This is shown in our single-bank '98 twine harness stop-motion. Where this occurs the mill gets the advantage of less drop wires to buy and handle. The mill has, however, to keep the looms on cloth so organized as to use this type of motion.



DOUBLE STEEL HARNESS.
2 SHADES.

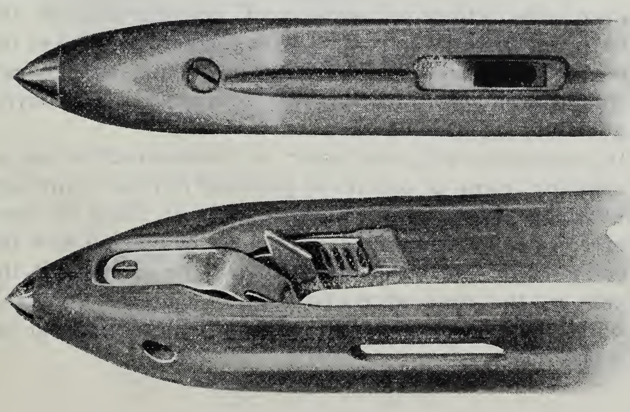
In some cases where the strength of warp and the ease of weave warrants, we use our double steel harness stop-motion. Its advantages are the combining of harness and stop-motion, giving but one drawing in for a broken end, and one set of parts to handle for redrawing a new warp. We also build this motion to take as high as five harnesses.

The third great field developed by us arose from the fact that we had successfully solved the problem of making practical a filling changer and a warp stop-motion. On some qualities of goods mis-picks are a blemish so that we have to avoid them and this resulted in our perfecting a filling feeler which calls for a change of filling while there is a perfect pick in the cloth and before complete exhaustion of filling in the running shuttle.

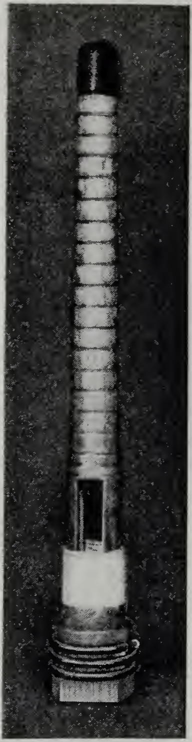


Number 8 Feeler.

From time to time we have introduced to the trade a number of types of feelers and after years of experience have reached a point where the greater part of our customers use our No. 8 finished feeler which measures between the disappearing yarn mass on the bobbin and the outside wall of the shuttle.



Shuttle for the Straw System.

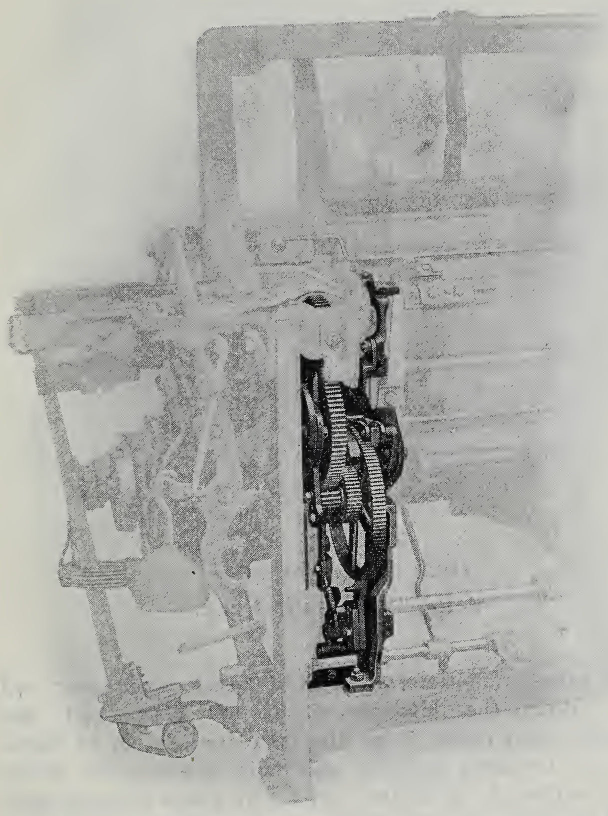


STRAW BOBBIN.

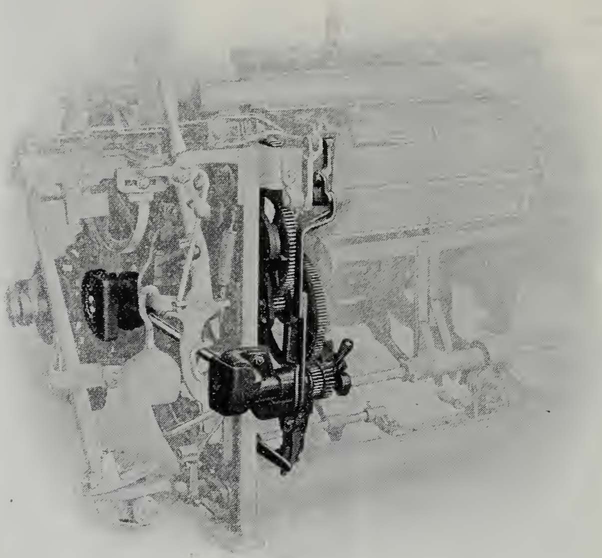
We have recently introduced to the trade the Straw feeler system which operates through the agency of a slotted bobbin. The feeler finger enters the shuttle and is driven back by coming in contact with filling. When the predetermined period of exhaustion is reached the feeler finger enters a slot in the bobbin uncovered by filling winding off during the weaving operation, remains quiescent and causes a change of filling. This system has given very satisfactory results in a number of mills.

We are also using in a number of mills our No. 15 needle feeler. This feeler operates on the principle of relative penetrability. It has protruding beyond its larger contact surface a needle point backed by a spring strong enough to maintain the point in its forward position as long as this point comes in contact with filling. The filling being relatively easily penetrated by the needle point allows the point to sink into its mass and does not overcome the strength of the spring. When, however, the filling is woven off enough to allow the needle point to come in contact with the hard surface of the bobbin the resistance of the spring is overcome and a change of filling caused before its complete exhaustion. This device has gone into use in some mills.

In connection with our feeler we recommend the use on the spinning frame of one of our patented devices to produce a preliminary winding or reserve supply of filling of short traverse. Of necessity some yarn must be ejected with the out-going bobbin and this quantity will be smallest if the traverse at the time of transfer be as short as practical. We build these devices for all spinning frames in use in our customers' mills.



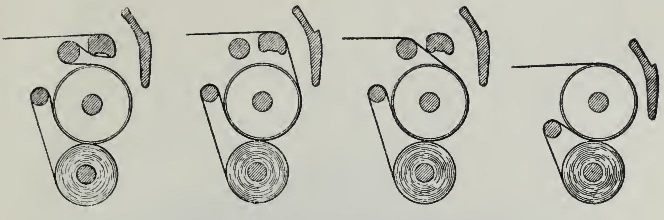
HIGH ROLL TAKE-UP.
SPUR GEAR.



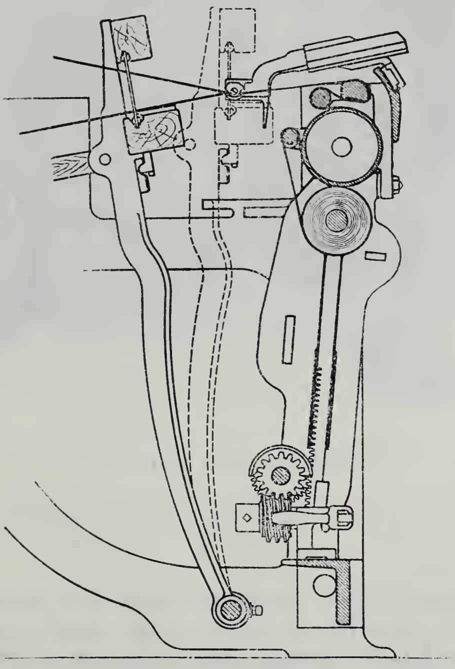
HIGH ROLL TAKE-UP.
WORM AND WORM GEAR.

Our take-up motions are of two types, spur gear and worm. With the introduction of cut gears and the advantages that come from the perfected action of these gears, the tendency is more and more towards the worm take-up, although on certain grades of goods the spur gear take-up is still used. The high roll take-up introduced by us and generally used on our looms has the advantage of enabling a much larger quantity of cloth to be wound on the take-up cloth roll shaft than was possible on the low roll take-up.

On some types of goods where heavy pick goods are used and where the goods are full, it is advisable to interpose some means to take up the oscillating pull on the cloth between the fell and the take-up roll. This pull results in chafing the cloth on the take-up roll and putting a strain through it on the train of gears in the take-up motion.

