TYPOGRAPHIC

PRINTING MACHINES

AND

MACHINE PRINTING.

A PRACTICAL GUIDE TO THE SELECTION OF BOOKWORK, TWO-COLOUR, JOBBING, AND ROTARY MACHINES,

With Remarks upon their Construction, Capabilities, and Peculiarities.

ALSO INSTRUCTIONS IN MAKING READY, THE PREPARATION OF ENGRAVINGS, ETC.

BY

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WITH NUMEROUS ILLUSTRATIONS.

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PREFACE.

AT the time this Handbook was originally planned and announced, no modern practical work on Printing-Machines or Machine-Printing existed. It was at first intended that the subject of Machine-Printing only should be treated of, but, after consideration, it was decided to include descriptions of the details and principal points of construction of all classes of typographic printing-machines.

When an apprentice is first put to machine, from press, it is as necessary that he should be acquainted with the mechanical movements of a machine, as to know how to patch a sheet or overlay a cut; for a workman who has studied the construction of the machine which he has been trusted to manage will seldom, if ever, be without resources should an unforeseen difficulty arise. In the following pages, therefore, the different working parts and peculiar merits of bookwork and newspaper machines have been briefly described and illustrated by diagrams.

In treating of those matters which relate to the general management of machines, this manual does not pretend to teach a trade which can be acquired only by practical experience; it simply gives the general principles of Making Ready, which it is hoped will prove useful to the inexperienced, and points out the peculiarities of the machinery employed. Many workmen are trained in offices where but one or two machines are in use, and these perhaps

of the old-fashioned kind ; they may, therefore, have lacked the opportunity of becoming acquainted with more modern and perfect inventions. To such, the following pages, in giving an idea of the improvements that have been introduced, will be of especial interest.

The work for which each class of machine is suited having been generally indicated, this Handbook may be useful as a guide to intending purchasers, who, however, will of course form their own opinion of the workmanship and the comparative merits of rival machines.

The important subject of Motive Power could not be omitted in a treatise like the present ; accordingly there will be found a short account of the various forms of steam and gas engines and other motors now employed in the printing business. A few remarks have also been offered upon the management and economy of the Warehouse, and the names and descriptions of various approved appliances mostly in use in that important department of a printing-office have been given.

To the Editor of the *Printing Times and Lithographer*,—in which publication much of the matter contained in these pages originally appeared,—the author must acknowledge his indebtedness for valuable assistance throughout the progress of this work, which was begun at his instigation and has been sought to be carried out in accordance with his suggestions.

F. J. F. W.

LONDON : *December*, 1879.

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TYPOGRAPHIC PRINTING-MACHINES AND MACHINE-PRINTING.

CHAPTER I.

The want of a Treatise on Letterpress Machinery — Distinction between a Machine and a Hand-Press—Platen Machines—Cylinder Machines—Rotary Machines.

LTHOUGH many excellent treatises on Presswork have been written, there has not, up to the present time, appeared, in this country at least, any practical guide to Machine-work. Nearly every printing-office now possesses a machine, and every printer is called upon to know at least something of its working. Therefore, if technical hand-books are of any use at all, they are surely required for this branch of industry. The want that exists is rendered additionally unfortunate from the fact that in machine-work, more than perhaps any other kind of work in the printing-office, it is necessary to have a knowledge of "first principles"; of the mechanical motions that actuate the apparatus; the nature and uses of the different parts; the methods of ensuring, as far as possible, immunity from accidents, and of meeting them when they occur; and, above all, of the different modes of getting the whole to produce the best kind of work of which it is capable.

With the view of supplying this desideratum, the following chapters, which appeared originally in the pages of the *Printing Times and Lithographer*, have been compiled. We propose to begin with some purely elementary instruction for the benefit of those who are entirely unacquainted with the subject, and then to proceed to matters of technical detail, which are of importance alike to the employer and his workman.

Difference between a Machine and a Press.—In the United States every kind of apparatus that prints from type and relief surfaces is termed a "press"; we make a distinction, calling one apparatus a machine, and the other a press. Strictly speaking, however, both are *machines;* and, to be technically accurate, both machines are *presses.* It is the automatic or self-acting character of a press that, amongst English printers, entitles it to be called a machine, in contradistinction to a hand-press.

In press-work the following operations are requisite to print a sheet:—

1. Inking the form.
2. Laying the sheet on the tympan.
3. Turning down the frisket and tympan.
4. Running-in the carriage.
5. Pulling home the impression.
6. Releasing the handle.
7. Running-out the carriage.
8. Raising the tympan and frisket together, and then the frisket alone.
9. Taking off the sheet.

In machine-work only three of these operations are generally necessary:—

1. Applying the power to the machine (which may be by a hand-wheel or treadle, or by steam, gas, or water power).
2. Laying-on the sheet, or feeding.
3. Removing or taking-off the sheet.

At least two of these operations may be performed by boys, or by unskilled labour, whereas, in the case of the hand-

press, thoroughly experienced workmen should perform the whole of the work.

Some machines are still more completely automatic, for appliances are fitted which deliver the sheets evenly on the taking-off board; and an apparatus has recently been devised for laying-on, or feeding, single sheets mechanically. Some of the American rotary machines printing from the web, or continuous roll of paper, are absolutely automatic; —they feed and take off the sheets, which they also cut, fold, count, and bind, as well as print.

In the press the mechanical appliances generally adopted to obtain the impression are the knuckle-joint and the lever; in the machine (the platen machine excepted) these may be said to be exchanged for the wheel, or the principle of rotation. Hence the possibility of rendering so many movements *automatic.*

The two principal kinds of machines in use are the Platen and the Cylinder.

To elucidate the subject, we shall intersperse our remarks with diagrams of the mechanism of which we treat. In these diagrams—

The *black parts* represent the inking apparatus;

The *diagonal lines* the cylinders which give the impression;

The *perpendicular lines* the types or plates;

The *arrows* the track of the sheet of paper.

The *Platen machine* is that which most nearly resembles the hand-press, the form being laid on a flat bed, and a flat platen being brought down upon it.

Fig. 1.

The above diagram will illustrate the principle of the platen machine. When the bed containing the form (*b*) is brought into its proper position, the platen (*a*) descends upon it, and gives the impression.

In the second class of machines a cylinder is substituted for the platen, thus—

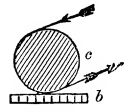


Fig. 2.

The bed (*b*) is flat, and the surface of the cylinder (*c*) moves at the same speed as the bed, or "coffin."

The *rotary machine* is a further development of the same principle. The impressing surface is cylindrical, but so also is the bed, and consequently the form or platen, thus—

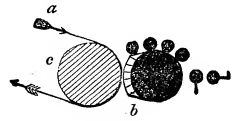


Fig. 3.

Here *c* is the cylinder which exerts the pressure, and *b* is the type-form on a cylindrical bed. The paper (*a*) passes between the two, and so receives the impression, *i.e.* becomes printed. Many newspaper-machines are constructed which work from a long roll of paper, which is cut into separate sheets before being delivered to the taking-off board.

It may be necessary for present purposes merely to say that platen machines are chiefly used for fine bookwork, and rotary machines for fast newspaper work. Ordinary bookwork and periodical publications are generally done on *cylinder* machines, and to matters in connection with these alone we shall first of all address ourselves.

CHAPTER II.

Introduction of the Cylindrical Impression—The Composition Roller—Tapes — The Ink-duct — The Perfecting Apparatus and the Vibrators.

IN order to understand the characteristics of modern printing machinery, it is necessary to go back to the origin of the apparatus, and to point out the successive improvements which have been introduced into it. We intend, therefore, to begin at the invention of the machine, and to follow the subject up to the latest modifications which have been effected. We must discard, for our present purpose, all matter of an exclusively historical interest, and all reference to the character, achievements, and merit of the inventors. Indeed, our review will only adopt the chronological order, because that happens to be essential to presenting an intelligible account of the improvements and alterations which have from time to time been introduced.

The first suggestion of a machine for printing was made by Nicholson in 1790. He took out a patent for certain improvements, which really formed the basis of all subsequent machines. His specification (No. 1748, A.D. 1790) described all the essential parts of a modern cylindrical machine, and had he only been able to *curve* the type-surface, in order to fasten it round a cylinder, he might have enjoyed the distinction of being the first actual maker of a printing-machine. As he could not actually accomplish this, he can only be regarded as the suggester of the invention. Nicholson's proposal was as follows :—

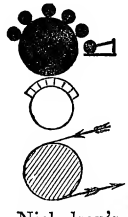


Fig. 4.—Nicholson's Arrangement for Arched Type.

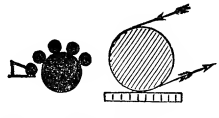


Fig. 5.—Nicholson's Arrangement for Common Type.

Eng. pat. 1748 of 1790 - Figs I & II.

Had Nicholson known how to cast a plate from the types and to bend it round the second cylinder, or how to fasten the types upon it in the manner that was adopted by Hoe, he would have made a practicable machine. Failing this knowledge, he devised *tapering* types, which were altogether impracticable.

The first working printing-machine was the invention of a German named Kœnig, who took out a patent in 1810, and another in 1811, for improvements in the common press, but they produced no satisfactory result. He then turned his attention to the use of cylinders in order to obtain the impression. Two machines on this principle were constructed for the *Times*, and were set to work in November, 1814.

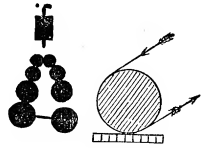


Fig. 6.—Kœnig's Single Cylinder for One Side of Sheet.

In this machine the type was made to pass under the cylinder, on which was wrapped a sheet of paper, this paper being firmly held to the cylinder by means of tapes. The ink was placed in a cylindrical box, from which it was forced by a powerful screw depressing a tightly-fitted piston; thence it fell between two iron rollers. Below these were placed several inking-rollers, two of which had, in addition to their rotatory motion, an end motion,—that is to say, a motion in the direction of their length.* The whole system of rollers terminated in two, which applied the ink to the type. In order to obtain a great number of impressions from the same form, a cylinder on which the paper was wrapped was placed on each side of the inking apparatus, the form passing under both. This machine produced 1,100 impressions per hour, but by subsequent improvements the speed was raised to 1,800, the sheet being printed on one side only.

* This was the origin of what are now called "wavers."

The next step was the invention of a machine, also by Kœnig, for perfecting the sheets. It resembled two single machines placed with their cylinders towards each other, at a distance of two or three feet. The sheet was conveyed from one cylinder to the other by means of tapes, as shown in the diagram annexed. At the first impression-cylinder

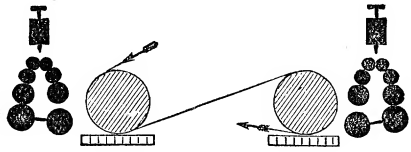
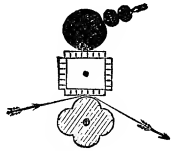


Fig. 7.—Kœnig's Double Cylinder for Both Sides of Sheet.

it received the impression from the first form, and at the second impression-cylinder it received the impression from the second forme. This machine printed, on both sides, 750 sheets per hour.



3757-13
Rotary

Fig. 8.—Donkin & Bacon's Rotating Prism Arrangement.

About this time Donkin and Bacon were also experimenting on printing machinery, the result being that they took out a patent in 1813 for a machine in which the types were placed on a *revolving prism.* The ink was applied by a roller which rose and fell in accordance with the irregularities of the prism. The sheet to be printed was carried on to another prism, so formed as to meet the irregularities of the type-prism. The machine after several trials was found to be too complicated, and the plan was abandoned.

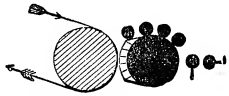


Fig. 9.—Cowper's Single Cylinder for Curved Stereotype.

Donkin and Bacon, however, made one great improve-

ment, which has been retained in all subsequent machines. They introduced composition rollers, made of treacle and glue. In Kœnig's machine the rollers were covered with leather, which never satisfactorily answered the purpose.

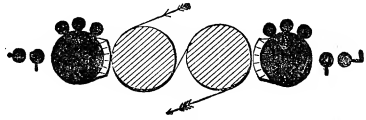


Fig. 10.—Cowper's Double Cylinder for Both Sides of Sheet.

In 1815 Cowper obtained a patent for curving stereo plates in order to fix them on the cylinder. Machines partly on the principle introduced by him are at work at the present day.

It will be seen that the same principle engaged the attention of Nicholson, Donkin and Bacon, and Cowper—viz. the arrangement of the type on revolving cylinders. It is only within the last few years that this has been accomplished by Hoe, with his conical column-rules, and by curving the stereo plates. The latter system, although, as we have said, introduced by Cowper, was not carried to anything like perfection until the *Times* experiments of 1860 and succeeding years demonstrated its entire practicability.

As Cowper's machine is virtually the model upon which the perfecting machines of the present day are constructed, we may devote to it a little more attention than to its now obsolete predecessors. Our account is taken from a careful article in the edition for 1876 of Brande's "Dictionary of Science and Arts," written by the late Mr. Courtney, formerly overseer at the printing-office of Messrs. Spottiswoode & Co. :—

"In this machine two paper [impression] cylinders are placed side by side, and against each of them is placed a cylinder for holding the plates. Each of these four cylinders is about two feet in diameter; on the surface of the plate-cylinder are placed four or five inking-rollers, about three inches in diameter; they are kept in their position by a frame at each end of the plate-cylinder, the spindles of the rollers lying in the notches of the frame; thus allowing perfect freedom of motion, and requiring no adjustment.

The frame which supports the inking-rollers, called a *waving-frame*, is attached by hinges to the general frame of the machine; and the edge of the plate-cylinder is indented, and rubs against the waving-frame, causing it to wave or vibrate to and fro, and consequently to carry the inking-rollers with it, thus giving them a motion in the direction of their length, called the *end motion*. These rollers distribute the ink on three-quarters of the surface of the plate-cylinder, the other quarter being occupied by the curved stereo plates. The ink is held in a trough; it stands parallel to the plate-cylinder, and is formed by a metal roller revolving against the edge of a plate of iron. On the plate-cylinder the ink becomes distributed as before described, and as the plates pass under the inking-rollers they become charged with colour. As the cylinder continues to revolve, the plates come in contact with a sheet of paper on the first paper-cylinder, when it is carried by means of tapes to the second paper-cylinder, where it receives an impression on its other side from the plates on the second plate-cylinder, and thus the sheet is perfected."

These machines were the first in which the present method of supplying and distributing the ink, and applying it to the form, was adopted. They were only adapted, however, for curved plates. It was reserved for Applegath, in conjunction with Cowper, to apply the principle to a flat surface printing apparatus. He effected this design in the following manner :—

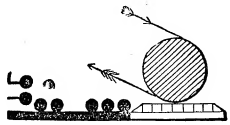


Fig. 11.—Applegath & Cowper's Single Machine.

Applegath perceived that it was only necessary to do the same thing on an extended flat surface, or table, which had been done on a cylindrical surface. In partnership with Cowper, he constructed a machine for printing both sides of the sheet from type, securing by patent the inking apparatus and the mode of conveying the sheet from one impression-cylinder to the other by means of drums

and tapes. Cowper had given the end motion to the distributing-rollers by moving to and fro the frame in which they were placed, but Applegath suggested the placing of these rollers in a diagonal position across the table, thereby producing their end motion in a simpler manner.

Cowper
1794-18
2nd.

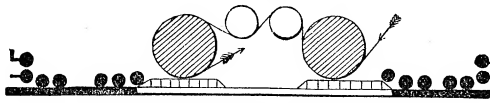


Fig. 12.—Applegath & Cowper's Double Machine.

These diagonal rollers, now called wavers, possess the very important advantage of spreading out the ink in a smooth, broad stratum, by the sliding of the table in a different direction to the lines of their revolution. Applegath also contrived a method of applying two feeders to the same printing-cylinder. No fundamental principle has been since introduced.

In the preceding cursory review we have seen how the cylinder, tapes, composition rollers, wavers, vibrators, and the ink-duct were gradually introduced, and the construction of the modern cylindrical printing-machine arrived at. In due time we shall treat separately and fully of the construction and management of all the various kinds of printing-machines in use in this country. In our next chapter we shall briefly consider the qualifications and duties of a good machine-minder, and then at once pass on to a practical consideration of the important subject of "Making Ready."

CHAPTER III.

Prevalent Ignorance of the Principles of Machinery — Respective Qualifications of Newspaper and Bookwork Machine-minders.—Difficulty of Managing Boys; their Proper Treatment. — Prevention of Spoilage.—Disposal of Rags and Paper.

IT is a fact within the experience of every master printer, that a large proportion of compositors are efficient only as plain type-setters, and quite incompetent to lay down correctly a sheet of octavo, to tastefully display an

advertisement, or to put together effectively the lines of a broadside, although these operations ought certainly to be performed properly by an apprentice in the third year of his time. This want of technical knowledge and experience is not confined to the composing-room ; for, in most instances, the machine-minder has an equally superficial knowledge of his trade. So long as he has to operate upon a form which consists only of plain type, all goes well, but when plates have to be made ready, or engravings "brought up," matters do not proceed so satisfactorily, and waste of time or imperfect work exposes the deficiency. Again, it is difficult to find a man who is equally able to manage the Anglo-French, the Platen, and the Wharfedale machine. The principles of making ready, however, are very nearly the same in all, and we are convinced that a little study of the construction of each machine would enable a man to prepare a form with equal success on either of the machines mentioned. In some cases, however, considerable allowance should be made, for a man has but little chance of becoming familiar with a machine he has had no opportunity of working, and it too often happens that his experience as an apprentice is obtained in a small office, where, perhaps, only one or two machines are employed.

It is right, however, to mention at the outset that the qualifications necessary to fit a man to manage newspaper machines, especially those constructed on the rotary principle, and used for printing daily and weekly newspapers, are quickness (as distinguished from fussy haste), a thorough knowledge of the construction and peculiarities of his machine, a strong nerve, and, above all, unremitting care. Should a roller be left out of its place, or a plate insecurely fastened, the consequence to one of these machines would indeed be disastrous. A practical engineer is sometimes selected for a newspaper machine-minder, on account of the greater experience he generally possesses.

In producing daily papers, quality is necessarily made subservient to speed, and if our favourate journal possesses the merit of containing the latest details of the previous day's news, we are not over critical about its typographical appearance. The case, however, is very different with bookwork—so different indeed as almost to constitute it a

separate trade. The newspaper may be destroyed in a few hours: the book, or bound-up serial, remains, perhaps, for a century, a credit or a disgrace to the establishment from which it proceeded.

Perhaps one of the greatest difficulties the machine-minder has to contend with is his boys, although we think that lately an improvement has been noticeable in their general conduct. One reason, doubtless, is that fewer are required than formerly, in consequence of the introduction of the taking-off apparatus; and, in the case of rotary machines, no boys are needed at all, except to remove the sheets from the taking-off board. Thus the advantage is afforded of a greater selection. We must commend the united action of machine-overseers, who have lately introduced a system of refusing to engage a boy without the production of a written character from his last place. By this means boys who seriously misbehave themselves in any way are excluded from the trade.

We attribute the difficulty of managing the boys greatly to the lax discipline exercised by the minder. During the time he is patching a sheet, &c., when he supposes the boys are rather in the way than otherwise, they are allowed to do just as they think proper, and consequently are ripe for any mischief which may present itself. In a machine-room, above all places, there is always work to be done. Boys can always be profitably employed in cleaning and wiping up the machine, besides which the accumulation of paper, which is so noticeable in the majority of printing-offices, might be profitably prevented by insisting that it be continually collected and placed in baskets, which ought to be provided for the purpose.

As a rule, the way in which minders treat their boys is very reprehensible, and we often wonder that the latter are not more refractory than they really are. We know they are very troublesome, but it must be remembered that they never will improve unless the minder takes a real interest in them. They cannot be expected to be skilled, and the little they do know is picked up from their slovenly *confrères*, instead of being taught them by their temporary master. If the machine-minder would only take the trouble to teach them their duties—how to clean rollers

properly, wash up without waste of lye and turps, how to brush the forms over without battering them, he would speedily find that they would take greater interest and pleasure in their work, besides being of more general assistance. The layers-on and takers-off should not be allowed to settle between themselves whose office it is to perform the various duties, but the minder should decide, and insist with firmness on that which he considers just. Much ill-will and unseemly squabbles might be saved in this way.

It is a well-known fact that a great quantity of work is spoiled by the dirty fingers of the layers-on or takers-off. Proper provision should be made for washing, that no excuse could be offered, and the minder should in all cases insist that the boys should well wash their hands before commencing printing, and on every occasion when the rollers have been handled. It is a lamentable thing to sometimes see really good books having one or two well-thumbed sheets bound up in them. We are perfectly aware that this may sometimes be caused in the warehouse or binding departments, but the machine-boy invariably gets the credit of it.

In some houses the boys are provided with jackets and overalls, which cost from 2s. 4d. to 4s. each. Besides adding to the general neatness and cleanliness of the office, they save the ink and grease from destroying the clothes. The firm give the order to the clothier, and deduct 2d. or 4d. weekly from the wages. Boys will sometimes decamp, leaving themselves debtors, but since they must apply to their last overseer for a character, this rarely occurs.

Rags and paper that have been saturated with oil or turps should never be allowed to accumulate, as they are dangerous in case of fire. Iron pails should be provided, in which they can be placed when done with, or they may be carried directly to the stoke-hole to be burnt. We believe that many fires have been caused by allowing such matter to collect in corners, &c., as it quickly generates heat, and combustion takes place at a comparatively low temperature.

CHAPTER IV.

Making Ready a Form.

BEFORE discussing the merits and peculiarities of the various printing-machines now in use, it may not be out of place to explain the general principles of "making ready." The shopkeeper has a saying that "well bought is half sold." The machine-minder might with equal reason adopt as a maxim, that a form well made ready is half printed; for however limited a number of copies may be required, it will be found the best and most economical plan to prepare the form properly before attempting to make a start. Neglect of this rule invariably involves frequent stoppages, and clumsy stratagems are then often resorted to, that tend to injure both the type and the machine, without properly effecting the desired result.

Making ready a form is, in reality, simply obtaining a level and effective impression from the type or plates on the sheet of paper. There exists a too-prevalent idea amongst workmen that a form of a particular size requires a certain number of patched sheets to be applied before it can possibly be in a fit condition to be printed from. In point of fact, this is entirely erroneous. If the "coffin" or bed of the machine were to present a perfectly even surface, and a form of type, or exactly level plates, were placed upon it, a true cylinder and a clean blanket would produce an even impression, and no patching would be required; in which case, the making ready would be confined to simply laying the form on the machine in such a manner as to ensure the correct lay and perfect register. The presence of cuts, however, would, even under these circumstances, render necessary the process of overlaying, in order that the proper artistic effect should be produced.

Making ready for machine-printing may, therefore, be defined as the operation necessary to produce a perfectly even impression; and this consists in depressing or elevating portions of the plates, or otherwise manipulating the pressure imparted by the cylinder, in order to remedy either the inaccuracies in the workmanship, or in the materials used

as the printing surface, or in the machine itself. It is not to be inferred that the fact of a form requiring making ready necessarily implies any deficiency or blemish in the construction of the machine or in the quality of the materials used. It may be said, indeed, that there are so many details belonging to the printing-machine, such a variety of working parts, that it would be practically impossible to ensure absolute perfection in every one of them.

We may refer as an illustration of the preceding remarks to the well-known fact, that a proof of a wood-cut pulled at a common press, without any special preparation whatever, frequently "comes up" better than the laboured production of the machine-minder, who may have spent hours in underlaying, overlaying, and all the other artifices common to the trade. The reason of this is the adaptability of the blanket to the surface of the block. If, however, a number of copies were thus worked off, the effect would be very different, for the blanket would lose its elasticity, and, therefore, its power to adapt itself to an uneven surface.

Without in the least disparaging the efforts of the overlayer, and while fully recognising the artistic ability and experienced judgment frequently displayed by competent workmen, we would warn the beginner not to do more than is absolutely necessary in this way. The normal condition may be taken as that in which no overlays whatever are required; and it is only to rectify some *abnormal* condition of the surface or the cylinder that patching is permissible. To overlay and underlay when not required, is like giving medicine to a man in a perfect state of health. What would be of service to him in sickness, is detrimental to him in health. So in machine-work; the expedients that are necessary with imperfect materials and appliances, are altogether unnecessary and worse than useless when these are in perfect condition.

It must be borne in mind, that the sheet of paper to be printed has to pass between two surfaces; and it is absolutely necessary that each surface—the type and the cylinder or platen—be perfectly level, or the impression cannot be satisfactory. If they are not in due juxtaposition, either the under surface—the form—must be

"levelled up," or the upper one—the cylinder—has to be treated in the reverse way, and to be brought closer to the type.

The amount of work requisite in the preparation of a form for printing greatly depends upon the skill and experience of the workman. It is a well-known fact that some can effectually accomplish with one overlay or an underlay that which others can but imperfectly do with three. This is no doubt in a great measure owing to the erroneous idea, before mentioned, that a form *must* require a certain amount of work; and this leads to carelessness—the workman thinking that even if he has put a piece too much on any place, it can be remedied in the sheet that he assumes must follow—little thinking, perhaps, that every patched sheet he places on the cylinder is liable to make the work less perfect, besides wasting both time and material. We would strongly impress the above facts upon all machine-minders, especially apprentices, feeling quite sure that if more thoughtful calculation were brought to bear upon this branch of the business, the result would be infinitely more gratifying to the workman (to say nothing of the saving in labour) and more profitable to the master.

Preparing the Machine.—Before laying on a form it is necessary that every portion of the machine be well oiled. It is much better that the minder should do this himself, as then he will be sure that no part has been forgotten; besides which, by constant intercourse with all the working and wearing parts, he is better qualified to manage it thoroughly. If this, however, is not convenient, a careful lad should be selected to do the work. We would advise that the oiling be done a very short time before starting, otherwise the oil that has been poured on will run to waste, and make a mess on the floor, the parts necessary to have it being drained of the oil. The workman should always be provided with a bodkin or probe of some kind, to clear the oil-holes of any dirt or residuum that may have got into them. All the bearers should be well cleaned, the pieces of packing used for the previous form carefully removed, and if any tacks have been used, they must be taken out, as wood bearers are quickly destroyed if tacks are driven in to save a little extra trouble. We may here give a caution as to the use of

tacks. They should always be driven in with great care. If struck too heavily, and driven too far into the bearer, the head will come away from the body. The result will be that the packing will leave its proper place, and most probably shift to another portion of the bearer, causing a friar. Particular care should be taken that the coffin is perfectly clean—free from grit or pieces of pasted paper that may have dropped from the cylinder in clearing away the making-ready of the previous form. The best method of cleaning is to oil the coffin, and then rub it till dry with a stout rag or some cotton waste. An ordinary brick is sometimes employed for this purpose, when the substance to be removed adheres firmly to the iron.

In order to afford a foundation upon which to secure the sheets and blanket, thin calico, a little larger than a full-sized form, is placed round the cylinder. This is sewn with stout thread to thin, flat iron bars, which, in the case of an ordinary cylinder-machine, fit upon a series of pins piercing the cylinder, and can be moved by means of screws so as to stretch the calico tightly over the surface. This lining is fixed in a different manner in Wharfedale and Anglo-French machines. The cylinders being much smaller in circumference, the calico is fastened to a rod under the grippers, and carried entirely round the cylinders.

As the calico will last for some considerable time, it is important that it be of good quality; that of a knotty and uneven texture should be avoided.

Preparing the Cylinder.—In preparing the cylinder, experience alone can teach the number of sheets that should be pasted next to the calico. This depends greatly upon the height of the cylinder-bearers. In some cases half a quire of paper may be required, in others five or six sheets will be amply sufficient. These must be fastened together by pasting them at one end. In the case of an Anglo-French or Wharfedale machine, the pasted end should be securely fastened to the extent of an inch in the cavity of the cylinders (under the grippers), and be well stretched over, the sheets at the other end being then pasted to each other. Great care must be taken that they lie perfectly flat together, and are also securely fastened to the cylinder. Having thus prepared a perfectly level, and, to a certain extent, elastic

surface, upon which to place the overlays, the final covering—the blanket—must now be placed in position.