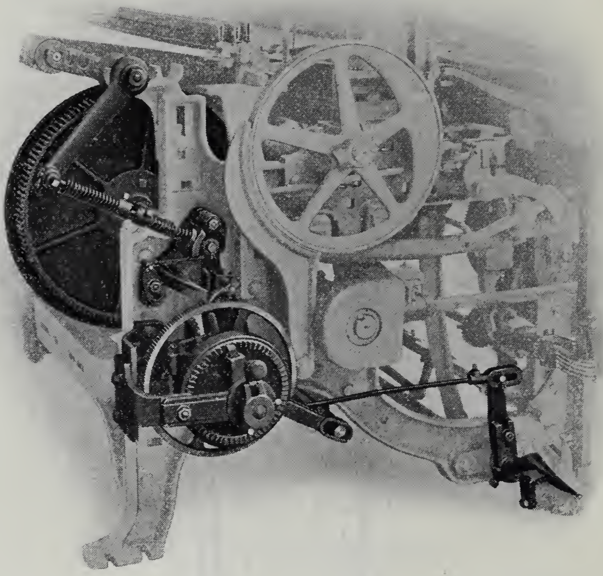


NUTTING TAKE-UP.
VARIOUS METHODS OF OPERATING.



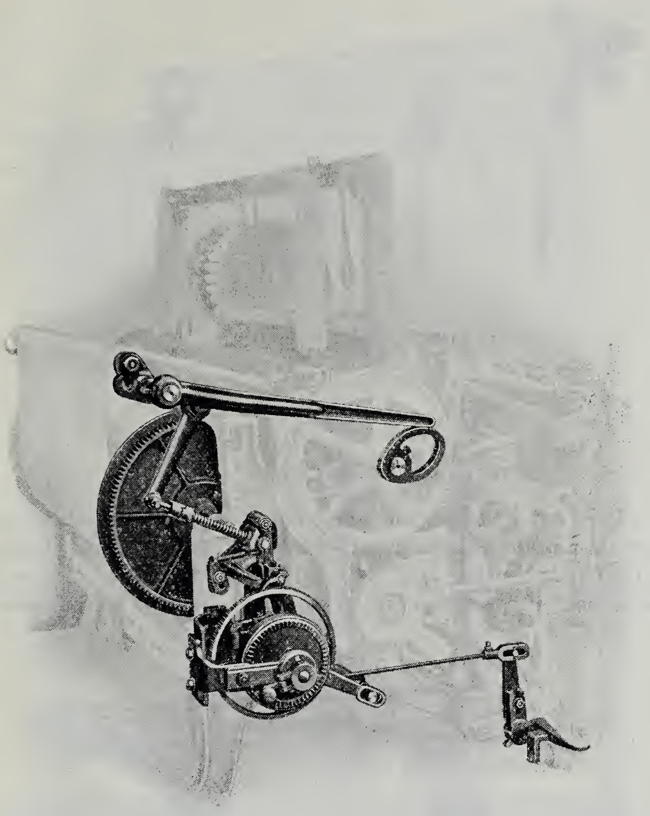
NUTTING HIGH ROLL WORM TAKE-UP.

For this purpose we use our patent Nutting Take-up and the cloth is drawn in various ways over and around the cloth guides as the grade of cloth demands. We also have a corduroy take-up which handles very high pick goods, and is a combination between the high and low roll take-up.



DRAPER-ROPER LET-OFF.

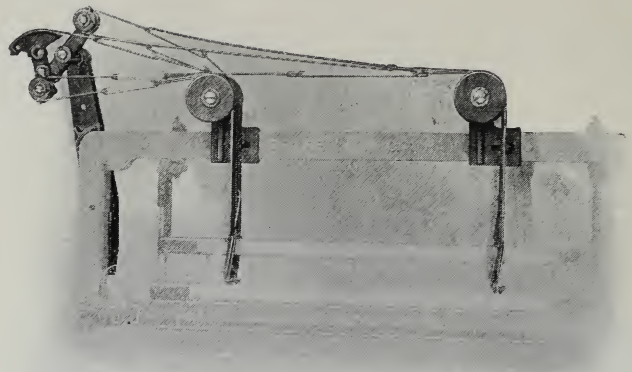
Our Draper-Roper let-off has gone into extensive use and for the majority of looms is the best let-off. For evenness of let-off, through its capacity to let off at each pick and at the same time to increase its amount on any pick where the strain on the whip roll has become great, it is unexcelled. It is also so designed that with the diminishing diameter of the yarn mass on the yarn beam, the normal length of stroke of the pick pawl is gradually increased, thus automatically keeping the tension of yarn from full to empty beam uniform. Where the character of the goods requires it we use other types of let off.



DRAPER-ROPER LET-OFF WITH VIBRATING WHIP ROLL.

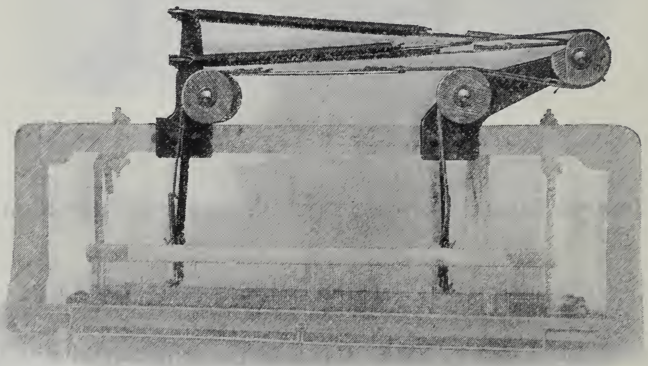
There is a large use of this let-off in combination with the vibrating whip roll. This predetermined motion of the whip roll is an aid to some kinds of weaving in that it tightens the warp between the whip roll and fell of the cloth and is timed to meet the requirements of various weaves.

The goods woven on the Northrop Loom are now so diversified that a great variety of harness-motions are in use on our looms, side cams, dobby, jacquard, roll and shaft, in fact all the harness motions used in single-shuttle weaving.



LACEY TOP.

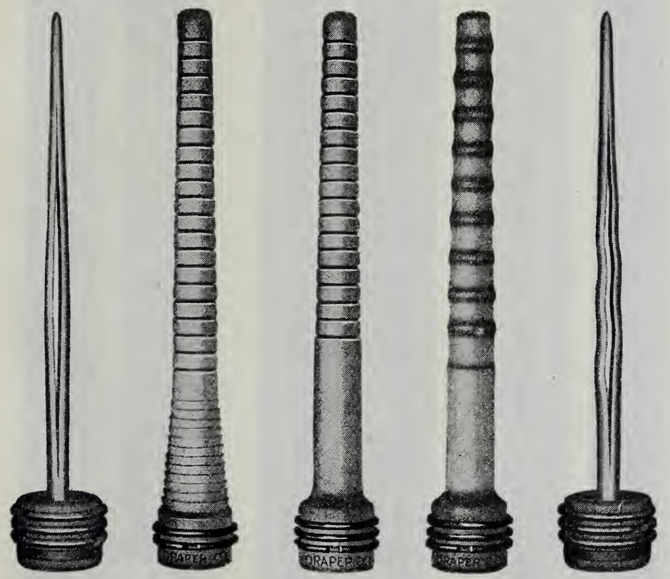
This cut and the following one represent two types of harness-motion patented and introduced by us. The Lacey top harness-motion can be used either for 2, 3, 4, 5 or 6 harnesses, where there are multiple shades of even sequence.



DWIGHT SPRING TOP.

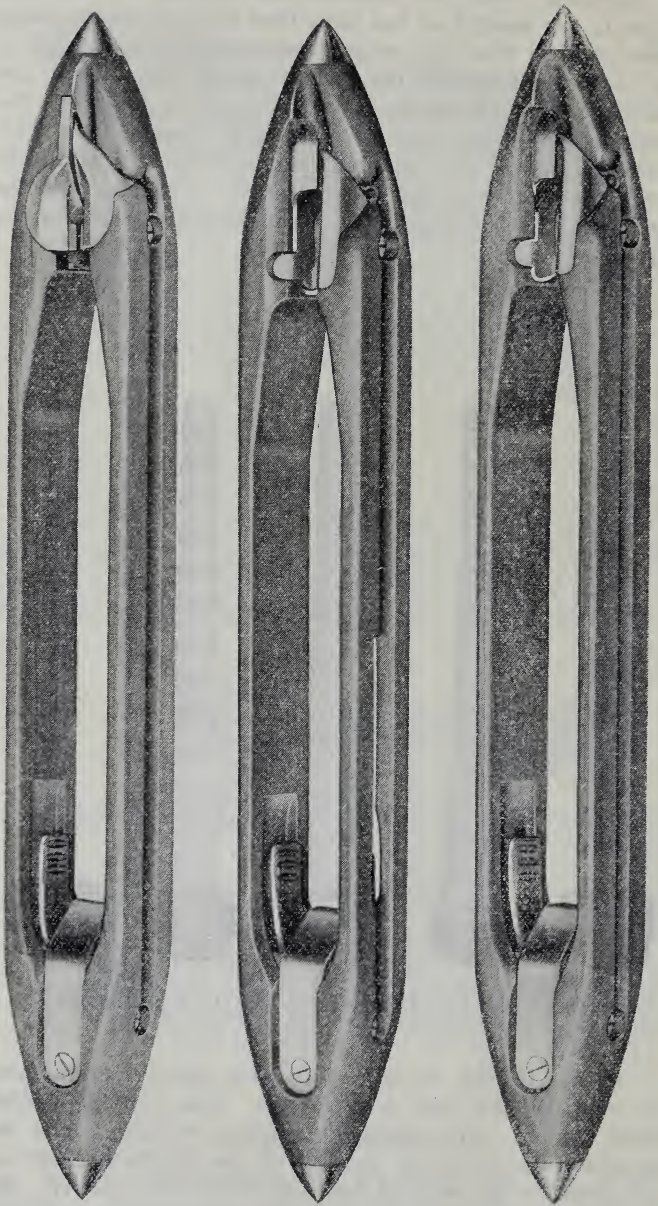
We have developed our Dwight Top to take care of cases where it is desired to set each harness independently and where the sequence is irregular and can be made for as high as eight harnesses.

The two main accessories necessary for the operation of a Northrop loom are bobbins and shuttles. These two adjuncts are bought at the same time as the loom and being made of wood wear out much faster than the loom itself, in the case of the shuttle the usuage being both violent and constant. Our customers know this and we know it. We manufacture these two articles with quality our first consideration. We realize that they are relatively perishable elements, and the better we can make them the better for the running of the loom, and the better for our customers.

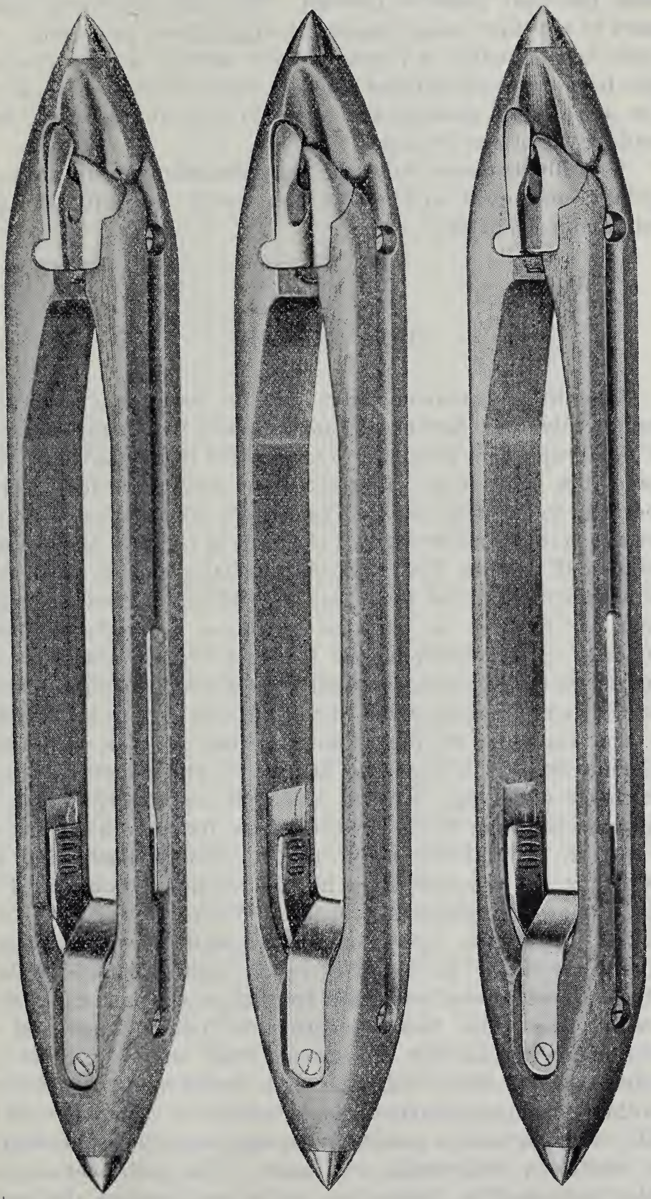


NORTHROP LOOM BOBBINS AND COP SKEWERS.

As to bobbins, we have for some years manufactured our own bobbins from tree to loom. Our complete bobbin blank plant, our specially designed machinery and our personal interest in the success of the Northrop Loom all contribute to our making bobbins of the first quality. We furnish cop skewers and the same care and interest go into their make-up as is put into our bobbins.



NORTHROP LOOM SHUTTLES.



NORTHROP LOOM SHUTTLES.

Our shuttles are manufactured with the same end in view, the best possible product. We want Northrop loom users to buy their most important supply from us because we know how essential a properly made shuttle is to the loom. Our best types of shuttles can be secured nowhere else; they are a patented product and are sold only for use in looms made by us or our licensees.

The illustrations show the more commonly used types of springs and eyes and cover the great majority of all outstanding shuttles.

LOOM REPAIRS.

On the permanent parts of the looms we advocate persistently that Northrop Loom repairs be bought from us as Northrop Loom Builders. Our service is unequalled. We make it a point to give first attention to repair orders. The best way to cultivate the field for orders for new looms is to keep such looms as we have in the mills in the best of running order and making cloth. Local foundries cannot have the same interest that we do nor can they make as good castings from our castings as patterns as we can from the original patterns. Even assuming the use of patterns, they do not appreciate the importance of correct sizes and shapes of parts for they cannot realize the relation of one part to another or to the whole as we must, nor can they get the necessary information. They have no access to the drawings from which we make our patterns and it is impossible to take a finished casting with its variation from its pattern and make a pattern to duplicate the original. Where machining is necessary the machine shop in the mill has not our fixtures and cannot give duplicate results. Where trouble is to be looked up in the operation of a particular loom, past experience is of no aid if a repair casting has been put into the mechanism that is not from the same pattern as the broken piece. This means a return to fundamentals and a long delay in clearing the ground that would be entirely unnecessary if our castings be used throughout. Service is another consideration that should weigh very heavily with a mill. An idle loom is making no money and a constant worry to ambitious wide-awake overseers. The mill, because its order is so small in proportion to the total output of a local foundry, cannot be its first consideration. With us, service for the mill is the first consideration.

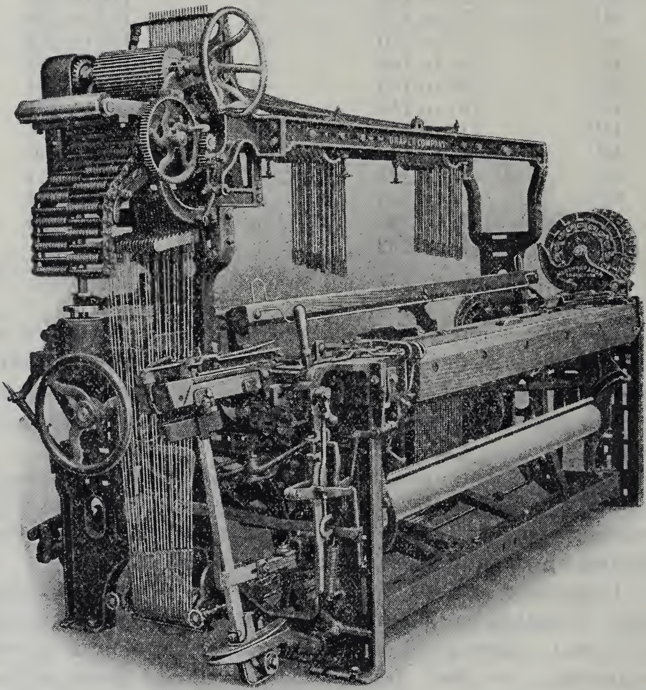
Speeds Recommended for Northrop Looms for Medium Weight Goods.

28″	185 to 190	64″	124 to 128
30″	180 to 185	68″	120 to 124
32″	175 to 180	72″	116 to 120
34″	170 to 175	76″	112 to 116
36″	165 to 170	80″	108 to 112
38″	163 to 168	84″	104 to 108
40″	160 to 165	88″	100 to 104
42″	154 to 158	90″	100 to 104
44″	148 to 152	96″	96 to 100
46″	144 to 148	100″	92 to 96
48″	140 to 144	104″	90 to 94
52″	136 to 140	108″	88 to 92
56″	132 to 136	110″	86 to 90
60″	128 to 132		

The following cuts illustrate our leading models of loom. They are designed to meet various cloth conditions, varying weaves. It would be impossible to divide and assign to each class of goods a particular loom to be invariably used.