The Blanket.—The thickness of the blanket ought to be regulated by the description of work to be done. Should the form to be laid on contain cuts, the blanket should be fine in texture and thin in substance, as the nearer the overlays are to the paper to be printed upon, the more effective will be the result. The blanket must be stretched over the cylinder as tightly as possible, and fastened to the lining with strong pins. It should be borne in mind that a blanket, especially after being used more than once, presents a slightly uneven surface, and, when it is once fixed, must remain exactly in the same place while the form is on the machine, for, if shifted even to the extent of an eighth of an inch after either underlaying or overlaying, the impression will be irregular.

Movable Forms. — If a form be composed entirely of plain movable type, no difficulty should be experienced in making it ready: the type being of a uniform height throughout, the impression should be even, or nearly so. Type is never underlaid, excepting in rare cases, where one part of the form is composed of old material that has been worn down by constant working, and the remaining portion of new type. It will then only be necessary to place a thin piece of paper under the old type, and no paste should be used. If, however, there are cuts, they will rarely be found to be of the same height as the type—the blocks, in nine cases out of ten, being the lowest. These blocks should be raised to the level of the type by pasting a thickness of paper or glazeboard to the back of the block. The practice of using spongy brown paper, stuck on with roller composition, is both clumsy and ineffective. If the cut be too high, it must be reduced by taking a shaving off the back.

CHAPTER V.

Underlaying.—Cutting the Vibrators.—Wavers.—Inking-Rollers.—Packing on Roller-Bearers.—Packing on Cylinder-Bearers.—Running up Colour.—Making Register.—Register Racks or Tappetts.

OWING to the imperfect nature of most of the stereotyper's and electrotyper's machinery in ordinary use, the plates are almost invariably uneven; and this defect is often aggravated by the imperfect metal blocks upon which the plates are mounted. American stereotypers, it is said, have succeeded in producing plates that are perfectly level, thus saving underlaying; and the use of mounting-blocks that are absolutely true enables the machine-minder, it is said, to make ready his form as speedily as if it were type. Most printers would be glad to learn if this statement be true, and, if so, by what means such accuracy is accomplished.

Before pulling the first impression, be sure that the "pitch" for the lay is correct, that is to say, ascertain that you have given sufficient margin on the paper that is to be printed. In the case of an Anglo-French or Wharfedale machine, if the form be fixed too near the ink-table the grippers will pull on to the plates, battering some of them. A gauge should be kept, for the purpose of measuring the distance between the ink-table and the first row of plates, in order to ascertain how near the form may be secured without danger. The form must then be "centered" in the coffin. This can easily be done by measuring the distance from the bearers to the edge of the form. The furniture employed to fix the chase to the machine must be perfectly sound, and the filling-in solid, otherwise it is likely to spring and render the form insecure; the probable result being, that while the machine is running, the rollers will draw out some of the furniture or quoins, and a serious batter will necessarily ensue.

Great care should be taken that both the stereo metal and the chase are perfectly flat on the coffin. If not, it will be impossible in either case to obtain a fair impression,

and in the latter the tapes will be cut by being pulled on the chase. The best way to ensure the stereo being flat is to unlock the form all round, and to lay a piece of, say, double-broad furniture (or, better still, a piece of wood three inches square, having leather firmly fixed on one side) on to the corner of each plate, then tap it gently with a hammer, also giving a smart blow on each side of the chase. This will effectually prevent the latter from "blacking."

The form should again be slightly locked up, which may be done with the fingers. After carefully seeing that the surface of the plates is perfectly clear from pieces of reglet, lead, &c., roll the form with a hand-roller and pull an impression. This latter must be done slowly, on no account allowing the machine to run at full speed, or you will obtain a defective impression. There is another reason for pulling a sheet carefully. It is necessary, in order to ascertain what impression there is on the machine, that is to say, whether the cylinders are properly adjusted to suit the particular form, which in its composition might vary considerably from the one previously worked, and require more or less impression, as the case may be. Should any of the pages be in their entirety much lower than the rest, which is sometimes the case, the best plan is to put a piece of glazeboard under the corresponding blocks.

An underlay ought to be as thin as possible, or, when it is pasted in its place, great difficulty may be experienced in securing the plate under the catches again. As a general rule, the impression on the edges will be heavier than on the body of the page, as the blanket and sheets round the cylinder invariably "dip" or drop slightly into the gutters of the form. This may be partially remedied by "packing," or putting pieces of cardboard on the cylinder-bearers, to which future reference will be made; but it is advisable to prevent this in the underlaying, by lightening the impression on the edges of the plate.

Careful underlaying is indispensable to good printing, for no matter how well the cylinder sheet may be patched, it is impossible to obtain a clear, sharp, and level appearance if the primary process be carelessly done. This part of making ready is often considered merely an operation

to be done with the least possible care, whereas, in reality, it is more necessary to underlay a form properly than to overlay it, as a level impression is all that is required. It must also be remembered that to level *up* the plate not only secures an even impression, but insures uniform inking; while levelling *down* by overlaying renders the inking irregular.

In many instances one underlay is sufficient, but never more than two should be required. In putting the paper on the plate as little paste should be used as possible, for when the form is worked off, the underlay generally adheres so firmly that it has to be scraped off with a knife, added to which it is liable to make the impression lumpy.

Before leaving this subject we would strongly caution the workman against a practice which is always to be deprecated, and is often the cause of serious batters. We refer to the knocking the top of the catch with a hammer. If the catch be as high as the plate, which is sometimes the case, a piece of narrow furniture should be laid on the top, and a gentle tap of the hammer will effectually prevent it from blacking. Some machine-minders do not appear to consider their underlaying complete until they have tapped every catch round the plates with the iron head of a hammer. The result is, that the catches are soon damaged, and often a brass top breaks while working, and is carried by the rollers on to the face of the form. Sometimes, again, the plate is struck instead of the catch. When the plate is lifted, the bevel that was under the catch is found to be broken, and the next time the same plate is used it has to be fastened in a different place. Eventually all the bevel is destroyed, and the plate has to be repaired before it can be properly secured.

Cutting the Vibrators.—After having obtained a level impression by underlaying, the next thing to be done is to cut the vibrating-rollers. Experience alone can teach how to cut these effectively. Firstly, the roller should be placed loosely in the sockets in which it is to be fixed, and then rolled evenly along the ink-table on to the form. After marking the vibrator, to show the width of the plates, it may be lifted off the machine, and the composition that corresponds with the gutters cut away, also about half an

inch *into* the ends of the pages, or the ink will accumulate in a direct line on the table and make the edges of the letter-press dark and muddy. The composition should be removed with a sharp knife, care being taken that it is not cut too deep, or it will loosen the composition on the other parts of the stock. As it is hardly possible by means of the screws at the back of the ink-duct to regulate the ink-supply to the ductor-roller as required for ordinary "cut" or "broken" letterpress forms, the vibrator has to to be so cut away that it takes from the ductor-roller only just sufficient ink. The roller in this case may be cut uniformly, and the best way is in the shape of the worm of a screw, thus—

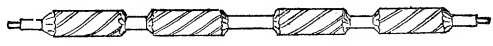


Fig. 13.—Vibrator—Composition partially cut away for ordinary letter-press form.

The composition must be cut with a clean and sharp edge, in order that no small pieces may become detached while working, and cause an unsightly "pick." The ends must be heated until slightly melted, that they may adhere more firmly to the stock. In some cases, as, for instance, when there are heavy blocks in the form, a greater quantity of ink will be required, so that the vibrator will not need cutting to such an extent as shown above.

Wavers, or distributing-rollers, are, as a rule, of the same diameter as the vibrator. Their duty is simply to distribute the ink evenly over the ink-table, and not to touch the surface of the form. When new, they should be trimmed by cutting about two inches of the composition away from either end. Those portions, as in the case of the vibrator, should be slightly melted, and pressed to the stock.

These rollers are so placed in the forks as to make them run diagonally partially across the table, two in one direction and one or two in the opposite, so as to insure a more perfect distribution. The better the distribution, the more satisfactory the printed work will be, and this in a great measure also depends upon the condition of the rollers. They must be clean and "tacky," and, after standing any

time, should be wiped down with turps, and then with a rag dipped in warm water. In the case of an Anglo-French machine, upon which we now suppose we are making ready, the waver nearest the form is supplied with a "lift," because in this machine the table runs so far out that the waver, if not slightly raised, would touch the form.

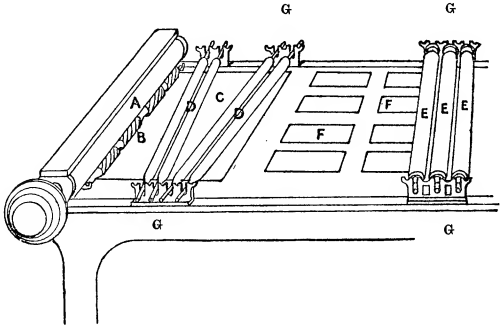


Fig. 14.—Inking Arrangements:
A, Ductor-roller; B, Vibrator; C, Ink-table; D, Wavers or Distributors; E, Inking-rollers; F, Form; G, Roller Forks.

A hint may here be given as to the regulation of the duct. The machine should, for a short time, be run without rollers, and care taken that no more ink than is necessary should be let out. This can be tested by running the finger along the surface of the duct-roller while it is revolving. The supply of ink can, to a certain extent, be governed by regulating the ratchet or ductor-band, as the case may be.

Inking-Rollers.—These are in diameter at least twice the size of the wavers, and the stocks much thicker. In our opinion, the larger the diameter the better, as the greater amount of ink carried on the surface the farther it will go over the form.

The ends should be cut and melted in the manner before described, and great care should be taken that they are always fresh and clean, otherwise the ink they carry will be insufficient in quantity and uneven in distribution; and, further, they will deposit the whole at the first revolution,

leaving the end of the form uninked. These rollers are provided with gun-metal or iron wheels on each end, which run upon the roller-bearers parallel with the cylinder-bearers. As the wheels are apt to become loose after much wear, they should be fastened on immediately they are discovered to be so, as accidents may arise from this not being attended to.

Packing on Roller-Bearers.—In order to prevent the rollers from dropping into the gutters of the form and scraping the edges of the plates, leaving a thick ridge of ink, pieces of packing must be fastened on to the roller-bearers which lie outside the cylinder-bearers. The packing should consist of a piece of thin leather, or two or three pieces of thick wrapper fastened together by glue, and cut grad-

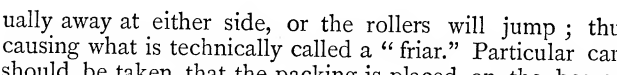


Fig. 15.—Roller-Bearers.

ually away at either side, or the rollers will jump; thus causing what is technically called a "friar." Particular care should be taken that the packing is placed on the bearers exactly corresponding to the gutters, or the edges of the plates will not be inked. A straight-edge laid along the gutters to the edge of the bearer will materially assist in insuring this. It is very important that the packing be securely fastened, or it will become detached while the machine is working. Tacks are generally used for this purpose; but the cautions we have already given as to their treatment should be borne in mind.

Packing on Cylinder-Bearers.—As the blanket or paper on the cylinder is apt to slightly bulge or "dip" in the gutters of the form, a thin piece of packing must be fastened on the cylinder-bearers, corresponding with the gutters, in order that the impression may be slightly borne off. If this is not done, the edges of the pages will appear thick and hard. This will generally prevent "slurs" and the hazy appearance not uncommon in ordinary book-work. As these slurs are caused sometimes by the cylinder-brasses wearing away, thus allowing the cylinders to shake while giving the impression, it is absolutely necessary to keep the

latter tight upon the bearers, in order that they may not dip, however slightly, into the gutters after leaving the page, and thus produce the slur referred to.

Running up Colour.—Before making register the colour must be run up. This is generally termed "inking up." The wavers should be wiped down with a damp rag, and put into their respective forks. After making quite sure that nothing remains on the surface of the plates or on the coffin, the machine should be allowed to run until a fair surface of ink has been deposited on, and distributed over, the table. A sheet of paper ought to be placed over each form to prevent the blanket being prematurely blackened; but care must be taken that the sheet is perfectly flat to the plates, or a waver may catch it; and, besides, the sheet being taken round, there is the possibility of it getting caught by another waver, and the probability of the two being jerked out of the forks. Rollers are sometimes doubled up by this means, as they generally fall vertically down the pit of the machine, and when the table returns it strikes them in the middle, giving the machine a severe jar and disabling the waver.

Before putting the inking-rollers into their places, a couple of sheets should be run in the machine, to prevent an impression being pulled on the blanket when starting. In order to work the plates down, and to insure the proper inking of the form, about a quire of waste-paper must be fed in before a clean sheet is printed.

Making Register.—When a "clean sheet"—that is to say, a perfect copy—is printed, the register may be easily ascertained by holding the sheet up to the light. It must be remembered, if a page is moved after the form is overlaid, its overlays must be shifted; hence it is important that the form be in perfect register before proceeding any further.

The amount of alteration necessarily depends upon the manner in which the form has been originally gauged. If this has been done carelessly, a great deal of time will be lost, as it takes very much longer to properly adjust the plates after underlaying than before the form is laid on; besides, there is the possibility of disturbing the impression by moving the pages. As it is much more convenient to work on the outer form, owing to its being

more accessible, it is generally selected for making any alterations that may be necessary.

Register-Racks or "Tappetts" are put to some machines to render the machine less liable to "throw" out of register. They consist of four or five small teeth placed on the end of the coffin, and the same number on the cylinder to correspond. On new machines we think they are unnecessary, because all the parts are perfectly tight; and even on machines that are worn, they are liable to give a slight jar. We have very rarely heard them well spoken of, and think that when a machine requires tappetts it ought to be repaired.

There are several other causes which operate in throwing a form out of register. Keys securing the wheels to the spindle or shaft may work loose. The pulleys upon which the tapes run may be stiff, causing the tapes to travel unevenly, and the sheet to drag. The grippers may not be properly adjusted. The paper may be too wet, or the ink may be too stiff. One thing, however, must not be overlooked: on no account have your driving-strap too tight. If precaution be used in this way, many accidents will be prevented, for the strap, if loose, will more readily slip round the tight rigger, when the machine has received a sudden check; whereas, if the strap be too tight, and anything to get on to the form, or a roller jump out, some portion of the machine will break. If the strap be old and worn, of course it will snap at once.

CHAPTER VI.

OVERLAYING—Forms without Cuts—An Outer Form with Cuts—Pulling the Impression on the Cylinders—Cleaning the Plates—Patching for Overlays—Pasting up the Overlays—Inking-up.

OVERLAYS.—In some printing offices a man is employed solely to cut overlays, so that when a form is laid on they are already prepared. This, however, is not always the case, the majority of machine-minders having to prepare their own overlays, which is the better plan, as the workman then knows the material with which

he has to work. Besides which, being amenable to censure if the cuts are ineffective, he should certainly be able to claim the credit when they look well. The pulls from the cuts should be obtained before laying the plates on the machine, as the inking and impression can be better regulated at the hand press. Four impressions should be taken, one on thick plate, and the remaining three on ordinary printing paper. By some machine-minders, cream-wove, hard-made paper is preferred. In all cases good proofs are indispensable, as the minutest details should be distinct.

The pressure to be given in order to print an engraving properly must not be uniformly equal, or the effect apparent on the India-proof will not be attained, for instead of the impression containing light, medium, and darker shades, it will be uniformly dull and "lifeless"—the light tints will be too hard and black, and the solids will neither be firm nor contain enough colour, nor will the medium tints possess any of the mildness and softness which ought to pervade the part of the engraving.

It ought to be perfectly understood that the cutting of an overlay must not be performed in a merely mechanical manner. It is a common practice, after having hastily looked at an impression of an engraving, to immediately commence cutting out the lights and heightening the solids, regardless of the greater artistic effect to be produced. In many cases the paper is cut abruptly, without any study of the required gradation of light and shade; and the workman is satisfied, after having finished, by feeling the overlay, and finding the blacks heightened and the lights depressed. This is, however, not the proper method.

Before commencing operations, the India-proof supplied by the engraver should be properly studied, with the aim of producing as nearly as possible the same effect. The prospects of success depend, in some measure, upon what class of machine the cut is to be worked. If a thick blanket intervenes between the engraving and overlay, the difficulty is increased, and the overlay must be slightly thicker; whereas on a platen, or even a tumbler or Anglo-French, when paper is used as the external covering to the cylinder, instead of blanket, the thinnest piece of paper has an effect. So it must be borne in mind what test the overlay

will be subjected to, and the thickness must be regulated thereby.

It will be patent to all that engravings worked at machine rarely, if ever, equal the proof supplied with the cut. In the latter, superior ink is used; the India-paper is beautifully soft, with a splendid surface; and the use of the burnisher enables the engraver to obtain altogether a superior effect. In addition to this, where extreme lightness and delicacy of tint are required, the ink is partially "wiped" from the block, so that, putting aside the fact of the thoroughly-experienced eye for artistic effect, the means employed in the production of an India-proof are altogether of a different and more effective character than those at the disposal of a machine-minder.

In making an overlay, the groundwork must be first prepared on the proof that has been pulled on plate-paper. Supposing the subject to be a landscape, the sky should be "peeled," *i.e.*, a thin layer of the paper scraped evenly off. It is not advisable to cut the lightest shades away altogether, as it may cause them to look "rotten." Just sufficient impression should be given to allow the fine lines to appear plainly, but not indistinctly. Considerable judgment must therefore be used in preparing the extreme lights. After having finished the foundation, the blacks or solids must be added. These will always be found in the foreground. In fastening the pieces on to the first proof, the paste must be of the thinnest consistency, and very sparingly laid on, as it soon dries, becomes hard, and gives impression where not intended, thus marring the effect.

From proof number three must be cut all the lighter shades, retaining the darker and medium ones, and these must be pasted on. The fourth and last pull should possess the extreme, medium, and lighter shades—only the lightest part being cut away—and fastened on as before. The greatest care is necessary that the pieces be fixed on exactly in their places; if not, the overlay is worse than useless. The extreme edges of the overlay should be scraped, or cut gradually away, to prevent them from appearing hard and abrupt.

At the present time many foreign *clichés* are imported, and duplicate electros are taken to work from, so that in

case of an accident another cast can be speedily produced. The consequence is, that the fine work in the last electro, in many cases, is very shallow, or even gone altogether. When such is the case, an engraver should be employed to open up the parts where lights once existed. If this is impracticable, the machine-minder must endeavour in the overlay to humour the electro as much as possible. In instances like these, the work is very much more tiresome, and the result far from satisfactory.*

In figure subjects, the fleshy parts—the face, arms, &c. —should be soft and delicate; in fact, nothing condemns an illustration more than the dark, muddy face and hard outline. We would certainly prefer them "rotten," or indistinct, of the two; but the medium should always be aimed at, and attained. Of course, the surface and substance of the paper have a great deal to do with the satisfactory appearance of engravings. When rolled paper is used less labour and ink are required, and the effect is infinitely superior.

Woodcuts are rarely placed on a machine, for one or two reasons. If by any chance a batter were to occur, the block would have to be plugged and re-engraved, involving considerable expense and loss of time. Cuts are apt to warp,† too, from being frequently wiped out, and also by the rotary motion of the cylinder. This is almost impossible, however, with electros, and if any damage occur in the shape of a batter, in nine cases out of ten it can be remedied by being knocked up from the back.

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* We often notice, in various periodicals issued at the present time, examples of the above. The engravings, in some instances, look more like impressions taken with a planer than illustrations, and we are convinced that the fault lies less with the printer than with the material supplied.

† When warping happens, a very good method of restoring the block to its original shape is to lay it, face downward, upon a bulk, with a few thicknesses of damp paper under it, and to place a flat weight of some kind upon it. In the course of an hour or two the block will be restored to its former position. This method is preferable to wetting it with water, which is often practised; for the latter swells the fine lines of the engraving, and consequently affects the overlay. When woodcuts and type are worked together, the engravings should be taken out before the form is washed.

Here we may mention the frequent appearance in illustrations of small white spots, about the size of a pin's head. These in the majority of instances are small batters, caused by pieces of grit being pulled on to the cut, or by the shrinking of the metal beneath the copper shell. Under any circumstances these will occur, and should be attended to immediately they are perceived. The plate should be lifted, and by means of a pair of callipers the exact place can be marked underneath. Place the face of the electro downwards upon a piece of thick paper, to prevent its being scratched, and by means of a small punch force up the place marked. This should be done with care, or the work on the surface of the plate will suffer.

Impressions for Overlaying Form without Cuts.—If there be no illustrations in the forms, a sheet can be fed in, and the machine stopped, after having taken the impression of the inner form. The sheet can easily be released by opening the grippers with the hand, and a fresh sheet substituted. The machine may now be set in motion again (a set-off sheet having been fed-in in the usual way, in order to give a correct impression), and then the sheet will be delivered printed with the outer form only.

Outer Form with Cuts.—Supposing the overlays to be already prepared, after the impression of the inner form has been obtained, as described above, the taking-off board should be lifted, the inkers and wavers taken off, and the overlays placed on their respective plates, face downwards, as correctly as possible, the sheet laid over the form, and the impression pulled. If this be done without the overlays as described, the impression will be incorrect, as they bear off the pressure on the surrounding letterpress, and after pasting up the patched sheet on the cylinder with the overlays, the result is found to be very different to what was anticipated.

Pulling the Impression on the Cylinders. — After taking the proofs for patching, and before washing up, an impression must be pulled on the outside sheet of paper on the cylinder, which will be immediately under the blanket, in order that the overlays may be placed in such a position as to fall exactly over the respective plates for which they are intended. This is commonly called

"pulling the cylinder." The forms should be properly inked, and the blankets taken off. But previous to doing the latter, the exact position of the edges of the blanket should be indicated by making several marks on the sides and ends with chalk on to the cylinders, so that in replacing the blankets they may be stretched to occupy exactly the same place they originally occupied. This precaution should always be taken, as the blankets vary slightly in thickness in different parts, in consequence of frequent usage. The machine may now be set in motion, in order that the impression may be pulled on the lining of the cylinders, the exact position of the pages being thus ascertained.

Cleaning the Plates.—Cleanliness in printing, as in everything else, is necessary to success. After pulling proofs, whether for under or overlaying, the plates should be well brushed out with turpentine, and wiped perfectly dry with a clean rag. If this is not done, the ink will dry in the beards of the letters and on the surface of the engravings, and considerable difficulty will be experienced in properly clearing the plates from "picks." Neglect will sometimes necessitate burning the surface of the plates by means of turpentine. As this is not in any way conducive to the good appearance of the work, it ought to be avoided by cleaning the plates before the ink is dry. Care must be taken that the brush used is not too worn, or the wooden back will injure the surface.

Patching for Overlays for Type.—The impression-sheet should be pinned on a board, which ought to be slightly larger than the sheet itself. A very light place must be selected for the patching, gas, if possible, being avoided, and the board fixed at an angle of about 45°, when the heavy and depressed portion will readily be seen. As the impression should now be comparatively level, medium thin set-off paper is all that is necessary to be used, with as little paste as possible. Cut the paper into strips of about half an inch in width (which is a better plan than tearing it), thereby saving both time and material. It is also easier in the manipulation.

Pasting up the Overlays.—After the sheets are duly finished, the pages must be cut out separately, the same precaution being taken, as in underlaying, of lightening the edges. To prevent the head-rules appearing dark and battered, the

impression on them should be as light as possible. We are glad to find that in many instances head-rules are being abolished altogether; for, be as careful as you may, they very seldom look really well. The pages should now be carefully pasted on the cylinder—true to a hair-lead on their respective places—together with the overlays to the cuts. It is impossible to be too careful in putting up the latter, for if they are misplaced even the thickness of a lead, they are perfectly useless, and will have to be readjusted. The blankets must now be put on, stretched to the chalk-marks corresponding to those marked on the cylinders made before unpinning them.

"*Inking up.*"—The wavers having been wiped down, the colour should be again run up, a sheet being placed on the forms, as described on p. 25. Run a couple of sheets in the machine, treat the inkers in the same way as the wavers, and place them in their respective places. Set the machine in motion, and run a quire of clean waste. Waste set-off sheets should be fed-in during the latter operation, to prevent the blanket of the outer form from becoming dirty, or the clean sheets that follow will be useless, in consequence of the accumulated ink that will be sure to set off from the inner form.

Although it is very probable that yet another sheet will have to be patched before the work is satisfactory, it is necessary that everything be now got into thorough working order. The ductor should be set, regulating the supply of ink by means of the short and long screws at the back. After having run up colour, distributed it, put the inkers in their places, and run through the waste, as above, a quire of clean sheets should be printed, when any defects in the making ready will be readily perceptible.

After being satisfied that another patched sheet is necessary, pull impression-sheets of the forms, as before, two of three clean sheets printed being used for the cuts. These will most likely require a little more attention; probable the solids will have to be made firmer, and the lights softer. The India-proofs should be compared with the impressions, with the view of making the final touches to the overlay thoroughly effectual.

This last patching should take a comparatively short

time, as there really ought to be little to do. Any additional pieces put upon the illustrations should be judiciously calculated, as in proportion to the impression put on the cut so the pressure of the surrounding pages of letterpress will be borne off.

We have known frequent instances of machine-minders putting four, and even five, patched sheets on the cylinder, every time adding something to the cuts, and then being surprised to find, on holding the impression-sheet up to the light, each successive one more irregular than its predecessor. The overlays to the cuts will then be like boards, and almost as useless. Then follows the slovenly habit of pasting pieces of paper on the blanket, which always, to our mind, shows an incompetent workman. Two overlays ought to be sufficient; more than three should never be required.

CHAPTER VII.

Rollers—Importance of Proper Rollers—Effects of Temperature—Effects of Friction—Influence of different kinds of Ink—The Patent Composition for Rollers—How to ascertain when a Roller is in good condition—Roller-wheels—Riders and their Treatment—Monks and Friars, and the mode of preventing them.

THE importance of this subject cannot be over-rated, as good printing depends, to a very great extent, upon the condition of the rollers—the vibrators, wavers, and inkers. Constant care and judgment are required in their treatment, as the materials of which they are made render them particularly sensitive to warmth and cold. The form may be perfectly made ready, the paper be of the best quality and surface, and superfine ink used, yet the result will be unsatisfactory if the rollers are not in fit condition. Indeed, rollers well chosen will often compensate for deficiencies in hurried making-ready, and will hide many glaring defects which would become painfully apparent were the rollers out of condition.

If the temperature be too warm they will fret and burst, if too cold they will become hard, akin to leather. The

composition should be neither too hard nor too soft; but certain soft elasticity is desirable, so that it can adapt itself to the form in every place.

When rollers are very soft and pulpy and inclined to leave the stocks at either end, consequent upon the temperature being high, they should be lifted out of the machine, and stood in a cool place until the composition becomes firmer. They must be constantly watched, for if they burst while working, it necessitates the table and form being thoroughly cleaned, as the detached composition adheres firmly to both.

By having a duplicate set of rollers at hand much time and labour may be saved, especially in the summer, in warm, confined machine-rooms. Under these conditions it will sometimes be found necessary to change the rollers every hour—say every two reams. Long stoppages may be often avoided by adopting this plan, and the work will look very much better.

The less violent friction the surface of a roller is subjected to, the longer it will keep in condition, so an allowance should always be made for the speed at which a machine runs. In a warm temperature the rollers, on an Anglo-French machine for instance, running from 750 to 900 copies per hour, will last much longer than on a machine printing from 1,200 to 1,500. In the latter case the rollers should be slightly firmer than in the former. In the case of a Napier platen, where the rollers travel over the form four times between each impression, a duplicate set should *always* be at hand, as, even in moderately cold weather, the amount of work they have to perform soon renders them temporarily unfit for working.

When rollers become hard, as they will in cold weather, they should be wiped down several times with a rag dipped in hot water, which will slightly soften and render them "tacky." Care must be taken that no drops of water be left on the surface, as damp penetrates the composition, causing swellings, which burst, leaving punctures. Washing them with strong lye, and allowing them to be exposed to the atmosphere when not in use, soon renders them useless. It must also be remembered that it is also a very injurious practice to wash rollers too much. When they become

hard and leathery through long usage, they should be at once discarded, as it is almost impossible to restore them to a proper working condition.

Ink will also affect the rollers. If there is much "dryers" in its composition, it will dry or "cake" upon the surface of the rollers in a short time, unfitting them for decent work. The only way to really remedy this is to have several auxiliary rollers ready, and change when they become flat, wiping down the ones just lifted, that they may be ready when again required.

The patent composition recently introduced certainly requires less attention than that ordinarily used. Temperature does not affect these rollers, and it is not necessary to wash them at meal-times, or even at the end of the day, so long as they can be placed where no dust can accumulate on the surface. We have found, however, that the introduction of a roller of the ordinary composition is an improvement, as the patent composition is apt to deposit its ink on its first revolution. However, in the case of newspapers, where the machines are worked at a tremendous speed, and to printing-offices where the facilities for making or changing them are not so great as in London, these patent rollers are a considerable boon. Turpentine only should be used when it is necessary to clean them. Lye or water must be avoided, as either of these soddens the rollers and makes them totally unfit for work.

The greater the *diameter* of the inking-roller the better, as it carries a larger inked surface to the form. The smaller the roller, the sooner the ink is exhausted.

Iron stocks we consider better than wood, as the metal renders the rollers heavier, in many cases obviating the use of a rider, although it is urged by some, that the wooden stocks facilitate more the distribution of ink, as the specific heat of wood is greater than iron. But this latter we think of little moment.

The *working condition* of a roller can be easily ascertained by the feel. If, when pressing the finger into the composition, it leaves an indentation, the roller is either too new or the temperature in which it has been kept has been too warm. No attempt should be made to work a roller in this condition, as the surface will be injured, or the composition

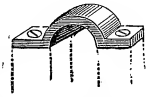
leave the stock. When rollers are first delivered by the maker they are invariably unfit to use, being too new, and should be stood in a moderately cool place for at least a week. If a roller be too green, it will not take up the ink evenly, added to which, it is liable to change the nature of the latter, which loses its brilliancy. An "inker" in prime condition should feel, when the finger is drawn along it, "tacky," *i.e.* somewhat rough and adhesive. In this state it will take the ink well from the table, and also deposit it almost uniformly over the form. As we have said before, if the roller be old and tough, with a bright leathery surface, it should not be used. If it takes the ink from the table, it will do so unequally, and deposit nearly the whole of it on its first revolution, leaving the end of the form farthest from the table without ink.

The length of time a roller should last cannot be accurately fixed, as there are so many agencies at work—speed of the machine, the class of work it has to perform, the kind or quality of the ink, and above all, as we have before said, the temperature. But careful attention will in all cases materially add to its durability.

It may not be out of place, perhaps, to here call attention to the destruction of *roller wheels*. We have rarely found a machine, excepting when entirely new, with its inkers in perfect condition—in many instances the wheels being broken, or absent altogether. This is to a great extent due to the carelessness of the boys, who in removing the rollers from the machine bang them down on the floor, and often insecurely place them against the nearest bulk or wall, when the slightest touch will send them to the ground. Considering the brittle nature of the iron of which many are sometimes made, and the weight of the roller, it is not to be wondered at that they quickly become destroyed if they are not carefully treated. If the wheel is made of gun-metal it is generally battered instead of being broken. We would advise the machine-minder always to impress upon his boys the necessity of carefully handling the inkers, for careless usage not only damages the wheels, but injures the composition. A piece of roller-rack should be fastened horizontally against the wall of the machine-room, and when the rollers are lifted from the machine

they can be securely lodged until it is convenient to wash them.

RIDERS—We look upon these as necessary evils. When, however, heavy cuts abound and the stocks of the rollers are of wood, then a rider is desirable in order to give additional weight to the roller, and that the ink may be better deposited upon the plates; but care should be taken that the composition of the roller or rollers upon which the rider is placed is not too fresh or soft, or the surface will be entirely destroyed by the friction. In fact, the rollers upon which the riders are to be placed should be slightly firmer than otherwise, in order to resist this friction. Riders are also used with advantage when the rollers are apt to jump, causing friars. In all cases careful attention should be given to the fastening of the rider. Some machines are provided with a brass cap fastened on the tops of the forms so as to cover each end of the spindle. By means of screws it can be easily adjusted or removed. Some plan should always be adopted, as the rider is liable to jump out while the machine is in motion, doing considerable damage. We have seen machine-minders bind tapes, and even string, round the top of the forks, to prevent an accident; but this is a clumsy expedient. A simple way is to drill a small hole through the forks, as near the top as possible, and run a thick piece of wire through them, thus securing both the rollers and riders. We would also recommend the above simple roller-guard in the case of all fast machines, as it prevents the possibility of a roller jumping out at any time.



Monks, or thick ridges of ink running across the form, are owing to the imperfect distribution of ink by the wavers, or are sometimes caused by the ductor-knife or roller being out of order and allowing the ink to escape at intervals in larger quantities than is required. If they are owing to either of the last-mentioned causes, the defect can only be remedied by the knife being ground or the roller turned. Rollers in bad condition will sometimes produce monks.

Friars—named, we suppose, in contradistinction to the former—appear across the page or pages as lighter patches

than the greater part of the form. This may be the effect of some foreign substance having got on to the roller-bearers, causing the inkers to jump, or of the shifting of the roller-packing, or, as in the case of monks, by the bad condition of the rollers; under any circumstances, the cause may soon be discovered, and remedied with little trouble or ingenuity.

CHAPTER VIII.

MISCELLANEOUS HINTS AND DIRECTIONS.—Blanketing, Woollen and India-Rubber—Quality of the Paper to be Printed—The Set-off in different classes of Machines—How to stop a Machine while it is in work—Renewing Tapes—Lubrication—Cleanliness.

BLANKET.—For superior work, the finer and thinner the blanket the better. Coarse and thick material is only fit for newspapers, or in cases where speed in the making-ready is more important than the quality of the work. Formerly, superfine black cloth was used for cut work, but of later years printers' blanket has been manufactured equally as fine, and can now be procured of almost any width and substance.

India Rubber, though more expensive, is more durable, and is preferred by some for its elastic properties. For general use we think it superior to the ordinary blanket, but we cannot recommend it for fine work.

Paper.—As in the case of rollers, the machine-minder should pay particular attention to the condition of the paper he has to print. Although he is rarely called upon to prepare the paper for working, he ought to be able to tell to a nicety when it is properly and evenly damped. Paper too wet, produces a heavy and clammy impression, and when in this condition the surface will peel, adhering to the form in the working, and cause ugly "picks." On the other hand, if it be too dry the printing will appear rotten, and it becomes necessary to increase the impression, the mark of which, when the ink has been dried, will be found difficult totally to remove, even by the hydraulic press.

In order to economise in the manufacture of paper,

many materials are now used, which unfortunately have a very prejudicial effect upon the appearance of the ink. Lime is frequently employed to give common paper a whiter appearance. When this is the case the paper will mackle in the working, and will contract at various portions of the sheet. Different kinds of paper require different treatment at the hands of the wetter-down; but it is scarcely in our province to enter into the details of the peculiarities of paper in these articles.

Paper should be wetted down at least twelve hours before it is required for use. If it is inclined to mackle or crease it must be "turned," and, if possible, put into a standing press for some time. Indeed, for fine work, it will always be found advantageous to give the paper the benefit of a few hours in a press. We may here incidentally mention that the Boomer and Boscher press is particularly adapted for this purpose.

Paper that has been rolled, must be worked as soon as possible after it has left the rolling-machine, in order that it may not get dry and hard. If, however, this is impossible, it must be worked dry, for if wetted a second time the extra surface imparted by the rolling-machine will suffer. Rolled paper is much harder than that ordinarily used, and therefore a greater impression is required. As the ink lies *upon* the glazed surface, instead of sinking *into* the substance (thereby producing a greater density and brilliancy of colour), the sheets should be interleaved with set-off paper, and if possible allowed to remain until after the work is dry; otherwise, the pressure of the sheets upon one another will cause the ink to set-off.

It will be noticed that in unrolled paper there is always one side smoother than the other, and care must be taken when it is placed on the laying-on board, that the side with the best surface be placed undermost, in order that the outer form, which generally contains cuts, may be printed on it.

In the majority of American first-class publications, the ink bears an exceptionally glossy and finished appearance, which is especially noticeable in the illustrations. This is owing, not so much to the quality of the ink, as to the paper, which has a splendid surface. Why this paper should

have hitherto been peculiar to our transatlantic cousins we are unable to surmise, except that the price is greater than the profits of the publishers in this country will allow. But we are glad to learn that an eminent English paper manufacturing firm has at length succeeded in making it cheaper than hitherto, although the cost is about 25 per cent. greater than the paper ordinarily used. If this paper should find favour here it will be a great boon to printers, enabling them to make their work look more finished with less labour.

Set-off.—Excepting in the case of the commonest class of work, no cuts should be printed without set-off paper being used. Every time the outer form of a sheet is printed, a certain amount of ink is deposited on the blanket from the text of the newly-printed inner form, especially from the portion backing the engraving, as the impression is there heavy and solid. The result is, that the blanket quickly becomes saturated with ink, and a dirty mark is left directly behind the cuts. This can be remedied by running separate set-off sheets the same size as the white paper, in the case of an Anglo-French machine, and by using the endless rotary set-off in the case of a drop-bar.

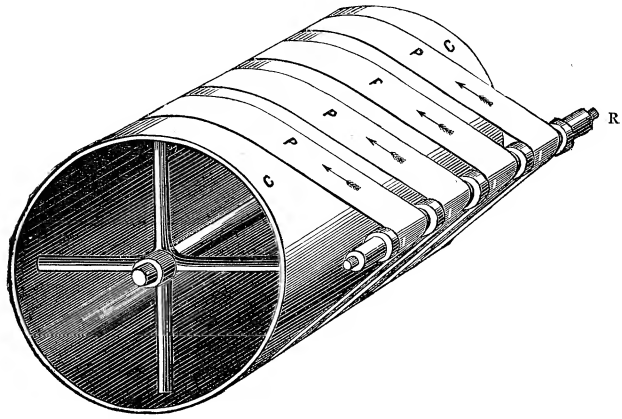


Fig. 16.—C, Outer-form Cylinder; P, Endless Set-off Paper; R, Roller, with India-rubber Guides.

It will be noticed that the rotary set-off paper will last for some considerable time, from the fact that the portion which takes the set-off changes its position with each impression, because its length is much greater than the circumference of the cylinder—travelling over a bar fixed over the taking-off board,—as will be seen by the preceding diagram.

If this were not the case the pieces would have to be changed at least after every 50 impressions. The paper should be cut into strips of the same width as the pages, and about four inches be allowed for fastening, as little paste as possible being used, or it will cause an ugly mark across the page or cut upon which it happens to fall. To prevent the strips from "wandering" from their right position, the roller over the taking-off board must be provided with india-rubber rings, about half an inch wide, fitting moderately close, but which can be moved backwards and forwards as required. The slips must not be too tight, or they may break, neither should they be too loose, or the rollers will catch and tear them. The roller R in the above diagram is fixed to the top of the side frame of the machine by means of iron brackets.

Oiled rotary set-off sheets are sometimes used. The paper should be well saturated with ordinary oil, and thoroughly dried. The difficulty in fastening is sometimes urged against their use, but if they are overlapped, say six or eight inches, and thin paste used, little trouble will be encountered. They are much stronger than ordinary paper, and last very much longer, saving time in renewing, and material in economising the paper.

In the case of an Anglo-French machine, where separate set-off sheets are used, a ream of paper may be used to at least 20 successive reams of white paper, when it can be dried and used again. The thinnest paper will do for this purpose, but we have found that it is unadvisable to have it too poor in quality, for if too thin it becomes quickly destroyed by careless boys and the action of the tapes, and it is not worth drying for future use. We have seen the rotary set-offs, as described above, used on the Anglo-French machine, but unless extreme care is used, the grippers will tear them, besides which the temporary erection necessary for their running is anything but elegant or effective.

In the case of a Bremner, Wharfedale, or any one-sided machine, if a set-off sheet is required when perfecting, a sheet a little larger than the paper being printed, pasted on the cylinder, will answer every purpose, and can be speedily and easily renewed when required.

Stopping the machine while at work.—When, from any cause, it is necessary to stop a perfecting machine while in full work, always run a couple of sheets of waste before striking off, or the sheets that are in the machine will be spoilt, because of bad register. If the machine be somewhat old, this will be still more apparent. The reason is, that on starting again, the machine is subjected to a certain shock, which of course is absent when it is running uninterruptedly.

Dirty tapes.—Immediately a tape becomes dirty it should be changed, or else it will leave a black impression in that part of the sheet where the gutters occur. If a tape breaks, and becomes inked by the rollers, it should not be used again, as it is not worth while risking the spoiling of work for the sake of a few yards of webbing. When it becomes necessary to renew a tape it can speedily be done by pinning the new piece to the next tape and slowly moving the machine until the end makes its reappearance, when it can be shifted over to its right position, sewn, and tightened by means of the pulleys.

Oiling the machine.—As we have before observed, great care should be taken that the machine is always well lubricated, and before starting in the morning every bearing and joint should be thoroughly oiled. No person is so fit to do this as the machine-minder himself, who is acquainted with every part of the machine, and is solely responsible for its working. If boys or irresponsible persons are appointed to do this work, there can be no assurance that it will be done properly. A machine will work very much better when every wheel and spindle runs freely, without friction or wear; besides which, improper lubricating has much to answer for, in the shape of bad register.

Cleanliness.—A good workman may generally be known by the condition in which his machine is kept. The woolly fluff that becomes detached from cheap paper, together with superfluous oil, ink, &c., soon mar the general appearance

of the machine, while a little labour expended occasionally upon the bearings, &c., will keep the machine bright and tidy. If any portion be rusty, and oil and cotton waste fail to restore the brightness, emery cloth should be used. As the dust rapidly accumulates on the surface of the ink and upon the ductor roller, the ductor should be well cleaned with turps at short intervals, or the machine-minder will be perpetually troubled with "picks."

PART II.

PRINCIPLES OF PRINTING-MACHINE CONSTRUCTION.

CHAPTER IX.

Order of Treatment of the Subject—The Platen Machine—Its Capacity and Dimensions—Arrangement of the Working Parts—Method of Working—Covering the Tympan and Frisket—Centring the Form—Arrangement of the Frisket—Underlaying the Form—Adjustment of the Impression—Creasing of Paper—Side Marks—Avoidance of Set-off—Method of Driving.

THE first two chapters* of this series were devoted to the principles which pervade the various kinds of modern practical Printing Machinery; and we then treated generally upon making ready, machine-room economy, &c. We have now to show, by an examination of the several machines now in use, how those principles have been applied, and also how the machines themselves can be worked with the greatest efficiency. This involves, in fact, an account of the different mechanical peculiarities of the apparatus now used for obtaining the best impression from the type or plates.

In the chapters referred to we have pointed out the difference between what is called a "machine" and a hand-press, and how the introduction of the rotatory movement has rendered the latter more or less automatic. It is only following out this course of procedure to examine, first of all, machines founded on the principle of the hand-press, and capable of being driven by a wheel, actuated either by hand or steam-power. These are termed *Platen Machines*,

* *See* pp. 1, 5.

as the impression is obtained by means of a platen. We must except, however, the small treadle or traddle (the latter is the more correct expression) machines, for convenience sake, as some points that distinguish them entitle them to be placed in a separate and independent category. These machines will be treated on under the head of "Jobbing Machines."

After the platen machines—which, in mechanical, although not in chronological, sequence, as far as their invention is concerned, carry us from manual to self-acting presses—we propose to notice the Cylinder machines and their various combinations, in the shape of Perfecting and two-colour machines. Newspaper—or rather rotary machines—will follow, and the subject may be fitly concluded with notices of a number of unclassifiable machines, constructed to perform work of a peculiar kind in a peculiar way.

The Platen Machine.—The first platen machine was made, we believe, for Messrs. Spottiswoode, in 1830.

Platen machines have long enjoyed the reputation of being capable of producing the finest work that can be done on a machine; whether that reputation will be maintained in face of the improvements that are constantly being introduced into cylindrical machines is, however, extremely problematical.

The advantages hitherto attributed to the platen over the cylinder machine are these :—

First, it gives a perfectly *flat impression*, thus obviating the slur so frequent on cylinder machines.

Secondly, it dispenses with the necessity of placing a blanket between the overlay and the form, which plan is generally adopted in the cylinder machine. A parchment sheet, only, intervenes between the paper to be impressed and the overlay and patched sheet.

The disadvantage of the platen is, besides comparatively slow working, somewhat indifferent inking. This evil, however, has been minimised by the improvements of Messrs. Napier, to which attention will be directed in due course.

Capacity and Dimensions.—Platen machines are generally constructed to print double demy; sometimes double royal; but seldom as small as double crown.

The *length* of a double-demy platen is about 13 feet.

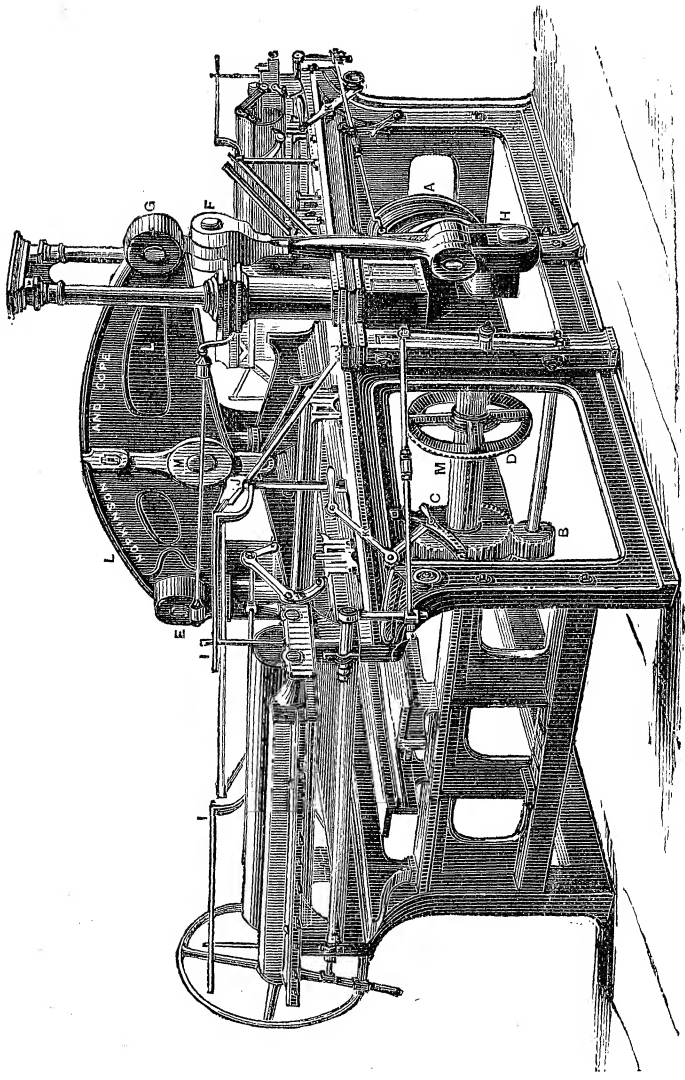


Fig. 17.—The Double Platen.

Arrangement of the Working Parts.—The platen is placed in the centre; the inking-tables and the coffin are at either end. Both the coffins and ink-tables are worked by the same gear, which lies under one of the tables, and consists of a large iron drum, A (Fig. 17—detailed in Fig. 18), about 20 inches in diameter, and 3 feet 6 inches in length, which constantly revolves in one direction. Round the extreme ends of this drum are two grooves, about 1 inch deep. At a certain point, each of these grooves is directed into others, exactly the same depth and width, which traverse the length of the drum in this direction (Fig. 18), losing themselves in

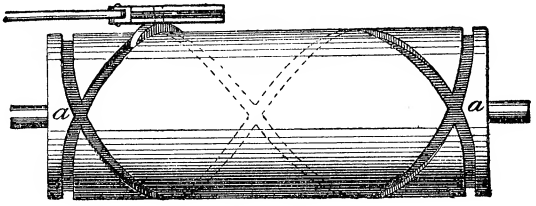


Fig. 18.

the circular groove at the other end. Immediately above the drum is a slide (Fig. 18, *c*), about 16 inches long and 2 inches thick, running upon two parallel bars. As will be seen by the enlarged diagram (Fig. 19), to one end an iron

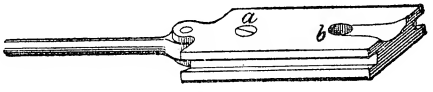


Fig. 19.

rod is fastened, which runs through the impression-bed, securing another slide similar to the first, under the coffin at the other end of the machine. Into the hole *a* (Fig. 19), underneath, is loosely fixed a shape (Fig. 20), which works into the groove of the drum, so that when the latter revolves, the shape is, owing to the circular direction of the groove, propelled along to the other end, where it remains stationary

until the drum has made one revolution, when by means of a half-diamond shape (Fig. 18, *a*) it is again led along until it reaches the other extremity. It then remains still, allowing the platen to descend and take the impression before it is again put in motion.

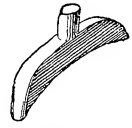


Fig. 20.

Fixed underneath the centre of the inking-table is a pin, secured by a strong spring. When it is desired to run either of the coffins or "ends," as they are called, under the platen, by means of a striker (Fig. 17, K), this pin is let down into the slot in the slide (Fig. 19, *b*), which, by means of the shape (Fig. 20), takes the coffin under the platen, returning after the impression has been given. By this means, either or both ends can be worked or kept standing, although the platen itself may be in motion.

The manner in which the grooved drum (A, Fig. 17) is driven is extremely simple. On the driving-shaft, inside the frame, is a small pinion-wheel (B), which works another large wheel on a shaft immediately above (C), and to which the bevel-wheel (D) is fastened. The latter works in a corresponding wheel at right-angles, fixed to the end of the drum-shaft, which thus acquires a rotary motion.

The platen itself in shape is somewhat similar to that of the ordinary hand-press, but much heavier. At the top is a cup, into which fits a stout bolt, rounded at the base, in order that it may work freely. This bolt is fixed to the beam of the platen (L) by means of the bolt (M); so that although the beam is stationary at E, the platen itself has a strictly perpendicular motion. In order that the platen may be kept perfectly straight, on either side of the frame is a groove (Λ), corresponding with a gun-metal shape fixed on each side of the platen.

The platen is worked by the connecting-rod (F) fixed to the cross-beam at G. The connecting-rod acquires its

motion from the shaft (M), carried through the frame of the machine, and terminating in the crank at H.

The laying-on board is situated immediately above the ink-table, being supported by a slight iron frame (I), fixed to the top of the side-frame. The tympan and frisket are fastened to the end of the coffin, near the platen, by gun-metal hinges or "joints."

When stationary, the frisket and tympan lie at an angle with the form beneath, as will be seen in Fig. 17. About two inches from the platen, on either side of the machine, are two iron bars (J), secured to the side-frame at one end, and to the support of the laying-on board at the other. Immediately the impression is given, and when the coffin is carried out to the end of the machine, the frisket and tympan run up these bars, and down again to meet the form for the next impression, time being allowed for the taker-off to lift the tympan and remove the newly-printed sheet, and also for the layer-on to place another on the frisket.

The roller-forks for the inkers are beneath the tympan-slides, and the wavers lie underneath the laying-on board.

In some machines the vibrators are worked by a cam at the base of the frame near the crank-shaft; while in others the bell-crank is used. The duct-rollers acquire their motion by the latter motion.

METHOD OF WORKING.—We have already stated that only a skin of parchment intervenes between the form and the overlay. Hence the thinnest piece of paper tells; and this fact necessitates great care and the exercise of much judgment in making ready on this kind of machine.

Covering the Tympan and Frisket.—The tympan must be covered with parchment, which should be thin and uniform in thickness, and stretched on the frame in such a manner as not to be readily drawn out of shape; neither must it be too loose, or it will be liable to hang in the frame. The way to ensure this is to paste the parchment well round the edges, and place it on the frame. After it is thoroughly dry, sponge the body of the parchment, which will bring it to the required tension. Linen is sometimes used for covering the frame which fits into the top of the tympan, instead of parchment, as the platen continually descending on it, is apt to cut the parchment at the edges.

Over the frisket or light iron frame, which is fixed immediately under the tympan, must be pasted a sheet of brown paper.

Centring the Form.—When the form is laid on the coffin, it must be exactly centred. A small nick will be found on the bar at the end of the coffin, and another on the edge of the ink-table. By stretching a piece of thread from one to the other, the centre of the coffin may be found to a nicety.

Arrangement of the Tympan and Frisket.—After having fixed both the frisket and tympan upon the pins running through the knuckle-joints, sufficient paper should be fixed in the tympan, by sewing it through the parchment, at the top end, so that it can be lifted from the bottom and thrown back again. Thin set-off paper is the best for this purpose. Care must be taken that the pins upon which the frisket and tympan work are securely fastened, or they will loosen and come out while working. Copper wire may be used for this purpose.

Roll the form with a hand-roller, and allow the frisket and tympan to run under the platen, and a slight impression will be left on the frisket. Having done this, cut the marked part out and about a pica beyond, so as to obviate any risk of the edges of the frisket touching, or "biting," the edges of the pages.

As the brown paper is apt to break from continual wear, pieces of tape must be fastened along the space between the pages. This is done by making a hole in the brown paper at the edge of the frisket, exactly opposite the gutters and backs, and tying the tape securely on the *under side*, fixing it tightly at the opposite side by the same means. All the backs and gutters of the frisket should be treated in the same way. After they are tied on, put some melted composition on the under side of the tapes and press to the paper. The frisket will then be sufficiently strong for any number of impressions.

To prevent the possibility of the sheet touching the form before the platen descends, small cubes of cork must be fastened on the under side of the frisket, on the tapes already mentioned. Let the cork be cut in pieces about $\frac{3}{4}$ or 1 inch long; and when laid on the furniture between

the gutters they should be about a pica above the surface of the form. The number of pieces required must be determined by the size of the pages. The cork should be well fastened on with composition, or the pieces will come off during the working.

Making Ready the Form.—After having levelled the pages by underlaying in the ordinary way (*i.e.* if the form be stereo or electro plates), fasten the points on the top and bottom of the frisket, run up colour, make register, and pull a sheet for patching. If there be engravings in the form, first cut the overlays and place them face downwards on their respective places before pulling the sheet, in order that a correct impression may be obtained. Patch the sheet, and paste the overlays in their position. When this is done, lift up the paper inside the tympan, and place the sheet, face downwards, next the parchment, allowing the point-holes in the paper to drop on to the points that pierce the tympan.

Adjustment of the Impression.—The impression may be increased or reduced by screwing up or loosening the wedges in the centre of the platen. They lie under the cup, immediately above the platen, which is raised or lowered by the means described.

When it is necessary to run an end of the machine under the platen, care should be taken that the slide is exactly under the pin before letting the spring down; otherwise it is probable that when the slide comes out, instead of the pin gliding into the slot, the end of the slide will strike it, and, besides pushing the table beyond its proper limits, bend or break the pin. As the duty of starting the end devolves upon the laying-on or taking-off boy, he should be strictly enjoined to wait until the proper time before letting down the lever.

Inking.—As we have already mentioned, the inking on these machines is somewhat defective. Great care should therefore be taken in the regulation of the supply of ink from the duct. Some platens are supplied with revolving ink-cylinders, with a mouse-roller, the nature of which will be subsequently explained, fixed parallel with the duct. This we think a great advantage, although slightly more troublesome to the workman. In fact, we have known this motion to be discarded altogether, although the appliances have been fitted to the machine. We are sure, if the machine-

minder would realize the advantages of this improved distribution, he would not object to the additional trouble involved by its use.

It will be noticed that the extremity of the form only receives the advantage of being inked by one roller, the ink on which is partially exhausted by having previously performed several revolutions. This might be obviated if the makers of these machines were to provide a double set of roller-bearers, so as to keep the two back inkers off the surface of the first half of the form. By such an arrangement, the end nearest the platen would have the advantage of being always inked by rollers newly charged.

Creasing of Paper.—It will be sometimes found that the paper will crease after a start is made. This is chiefly owing to the air getting between the sheet and the frisket, and may be remedied by the cutting of holes in the paper round the sides of the frisket, through which the air may escape.

Side-marks.—Bottom and side-marks can be made of strips of glazeboard, bent something after this shape, so

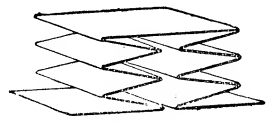


Fig. 21.

that they are not injured by the impression, but resume their original form after the tympan is raised. When perfecting, of course, these must be removed.

Avoidance of Set-off.—For the prevention of set-off, a thin sheet should be pasted at each corner, and fastened to the tympan. This can easily be renewed when required.

Method of Driving.—Perhaps of all ordinary printing machines the platen kind require the most power to drive. They should be driven from a counter-shaft by means of a stout cross strap, which must be tightly laced. Driving from same shaft as other machines should, if possible, be avoided, as the power necessary to give a heavy impression will frequently cause a check to the engine, which will seriously affect the register of work on any ordinary machines that may be running at the same time.