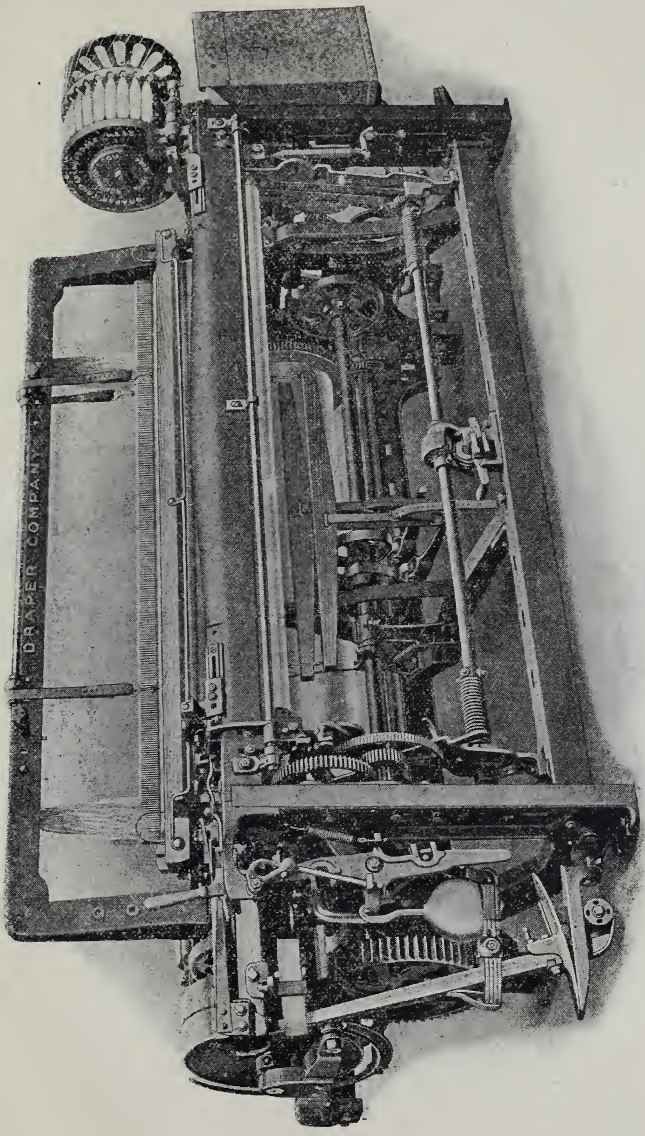
In settling this question our customers have the benefit of our long experience and careful consideration of the cloth desired to be produced. Our various models cover however a range which among other goods includes:—

Broad and narrow sheetings, pillow tubing, seamless bags, chambrays, blankets, flannels, ginghams, coutils, wide and narrow convertible goods, Jacquard woven bedspreads, worsted dress goods, standard print cloths, turkish towels, book cloths, corduroys, hollands, domets, velvets, drills, "Red Cross" bandages and surgeons' specialties, warp and filling sateens, automobile cloths, cottonades, saxony cloth, flannelettes, osnaburgs, shirtings, tickings, coarse specialties, fine silk and cotton goods, oil cloth goods, crash towels, cambrics, flat duck, stripes, denims, lawns, jeans, Jacquard woven specialties, khaki goods for United States and other governments, table cloths and damasks, worsted linings, curtain fabrics, Marseilles quilts, asbestos goods, seersuckers, skirtings, organdies, percales, mosquito nettings, very fine fancy goods, awnings, twills, Marquisettes, wide print cloths, outing cloths, shade cloths, fancy dobby weaves, covert cloths, percales, dimities, cheviots, alpacas, crepes, silesias, etc.



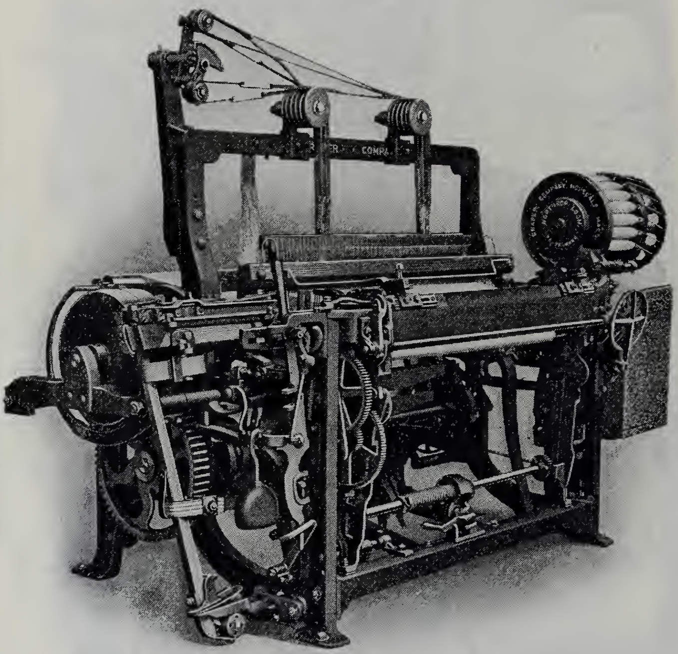
MODIFIED D MODEL WORSTED LOOM.

The loom shown in this cut is equipped with 20 harness Crompton & Knowles Intermediate head, Center fork stop-motion, Side fork at Battery end, No. 8 Finished Feeler, No. 14 Battery, Low Roll Spur Gear Take-up, extra heavy Friction Let-off, Yielding Whip Roll.



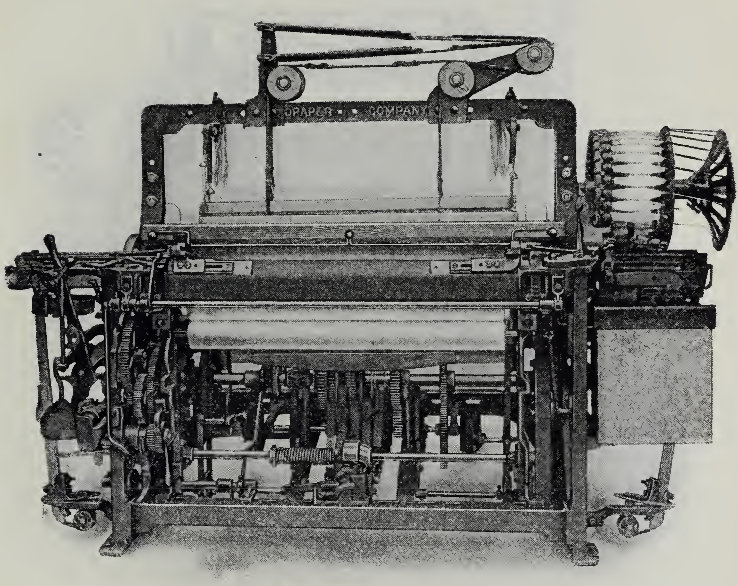
Modified D Model Loom for Sheetings.

The loom shown in this cut has Roll and Shaft Top, String Harness, Cams on Cam Shaft, High Roll Spur Gear Take-up, Single Fork, No. 3 Battery, Tight and Loose Pulleys, No. 2 Single Thread Warp Stop-Motion, Bartlett and Chain Friction Let-Off.



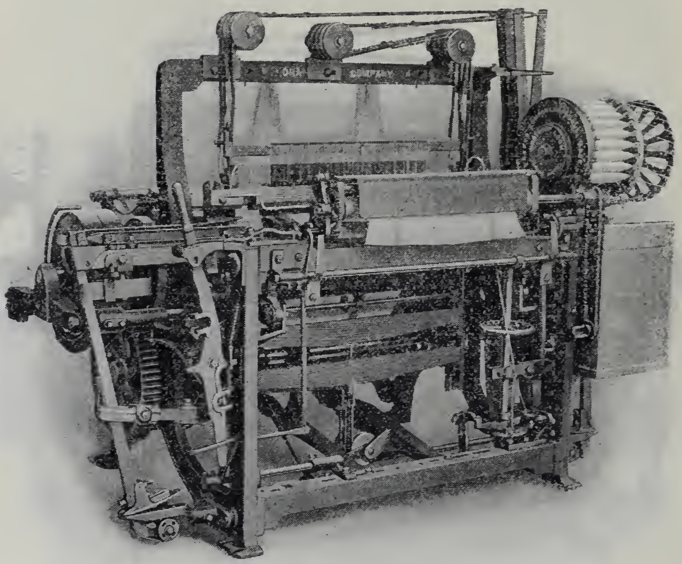
36 Inch E Model Loom.