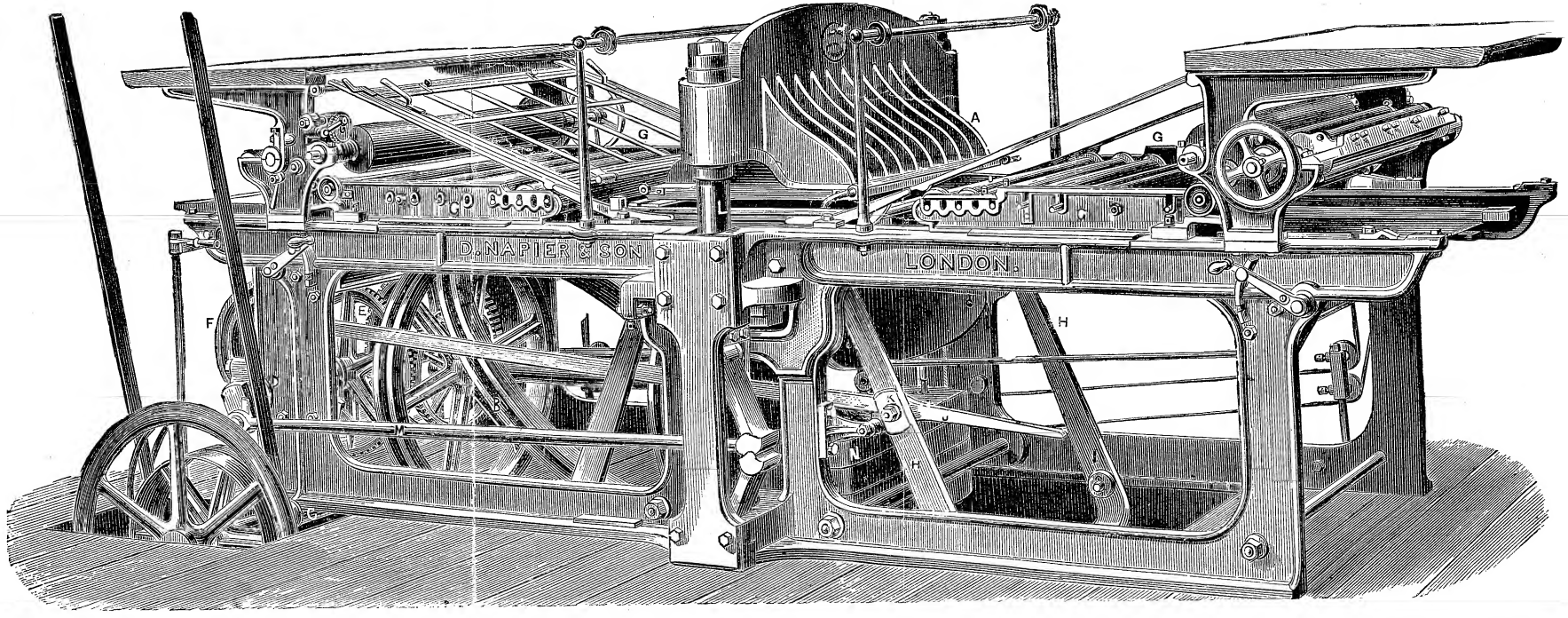


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Fig. 22.—The Napier Platen.

CHAPTER X.

THE NAPIER PLATEN.

Its Advantages — Capacity and Dimensions — Arrangement of the Working Parts.

THIS machine is constructed on the same principle as the last one described, but it differs from it in many material points.

Advantages.—One of the great advantages of the Napier platen, the importance of which can hardly be over-estimated, is, that greater pressure can be obtained with less than half the driving power required by the machine last described. This is owing to knuckle joints being adopted in place of the crank-shaft, for giving the impression (Fig. 22). An arrangement is also added by which the form is twice rolled between each impression.

The grooved cylinder of the Napier is greater in circumference than that in the old platen. By this arrangement the platen is allowed to rise at least one inch above the tympan, after the impression has been given, before the coffin is moved back from under the platen. This lessens the probability of the edge of the tympan catching the sides of the platen and preventing an occasional "double-up."

An improvement is also made in the mode of carrying the tables to and fro, a clutch being used instead of the pin and slot. This prevents the possibility of the table becoming detached from the slide, as sometimes is the case in the ordinary platen, by the pin jumping out of the slot.

Capacity and Dimensions.—These machines are mostly made double-royal size, but one has recently been constructed to print a quadruple-crown sheet.

Although Napier platens are sometimes run at as many as 800 impressions per hour at each end, it is very unad-

visable to drive them at so great a speed, and for these reasons :—Firstly, the roller-carriages travel so quickly that, notwithstanding the rollers pass four times over the form, they have not sufficient time to properly deposit the ink, and the object of increased inking is lost. And it must be remembered that, as there are no roller-forks, as on other machines, it is impossible to use a rider. Secondly, the wear and tear is so great that the machine is liable to quickly get out of repair.

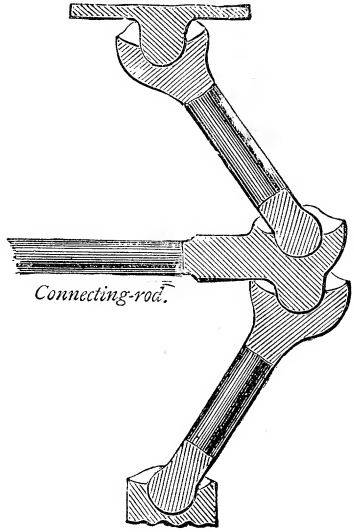


Fig. 23.

About 500 impressions at each end is all that can be reasonably expected, if good work is required. If the machine is driven beyond this speed, the work suffers, as well as the machine itself.

Arrangement of the Working Parts.—As will be seen from the illustration, the platen itself (A) resembles the ordinary machine only at the base, the cross-beam being dispensed with. The tables and coffin are driven by the

same means as described in the preceding article, *i.e.* by the grooved drum (B), enlarged in Fig. 24; but here the similarity of the working of the two machines ends.

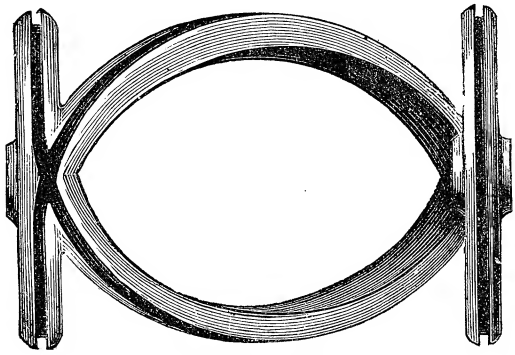


Fig. 24.—The Grooved Drum.

The driving-shaft (C), which is situated at the extreme end, works another shaft (D) immediately above it. This is furnished with a bevel-wheel (E), by which the grooved drum is driven. The spindles of the rollers, both inkers and wavers, are fitted in two parallel bars (G), which work in a groove on the top of the side-frame. These bars are secured in the centre by arms, which are attached to a light frame (H), the sides of which work freely on a pin on the inside of the side-frame at the base of the machine (I). From the cams (F) on the shaft (D) extend long arms (J), reaching to each inking-frame; the one that works the farthest end being necessarily double the length of the other. Towards the end of each of these arms is a small slot (Fig. 25), which drops

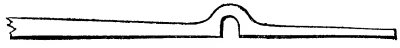


Fig. 25.

on to a pin on the side of the frame at K, which is attached to the inking apparatus. Shuttles on the arms work in the cam-wheels above referred to, and the latter are so made that the arms are propelled backward and forward twice

between every impression, carrying the inking-frame; the rollers thus travelling four times over the form between each impression. When either of the ends is struck off, the arm described above is raised from off the pin on the inking-frame. From this it will be seen that great care is requisite in striking off, that it be done when the end is fully out, otherwise the frame holding the rollers will be left on the form, and most probably travel towards the platen. Breakages not unfrequently happen from this cause.

In the original platen machine, as has been already explained, the platen receives its motion from one side only, the cross-beam being firmly secured on the other. The arrangement is entirely different in the Napier. The platen-head, which is cast in one large piece, is supported by means of two powerful rods (L), one on either side. Below the top of the side-frame each of these rods is diverted, as it were, so as to form an elongated square, in which is sufficient to allow space for large and powerful knuckle-joints, which are worked by connecting-rods (M) extending from the shaft at the end of the machine (enlarged in Fig. 23).

By this simple but powerful motion, the strain or jar that is so frequent in the other platen is altogether avoided.

In order to steady and assist the platen in rising after having given the impression, a heavy weight (N), extending across the machine, is secured to two strong gut bands, fastened at the other end to the chills of the knuckle-joint. Theoretically, this weight should be as heavy as the platen-head, in order to secure a perfect balance. The gut bands run over a series of pulleys, and care must be taken that the latter are always well lubricated, or the friction will soon cause the gut to snap. But however careful the workman may be, they will occasionally break; and, in order that the weight upon being liberated may not drop down the machine-pit, it is necessary to make a support from logs of wood, so that the fall may be but two or three inches. Although it is possible to work without this balance-weight, the chills, and consequently the platen, will be observed to tremble considerably if it is dispensed with.

The distribution of the ink is facilitated by a drum being placed parallel with the ductor, from which it is supplied

by the vibrator. This drum has a side motion, to and fro (Fig. 26).

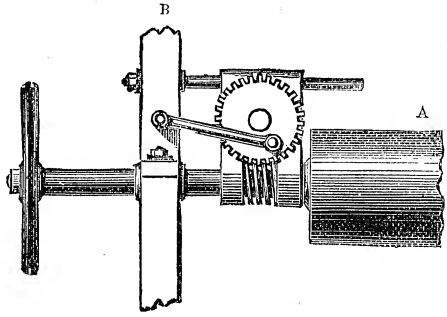


Fig. 26.—A, Ink-drum ; B, Frame of Machine.

The end roller nearest the ductor has a pulley on either end, and by a small shape on the frame is raised to the ink-cylinder. The roller-frame works the ratchet, which turns the ductor-roller. As mentioned above, both inkers and wavers are placed in the same frame, but the distributing-rollers are placed slightly higher than the inkers, in order to prevent the former from touching the surface of the form.

The impression is regulated by steel wedges on the top of the chills. These can be forced in or withdrawn by means of set screws.

The *method of working* this machine is similar to that of the last, with the modifications necessitated by the altered construction, as detailed above.

As we have mentioned before, the machine-minder must constantly watch his rollers, especially in hot weather, as the rapidity with which they necessarily travel over the form soon renders them useless if they are not in fit condition. Much trouble and delay may be saved by having a duplicate set at hand.

It is almost unnecessary to say that these machines are models of good workmanship and fitting. Although they cannot be classed amongst the most economical of machines, either as to original cost or in the working, it is undeniable that they are particularly suited for the finest class of cut-work.

THE "MIU" PLATEN MACHINE FOR ENDLESS PAPER.

ALTHOUGH this machine is comparatively unknown in this country, we think it deserves notice from the fact that it is the first platen to which the continuous roll of paper has been applied. It is the invention of Herr Tilgmann, of Finland, and derives its somewhat peculiar appellation from having been named after the inventor's deceased wife.

Unlike the ordinary platen machines, the coffin, and consequently the form, is forced up to the platen-head, which is stationary. This motion is somewhat similar to that in the Adams (American) press. On reference to the illustration, it will be seen that in this case it is effected by means of the two sectors *f f* working in gear, and driven by the connecting-rod from the large cog-wheel: *a* is the roll of white paper, which first passes down in a perpendicular direction, then under the platen *b*, where it receives the impression. It then runs between the cylinder *c* and pulleys *d d*. If desired, it can at this place be cut into separate sheets. In the case of wall-papers—for which this machine is particularly adapted—instead of being cut at the point indicated above, the paper may be conducted over the roll *a* and rewound preparatory to the next working.

The roll is unwound, either for feeding fresh paper or removing the finished print, by means of a gearing arrangement acting on the feed-roller, the printed paper passing between the cylinder *c* and the pulleys *d d*. It is, of course, imperative that the pulleys *d d* be fixed tightly on the cylinder *c*, as it will be seen that perfect register and even tension of the paper depend upon this motion. The pulleys can be adjusted to any position along the bar, and fastened by set screws, so that they can be adapted to paper of any width. In order to prevent the paper from wandering, these pulleys are placed as near the edge as possible.

The facilities afforded for making ready the form are simple and effective. Immediately under the platen is a kind of movable tympan or frame, secured to the platen-

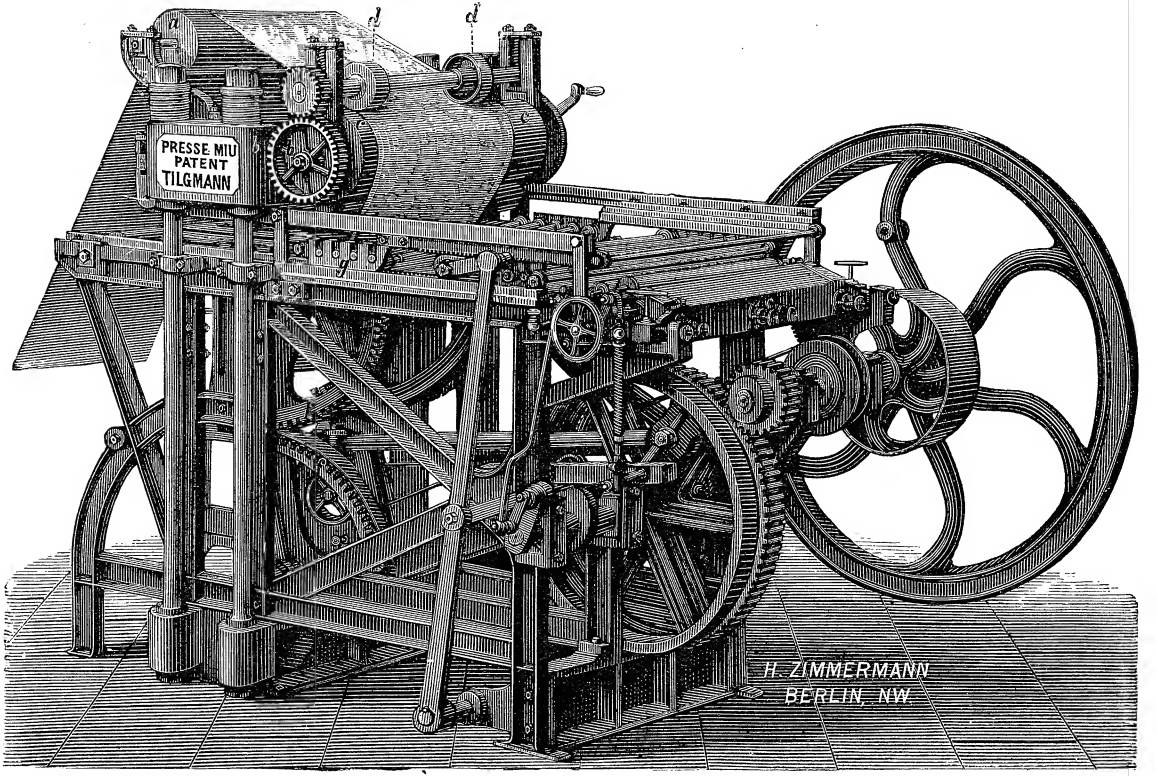


Fig. 27.—The "Miu" Platen.

head by pins. This frame runs upon a slide on the top of the side frame, and when it is desired to place the making-ready in position, the pins securing the tympan are withdrawn, and it is run out over the rollers. The overlay having been placed in position in the tympan, the latter is pushed under the platen-head and refastened. A somewhat similar mode is adopted on the Adams platen.

The inking apparatus consists of four inkers, three wavers, and a vibrator fixed in a movable frame, as on the Napier platen. On reference to the illustration, it will be seen that an upright rod, working upon a pin at its base, is connected to the roller-frame. The arm is worked by an excentric, and by this means the roller-frame is carried forwards and backwards over the form between every impression. The inking-table, which is about 30 inches long, is stationary. The end roller in the frame is used as a vibrator, and every time the rollers return from the form, the vibrator touches the ductor, which is placed in the ordinary position, and receives a regulated supply of ink. We are assured that the distribution is perfect in every particular. The machine at present in existence will take a double-crown form, but we presume that a larger size will eventually be made.

The printing is performed in such an accurate manner, and the lay is uniformly so exact, that in colour-work, where the paper has to be passed several times through the machine, the register is said to be absolutely perfect, supposing the pulleys *d d* be properly adjusted to the cylinder. In fact, this machine was built especially for register-work, and some very fine specimens of colour-printing have been accomplished by the inventor, Herr F. Tilgmann, at his office in Helsingfors, Finland. The "Miu" platen is also adapted for the printing of linen, cloth, or leather.

This machine is usually driven at the rate of 800 impressions per hour, and, if desired, the number can be increased to as many as 1,500. But at this latter speed both the register and distribution of ink are liable to become defective. As the impression is given by the crank and two sectors, the driving power required is very small—about $\frac{1}{4}$ horse-power; and although this machine could be driven by hand, it is very inadvisable, as the required regularity of motion could not be assured.

CHAPTER XI.

THE PERFECTING MACHINE.

Advantages—Varieties — The Web—The Drop-bar — The Gripper —Capacity and Speed—Arrangement of the Working Parts—Method of Working—Inking-up—Set-off Paper—Putting up the Tapes—Regulating the Impression—Lubrication.

PRINTING MACHINES to which the term "perfecting" is applied, are those which have two large impression-cylinders with two intermediate drums. By means of the latter, the sheet is turned from one side to the other on its way from one impression-cylinder to the other.

Advantages.—These machines may be run at a good speed. They are simple in construction, and possess no intricate or delicate parts, like the Anglo-French.

Although not constructed for the production of superfine work, they are particularly adapted for printing general magazines, and very fair cut-work can be obtained from them with ordinary care.

Varieties of the Perfecting Machine.—Perfecting machines are of three kinds—

1. The Web.
2. The Drop-bar.
3. The Gripper.

The above terms signify the manner by which white paper is conveyed into the tapes. We will describe these feeding appliances first, and then the parts that are common to all the three descriptions.

The Web Perfecting Machine is provided, directly under the laying-on board, with a drum, to the spindle of which are attached, on the off side, several cogs, resembling somewhat a quarter of a toothed wheel. To the underside of this shape is secured a wooden arm (Fig. 28). On the edge of the inner-form cylinder cog-wheel is a pin (F), which strikes the arm (A), and forces the sector (B) into gear with similar cap on the cylinder-wheel at F. A forward motion is thus given to the web-drum equal to about half its

diameter. Several broad bands or tapes are fastened to the drum (D), which, being carried over and under the laying-on board, are endless. When the arm is propelled forward, the bands acquire the same motion, and the sheet, being laid to *back marks* fastened to the bands, is consequently moved forwards, and passed between a revolving tape-roller and drum, on to the inner-form cylinder.

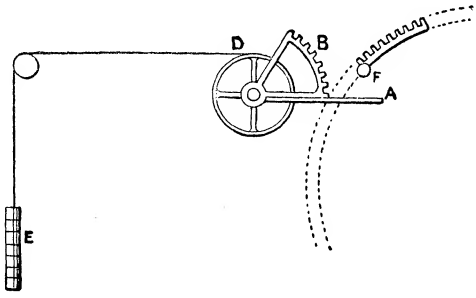


Fig. 28.—"Web" Laying-on Motion.

A, Wooden arm.
B, Sector.
D, Wheel on end of web-drum.
E, Weight.
F, Pin on cylinder wheel.

The inner-form cylinder wheel is indicated by the dotted lines.

In order that the web may return quickly, to give sufficient time to lay the next sheet, a band is attached to the wheel on the drum (D), carried over a pulley and heavily weighted at E. When the cogs are released, the weight forces the drum back into its original position.

As the layer-on has to lift or "fly" each sheet from a board above and behind the web, it is impossible to run this class of machine very quickly. About 1,000 copies per hour is the speed at which the "Web" is generally driven.

The Drop-bar Perfecting Machine.—This is the simplest of the three kinds, and is perhaps the best adapted for being driven at a high rate of speed. The "bar" or rod is made of steel, along which are fitted several metal discs or bosses about half an inch thicker than the bar itself. These can, by means of small screws, be shifted to any position along

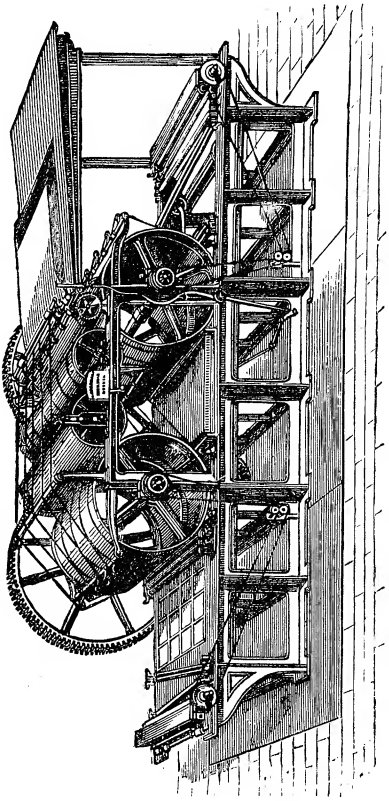


Fig. 29.—Dryden's Drop-bar Machine.

the rod, so as to suit the size of the sheet to be printed. To this bar* is fixed a short arm, with a pulley at the end, which works round a wheel with a "dip." Every time the pulley drops into this shape, the bar descends upon the paper laid to front marks; and the bar, possessing a rotary motion from the tapes, runs the sheet between a roller and a small drum on to the inner-form cylinder.

Messrs. Dryden have recently fitted to their Drop-bar machines movable front-marks. These are so arranged that the sheets can be stroked down flush to the marks, the latter slightly rising to allow the sheet to be taken, and dropping to their original position immediately after. Care, however, is required in laying-on, not to push the sheet too tightly to the front, or it will bulge, causing the lay to be irregular.

The Gripper Perfecting Machine.—This is undoubtedly the most useful of this class of perfecting machines, as it can be run at almost any speed, and at the same time a correct lay can be insured. As in the drop-bar, the paper is stroked down to front marks, where the grippers clutch the sheet and convey it into the tapes.

The grippers are fastened to a bar inside the iron gripper-drum, which latter revolves *twice* between every impression. Within the side-frame of the machine are two small cog-wheels working in each other, the upper one having a shape attached. This is so arranged that at every other revolution, the shape strikes a pin attached to the gripper-bar, causing the gripper to close on the sheet. On the frame of the machine, nearly under the drum, is a stout pin, which, when the grippers are down, strikes the small stud on the gripper-bar, and the sheet is released into the tapes. When the grippers are open, during one revolution of the drum, the stud on the gripper-bar clears the pin on the frame. The click-clack noise peculiar to these machines is caused by this ingenious mode of opening and shutting of the grippers.

Capacity and Speed.—This class of machine is made to

* In consequence of the discs on the bar wearing unevenly, as they will do after the machine has been in work for some time, owing to the incessant vibration, the lay is apt to be irregular, through one portion touching the paper a second before the remainder.

print various sizes, from double-royal to quadruple-super-royal or eight foolscaps. The speed per hour at which the perfecting machine is driven varies from 1,000 in the case of the Web, to 1,500 and even 1,700 in that of the Drop-bar or Gripper.

Arrangement of the Working Parts.—The surfaces of the impression cylinders are of two different thicknesses, that part which meets the coffin as the latter travels in and receives the impression being thicker than the remaining portion; so that when the form returns, it passes underneath the cylinder, without coming in contact with it. In order that the weight of the cylinder may be evenly balanced, a thick iron bar is usually fastened inside, in the centre of the thinnest part.

Two sets of stout pins pierce the cylinder at the ends of the impression portion, to which are fastened the bars for securing the calico lining. Upon the latter the making-ready and blanket are placed. The pins can be regulated by means of thumb-screws inside the cylinder.

The tables are fixed upon two parallel bars, called table-bars, which run upon a set of heavy pulleys on each side of the machine. Two of these pulleys, directly under each of the cylinders, are much larger and firmer than the others, in order to resist the extra strain of the impression. These are called the impression-pulleys.

The tables are propelled by an upright spindle (fig. 30, C G) and rack (A B), driven by the bevel-wheel (E), fixed at the end of the driving-shaft (H). As the strain upon the spindle is very great, having to resist the backward and forward motion of the table and coffin, it is necessarily very thick, and besides being fitted at the base (G) into a socket, is secured in the middle by a strong bearing. The rack (fig. 31) is placed horizontally under the tables, the cogs downwards: it is supported at either end (M), by two iron bars, sufficient play being allowed between the bars to admit of the rack moving from one side of the machine to the other. The rack, as it were, travels *round* the spindle, the latter being stationary in its bearers. When the end is reached, the rack moves rapidly to the other side of the spindle by means of the circular end, (fig. 31, K D), reversing its motion again when the other end has been attained.

In fig. 30, C, we have endeavoured to show the working of both the spindle and rack. AB is a section of the rack in position. A large tumbler (C) fits close to the sides of the rack, and assists in keeping it in its proper place. The pinion wheel (D) fits into a set of corresponding cogs in the rack (shown in fig. 31, D). The upright spindle, as we have before explained, is secured in a socket at the base, and on a bearing in the centre. It obtains its circular motion

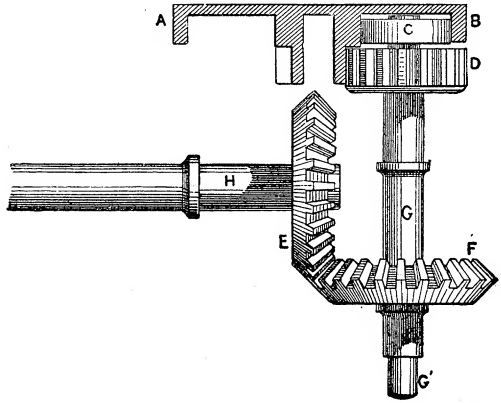


Fig. 30.—Upright Spindle and Section of Rack in position.

A, B, Section of rack.
C, Pulley.
D, Pinion wheel.
E, F, Bevil wheels.
G, Upright spindle.
H, Driving shaft.

by means of the bevel wheel (E) at the end of driving-shaft (H) working in the wheel (F). From this it will be seen that the rotary motion of the spindle, by means of the pinion wheel (D) working in the teeth of the rack, moves the latter backwards and forwards, rounding the ends, as shown in fig. 31, D K.

In order that the whole of the rack may move from one side of the machine to the other at the same time, when the pinion-wheel traverses round the end, and that it shall always be exactly in position, two long bars are made, having a short arm attached to the opposite end of each. The ends of these arms (M M, fig. 32) are bolted underneath the

coffins, inner and outer, and the other ends (N N) of the bars are fixed to the rack. Across the centre, these bars are joined, in order that they may work uniformly. A broad groove is made in the centre of the rack, large enough to allow

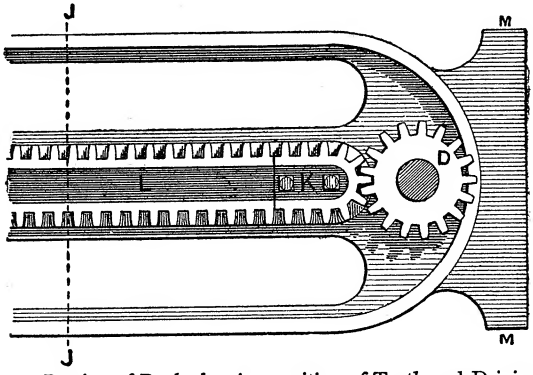


Fig. 31.—Portion of Rack showing position of Teeth and Driving-cog.

D, Pinion wheel.
J, Width of rack.
K, Rack end.
L, Teeth of rack.
M, End of rack supported between bars.

this cross-bar to work freely. As the correct working of the rack depends greatly upon this motion, which is called the "parallel motion," it is a very important point in the construction of a machine of this class that it be in every respect well proportioned and accurately fitted. Many

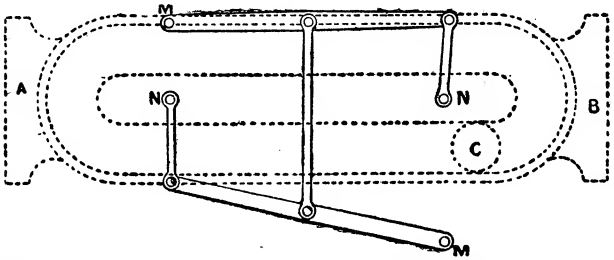


Fig. 32.—Upper side of Rack, showing position of Parallel Motion.