The loom shown in this cut is equipped with Lacey Top, Cams on Auxiliary Shaft (4 shade), String Harness, Single Fork provided for Feeler, No. 15 Battery, Tight and Loose Pulley, High Roll Spur Gear Take-Up, No. 8 Single Thread Warp Stop-Motion.



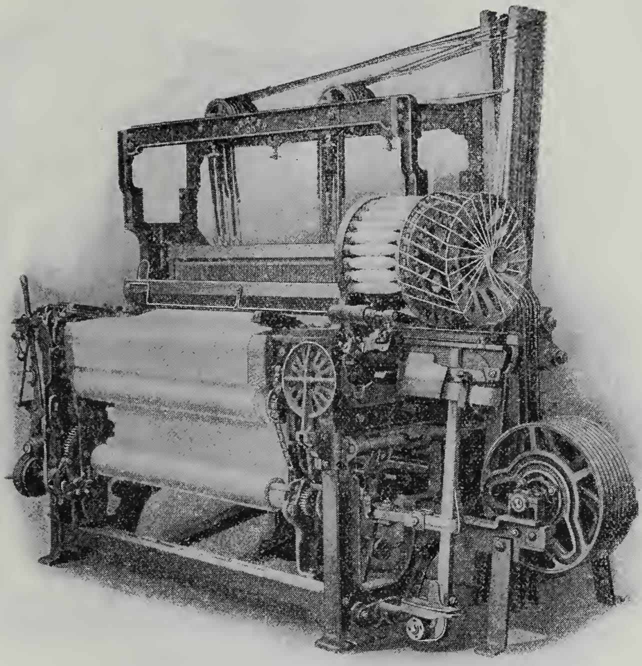
E Model Loom.

The loom shown in this cut has for equipment the Dwight Spring Top, String Harness, 5 Shade Cams on Auxiliary Shaft, Single Fork, No. 13 Battery, High Roll Worm Take-up, No. 5 Stimpson Selvage Motion, No. 8 Single Thread Warp Stop-Motion.



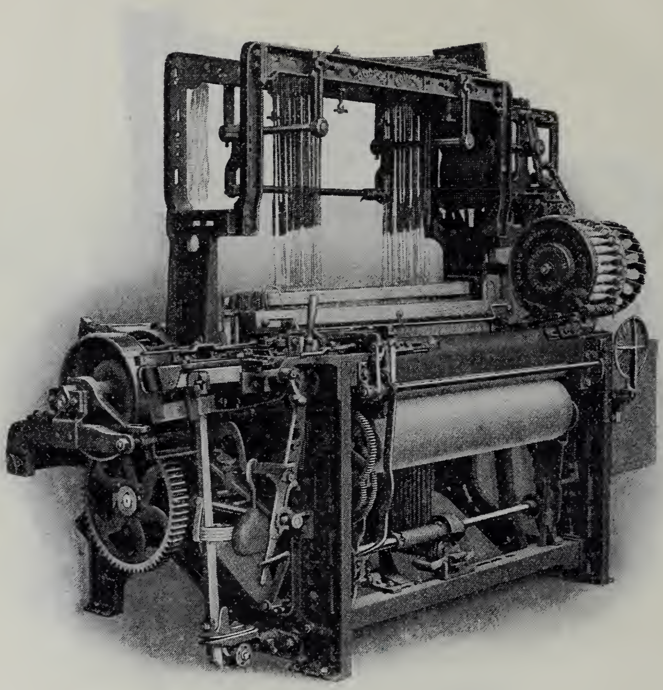
E Model Side Cam Bag Loom.

The loom shown in this cut has Side Cam-motion for bag weave, No. 26 Special Bagging Take-up with Spike Roll, and chain for controlling length of bags, Steel Harness Warp Stop-Motion, Double Fork, No. 3 Battery and Tight and Loose Pulleys.



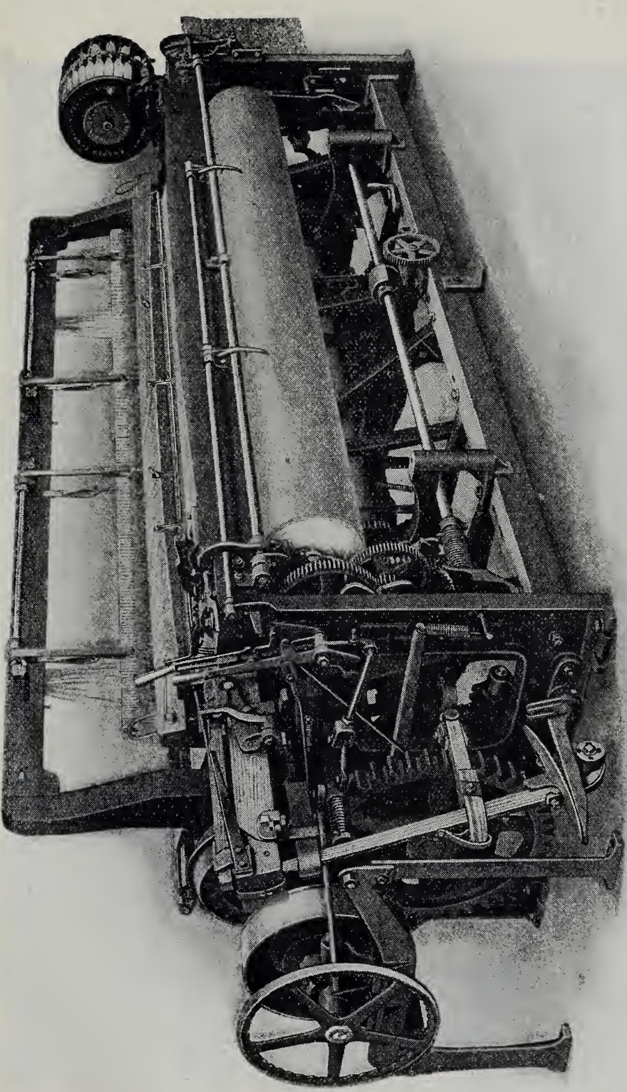
H Model Loom.

The loom shown in this cut has Side Cam Motion, Semi-Low Roll Take-Up, Corduroy type, Worm Drive, No. 3 Battery, Single Fork with Feeler, Vibrating Whip Roll, vibrating from Swords, No. 2 Single Thread Warp Stop-Motion.



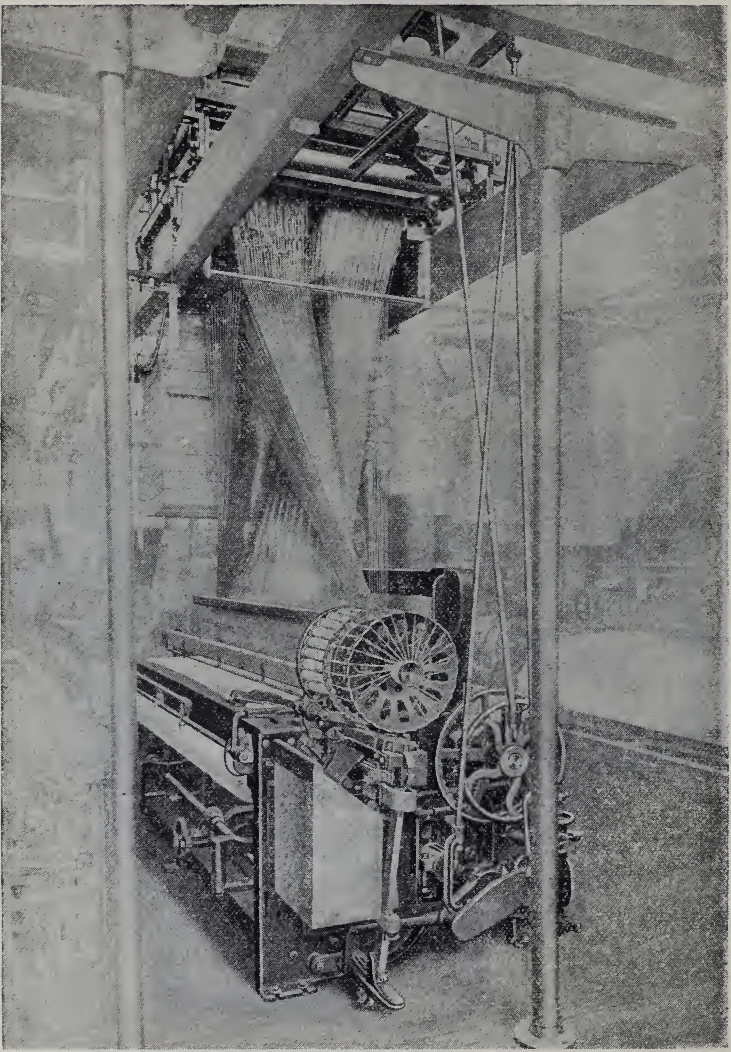
K Model Loom.

The loom shown in this cut has 20 Harness Crompton & Knowles Stafford type of Dobby; also cross shaft type of Roll and Shaft Top suspended from Dobby arches, Single Fork, No. 8 Finished Feeler, No. 5 Battery for Cops, Disc Friction Pulley, High Roll Worm Take-Up, Whip Roll with Durkin Preventer, No. 7 Single-Thread Warp Stop-Motion.

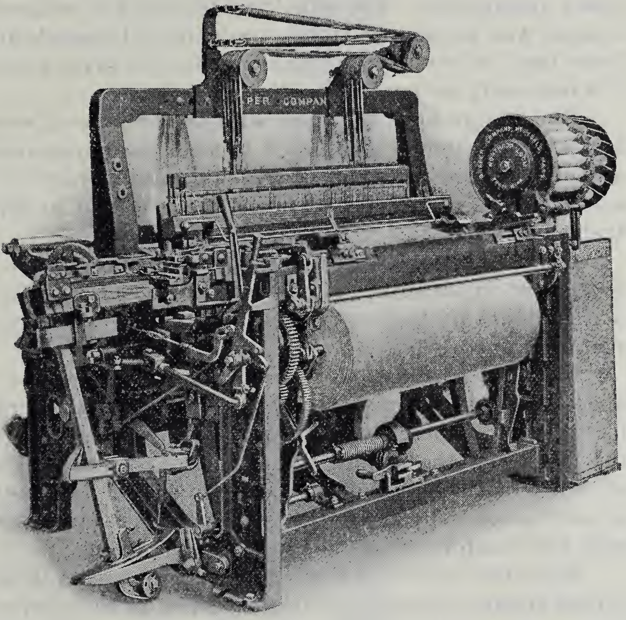


L Model Loom for Wide Sheetings.

The loom shown in this cut is equipped with Roll and Shaft Top String Harness, 2 Shade cams on Auxiliary Shafts, High Roll Spur Gear Take-Up, Single Fork, No. 3 Battery, Easy Shipping Motion, Disc Friction Pulley, Auxiliary Drive, Cut Driving Gears, No. 2 Single-Thread Warp Stop-Motion, Compound Let-off for 2-piece Beam.



L Model Loom with Jacquard.



P Model Loom.

The loom shown in this cut has the Dwight Spring Top, 5 Shade Cams on Auxiliary Shaft, String Harness, No. 15 Battery, Single Fork, No. 8 Finished Feeler, Easy Shipping Motion, High Roll Spur Gear Take-Up, Friction Let-Off, No. 8 Single Thread Warp Stop-Motion, 3 Banks of Drop Wires.

LOOM TEMPLES.

The loom temple we have been manufacturing for a long time. For its earliest improvements our predecessors were solely responsible. The cylindrical toothed roll reciprocating temple was introduced to the trade from Hopedale and has been used universally on common looms for sixty years, and is a necessary element in our Northrop Loom.

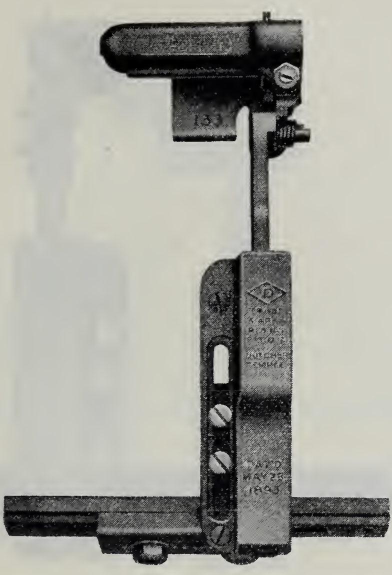
Our designs have kept pace with the advance of weaving, and we have temples prepared to meet the requirements of any of the manifold types of woven goods. Wherever cases arise that need special treatment we are glad to give our trained consideration to the problem.

Our foundry work on temple castings is very high. Our equipment in patterns and molding machines is complete and our standard of foundry product in size and smoothness of surface is unexcelled.

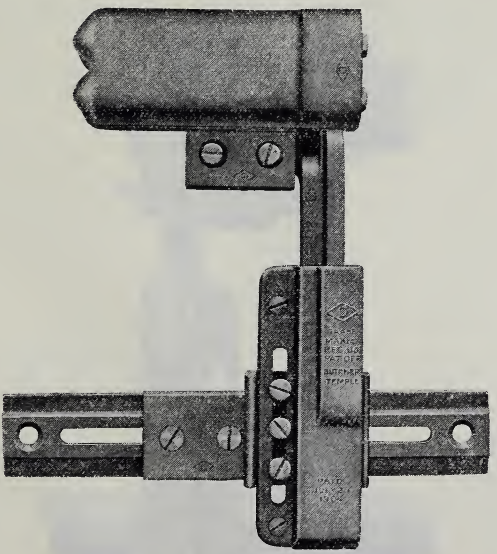
On temple rolls, we have the advantage of long experience and the use of highly specialized machinery used in the various processes that have to do with the making of the teeth and the drilling and setting of the rolls. There is no other outfit that can compare with ours in this line. All of our temple rolls are marked with our trade-marks and the rolls are sold for use only in temples made by us.

With the advent of the Northrop loom we developed the thread-cutting temple. The later types of this device with our more recent improvements we control by patents and put on all our Northrop looms.

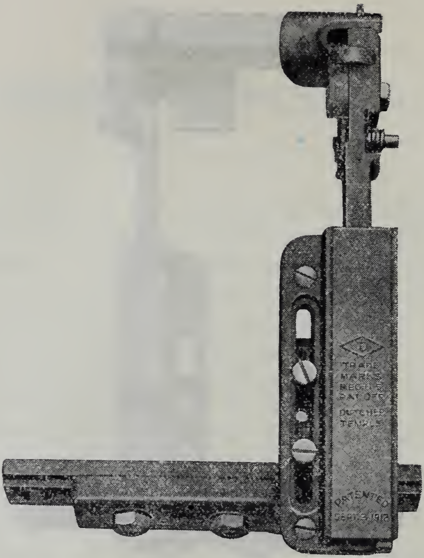
The following cuts show a few representative types of temples, but do not begin to comprise the number of temples we carry to adequately cover our field.



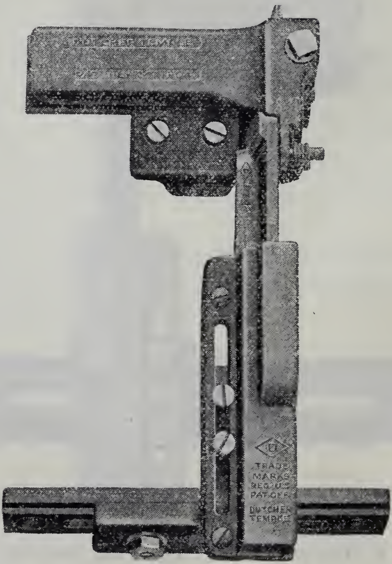
REGULAR 2½ INCH ROLL TEMPLE FOR E MODEL NORTHROP LOOM.



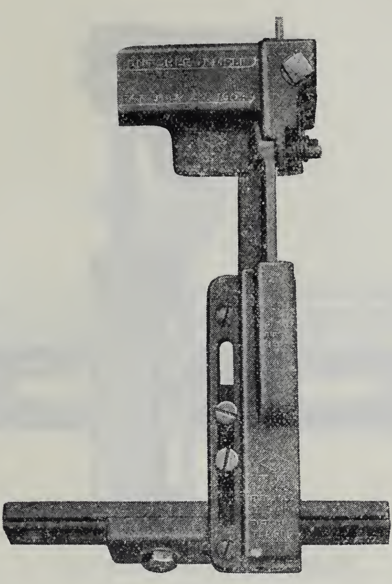
HEAVY DOUBLE ROLL TEMPLE FOR DUCK OF CERTAIN GRADES.



Selvage Roll Temple for Northrop Loom.

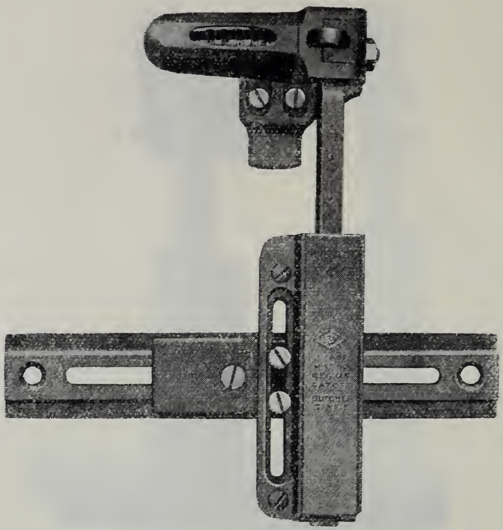


Double Roll Temple. L Section Bar.