M M, N N, } Parallel Bars.
C, Pulley of Upright Spindle.
A B, Extreme ends of Rack.

machines have been condemned as being almost useless, through the parallel motion being wrongly calculated. It will be seen that without this, the rack would have a tendency to move to either side of the machine in an irregular manner.

There have been many discussions as to the respective merits of the broad and narrow racks. The broader the "ends" are, the more gradual is the return; and we think that, taking into consideration the shock a machine necessarily receives upon the reversion of the tables, that the wider are the better, the shock being less violent.

As the "ends" are subject to more wear than the other portions of the rack, from the constant jar consequent upon the return of the tables, they are made in separate pieces (fig. 31, K), and can be easily changed, supposing a tooth becomes damaged. Spare ends should always be kept in readiness, as accidents frequently happen to this portion of the machine.

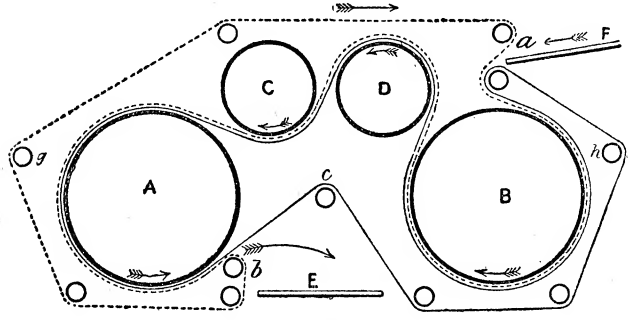


Fig. 33.

A, Outer-form cylinder.
B, Inner-form cylinder.
C D, Intermediate Drums.
E, Taking-off board.
F, Laying-on board.

The outer-form cylinder-wheel is driven from a small cog on the driving-shaft, and the former works in the inner-form wheel. The impression-cylinders have therefore a contrary motion.

On each side of the inking-tables are dovetailed pieces of gun-metal, flush with the side-frame, in order that the

coffins may run perfectly true, and not shake when in motion.

The intermediate drums acquire their motion from a cog-wheel inside the inner-form cylinder-wheel. These drums are made of wood, iron being unnecessary, as they are subjected to no great strain, their office merely being to turn the sheet for perfecting.

One of these cylinders is termed the "register drum," as it can be raised or lowered on either side by means of screws, thus facilitating the process of making register.

Appended is a diagram showing the travel of the sheet, and that of the tapes which convey the sheet.

It will be seen that the tapes, being endless, taking in the sheet at *a*, liberate it on the taking-off board at *b*, parting company at that point, one travelling under the outer-form cylinder, over the drums, and the other passing over the roller *c*, thence under the inner-form cylinder, and joining the other again at *a*.

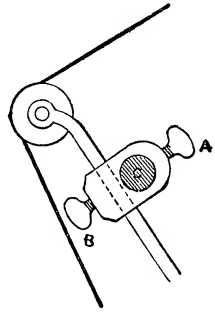


Fig. 34.—Tape-pulley.
A B, Thumb-screws; C, Tape-bar.

On the tape-bars *g* and *h*, are a series of pulleys, over which the tapes travel. These pulleys are fixed to the end of long spindles, and by means of thumb-screws (fig. 31, A B), can be lengthened or shortened, greatly facilitating the regulating of the proper tension of the tapes.

Some drop-bar machines are so constructed that the outer form is printed first. This necessitates the laying-on

board being placed above the outer-form cylinder, and the consequent different disposal of the tapes.

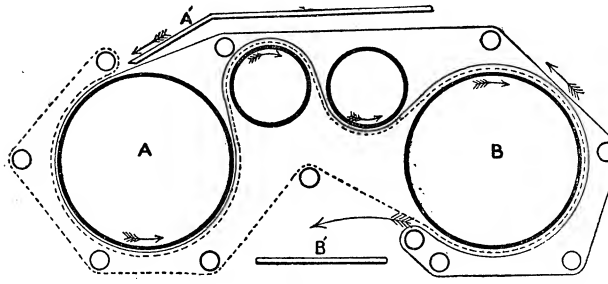


Fig. 35.

A, Laying-on board. A, Outer-form cylinder.
B, Taking-off board. B, Inner-form cylinder.

The most successful Drop-bar machines are made by Messrs. Dryden & Foord and Messrs. Benson & Adams. Messrs. Middleton are the makers of the Gripper. We can confidently speak in terms of praise of all the above, which are largely used in the London trade. Messrs. Dryden's machine is the lightest in construction.

An extra fast machine is also made by Messrs. Dryden, which is capable of printing good bookwork at a guaranteed speed of 1,900 or 2,000 copies per hour. This is one-third faster than any other gripper or drop-bar machine.

The machine is constructed somewhat on the same plan as their ordinary drop-bar, with the exception that the laying-on board is placed in such a position as to be almost on a level with the axle of the inner form impression-cylinder, instead of above it. By this arrangement, the drop-bar is made to descend upon the sheet when the outer form is being printed. The cylinder is consequently perfectly tight and steady on its bearers when the sheet is taken into the tapes. This prevents a bad lay occurring from any vibration which might be caused on the reversion of the tables. Another advantage justly claimed is, that the laying-on board, in being placed so low, is always under the eye of the machine-minder. Added to this, space is economized, the height of the machine being

very much lessened. In fact these machines could be placed in a space inadequate to the requirements of an ordinary perfecting machine.

Every part of the machine is made both heavy and solid, in order to resist any strain consequent upon the increased speed. The bevil-wheel and pinion, together with all the driving-gear underneath the tables, are made of steel. A quadruple demy machine weighs about ten tons, being 25 per cent. heavier than the ordinary drop-bar.

Great attention has been paid to securing of the inkers. The roller-forks are entirely closed in at the top, and to obviate the possibility of the inkers jumping, screws are adjusted so as to fit tightly on the roller-spindle. This also renders the use of riders unnecessary. The roller-wheels are supplied with india-rubber tires; but as they are apt to become quickly bruised and also to pick up any dirt, &c., that may fall on the roller-bearers, we consider their use a questionable advantage.

The side and end frames stand upon a substantial foundation, consisting of a stone coping 18 inches wide, and each corner of the frames is secured by an iron bracket fixed in the stone. This prevents any vibration upon the reversion of the tables.

Although it must be confessed that the machine is somewhat noisy when running, there is little or no vibration, notwithstanding its great speed.

METHOD OF WORKING.

Inking-up.—The ductors are worked by gut bands running on wheels on the end of the ductor-rollers, with grooves of smaller and greater diameter, by which the supply of ink can be regulated. The bands run over similar wheels on the shaft of each impression-cylinder. If a greater supply of ink is needed, the band is placed round the larger groove on the cylinder-shaft, and the smaller one on the ductor; and if a lesser, *vice versâ*.

Sometimes these bands will come off while the machine is working, in which case care must be taken that they are not crossed in the replacement. If so, the ductor-roller will turn the reverse way, and empty the contents of the

duct on the table, causing a terrible mess. We have seen this result from boys being allowed to replace the bands; but the machine-minder should never allow any one but himself to interfere with the ductor bands.

Set-off Paper.—As we have mentioned in a previous chapter, set-off paper can be used on these machines by means of a roller, which should be fixed about twelve inches under the drum nearest the outer-form cylinder. Pieces of narrow paper, the width of the pages, are cut in lengths, and passed over and under the outer-form cylinder, and the bar mentioned above. In order that the paper may not wander, thick bands of India-rubber should be placed on the bar, and they can be easily moved to any position. The paper, being confined between two of these rings, will travel without coming in contact with the tapes. Should it do so, it would be quickly damaged. Care must be taken that the paper is neither too tight nor too loose; in the case of the former, it will break, and in the latter, will either crease on the impression, or will wander into the tapes, with the result mentioned above.

In putting up set-off papers, as little paste should be used as possible, and the lap-over must be as short as is consistent with safety, as when the extra thickness comes upon a page the impression is marked. This is more noticeable in the case of cuts. The set-off paper must be carefully watched, and immediately it gets black or torn from continual wear, it should immediately be changed, or the work will be soiled.

When a change is desirable, it can be done by taking the new length, slightly pasting it to the old one, tearing the latter, and pulling it gently until the former is completely round the cylinder, when the dirty paper can be removed.

Putting on the Tapes.—Supposing one to break and come off, the new length can be fastened to the tape next the place it is to occupy, and the machine slowly moved until the pinned end comes above the cylinder; it can then be easily shifted to its right position and tightened by the tape pulleys (fig. 34). It must then be detached, and affixed to its other end. The machine-minder should be particularly careful that the tapes run freely, although not too loose, and that they are guided exactly between the gutters of the form.

If a tape wanders, it is probable that it will be cut, by being pulled on to the form. If this is discovered immediately, little damage will accrue beyond the destruction of the tape; but if the detached end falls unseen among the rollers, it may pull them out, either damaging the machine or battering the form. In the event of a tape becoming turned, it should be seen to immediately, as it is liable to run off the pulleys.

Regulation of the Impression.—In perfecting-machines this is done by means of the screws over and under the bearers on each side of the cylinders. When it is desired to increase the impression, loosen the bottom, and screw down the top. To lighten the impression, reverse this process.

Lubrication.—We cannot too strictly impress upon the machine-minder the necessity of thoroughly lubricating all parts of his machine every morning before starting. Tallow should be used to the rack, upright spindle, and cylinder-wheels. The tape-pulleys, cylinder-brasses, drum-bearings, and tape-bars should also be carefully oiled.

CHAPTER XII.

THE NAPIER GRIPPER MACHINE.

Origin—Speed—Arrangement of the Working Parts.

THIS machine was, as already mentioned, the original of the Anglo-French. That the latter machine upon its introduction should have so quickly superseded the Napier is not at all strange, when we consider that the latter entirely lacked the number of rollers necessary for good distribution and any appliance to prevent the set-off; added to which its construction was far too light to enable it to produce heavy cut-work. We believe, indeed, that very few are now manufactured, as they have been compelled to yield to the improvements introduced into machines of more modern make.

Speed.—The Napier Gripper is driven about the same speed as the Anglo-French—from 700 to 900 per hour.

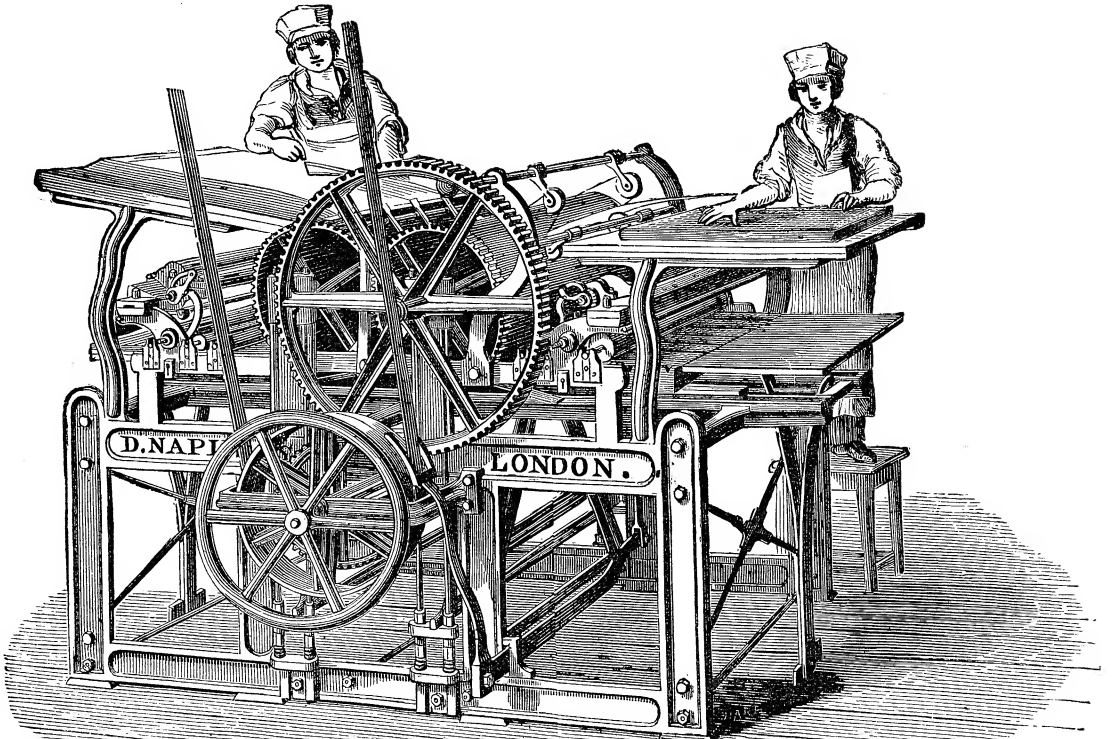


Fig. 36.—The Napier Gripper Machine.

Arrangement of the Working Parts.—The cylinders are made to rise and fall by a rocking-frame, and the tables are moved by means of the rack as in fig. 40. The universal joint and pinion-wheel are also employed. The rocking-frame is not worked by a separate cam, as in the Anglo-French, but by an arm from the collar of the pinion-shaft, upon which, consequently, there is a great strain.

The grippers are opened and closed by shapes on the cylinder-frame, instead of an independent folding frame. The ductors are worked by rods, which are driven by small bevel-wheels from a series of teeth at the base of the rack.

The ductors are placed only 12 inches from each cylinder, and no wavers are employed. The vibrator deposits the ink upon a wooden roller, which lies between two inkers. This roller has a worm at either end, and, as the tables travel to and fro, moves slightly in the direction of its length. In consequence of this wooden roller constantly moving along the surface of the two inkers, it will be seen that it has a tendency to injure the face of the composition. The inkers, with the assistance of this roller, distribute and deposit the ink as the table and forms move underneath. The ink tables, which are rather small, are made of wood.

In many instances a set-off motion has been added to the Napier machine, being constructed in the same manner as that made to the Anglo-French.

With this machine the minder has many little difficulties to contend with, and unless he is very careful, will probably fail in some material points. In the first place, the inking arrangements are so limited that unless the rollers are in prime condition, the distribution will be defective. As the ink is deposited almost direct from the ductor, it is absolutely necessary that the knife be set to a nicety, or the work will be unsatisfactory, in consequence of an irregular supply of ink. The somewhat frail and complicated gripper motion is also liable to get out of order, and the apparatus should be constantly watched. When out of repair, the grippers are liable to "turn" on the form.

It is frequently found that a minder who has worked one machine for some time is able to produce much better work than a stranger who is comparatively unused to it; not because the former is the more competent workman, but

because he is accustomed to the peculiarities of the machine's construction, or an occasional weakness in any of its working parts. This is especially true in the case of the Napier Gripper, showing that experience only can render the workman really skilful in the management of some machines.

The Napier Gripper is a very light and particularly compact machine, standing in so small a space as to be available where other machinery calculated to print as large a sheet could not be erected. In some cases this is a most important matter, and it seems, therefore, proper to mention the fact in the present notice.

CHAPTER XIII.

THE ANGLO-FRENCH MACHINE.

ORIGIN OF THE MACHINE—Its Advantages—Capacity and Speed—Arrangement of the Working Parts.

A FEW years ago the French enjoyed an unrivalled reputation for producing the best kind of machine-printing. This was attributable to two circumstances. In the first place, they adopted the plan of highly glazing their paper; in the second place, they devoted all their inventive power to the suppression of that *bête noire* of the machine printer,—the set-off. While we were occupying ourselves simply with rapid printing, and relegated fine work to hand-presses and platen machines, they improved upon the ordinary gripper machine to such a degree as to demonstrate the possibility of printing even the finest cut-work on a double cylinder.

As we have before mentioned, the original machine of this type was made by Messrs. Napier, and is commonly known as the "Napier Gripper." The superiority of the Anglo-French over the Napier will soon be apparent upon comparison of the working parts.

Advantages.—Inking arrangements similar to those of the ordinary perfecting cylinder have been applied, the ducts being placed at the end of the travel of the tables, instead of midway, as in the Napier, thus allowing room for at least

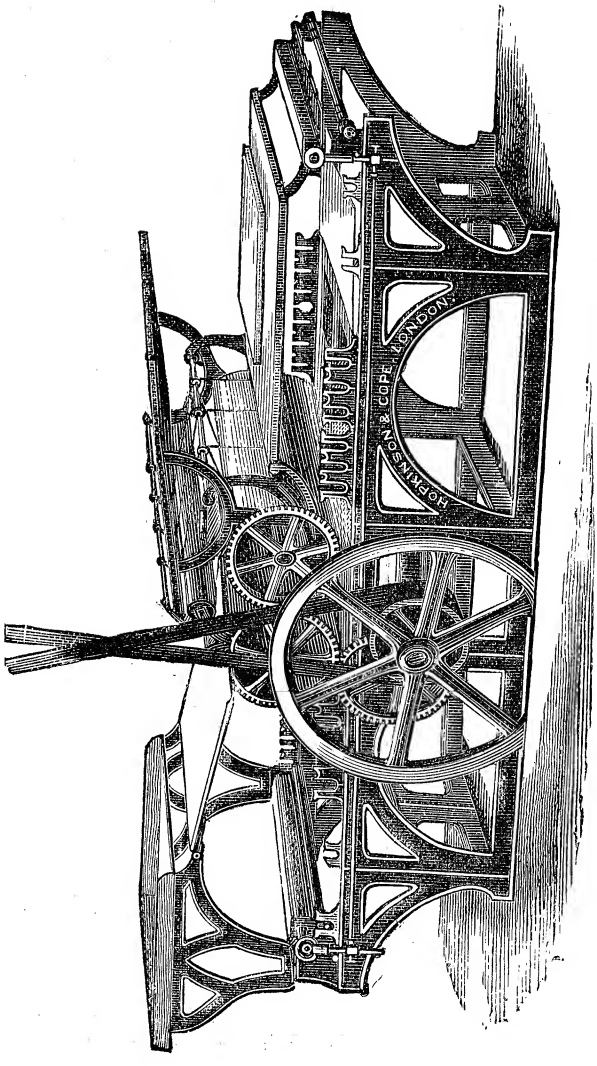


Fig. 37.—Hopkinson & Cope's Anglo-French Machine.

three distributing-rollers. An extra number of inkers has also been added. The apparatus for opening and shutting the grippers is considerably improved, the shapes by which this is accomplished being fixed on an independent movable frame. Added to which, the machine is very much stronger and heavier in every detail.

The Anglo-French is a far more complicated machine than the perfecting machine described in Chapter XI., and consequently cannot be safely driven at so great a speed; besides which, the tables have a longer travel.

Capacity and Speed.—The size mostly made hitherto has been quadruple crown, but these machines can be had as large as quadruple super-royal. They are usually run at the rate of 750 or at most 1,000 impressions per hour.

Arrangement of the Working Parts.—As will be seen from the above diagram, the Anglo-French machine possesses two cylinders, the diameters of which are about

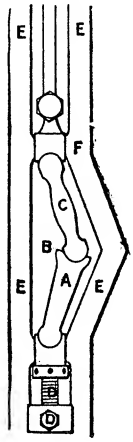


Fig. 38.

one-half of those of the ordinary Web or Drop-bar. Nearly the whole of the surface is utilized for the impression, so that in order that the form on its return may clear the blanket, it is necessary that one cylinder be slightly raised. This being the case, it will readily be seen that the cylinders are never on a dead level, but alternately rise and

fall. The rise and fall of the cylinders is effected by a "rocking-frame" at the base of the machine, under the cylinders. An extended portion of this frame pierces the side of the machine, and forms the base of a knuckle-joint. The upper portion is made of steel, secured at the top to the side of the machine, and fitting into the end of the rocking-frame before mentioned. This joint works in the manner shown in the above diagram.

Each cylinder is supported on either side by a cylinder-frame (fig. 38, E): A is the extended portion of the rocking-frame; B, the joint; C, the piece of steel, which is secured to the side-frame of the machine at F. When A and B incline to the angle as shown in diagram, the cylinder-frame, assisted by springs, ascends. When perpendicular, the frame is forced down, as the slot at F, into which the top of the joint works, is fixed. The set-screws at D are for regulating the impression.

In order that the frame E may rise quickly, powerful springs are placed on the side-frame between the cylinders,

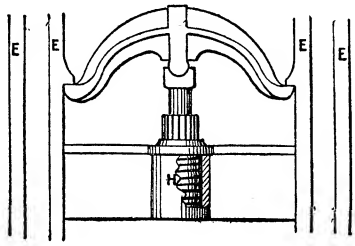


Fig. 39.

H, Spring. E, Continuation of Cylinder-frames.

which, while assisting the rocking-frame, also steady the cylinders while working.

As the rocking-frame is made in one piece, it necessarily follows that the contrary motion of the cylinders must be simultaneous, *i.e.* as it rocks to enable one cylinder to ascend, the same motion forces down the other.

This machine gives the impression to the sheet in the manner directly opposite to that of the ordinary perfecting machine. In the latter the sheet is printed as the coffin

runs *in;* but with the Anglo-French this is reversed, and the sheet is printed as the coffin travels to the end.

The tables are driven by means of a horizontal rack, with quadrants at each end. This rack, as will be seen from the diagram (fig. 40, F), is totally dissimilar to the one used on the Drop-bar machine, and consists of only one set of long teeth. The rack is fixed in the centre of the coffins. On the driving-shaft, just inside the frame, is what is called the universal joint, B. From this joint, carried to the rack in the centre of the machine, is a shaft, C, with a pinion-wheel, D, at

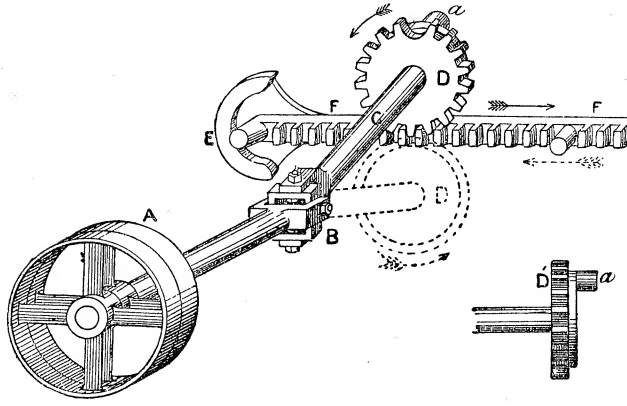


Fig. 40.

A, Riggers. | D, Pinion-wheel. | FF, Rack.
B, Universal Joint. | E, Quadrant. | *a*, Tumbler.
C, Pinion-shaft.

D*a*, Side view of Pinion-wheel, showing position of tumbler.

the end. This wheel works in the rack, and moves the latter to its extent. When it arrives at the end of the rack, the small tumbler *a* glides round the steel quadrant E, and travels *underneath* till it attains the other end, when the tumbler again travels *up* the quadrant, and then as before. The dotted lines represent the pinion-wheel in position travelling *under* the rack.

It will be noticed in fig. 40, near the tumbler on the pinion-wheel, the space between two of the teeth is greater than between the others. This cavity always falls on the end

and on the centre teeth of the rack, which are necessarily larger than the rest. Thus the pinion makes two revolutions to traverse the rack, and in order that the end teeth may better resist the shock of the reversion of the tables, they are made much stronger. The centre tooth is large, simply because the wider space in the pinion falls at that point on the completion of its first revolution, as mentioned above—not that any extra strength is needed at this part. The pinion-shaft C is supported near the wheel by a steel collar, to give strength and support. The end and centre teeth are so made that they can be screwed in or out, so that, in case of accident, they can easily be replaced.

When we say that the pinion-wheel travels *along* the rack, we do not wish to be taken literally, but that in reality the rack travels over and under the pinion-wheel, as the latter (the motive power) only revolves, changing its actual position simply from the top to the bottom of the rack, or *vice versâ*, when it arrives at either end.

As the quadrants at the end of the rack are subjected to a great strain, having, in conjunction with the pinion, to resist the shock of the reversion of the tables, they are faced with hard steel. Supposing either to become broken, they can be detached without much difficulty. The machine-minder should make a point of occasionally ascertaining the state of the quadrants, and should have them changed whenever they show signs of wear. It is advisable to have spare quadrants in stock, in case of accident.

Two strong springs, placed horizontally, are usually, though not invariably, fixed at each end of the machine, to partially ease the shock of the tables as they run to the extreme end, and to assist them on their return.

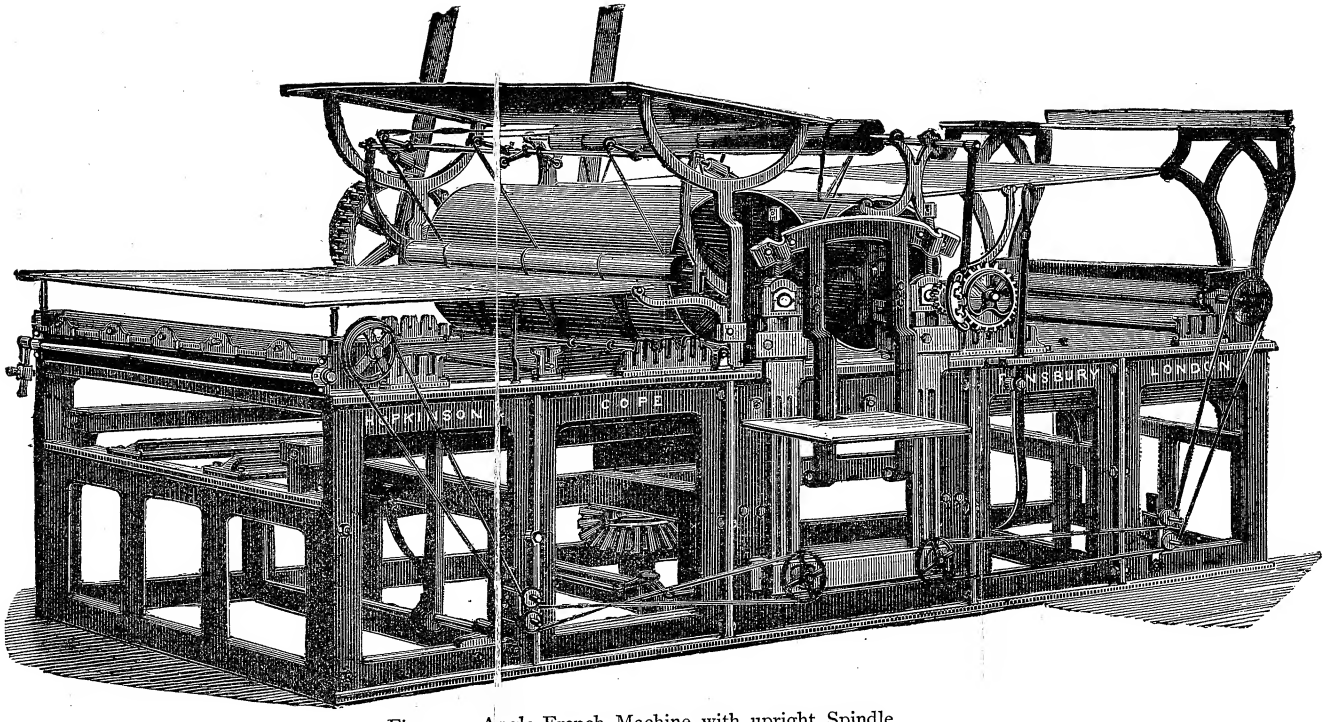
The tables travel upon a series of small runners or wheels, fitted into parallel bars on a strong frame on each side of the machine. In the case of large machines, the space between these frames is of course greater than in the smaller, and the middle of the coffin, from not having a central support, is apt to sink. In some instances we have even known them to split. Messrs. Marinoni, of Paris, in their new machines, have added an additional set of bearers in the centre, extending the length of the machine; thus obviating this possibility. It is impossible, however, for the rack

to be placed in the centre of the coffins, so it is fixed under the off-side, the pinion-arm being lengthened. This additional support to the tables we think a very great improvement.