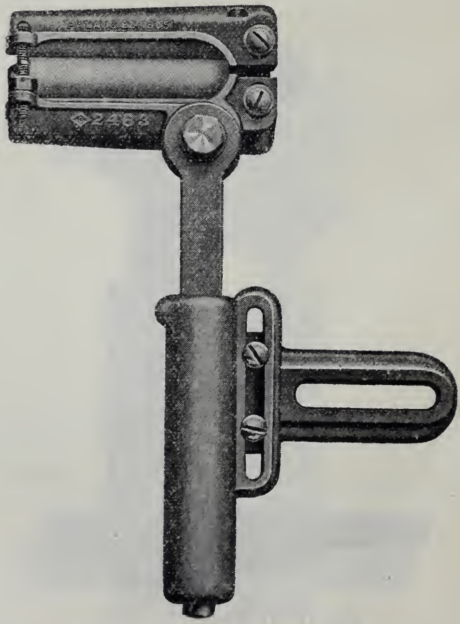


2½ Inch Double Roll L Bar Temple
For Northrop Looms.

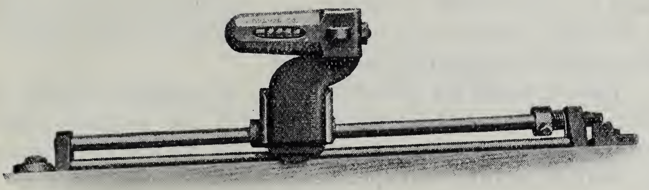
2½ Inch Roll L Bar
Thread Cutting Temple.



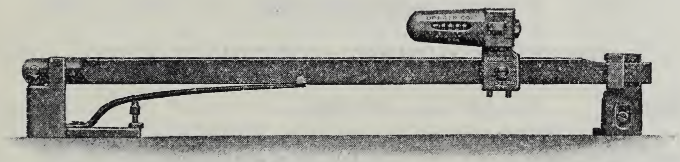
HARDAKER ROLL TEMPLE.



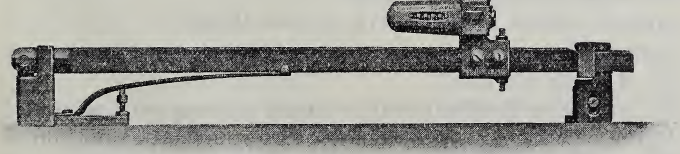
RUBBER ROLL TEMPLE.



HARDAKER WORSTED TEMPLE.



KNOWLES WORSTED TEMPLE.



DAWSON TEMPLE FOR WORSTEDS.

SAMPLE SPECIFICATIONS.

The following sample specifications of complete machines made by the Draper Company are intended to be of service in showing people connected with mills what points have to be considered in ordering machinery.

They give all the questions asked in actually entering an order, but are not intended for this use because minor changes have sometimes to be made and we prefer to handle this matter on prepared specification blanks.

SAMPLE OF

SPECIFICATION OF WARPERS

ORDERED FROM

DRAPER COMPANY, HOPEDALE, MASS.

Name Date 19

Place

Ship to Via what route?

How many Right Hand warpers?

How many Left Hand warpers?

What model?

Rise or Drop roll machine?

Do you want the Hicks Cone Drive?

Do you want the Beam Doffer?

What length of cylinder?

Our usual length is 54 inches.

Diameter of Beam Heads?

Diameter of barrel of Beams?

Largest number of threads on Section Beam?

Clock for how many Raps?

No. of yards per Rap?

Will you drive the Beam with threads running over or under?

Do you belt from above or below? Do you want Front Comb?

Will you have back combs or high or low back reeds?

Reeds are covered on top; combs are not. High reed 5′ between top rail and case, low reed 3″.

How many section beams?
How many V Creels?
Number of Spools? How many high? Long?
What height is your room, floor to ceiling?
Will you have Iron or Glass Creel Steps?
What number of Yarn?
Number ply if Twisted?
Send sample spool, also skewer, if used.
In sending samples please specify where from.
Additional specifications furnished when Balling Motion is desired.

SAMPLE OF

SPECIFICATIONS OF BALLING MACHINES,

ORDERED FROM

THE DRAPER COMPANY, HOPEDALE, MASS.

For Date 19
Place
Ship to Via what route?
How many for Right Hand Warper?
How many for Left Hand Warper?
How many Balls to be wound on one machine, (one or two)?
What model of machine?
What length of Traverse? (Regular size 30 inches.)
How many wood rolls? Shell or Solid?
Clock to stop every yards.
Register to register up to yards.
Are Leasing Motions wanted? Are Lease Combs wanted?
How many ends on inches?
What make of Warper is Balling machine to be applied to?
Do you use Machines for both Ball and Beam warping?
Length of Cylinder?
Diameter of Cylinder?
Diameter of Measuring Roll?
Diameter of Measuring Roll Shaft for Clock Worm?
Distance between ribs of Warper sides?
Diameter of Beam Arm Girt?
Diameter of Cylinder Gear?
No. of Teeth in Cylinder Gear?

Distance between Cylinder Gear and Warper Side?

If you are supplied with Rolls, are they Shell or Solid and what is the Length?

If Shell Rolls, give diameter of Shaft   Length over all

Distance between shoulders

Our standard size for this shaft at square part is 1³⁄₁₆" diameter, but we can furnish 1¼" if desired. Ends of shaft are 1³⁄₁₆" diameter (round.)

What number Yarn?

Number Ply if Twisted?

What is diameter of head and length of traverse on the spool used in warper creel?

Sample of

SPECIFICATIONS OF SPOOLERS

ORDERED FROM

DRAPER COMPANY, HOPEDALE, MASS.

Name   Date   191

Place

Ship to   Via what route?

How many Spoolers?

How many Spindles each?

Single or Double Rail?

Pattern of Spooler, "E," "H," "I" or "K"?

"K" is an "H" Model without Bobbin Chutes.

Send Sample Spindle if top is to match others, or give exact diameter of top.

What length traverse?

What Gauge?

Bobbin Holders or Side Spindles?

Rhoades Patent Bobbin Holder recommended for "H" Model, also recommended for "I" Model when Belt Delivery is used; Lawrence Patent if without Chutes or Belt. On "E" Model, only Lawrence Patent can be used. We do not recommend Bobbin Holders for spooling Twister Bobbins.

Send Bobbin full of Yarn.

Send Sample Spool.

What Style Guide? Improved Northrop, Lawrence or MacColl?

Give size of Spinning Ring used.

Give number of Yarn to be spooled.

Will you have Bobbin Chutes?
On "E" Model Spoolers we charge 15 cents per Spindle extra. We furnish without extra charge on "H" Model. We do not use Chutes on "I" Model.
Will you have Spool Raising Device? (25 cents per spindle extra.) (Recommended for Heavy Spools.)
Will you have Top Creel?
Will you have Side Boxes or Shelves? (If Shelves, give outside measurement of height and width of Doffing Boxes.)
Will you have Top Creel and boxes of Steel or Wood?
We recommend steel.
Belt Above or Below?
What diameter Pulley? Face?
Shall Machine be Shod or Taken Down for Shipping?
When Wanted?

SAMPLE OF

SPECIFICATIONS OF TWISTERS,

ORDERED FROM

DRAPER COMPANY, HOPEDALE, MASS.

Name Date 191
Place
Ship to Via what route?
How many Wet Twisters?
How many Dry Twisters?
Will you have Flat Tape, or Round Band Drive?
How many Spindles in each?
What pattern of Spindle?
If matching a present lot, send sample bobbin and spindle to ensure duplication.
Are brakes required on spindles?
Single or double Boss Top Rolls?
Single or double Line Top Rolls?
Single or double Line Bottom Rolls?
What Gauge?
Size of Ring?
Kind of Ring? (Vertical or flat-top?)
If Vertical Rings, is Carter Oiling Device desired?
Extra charge for this.

What length traverse?

Will you have Warp, Filling or Combination wind building motion?

If combination, state what we shall send out the machine set up on?

Will you use Single or Double-headed Bobbin?

What number yarn will you twist?

How many ply?

For how many turns twist per inch shall Twisters be geared? We furnish three twist gears and charge extra if more are ordered.

Will you twist from beams or spools?

If you twist from spool, send sample that you twist from?

In sending Spools, please specify on same where they are from.

Do you want T. H. Smith Stop-Motion?

Recommended especially for two-ply. Extra charge, Not recommended for wet twisting.

Do you want Wire Board Lifters?

Do you want Traverse Motion for Yarn on Rolls?

Unless otherwise specified, Cylinders on round band drive Twisters are 8 inches diameter; on flat tape drive 10 inches diameter?

What Diameter Pulley? Face of Pulley?