It may here be mentioned that latterly some Anglo-French machines have been constructed with the upright spindle and rack similar to the ordinary perfecting machine described in a previous chapter. The rocking-frame is dispensed with, and the cylinders are raised and depressed by means of powerful cams on either side, at the base of the cylinder-frame,—a much less complicated plan, and equally as effective. Machines thus constructed can be driven at as great a speed as the ordinary Perfecting, excepting where set-off sheets are used, in which case it would be impossible for the boys to take them off with sufficient quickness. Both Messrs. Dryden and Messrs. Hopkinson & Cope manufacture the Anglo-French, with upright spindle.

There being no intermediate drums for turning the sheet, the outer-form cylinder grippers take it directly from the inner. The grippers of the outer-form cylinder enter slightly the opening in the inner, and clutch the sheet, which is immediately released from the latter.

This arrangement is effected by means of a "folding-frame" on one side of the machine. The gripper bars are carried through the ends of the cylinders and provided with short arms, to the end of which are attached tumblers. On the folding-frame are fastened four shapes—one each, to enable the grippers first to take the white paper, then release it to the outer-form cylinder, and the latter to take it and finally throw it off on the taking-off board. These shapes are in such a position that, when the frame is forced in, the tumblers glide over them, causing the grippers to open. When the tumblers have travelled over the shape, the spring inside the cylinder shuts them tight on the sheet. Thus the frame is forced in when the sheet is first taken, and then forced back, by means of a spring, to enable the tumbler to clear the shapes, allowing the inner-form cylinder to take the impression. The frame again moves inwards, causing both the cylinder grippers to open,—the inner to release the sheet and the outer to take it; one set closing on the paper, the other ready for taking the next sheet. When the frame is forced in, to



To face p. 82.] Fig. 41.—Anglo-French Machine with upright Spindle.

enable the sheet to be first seized, the outer-form grippers simultaneously release the perfected sheet on the laying-on board; so that it will be seen that the paper is held by grippers throughout the whole of the printing. To prevent the folding-frame from being accidentally pressed in by the knees of the boy laying on the set-off sheets, a piece of stout iron wire should be fixed round the front, being secured on either side to the side-frame. We have seen sheets released and taken round the rollers, owing to the folding-frame having been carelessly touched. Tapes are employed under the cylinder merely to prevent the sheet from falling on the form.

In order that the tapes may not become alternately tight and loose by the rising and falling of the outer-form cylinder, the tape-bar (which works loosely in its bearers) above the taking-off board is provided with weights fixed on short levers; and when the tapes are inclined to loosen, from the cylinder rising, these weights raise the pulleys and keep the tapes at an even tension.

The set-off laying-on board lies above the outer-form cylinder, the layer-on facing the white-paper boy, so that the former has to stroke in the sheets with the left hand. The set-off is taken in by a drop-bar arrangement, similar to that described in the ordinary perfecting machine—*i.e.* by a revolving bar with discs falling upon the sheet. This is so arranged that the set-off meets the white paper exactly when the latter is being taken by the outer-form grippers, and passes *between* the cylinder and the printed side, being delivered to the taker-off simultaneously with the good sheet, when it is lifted by the boy from the top, and carried to the extremity of the board. It will be seen, therefore, that the set-off sheet only travels half round the outer-form cylinder.

The cylinders are driven from an intermediate wheel on the inner-form frame, which acquires its motion from a small pinion on the driving-shaft, the teeth being sufficiently deep to allow for the rise and fall.

The vibrators are moved by a small cam situated inside the frame, at the base; the duct by an eccentric on the driving-shaft, or in some machines by two long rods driven by a small bevel-wheel.

Some makers lighten the machine by substituting wood in the place of iron for ink-tables. This necessarily lessens the shock the machine is subjected to when the coffins return. But the wooden tables are apt to become injured by the iron ends of the wavers and inkers when the latter are being placed in and taken out of the forks, and the ink is apt to accumulate in these indentations. Therefore, on the whole, we think the substitution of wooden tables a questionable advantage.

The tables of the Anglo-French having a longer "travel" than other machines, the rolling is more perfect, the whole of the inkers (four in number) completely clearing the form.

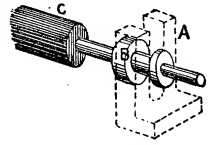


Fig. 42.
A, Roller-fork; B, Roller-lift; C, Waver.

Only in cut-work is this number of rollers really necessary. But this is one of the advantages which the Anglo-French possesses over other machines, for in the ordinary perfecting only one inker completely traverses the form, the others turning on the page, which is apt to cause a friar.

In order that the foremost waver may not touch the front pages of the form a roller-lift is used (fig. 42). When the tables travel to their full extent this lift runs upon the roller-bearers, lifting the waver above the surface of the form, and the inking-table being slightly narrower than the coffin, the lift is suspended between the fork and the table when it leaves the bearer.

In some machines an iron cylinder, having a rotary and side motion, is fixed parallel with the ductor. This materially assists the distribution. In this case two vibrators are required, one to feed the cylinder and the other to transmit the ink to the table.

Messrs. Marinoni have added a series of front lay-marks, which are fixed to a bar directly above the inner-form cylinder. They are made of brass, and about one inch

wide. Three inches of the fore-part of the laying-on board work upon hinges, and this portion is so raised that when the paper is stroked down, the latter can be laid close to the lay-bars. When the grippers are ready to take the sheet, the front portion of the board slightly drops, allowing the paper to be taken. By this means the lay can be more depended on, as the boy strokes the sheet, both at the side and front, to substantial "marks."

Messrs. Dryden some time ago fitted to the Anglo-French machine an apparatus by which both the printed and set-off sheets were deposited on the boards by means of flyers. The objection was urged that the frame carrying the tapes, &c., was fixed too near the outer-form cylinder, thereby impeding the minder in making ready. This difficulty has lately been overcome in an improvement by Mr. Paul, whose Patent Taking-off Apparatus can be easily affixed to any machine of this description. One advantage claimed is that the taking-off board is removed from its position immediately above the outer form. In the case of cut-work, this is an unquestionable advantage, as when it is desired to brush out a cut, or even clean the form, it can be done immediately, the tiresome delay in moving the board, together with the sheets, being avoided. Added to which, the form and rollers can be constantly watched during the working.

Three tapes are used, and the printed sheet is delivered round a small drum and runs on to a set of flyers, while the set-off paper is taken above and deposited in the same manner, the tapes parting and returning, one over the top of the machine, and the other under the outer-form cylinder. The apparatus really consists of a large frame, about 7 ft. high, extending across the machine. The taking-off boards are placed one above the other, and are each provided with a set of flyers.

The fitting of this apparatus necessitates but few alterations in the machine, and we are in a position to state that its working has proved thoroughly successful. The sheets are laid with the precision of an experienced boy, and we are sure that the trade at large will hail with delight any appliance that reduces boy labour (especially in the machine-room) to a minimum. Mr. Esson, of Johnson's-court, E.C.,

is the maker of Paul's Taking-off Apparatus, and we can speak highly of the manner in which it has been made and fitted.

We would advise, in cases where this apparatus is used, that the outer form, if it contains cuts, be worked on the coffin generally used for the *inner form.* This will prevent the possibility of the ink on the cuts from being slurred by the flyers, as then the cut form *would be delivered face upwards.*

PART III.

SINGLE-CYLINDER AND JOBBING MACHINES.

CHAPTER XIV.

SINGLE-CYLINDER MACHINES.—Their Varieties—Advantages—Capacity and Speed—Remarks on their Use.—Ashley's Automatic Feeder.

THERE are several varieties of cylinder machines in use which print but one side of the paper at each impression, those most in favour being the Main or "Tumbler," "Bremner," Wharfedale (of which there are several), Ingle, and *Graphic*.

These machines have of late been brought to great perfection; and, indeed, from some recently made, work has been produced which, in consequence of improved inking arrangements, excels that from the platen. To produce the best result, contrivances are added for double inking, together with improved distribution, while both a laying-on and taking-off apparatus can be easily affixed. These machines can therefore be made entirely automatic.

Capacity and Speed.—Single-cylinder machines are made of any dimension, from demy to quadruple royal. The speed at which they are run varies with the size of the machine and with the quality of work required, from 800 to 1,200 impressions per hour being the usual rate. If the form be twice rolled for every impression, the production, of necessity, is reduced one-half.

About 1,000 impressions per hour is the speed at which, say, a double-royal machine can be safely run. With a smaller, this number can be increased; but in the case of the very large make, 750 is all that can be relied on for good quality.

In giving the rate at which we think machines ought to be driven, it must be understood that we do not maintain

that it is impossible to drive them faster; but several points should be borne constantly in mind. No matter how well and substantially a machine may be built, it will soon show signs of undue wear if driven too fast; and one that is run at an average speed will last very much longer, produce better work, and will be the cause of less trouble and expense than one which is driven even 100 per hour beyond its normal speed. The makers are naturally anxious that their machines should prove as quick as desired by their customers; but we have found it a good plan always to deduct at least 10 per cent. from the guaranteed speed.

The process of making-ready on single-cylinder machines is easier to the workman than on the perfecting; not because there is less work required in the preparation, but because both the form and cylinder are more accessible. As a rule, the work is smaller, and the machine-minder is not compelled to twist himself into uncomfortable attitudes in order to reach any portion of the form, as is the case with the gripper, &c.

We have often found it advisable, especially in illustrated work, to put a sheet of paper over the cylinder in lieu of a blanket, it being obvious that the making-ready is more effective the nearer it is placed to the form. In rule-work, blanket should always be dispensed with, as it has a tendency to thicken the lines by dipping on either side. But in common work, where time can only be allowed, say, for one underlay and overlay, blanket should be used, because of its elastic properties.

As we have before said, work quite equal to that done on the platen can now be produced on the single-cylinder. The slur on the edge of the page can be obviated by keeping the cylinder tight on its bearers. Greater impression can be obtained, together with better distribution and inking; the register can be guaranteed; and the taking-off apparatus prevents the possibility of dirty marks from the boys' fingers. We strongly advise that all machines of this class should be provided with the automatic taker-off, as we have invariably found it both profitable and effective.

We have recently seen the Ashley laying-on apparatus applied to this class of machine, the fixing of which involves

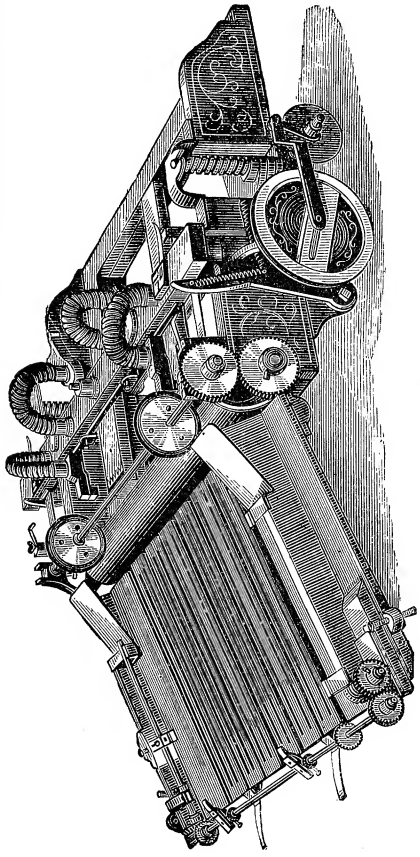


Fig. 43.—Ashley's Automatic Feeder.

but slight alteration. It can be made to lay on at the rate of about 1,200 sheets per hour, and proves to be very economical in the working, inasmuch as the sheet is always ready for the grippers, which cannot be said when a boy is laying on. Printers were at first sceptical as to correct register when perfecting, but we have seen it "perfect" with quite as much accuracy as an experienced pointer, and feel pleased in recording the complete success of this clever invention of Mr. Ashley. It is now adopted, in its latest improved form, by some of the leading houses in London.

For long numbers or ordinary magazine work the single cylinder is of course not so desirable as the perfecting machine, as the former would take at least two machines and increased labour to accomplish the same as the latter. As before mentioned, they are more adapted to the best bookwork, where speed is subservient to quality and price.

It should well be understood that good printing is almost next to impossible if the foundation of a machine be not solid and substantial. Ordinary wooden floors should, if possible, be avoided; but if this cannot be prevented, the frame on which the machine stands should be well made of hard wood about 10 inches wide and 4 inches deep. A piece of ordinary felt placed under the wooden frame will prevent vibration.

CHAPTER XV.

SINGLE CYLINDER MACHINES (*continued*).

Conisbee's "Main" Machine.—Arrangement of the Working Parts.

THIS machine, invented by and named after Thomas Main, a machine-minder, was the first really successful single cylinder, and the original of the more recent and improved Wharfedale.

Many improvements have been of late made in the Main machine by Messrs. Conisbee, in order to compete with the machines constructed with a stopping-cylinder. The laying-on board, which, in the original, was moved forward to the grippers, and back again several inches after the sheet had been taken, is now made somewhat

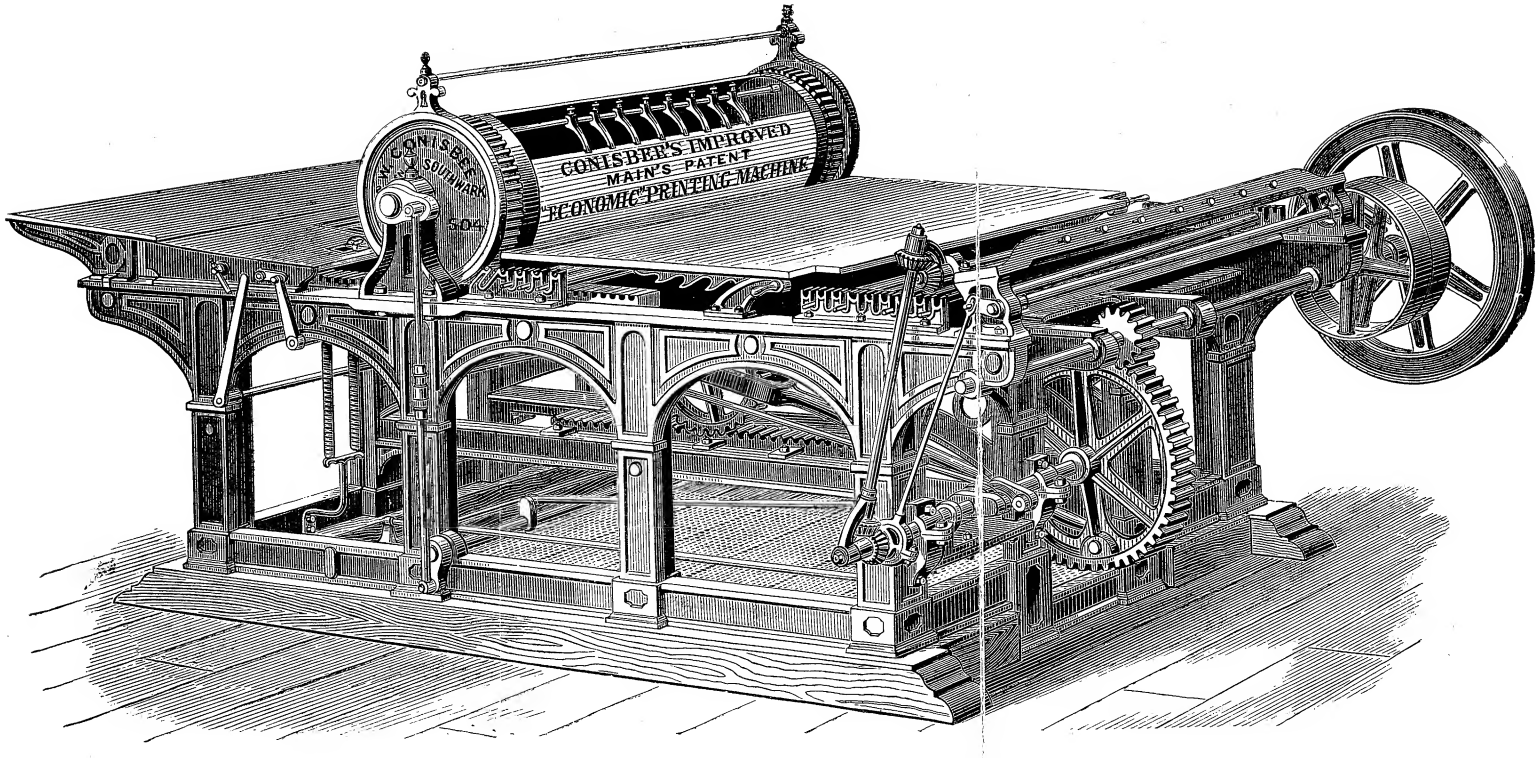


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Fig. 44.—Conisbee's Improved "Main" Machine.

similar to that of the Wharfedale. A contrivance for preventing the cylinder from taking the impression, together with the double-inking motion, has also been added. One great defect of the original "Main" was the lack of substantial support afforded to the table, thus causing the coffin to sink after a few years' wear; when this was the case, some difficulty was experienced in obtaining sufficient impression. This has, however, been remedied, and the machine now possesses all the improvements suggested by the many years' practical experience of Messrs. Conisbee.

Arrangement of the Working Parts.—The "Main" is better known as the "Tumbler," and is so termed from the double action of the cylinder, which, instead of remaining stationary after having given the impression, "tumbles," or returns in the opposite direction, with the table. Unlike the Wharfedale, the cogs on each side of the cylinder are *fixed* to the shaft, and are always in gear with the register-racks on either side of the coffin. When the sheet is printed, and the table is about to return, the cylinder is slightly raised, in order that it may clear the form returning underneath. This is effected by a crank-motion, on a shaft fixed directly under the cylinder at the base of the machine-frame, from which two strong rods reach to each end of the cylinder-shaft. An arm from a cam-shaft, at the extremity of the machine, raises and depresses the cylinder by alternately forcing the bell-crank to and fro.

Although the rocking-action of the cylinder renders the application of a taking-off motion somewhat difficult, a successful appliance has lately been added for this purpose.

As the sheets are liberated by the cylinder almost simultaneously with its return, a careful boy should be employed to take off. If he is not quick, the sheet is liable to drop on to the rollers with the result but too well known.

The first symptom of the machine wearing will be found in the blanket becoming blacked by the form on the return of the cylinder, the latter not being allowed to rise high enough. The only effectual remedy for this is to have the brasses of the crank-motion bushed, which can be easily and speedily done.

The best test of any machine, we think, is the length of time it can be worked; and if such is the case, the "Main" may indeed be classed as one of the most successful. It

is to be found doing good work in almost every printing-office of any pretension. In fact, one large printing firm in London has as many as forty-two in use at the present time.

It is unnecessary to add that all the racks are machine-cut, and that the general finish of the machine is all that can be desired.

We may add that Messrs. Harrild also make a "Main" machine, which in construction is almost identical with that of Messrs. Conisbee.

CHAPTER XVI.

HARRILD'S IMPROVED "BREMNER" MACHINE.—Its Origin—Arrangement of the Working Parts.

THE "Bremner" machine, named after the manager of Messrs. Harrild's establishment, was first introduced as an improvement upon the original *Main* and the more recent *Belle-Sauvage*. The latter was looked upon as almost perfect when it was originally made, but its inking power was limited. Although it was the first machine that had an arrangement to prevent the cylinder from taking the impression, in the event of a boy laying a sheet askew, the brake was defective, and merely consisted of a band of iron placed round the cylinder-shaft on the off side; so that if particular care were not taken in lubricating the cylinder-brass, the oil was liable to get under the band; thus rendering it perfectly useless. The consequence of this was that the cylinder would sometimes overshoot itself, and instead of remaining stationary until the coffin returned, travelled back in the register-racks, similarly to the tumbler.

Arrangement of the Working Parts.—The cylinder of the "Bremner" is situated in the centre of the machine, and nearly the whole of its surface is utilized for the impression. At the extreme end is the main shaft, which, by means of a cog, drives the cam-shaft, in the centre of which is a large wheel. To this is attached a connecting-rod, extending under the table, and which is fixed at the other end to a short shaft, having a large cog-wheel on each side. These two wheels,

called traverse-wheels, work in parallel toothed bars (traverse-bars) at the base, and into identical cogs on the underneath-side of the tables. By this means it will be seen that as the wheel to which the connecting-rod is fastened revolves, it moves the two wheels between the racks backwards and forwards; thus carrying the ink-table and coffin. The latter have, in consequence, a perfectly firm and steady motion. In order to balance the weight of the connecting-rod, a large weight is so suspended as to travel with the opposite side of the wheel to which the rod is fixed.

The tables travel upon a series of runners on either side of the machine, and are secured midway by a thin rod from the short shaft between the traverse-wheels, to keep them in their place on the bearers.

The cylinder is made with but one *fixed* cog-wheel (situated on the off side); the cog-wheel on the near side, although travelling in the register-rack on the coffin, being really detached, so that, after the impression is given, it travels back with the coffin.

On the outside of this wheel is a tumbler, which works a "pawl" or shape, on the inside, secured by a spring. On

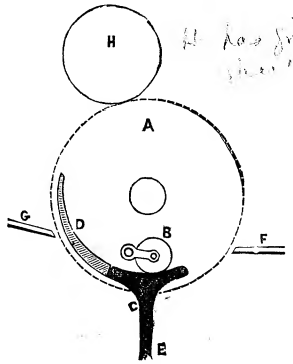

Fig. 46.—Showing the Working of the Grippers, and the Taking-off Apparatus.

A, Impression cylinder.
B, Gripper Tumbler.
C, Crutch.
D, Fixed Slide.
F, Taking-off board.
G, Laying-on board.
H, Taking-off cylinder.

the end of the impression-cylinder next the movable cog-wheel, is an iron shape, and when the detached wheel travels back with the coffin, this shape or pawl drops exactly behind the shape on the cylinder, forcing the latter over when the table runs out. By means of a crutch inside the frame of the machine, instead of allowing the pawl to fall behind the shape on the cylinder, the tumbler may be raised; thus preventing the former from being forced into gear. The striker nearest the cylinder is connected with a lever, which raises the crutch, and the tumbler is lifted above the shape, thus permitting the cog-wheel to return without the cylinder.

The cog-wheel on the other end of the cylinder is fixed to the cylinder-shaft, and several teeth on the under-side are filed away, in order to allow the rack on the coffin to pass underneath; but immediately the cylinder is moved by the pawl, this wheel is forced into gear, and travels with the table.

The grippers are governed by a cam on the shaft at the end of the machine. On the off side of the gripper-bar, outside the cylinder (Fig. 46, A), is a tumbler (B), which, when the cylinder is stationary, rests upon the small crutch (C), and keeps the grippers open. By means of a bell-crank and a rod from the cam, when the cylinder is thrown into gear, this crutch or shape slightly drops, allowing the spring inside the cylinder to close the grippers on the sheet of paper. When the cylinder has performed three-fourths of its revolution, the tumbler glides upon the fixed slide (D), which opens the grippers and releases the sheet, the tumbler finally resting upon the small movable crutch (C) before mentioned, which is really a continuation of the slide. The same action of the lever which prevents the pawl from forcing the cylinders into gear also prevents the small shapes dropping, the grippers closing, or the points acting; so that, though the machine may be in motion, the mere action of the cylinder-striker renders the cylinder and all its adjuncts perfectly motionless.

At the end of the cylinder-shaft, on the near side, is a disc, with a small slot on the underside. Connected with the cylinder-lever is a rod running outside the frame, and, when it is raised, it fits into the slot in the disc. This contrivance

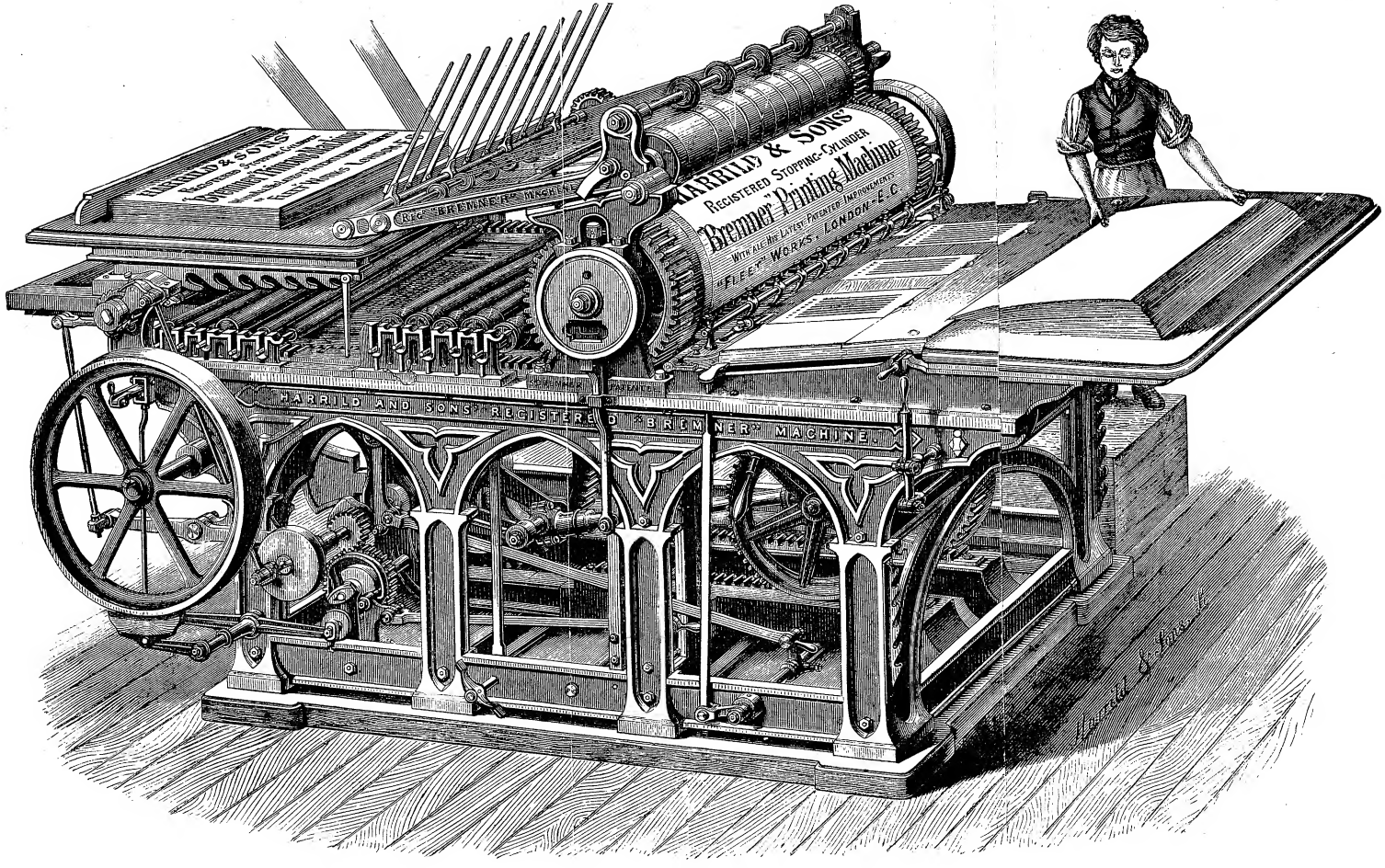

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Fig. 45.—Harrild's Stopping-Cylinder "Bremner" Machine.

prevents the possibility of a careless boy striking off the stopping-gear while the cylinder is in motion, as the lever can only be effectually raised when the end of the rod fits into the slot in the disc; the cylinder can, therefore, only be struck off while it is stationary.

The double-inking is effected by means of a small pinion on the cam-shaft working in a wheel twice its diameter. Inside the large wheel is a box-cam, actuating an arm carried to the rod supporting the lever which regulates the cylinder. On the end of the cam-arm is a slot which drops upon a pin on the lever-rod. As the cam-wheel is twice the diameter of the driving cog on the cam-shaft, it follows that the former only makes one revolution to two of the latter. When, therefore, it is desired to roll the form twice, the slot at the end of the cam-arm is allowed to fall on to the pin attached to the cylinder-lever. The double inking thus becomes self-acting, as the cam-rod raises the lever supporting the pawl-tumbler every other time the table returns.

The arm connected with the box-cam can, however, be thrown out of gear by being simply raised and rested on a bracket fixed for the purpose; so that the alteration from single to double inking can be effected while the machine is in motion, merely by allowing the arm above mentioned to drop upon the pin on the cylinder-lever, as above explained.

As a sufficient number of rollers for the inking of ordinary work passes over the form, it is only necessary to use the double-inking motion for superfine cut-work.

On the off side of the cylinder-shaft, outside the frame, is a wheel, on the bottom of which is a stop or piece of steel projecting inside. A cam from the cam-shaft works a strong steel rod, which reaches to this stop. On the other side to this is a bell-crank, one end close to a pin lying horizontally on the frame. Between this and the iron rod before mentioned, the cylinder is held firm when at rest. When about to make a revolution, the cam-rod slightly moves, allowing sufficient room for the wheel to move forward. After the revolution is performed, the bell-crank secures one side, and the cylinder, which moves about $\frac{1}{4}$ inch beyond its proper limit, is pushed back by the cam-rod, or pushing-back bar; thus ensuring

perfect register by firmly holding the cylinder in exactly the same place after every impression.

The sheet is laid to brass front-marks. When the cylinder is ready to take the impression, these are slightly depressed, and the front of the board is raised to the level of the grippers. This, as well as the raising and depressing of the points, is also effected by a rod extending from the cam-shaft.

The ductor is worked by an arm attached to a wheel on the cam-shaft outside the frame, and the vibrator by a cam on the same shaft.

The striker is connected with a brake, which clamps the underside of the fly-wheel, so that when the strap is struck off, the machine is stopped almost instantaneously.

The taking-off apparatus, while being simple, is very effective. Immediately above the cylinder is placed a drum (Fig. 46, H) one-half its size, and which works in a narrow set of special teeth on the off side of the cylinder. This drum is provided with a set of grippers, and takes the sheet from the cylinder in the same manner as the sheets are transferred on the Anglo-French; *i.e.* by entering the opening and clutching the paper simultaneously with its release from the impression-cylinder. The sheet then travels horizontally by means of tapes on to a set of flyers, which duly deposit it on the taking-off board. This plan we consider to be an improvement upon the original mode of running the sheet up a series of tapes, and down upon the flyers.

The taking-off frame can be lifted up during the making-ready, in order that the form and rollers may be attended to without difficulty. Near the drum on the frame is an iron wedge, loosely working on a pin, and when this frame is raised, the wedge fits into a notch made above the impression-cylinder.

When the cylinder is struck off, the same lever also prevents the flyers from acting; so that they only work when an impression is taken.

In order that this machine may be rendered as perfect as possible, a roller-rack is fixed under the taking-off board. When the latter is raised to a perpendicular position, the rollers can be lifted from the forks and placed in the rack,

saving the trouble and avoiding the possibility of their becoming damaged by being taken away from the machine.

In large-sized machines, where the taking-off board is of great weight, the rack above referred to is dispensed with, to give place to a parallel row of teeth, by which means the board can be moved backwards and forwards by turning a small wheel at the side.

Some time ago Messrs. Harrild erected two singularly fine "Bremner" machines for the *Illustrated London News*, which are sufficiently large to take a quadruple-royal sheet, and are made proportionately strong. The peculiarity of these machines lies in their having two inking-tables somewhat similar to the Dutartre machine. In order that the distribution may be perfect, forks are provided for fifteen wavers; and when we add that nine rollers cover the form, it will be at once seen that they are specially adapted for cut-work. We need only mention (to give an idea of their capabilities) that perhaps the largest wood block ever worked up to the present time was printed upon one of these machines — the "Sortie from Plevna," covering a quadruple-demy sheet.

In the demy machines, some of the movements are simplified. A rocking-lever is substituted for the traverse-wheels and racks. The former works upon a shaft at the base of the machine, and the other end is fixed to the underside of the coffin, the connecting-rod being fastened to the middle. In this way most of the old Belle-Sauvage machines were constructed. In demy machines this is sufficiently strong, but in those of larger construction it is not calculated to bear the strain.

CHAPTER XVII.

The Wharfedale Machines of Messrs. Dawson, Payne, Fieldhouse & Elliott, and Benson & Adams—F. Ullmer's "Standard"—Ingle's Machine—the "Quadrant."

WE have entered so minutely into the details of the "Bremner" machine, that we should only be repeating ourselves were we to describe the "Wharfedale," the construction of the two machines being almost identical.

Of course, we are unwilling to enter into the controversy as to which maker is most entitled to the credit of producing this almost perfect machine, as the improvements in each have been so gradual and so well carried out, that we are afraid, if we were to assign one movement as peculiar to one maker, we might be doing an injustice to the others. Perhaps the only material difference between Messrs. Dawson's or Messrs. Payne's machine and the one before mentioned, is the slight improvement made in the inking arrangements of the latter, an ink-drum being placed parallel with the ductor to aid distribution. This necessitates two vibrators being used.

In all respects, the Wharfedale is competent to produce the best work—good inking and a sharp impression being assured. It is, we think, a trifle lighter in the build than the one we have before noticed ; but this is of little importance, as the coffin itself is well supported, which is the most important point.

Messrs. Dawson's machine may be considered as being one of the most perfect of its kind. The machine is substantial in construction, and extremely well fitted in every particular. It is well adapted for first-class book and art work, a firm and good impression being assured. Being one of the first, if not the first, Wharfedale made, this machine has increased in popularity, and is at present in use in some of the largest book-work houses in the trade. We believe we are correct in stating that more have been manufactured than any machine similar in construction.

The taking-off motion described in the previous chapter is the invention of the Messrs. Dawson, and the fact of its having been adopted by other makers speaks as to its success.

Messrs. Dawson have several London agents, among whom we may mention Mr. Esson, Johnson's Court, E.C., and Mr. F. Ullmer, Farringdon Road, E.C.

Messrs. Payne also manufacture extra-large Wharfedales —four-sheet super-royal. In order that these machines shall not be weakened by their size, they are provided with a double set of gearing underneath, *i.e.* connecting-rods and large cog-wheels which work them. Additional

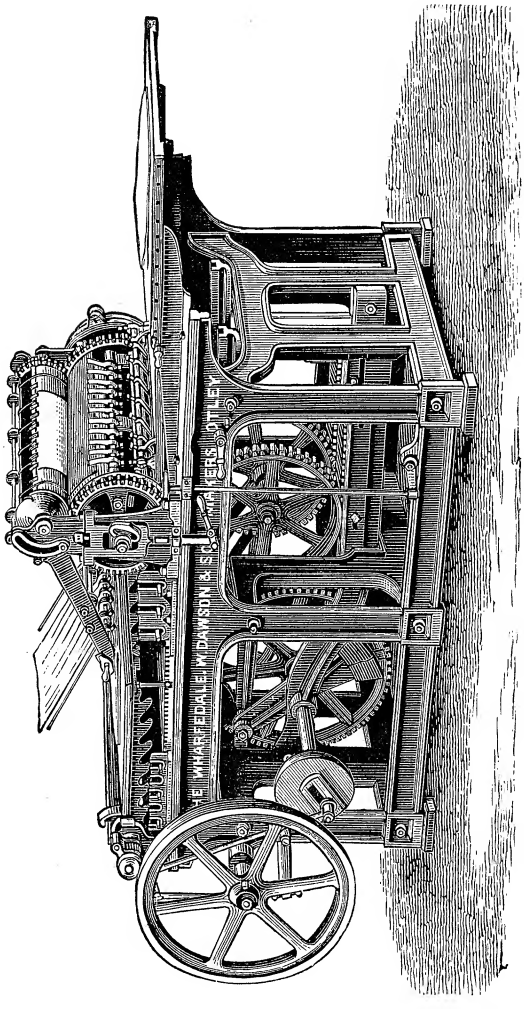

Fig. 47.—Messrs. Dawson's Wharfedale.

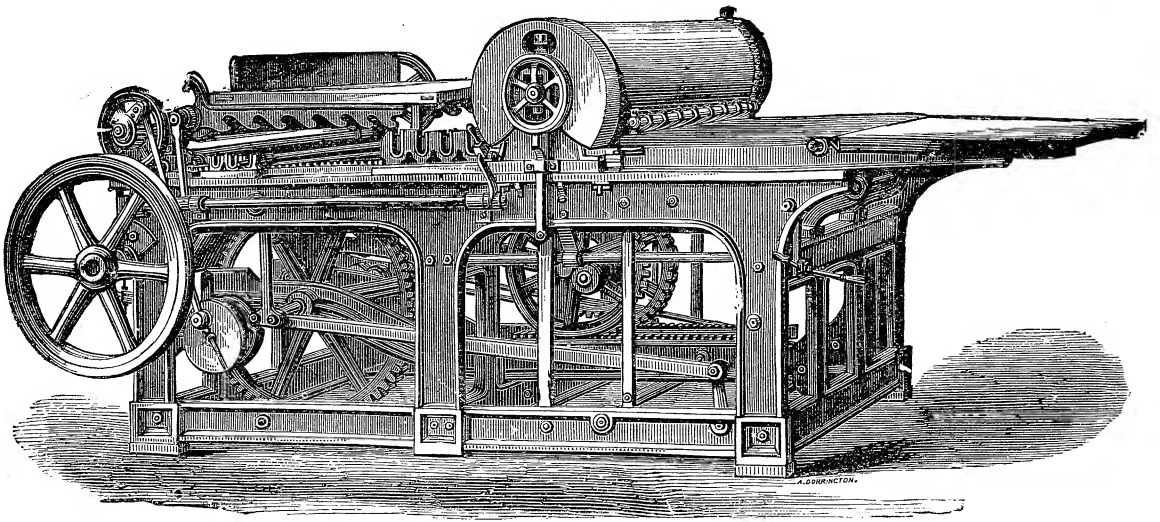

Fig. 43.—Messrs. Payne's Wharfedale Machine.

support is also afforded to the table and coffin by extra bearers. They have now been running for some considerable time, and have, so far, answered the most sanguine expectations.

We have examined one which would almost take on a quadruple-royal form, and it must be said that the quiet way in which it ran, together with its speed, greatly surprised us. Although on a floor, there was scarcely any vibration. Messrs. Payne may safely be congratulated upon the success of this huge machine.

The "Reliance" Wharfedale of Messrs. Fieldhouse, Elliott, & Co., Otley, is used largely in the North of England, but is comparatively unknown in London. Some of the largest Edinburgh firms have had them in constant work for many years, and their success in the North has been so great, that we are at a loss to understand why the makers have not taken means to give them publicity in London. Built exactly upon the same principle as the other Wharfedales, excepting in a few minor points, they do not call for special remark from us, except it be to draw attention to the great care taken by the makers in the finish of this machine. We may mention, however, as one advantage that in the taking-off apparatus all tapes are dispensed with.

Messrs. Benson & Adams' Wharfedale is, perhaps, simpler in construction than the foregoing, and being both strong and well made is fully valued wherever in use. Many are at work in London and the provinces. They are admirably adapted to good book and commercial work.

Messrs. Ingle's machine is, perhaps, only remarkable for the absence of any complicated movements. It is of very light construction, and is peculiarly adapted for printing light work, such as Government forms, &c. In consequence of its simplicity of make, it may be run at a greater speed than any of the single cylinders before mentioned.

Mr. Fredk. Ullmer's "Standard" machines are strong, and being extremely simple in construction are consequently not liable to get out of order. This is an advantage, as but a very short experience will enable the workman to successfully manage this machine. It is well

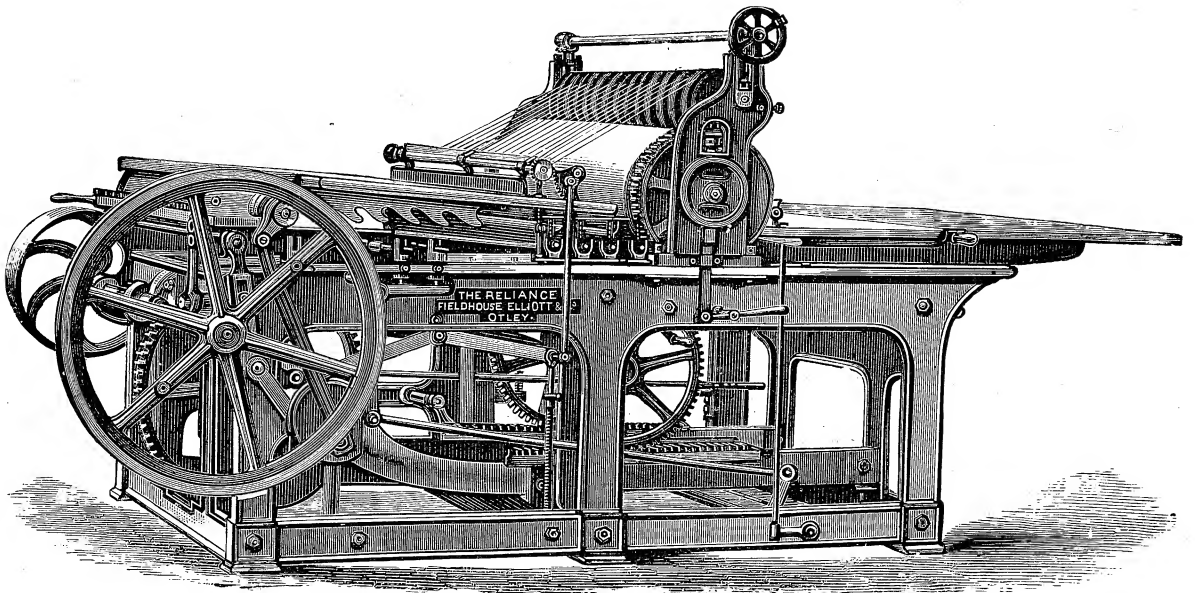

Fig. 49.—Messrs. Fieldhouse, Elliott & Co.'s Wharfedale.

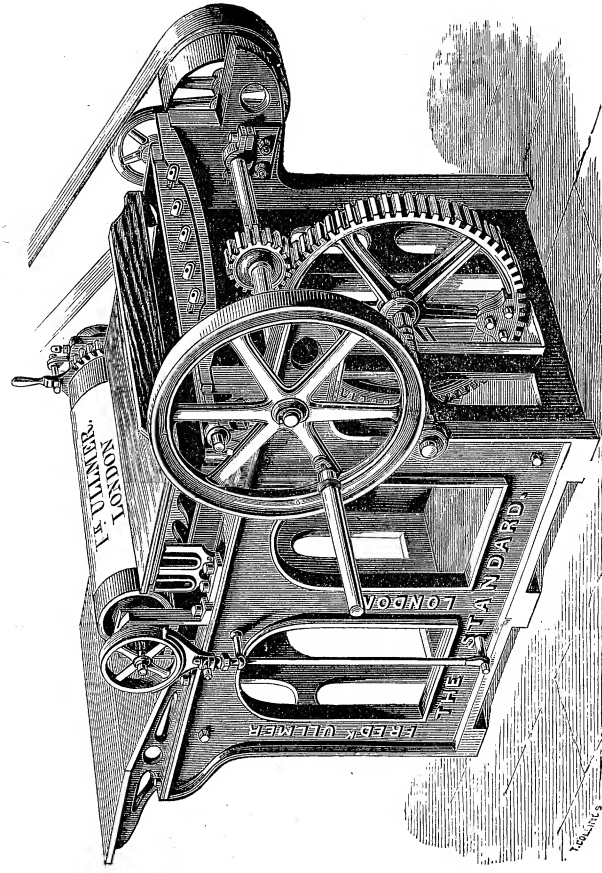

Fig. 50.—Ullmer's "Standard" Machine.

fitted and serviceable, and can be driven either by hand or steam power.

The "Standard" has become very popular among commercial printers, especially in the provinces, for the reason above stated.

The "Quadrant," made by Messrs. Powell, is a machine more especially suited for small jobbing work. In general

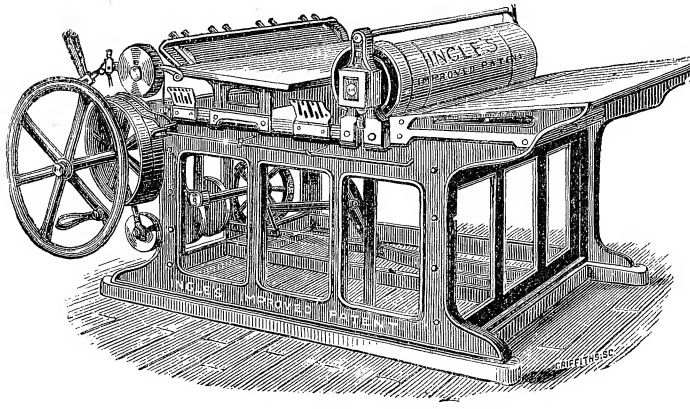

Fig. 51.—Ingle's Improved Machine.

construction it is somewhat similar to the Ingle. In all these machines the rocking lever is employed as the means of moving the table, instead of traverse wheels and racks, as in the Wharfedale. The demy machine is fitted with a treadle, and can be easily worked by the layer-on; and being provided with a taking-off apparatus, the whole process can be performed by the one boy.

Machines larger than demy are driven by steam. An ingenious appliance is fitted to the larger machines for "beating up" the work. It consists of four pieces of wood four or five inches in height fastened on the taking-off board. These can be placed to suit the size of the paper being printed. Every time a sheet is deposited by the

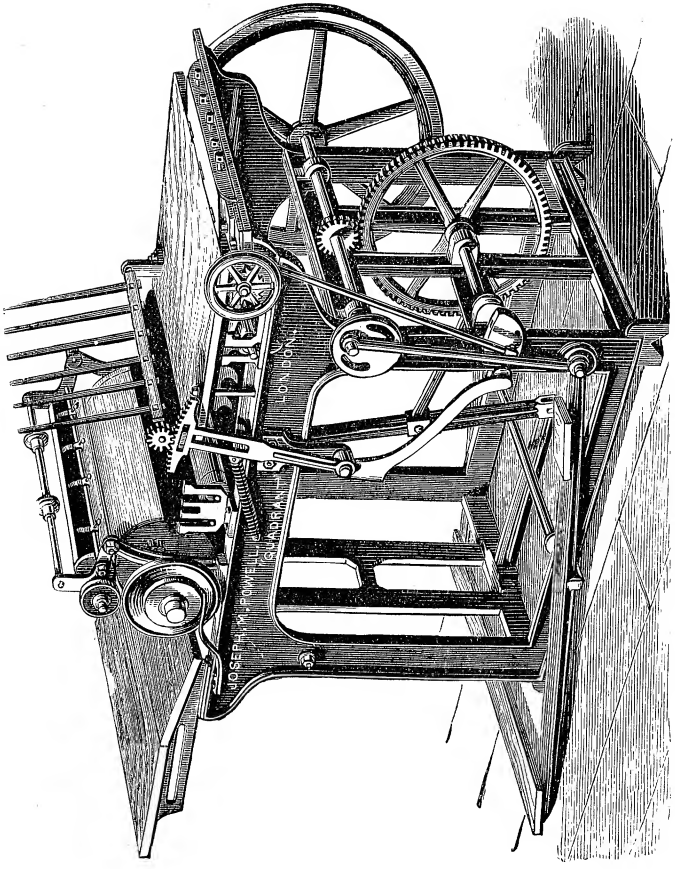

Fig. 52.—Powell's Quadrant Machine.

flyers, two of these guides, at right angles to each other, move slightly backward, and forward again, pushing the paper against the stationary guides, thus securing perfect evenness of lay. This apparatus is certainly a desideratum to all machines fitted with flyers.

There are doubtless other single-cylinder machines made than those we have drawn attention to, but we believe that those above constitute the principal ones at present in use in this country.

CHAPTER XVIII.

The "Graphic" Machine; the Dutartre Single-Cylinder Machine.

THE "Graphic" Machine, introduced by Messrs. Parsons & Davis, combines the improvements of the Wharfedale with extra strength. The inventors maintain that in the generality of machines the coffin has not sufficient support to prevent it from slightly giving under the impression. In order to remedy this they have erected a strong iron girder immediately underneath the cylinder and independent of the side-frames, so that the whole strain of the pressure is borne by this extra support. It is claimed therefore that the making-ready is more effective, and consequently that the forms require less overlaying; also that packing is unnecessary on the cylinder-bearers.

In addition to the centre girder, the gearing underneath the machine is placed on an iron bed, so as to give as much solidity to the machine as possible.

The cams, &c., are differently disposed to those of other single-cylinder machines, as instead of being near the driving-shaft they are placed nearer the portions they operate upon.

A two-feeder machine, built on nearly the same principle as the above, is also made by the same firm. The laying-on boards are placed on either side of the cylinder, which rocks somewhat like the tumbler, and alternately takes a sheet from each board. The sheet, after being released from the grippers, is carried by means of tapes to the

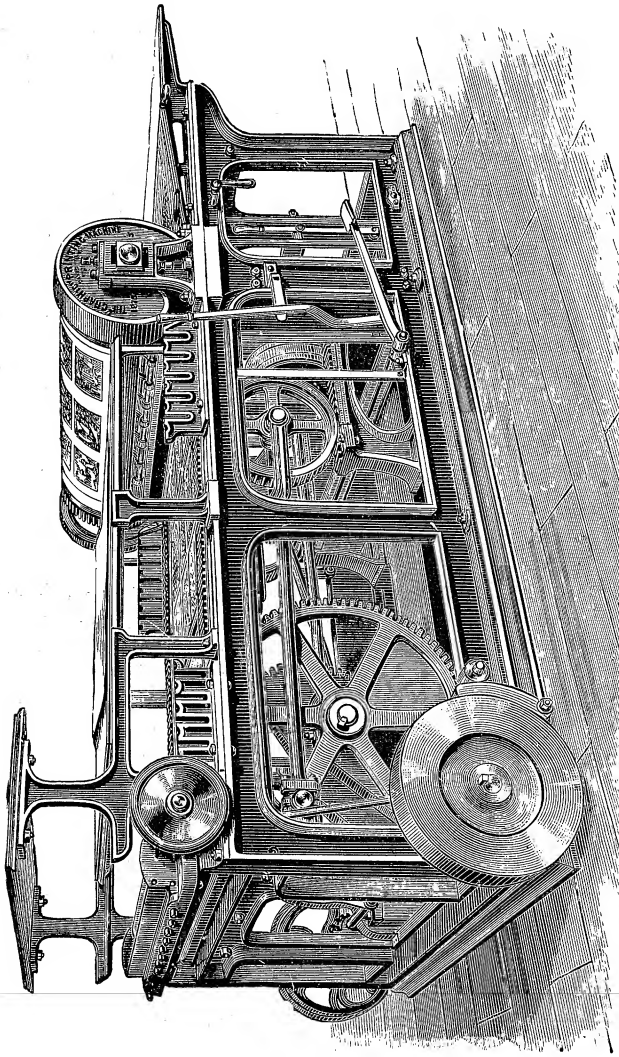

Fig. 53.—The "Graphic" Machine.

taking-off boards, which are situated above the layers-on. By this means as many as 2,000 sheets per hour are printed on one side. An advantage possessed by this machine is that one feeder can be speedily thrown out of gear, so that it can be either used as a one or two-feeder, as necessity requires. Messrs. Parsons & Davis have also constructed a typo-litho machine on the same principle. As its name implies, this machine is capable of printing from either type or stone, the necessary alteration from one to the other being but the work of a few minutes.

We are quite convinced of the strength of the "Graphic" machine, and of its capability of doing first-class work; but whether the distinctive advantage of extra strength claimed over the other machines justifies the necessary extra cost, we are unable to say. Suffice it to mention that these machines have been for some time employed in printing the cut-forms of the *Graphic*, for which they were specially constructed, and have performed their heavy work most satisfactorily.

The Dutartre Single Cylinder.

Although we believe there are only two of the original French machines at present working in England, others of similar construction, named the Franco-Bremner, have been specially built by Messrs. Harrild & Sons for Messrs. Cassell, Petter, & Galpin, and are working very satisfactorily. We may be excused for calling attention to this class of machine—so little known in the trade—as of all single cylinders we believe them to be the most competent to produce the finest kind of cut-work; the best evidence of which is the fact that Messrs. Cassell, Petter, & Galpin print "Picturesque Europe" and most of their Doré and other fine-art engravings upon them.

Its construction is somewhat different to the Wharfedale and ordinary Bremner machines, inasmuch as the side-frames are not so high, and the laying-on board is above instead of below the cylinder, giving an over-head feed, the same as in a lithographic machine, the angle at which the board is placed being less acute.

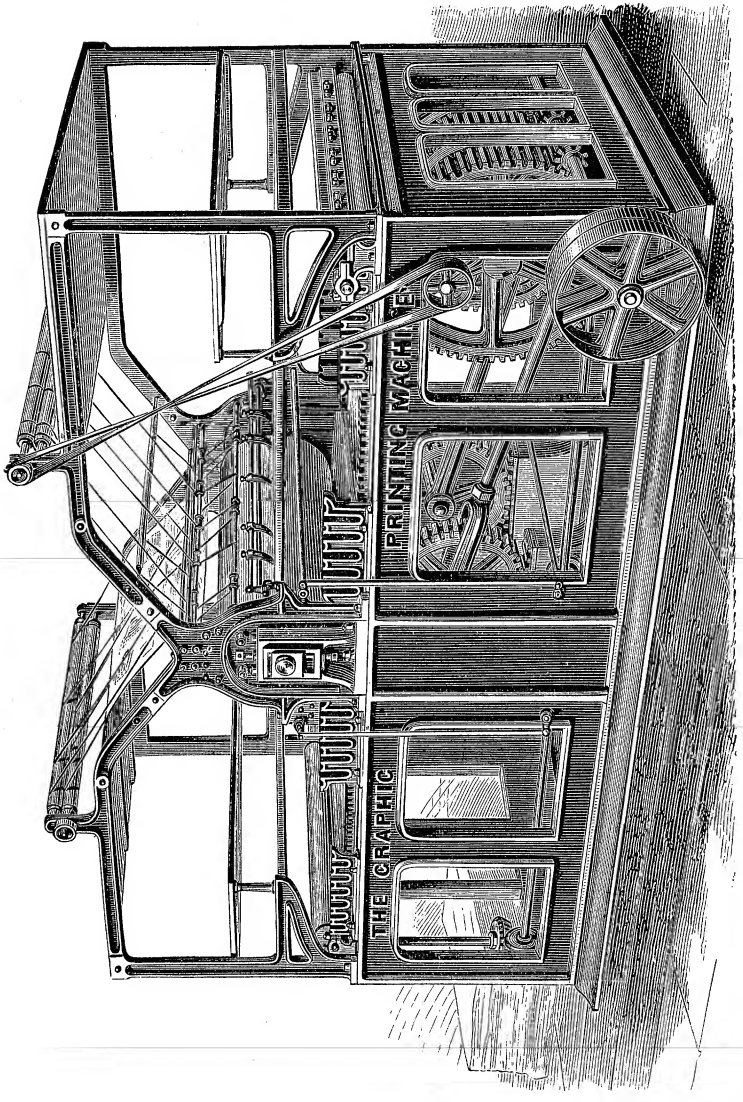

Fig 51.—"Graphic" Two-feeder.

The speciality of the Dutartre machine is the large number of inking-rollers that can be made to cover the form when desired. These machines are provided with a double set of ink-ducts (one at either end), and the type-tables having an extra long traverse, the form has the advantage of being rolled by two sets of inkers between every impression, besides which the forms can be double-rolled when necessary.

The taking-off board, like that in the litho machine, is under the laying-on board, and the sheets when printed are carried from the cylinder by means of tapes over two rollers and duly deposited on the delivery-table.

The vibrator is raised to the ductor by means of a series of detached movable shapes on the end of the ductor-roller. Fixed to the vibrator is an arm, having a pulley at the end. This works over the shapes before mentioned, and by its means the duration of the contact between vibrator and ductor can be regulated. In order to prevent the vibrator from resting on the ink-slab, and possibly leaving a ridge of ink when the coffin is at its extremity, one of these shapes lifts the vibrator from the table, allowing it to touch again on its return. All the movements of these machines are simple, well arranged, and easily regulated.

We do not think it necessary here to enumerate any further details of their construction beyond the above; these machines, as already stated, being almost unknown in English offices. Suffice it to say that they are very substantially built, well fitted, and capable of giving a heavy and sharp impression, without any indication of the slur common to some machines.

CHAPTER XIX.

TWO-COLOUR MACHINES.—General Principles of Construction—Advantages—Speed—Treatment of Coloured Inks—Messrs. Dawson's, Messrs. Harrild, and Messrs. Payne's Machines—The Leeds Rotary Two-Colour Machine: its Construction and Capabilities—Servante's Two-Coloured and Perfecting Machine—Rutley's Two-Colour Apparatus.

THE first really successful two-colour machine was made and patented by Mr. Conisbee, and purchased by Messrs. Waterlow in 1861, at whose establishment we are assured it is still doing good work. In construction they are somewhat similar to the ordinary single-cylinder machine, but are provided with two sets of inking apparatus, each of which acts totally independent of the other.