Pulleys run from 8 to 20 inches, by half inches, 2 ¼ to 4¼ inch faces. We recommend 12 inches or *larger* pulleys.

How belted, from Above or Below?

Shall machines be Shod, or taken down and Boxed?

Sample of

SPECIFICATIONS OF REELS

ORDERED FROM

DRAPER COMPANY, HOPEDALE, MASS.

Name Date 19

Place

Ship to Via what route?

How many Reels with driving pulleys on Right hand end?

How many Reels with driving pulleys on Left hand end?

How many Spindles each?

Live or Dead Spindles?

Space between spindles?
Size of skein desired? (54, 60 or 72 inch)?
Regular or Grant Wind?
Yarn to be reeled from Spool, Bobbin or Cop?
Send Sample full of yarn?
Gong to strike at each (hank or yards)?
Give number of Yarn to be reeled?
Is Change Gear Clock Wanted? (Extra Charge).
Belt Above or Below?
Shall Machines be Shod or Taken Down for Shipping?

Sample of
SPECIFICATIONS OF NORTHROP LOOMS
ORDERED FROM
DRAPER COMPANY, HOPEDALE, MASS.

Make out separate specifications for each model and size of loom.

For Date ordered 19
Address Ship to
Number Size Model

Right-Hand Belt from Above?
Left-Hand Belt from Above?
Right-Hand Belt from Below?
Left-Hand Belt from Below?

Kind of Cloth to be woven? Width? Sley?
For what number of picks shall we furnish Pick Gears?
Gears in excess of one per Loom charged extra.
For what number of picks shall we set up Looms?
Number of Warp Yarn Number of filling Yarn?
Number of threads in Warp?
Shall looms duplicate others in the mill?
If so, give date of previous order?
Is filling on Bobbins or Cops?
Total length of Bobbins or Cops?
NOTE:—It is necessary to send several sample cops with mule spindle, or bobbin and spindle. Mark Mule Spindle top and bottom, where Cop fits. Our regular sizes of bobbins take 5½″ traverse on a bobbin 6¾″ long; 6⅛″ on a bobbin 7⅜″ long; 6¾″ traverse on a

bobbin 8″ long and 7½″ traverse on a bobbin 8¾″ long. At least 200 per loom should be provided. Our regular cop sizes are 5½, 6⅛ and 6¾ Traverse. When cops are used we send 30 skewers with each loom. These are charged extra.

Shall we make Bobbin or Cop Heads Standard Butt?

Give largest diameter of full filling Bobbin or Cop measured on the Yarn?

Number of Battery? Diameter of Spinning Ring?

What Take-up?

NOTE:—Our "High Roll" construction admits of winding any diameter Cloth Roll up to 17″. Embodied with this we have three separate styles of Take-up.

Our regular pattern takes up with every pick and lets back to prevent thin places.

Our Worm Take-up without the let-back feature, is a positive take-up, and is especially designed for corduroys, velvets and similar fabrics which require 200 picks per inch and above.

Our Worm Take-up with let-back is designed for those who require a positive take-up and still desire the let-back feature.

What Let-off?

NOTE:—We furnish Roper; Bartlett; Friction; Roper and Friction; or Bartlett and Friction combined.

On "L" Model looms we furnish Compound Let-off and Compound with friction; on Corduroy looms we furnish a special let-off.

If friction Let-off shall we order Chain, Fibre or Rope Friction?

What Whip Roll Combination?

NOTE:—Drag Rolls are used only for very heavy weaves, heavy denims and goods of this character. If wanted, specify whether light or heavy pipe.

We recommend for most cloths Plain Pipe Whip Rolls; for heavy weaves, not taking Drag Rolls, Vibrating Whip Rolls; for very light weaves, Durkin Thick and Thin Place Preventors. Unless Vibrating Whip Rolls, Thick and Thin Place Preventors or Drag Rolls are specified, we shall furnish with Plain Pipe Roll.

Will you have Feeler? What type shall we furnish?

Will you have looms provided to take Feeler later?

Will you have Single or Double Fork?

NOTE:—Double Fork Looms measure 2″ more between loom sides than single fork (except on "L" Model Looms.)

Bunch Builders: Quantity? Make of Spinning Frame?

Shall we get measurements at Mill or Shop?

NOTE:—When feeler is used an attachment on spinning frames, called the Bunch Builder, is required to wind bunch of yarn on bobbin.

What Warp Stop-Motion is required?

NOTE :—We have four kinds:

Steel harness using one steel heddle for every warp thread, adapted for 2-3-4 and 5 harness work.

Drop-wire Stop-motion for cotton harness, which requires one drop wire for every two warp threads in a two-harness loom; adapted for 2-3-4 and 5 harness work.

Single Thread Stop-motion for cotton harness, using one drop wire for every warp thread. This stop-motion is adapted for any number of harnesses from 2 up and can be arranged with 2-3 or 4 Banks.

Single thread Lease Rod Stop-motions, for use with two banks of Drop Wires.

How many Steel Heddles or Drop Wires?

Are they to be punched for use in American Warp Drawing Machine?

Will you have No. 1, No. 6 or No. 9 Warp Stop-Motion Knock-off?

How many looms arranged for 2 Harnesses?

How many for 2 and 3 Harnesses? How many up? How many down?

How many for 2, 3 & 4 Harnesses? How many up? How many down?

How many for 2, 3, 4 & 5 Harnesses? How many up? How many down?

How many for 2, 3, 4, 5 and 6 Harnesses? How many up? How many down?

What Harness Motion?

NOTE:—We furnish the Roll and Shaft Top Harness-motion; the Lacey Top; Stimpson Top; or Dwight Spring Top.

We adapt our looms to take Dobbies made by Crompton & Knowles Loom Works.

We also furnish Special Side Cam Motion for Corduroy, Bag and Tubing Looms.

On what No. of Harnesses shall we set up looms?

How many up? How many down?

How many degrees rest shall we make Harness Cams?

Are Cams on Cam Shaft or Auxiliary Shaft?

If Auxiliary Shaft, shall we send gears to run 2-3-4 and 5 shade?

Single or Double Jack Hooks? (Not used with Steel Harness.)

Shall we supply Dobbies? How many Harnesses? What pattern?
Is Dobby to be driven from Cam or Crank Shaft?
Pawl or Worm Drive? Single or Double Index?
Shall we supply Single or Double Spring Jack; or Direct Springs?
Is Independent Selvage Motion required? Plain or Tape?
Which Selvage Motion do you want the Looms set up for?
Tight & Loose or Friction Pulley? Are Cork Inserts wanted with Friction Pulleys?
What Diameter and Face of Driving Pulley?
What width of Belt?
NOTE:—Regular size for tight and loose pulleys, 12″ diameter, 2¼″ face for 28″ loom. 14″ diameter, 2¼″ face, for 40″ loom. We strongly recommend this width of face, as wider pulleys are much more troublesome in shifting belts.
We furnish 16⅝ inch, 18 inch, and 20 inch Beam Heads. Which do you require?
NOTE:—When 20″ heads are used looms measure 3″ more in depth than with 18″. Regular heads for our broad sheeting looms are 16″ diameter.
Distance between Heads?
NOTE:—For proper width between Beam Heads we recommend 4″ more than size of loom. For those desiring extra space we supply Beams 5½″ wider than the size of the loom. For L Model looms we recommend 8″ wider than size of loom.
We furnish 5″ and 6″ diameter Yarn Beams. Which do you prefer?
NOTE:—We recommend 6″ barrel for 20″ Beam Heads, also with smaller heads if for fine yarn.
What width and type of Shuttle is required?
How many extra Shuttles? (Only one per loom included without extra charge.)
Will you have Temples with 1¾″, 2½″, 3½″ or 4¼″ Rolls?
How many Cop Skewers? Are they to have plain or corrugated blades?
We usually furnish 30 per loom. These are charged extra.
How many Bobbins? Style?
Are tips of Bobbins to be painted? If so what color?
Oil filled or not?
Shall we supply Bobbins with Brass Bushings in top or bottom of Bobbin, or both?
There is an extra charge for applying Brass Bushings.
NOTE:—Send sample spindle for use in fitting Bobbins.

Will you have Bolton Loom Seats? (One to each eight looms—no charge.)

Shall we supply Loom Trucks for moving the Looms?

These may be purchased or will be credited upon return.

NOTE:—Send us one complete reed such as you intend using on these looms. On orders for 25 to 100 looms, 2 reeds: over this quantity, 3. As the contraction on our High Roll Take-Up is considerably less on several classes of weaves than on other looms, it would be well to write us before ordering new reeds.

Pickers must be of short pattern not projecting above shuttle box.

We furnish sample sets of strapping and pickers without extra charge.

On Side Cam looms send us copy of Chain Draft.

When Wanted?

If more than one kind of Looms are ordered, please state which are wanted first?

By what lines shall we ship?

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