In regard to this class of machines generally it may be observed, that the cylinder is placed in the centre of the machine, and makes two continuous revolutions, giving an impression for each colour. The two coffins adjoin one another, each being provided with a complete inking arrangement—ductor, wavers, and inkers. The circumference of the cylinder being the same as the length of one coffin, it will be seen that when one revolution has taken place the first form has been printed, and on the second revolution the second form.

As the sheet is printed twice on the same side without being released from the grippers, perfect register is assured; and if this is not the case there is some fault in the imposition or in the placing of the forms.

Advantages.—When printing in two colours on other kinds of machines, such as a Platen or Wharfedale, perfect register in all cases cannot be relied upon, as there are so many causes that contribute to partial failure. The point-holes may be too large, or careless boys may often fail, in perfecting, to place the sheet on the pins. Added to this, the paper may be allowed to lie about and get dry before

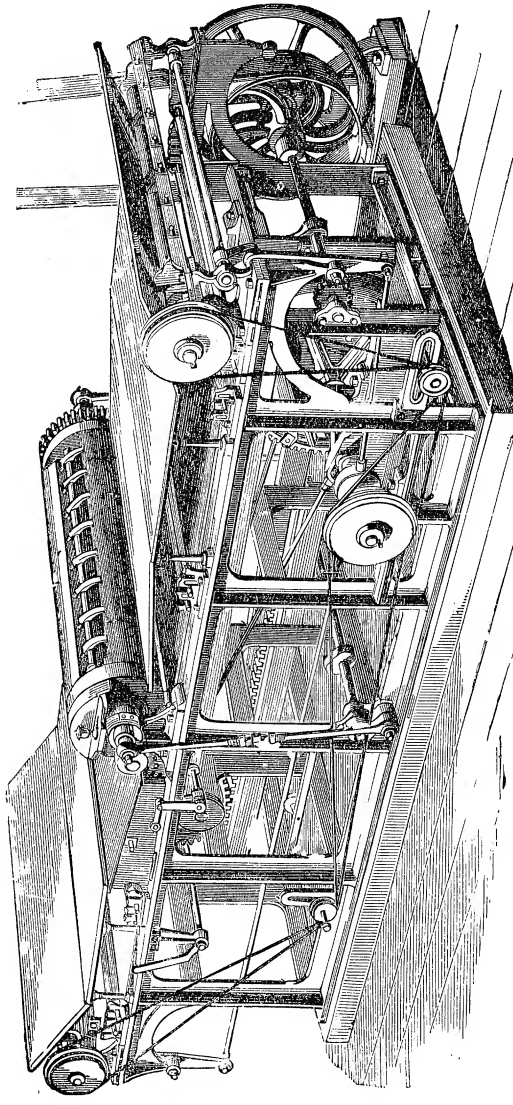

Fig. 55.—Consbee's Two-colour Machine.

the second colour is printed; the consequence being that the sheet shrinks, and perfect register is impossible. These and other accidents may interfere to prevent accuracy of register if two-colour work is printed by two operations. In the two-colour machine, however, these incidental causes of imperfect work are obviated, the two forms being printed almost simultaneously.

Speed.—The speed at which these machines are driven must necessarily be regulated by the class of job to be worked. In heavy broadsides, where the surface of the letters is great, 300 or 400 perfect copies per hour are all that it is advisable to print, as the paper, especially if very damp, has a tendency to adhere to the form and may tear away from the grippers; nor may the damage end here, for if the sheet be taken up by the rollers considerable delay will be caused. It is in all cases advisable to drive from a three-speed or cone-pulley, regulated to run 400, 500, and 750 copies per hour. The speed of the machine can then be increased or reduced by merely shifting the driving-band, which is the work of but a few moments.

In this class of work the rollers should be secured in the forks by a cap, or by some simple contrivance such as has been previously described, which prevents their jumping out in the event of a sheet becoming detached from the grippers. In all cases care should be taken that the grippers press tightly to the cylinder, in order that the sheet may be held secure during the printing; otherwise the work will be out of register.

Owing to the chemical composition of coloured inks it will be found necessary to wash-up much oftener than in black work. The rollers should be cleansed with turps, wiping them finally with a rag or sponge dipped in luke-warm water. In colour-work, especially in hot weather, it is advisable to have duplicate rollers in readiness.

A perforated gas-pipe should be fixed under each end of the machine, as by this means the tables can be gently heated in cold weather, which materially assists in the even distribution of coloured inks.

Messrs. Conisbee's two-colour machine is constructed upon somewhat the same principle as the original Main.

When we mention that more than sixty machines are at present in use, we need add little in their praise, as this fact alone speaks of their universal success.

Two-colour machines are manufactured by Messrs. Dawson, Messrs. Harrild, and Messrs. Payne. In construction they are very similar, excepting perhaps that the "Bremner" (Messrs. Harrild's) is somewhat heavier. There are many machines by the above makers in use in London as well as in the provinces, and they are all universally spoken highly of. The size mostly made is double royal.

Messrs. Dawson have erected for Messrs. Wilkinson, of Pendleton, a Wharfedale, capable of taking a sheet 75 in. × 60 in., which is by far the largest ever attempted, although it is guaranteed to print 600 copies per hour full size. While heartily congratulating the makers of this leviathan, we very much question the probability of such a size ever becoming generally adopted. In the first place, the machine should be run at a comparatively slow speed, and if the paper used be at all poor in quality two layers-on and two takers-off will be required. Secondly, the paper would have to be made specially, and in the case of broadsides the work of the bill-posters would be greatly augmented, to say nothing of the possible spoilage in the handling of this enormous sheet.

Messrs. Newsum, Wood, & Dyson's "Leeds" rotary two-colour machine consists of two cylinders working together, the smaller of which makes two revolutions to one of the larger. The latter is constructed with two flat beds equidistant from each other, the remaining surface being curvilinear, and serving as ink-tables.

As the cylinders work together it will be seen that when the type-beds or flat surfaces face the impression-cylinder, the latter must necessarily move forward to give the impression. This is effected by a cam on the large cylinder-shaft, assisted by a powerful spring. This motion is very ingenious, and we do not recollect having seen it applied before.

Although the inkers and wavers for each colour are placed together in a series of forks, at the top of the frame,

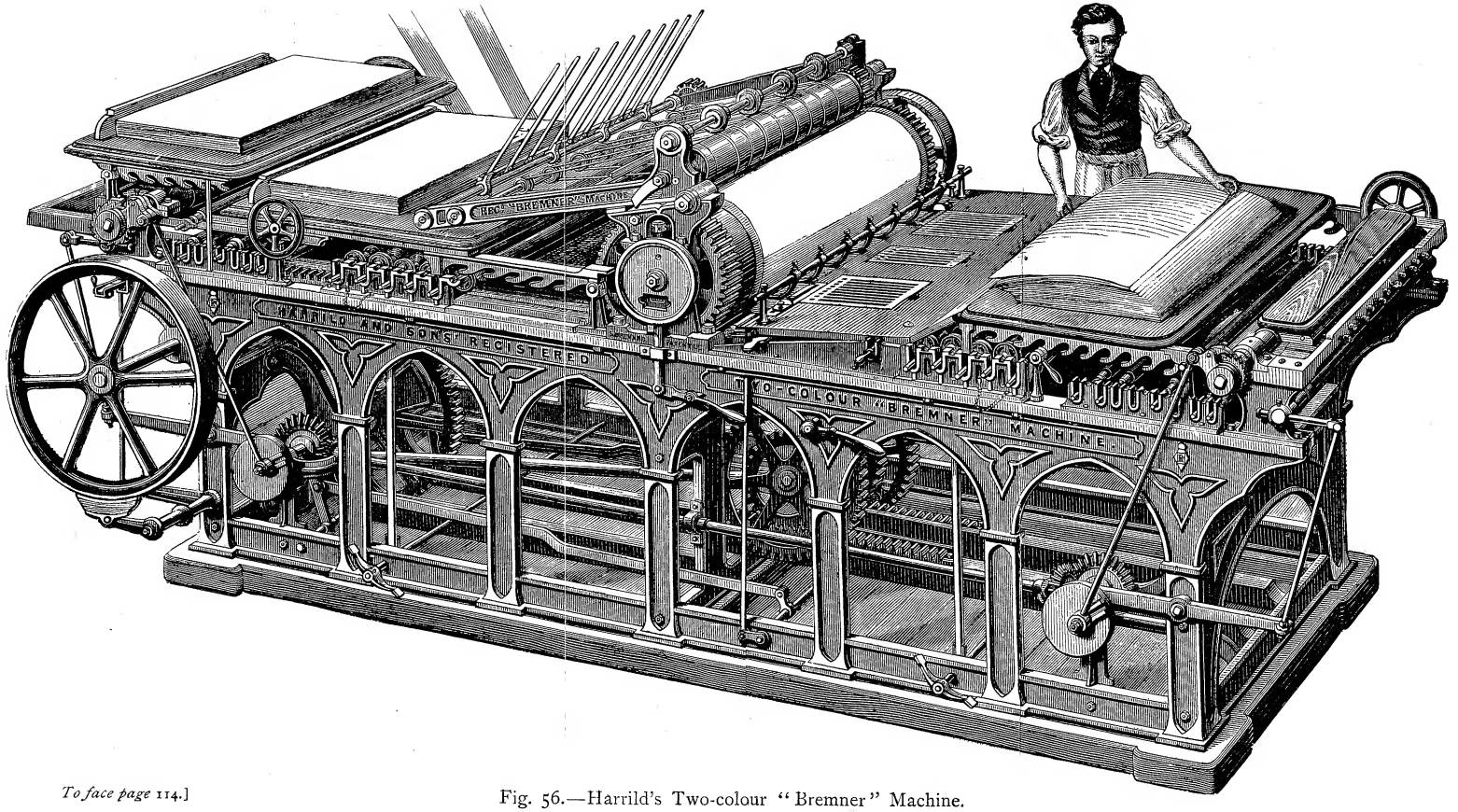

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Fig. 56.—Harrild's Two-colour "Bremner" Machine.

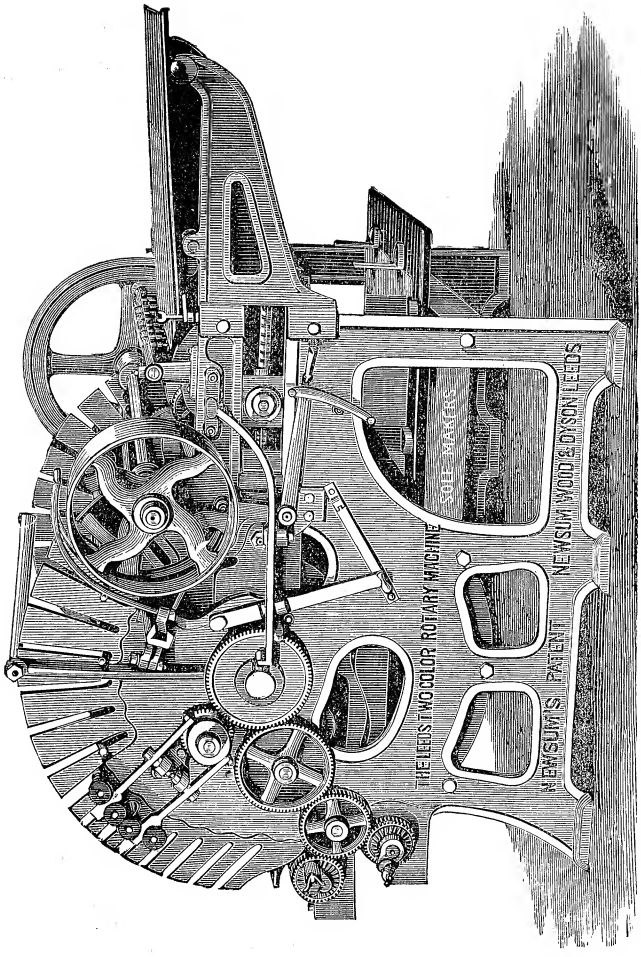

Fig. 57.—Newsum's Patent Two-colour Machine.

by means of a duplicate set of bearers they are alternately lifted above the inking surface as it passes underneath. Identical bearers are also fixed to the impression-surfaces. By this arrangement, when one inking surface is uppermost, only the proper rollers are allowed to touch, those of the other colour being raised by the bearers above described,—the same process being adopted as regards the form. In this manner each form is inked only by its proper rollers.

The sheet is taken by means of grippers, and is held firmly until both the forms are printed, when it is released

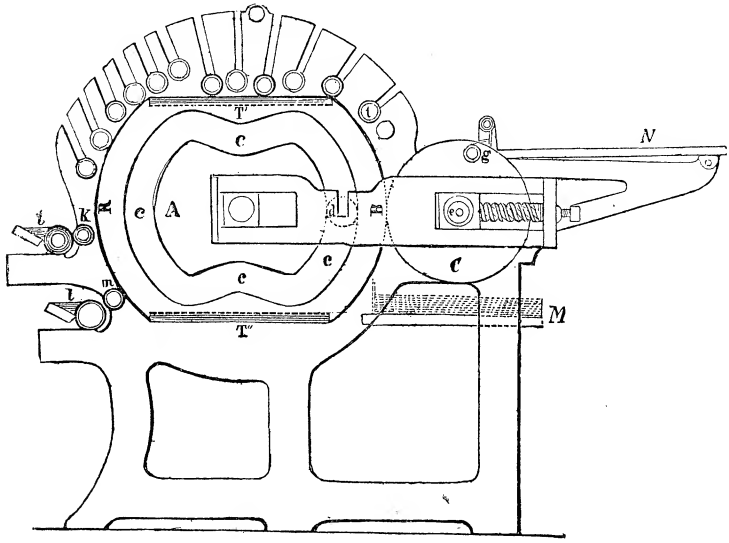

Fig. 58.—The "Leeds" Patent Two-colour Machine.

A, Irregular-shaped Drum.
B, R, Inking Surfaces.
C, Impression Cylinder.
c, Large Cam.
d, Impression Stud-runner.
K *m*, Vibrators.
l, Ductors.
T, Forms.
g, Gripper Tumbler.
N, Laying-on Board.
M, Taking-off Board.

to the taking-off board directly under the impression-cylinder. As the forms revolve, it will be noted that in one position the face will be underneath, and if it is intended to print large and solid forms, great care must be taken that they are securely locked up, or the type may fall out.

Many printers were afraid that this possible defect would cause some trouble. However, the machine has been well tested with all kinds of forms, and with ordinary care little or no difficulty will be experienced. Being rotary, the inking rollers always travel in one direction, and have not a tendency to lift the type from its feet.

The ductors are at the end of the machine, one under the other, each of them containing one of the coloured inks.

Capacity and Speed.—Double-crown is the only size that is at present made, and ordinary work can be printed about 800 impressions per hour. Several are now in constant work, and are spoken very highly of by the purchasers.

Messrs. Newsum, Wood, & Dyson have also introduced a small half-demy one-colour machine, somewhat similar in construction to the above. This machine can be safely run at a speed of 1,500 copies per hour.

Servante's two-colour and perfecting machine is constructed entirely upon the rotary principle, and is in appearance somewhat similar to a miniature Marinoni. By a slight alteration of tapes the paper may be printed twice on one side, or perfected, so that in the absence of two-colour work it becomes more profitable than the ordinary two-colour machine.

The paper has a very short travel, passing from the laying-on board immediately on to the first impression-cylinder, and is then conducted to the second cylinder, which is situated underneath the feed-board. The sheet is then automatically deposited on the taking-off board. The two ducts, inkers, &c., are, of course, entirely independent of one another, one set being situated under each of the plate cylinders.

Type cannot be placed round the cylinder, and the plates must be cast in a circular form, which may possibly account for the tardy adoption of this machine by the printing trade.

We believe we are correct in saying that, although an invention some years old, only two have as yet been made.

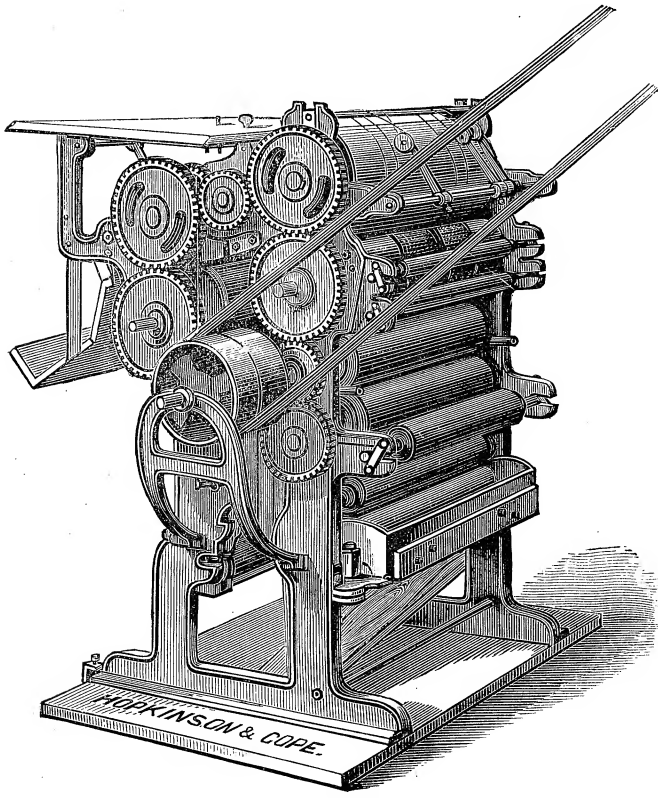

Fig. 59.—Servante's Two-colour and Perfecting Machine.

It is capable of printing 3,000 sheets per hour, and perfect register, good distribution, and first-class work are guaranteed. We may mention that Messrs. Hopkinson & Cope are the makers.

A machine capable of printing more than two colours has been invented by Mr. A. Payne, an Englishman resident in Leipsic. As many as five colours may be printed at one time, the most peculiar feature being, that the colours need not be restricted to mere straight bands, as in other appliances, but are applicable to the printing of lines having different-coloured initials, &c. The machine is somewhat expensive, one capable of printing three colours costing about £300.

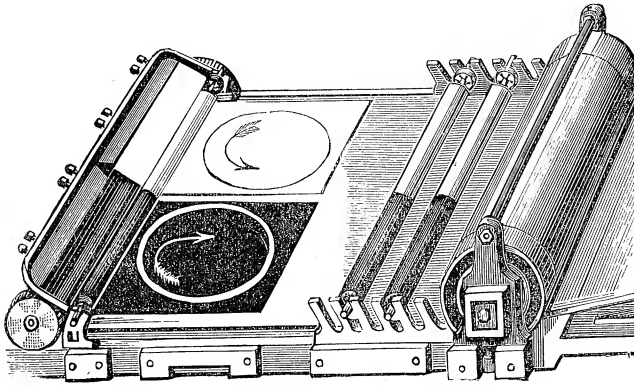

Fig. 60.—Rutley's Two-colour Inking-table.

Two or more colours can, however, be worked on an ordinary Wharfedale machine by means of a simple apparatus, which takes the place of the ink-table, and can be easily and speedily substituted. There are several now manufactured, all more or less successful.

These appliances are singularly suitable to those printers by whom two-colour work is only occasionally printed. The cost is comparatively small, and the time saved in the case of a long run is, of course, considerable.

Fig. 60 will give some idea of the invention of Mr. Rutley, by which, with a slight alteration, the ordinary one-sided machine can be made to print *two* colours at the same time.

The ink-table is divided in the centre, and in the middle of each side is placed a rotating disc on the same level as the main body. Two coloured inks may be placed in the ductor, divided by the ordinary leaden stops. It is thus unnecessary to cut the vibrator. To print a form in two colours, the sheet must not be more than half the size of the cylinder, the two forms being placed side by side. Every impression yields a pull in the two colours. The sheet must be turned, and again printed, when two copies in two colours are perfected.

The two tables can be slightly separated at will, but when it is desired to print in one colour only it is merely necessary to join the tables, and put the colour in the ductor in the ordinary way.

By means of BACON'S MULTIPLE-COLOUR APPLIANCE almost any number of colours may be printed at the same time. This is effected by the peculiar construction of the inking-table, which, instead of being made in one piece, consists of a number of narrow iron slabs or bars placed upon a frame of the same dimensions as the ordinary inking-table. These bars are made of the same length as the ink-slab, and really consist of four distinct pieces. Three of the pieces work upon pivots, and are wide in the centre, tapering toward each end. They are so constructed as to move slightly on either side at every turn of the table, somewhat similar to the knuckle-joint motion. The end piece nearest the ductor is stationary.

The different-coloured inks required are placed in the ductor, being divided by thin metal stops. A series of screws is fixed in a slight iron frame immediately above the ductor, which are turned down on the top of the stops to prevent the different inks from mixing by working underneath. The wavers, instead of being placed at an angle across the table, are made to run *perfectly straight*, the distribution being left to the slabs or bars before mentioned. The various inks are deposited by the vibrator upon the multiple-table in the ordinary way. As by the knuckle-joint movement the multiple ink-surface is moved slightly to a different position at every turn of the table, the ink is as

evenly distributed as if a number of wavers were employed. A reference to Fig. 61 will give an idea of the relative

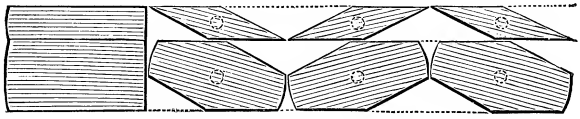

Fig. 61.

position of these distributing slabs, two sizes being shown. At the end of the traverse of the table they are shifted into the opposite position. At Fig. 62 is shown the medial position they assume during the change.

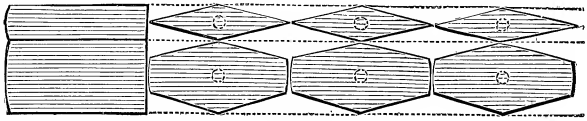

Fig. 62.

The movable bars are made for various widths, so that the largest or smallest line in a bill or poster can be supplied with any desired colour. As before mentioned, the bars are fitted on an iron frame, which takes the place of the ordinary ink-slab, and the movement of the joints is effected by a small lever hanging from under the table coming in contact with an iron plate fixed in an upright position on the cross-girders of the machine.

Supposing the screw-bars over the ductor and the lever plates under the machine to have been fixed (both of which can be allowed to remain when the ordinary inking apparatus is being used), the removal of the ink-slab and the substitution of the multiple-table are the work only of about two hours, and can therefore be done while the form is being made ready. But we see no reason why this table should not be retained in the case of black work, as it is only necessary to have a sufficient number of slabs to make up the proper width, and the wavers can be altered to run at an angle in the ordinary way.

In order to show what the appliance is capable of performing, a demy 8vo. handbill has been printed at one impression in eight colours, with every colour bright and distinct from the others. As the wavers travel perfectly straight the inks do not merge into one another, although the slabs belonging to each may be placed as close as is necessary.

Forms can be printed in any number of colours, and the time taken in the alteration of ink-tables (when deemed necessary) is very slight compared with the advantages possessed by the multiple-colour appliance in the production of coloured work. That this method will create a complete revolution in colour work generally we have not the slightest doubt, as the difference of cost between the printing of bills, &c., in one or say eight colours will be little more than that of the different inks.

As with other appliances of this nature, we may point out that it is not adapted to the printing of a single line in two colours, as in the case of initial letters, neither for coloured borders, as it will be seen from our description that the colours are carried in a perfectly straight line. The practical printer will readily see, however, that the use of the apparatus can be very greatly extended by printing the sheet three or more times, as by putting one colour on the top of another almost any number of effects can be produced.

This multiple-colour appliance is an American invention, the patent rights in this country being secured by Messrs. Middleton & Co.

In reference to two-colour machines generally we may state that in offices where broadside work is a speciality they are indispensable. The economy is unquestionable, both in the labour employed and the material used. But unless the supply of two-colour work is continuous, and it is found necessary to fill up the time by black work only, the production is, of course, just half of that on the ordinary Wharfedale.

CHAPTER XX.

JOBBING MACHINES.

THE GORDON platen, named after the ingenious American inventor recently deceased, first attracted attention in Europe in the Exhibition of 1862, since which time this class of machine has created quite a revolution in the production of jobbing printing, such as bill-heads, cards, invoices, &c. The "Minerva," more commonly known as the "Cropper," was the first English-made machine, and was speedily followed by other English and American machines similar in construction, of more or less excellence. The "Universal," "Liberty," "Bremner" treadle, and the "Minerva," are perhaps the most successful. In justice to the inventors of this class of machine it should be stated that the English have done but little in the way of improving the principle of the original. We may mention, however, that Messrs. Cropper introduced the revolving ink-disc.

By means of these little and inexpensive machines one boy can print upwards of 1,000 copies per hour of any sized sheet or card up to half medium. Their success was general, and a jobbing-office is now not complete without one of these invaluable platens. Indeed, without their aid it would be impossible to compete with any chance of success in these times, when the universal tendency is to cheapen. The simplicity of construction of these machines is a great recommendation to their general adoption. The whole of their mechanism is open to view, and there is nothing special to demand slight and delicate movements. The springs which secure the rollers are perhaps liable to wear quickly, and duplicates should always be kept in stock to prevent a stoppage. They can be easily and speedily replaced.

All the following are strictly *platen* machines, the impression being given by a flat surface. Although each has some movement peculiar to itself, they are all constructed more or less on the same principle.

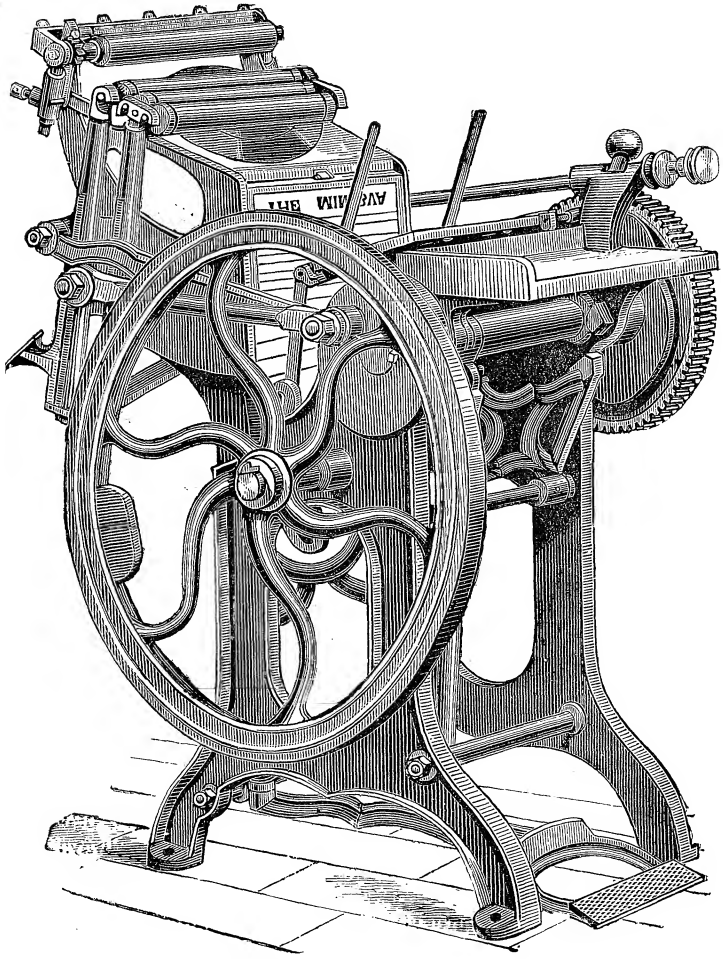

Fig. 63.—The Minerva.

The MINERVA, commonly known as the "Cropper," is especially adapted for small, light jobs, and can be driven by treadle or steam. A boy, with but little practice, can produce from 1,000 to 1,200 copies per hour. Since their first introduction they have been considerably improved and strengthened in many of their details, and now are justly valued both for their good and sharp impression as for their speed. The form is fixed in a stout frame, constructed for the purpose, and secured to the bed of the machine in a perpendicular position by means of clamps. The bed is attached to a separate frame working from the base of the machine, and moves slightly forward to meet the platen.

The inking arrangements are admirable, the distribution being aided by the round inking-table which, by means of a ratchet underneath, is moved slightly in a circular direction between each impression. In order to insure accuracy and strength, all the cogs and cams in the Minerva are machine-cut. As in all these small platen machines, an appliance is fitted, which, by means of a lever, enables the boy to prevent an impression being taken when a sheet is laid unevenly. This also admits of the form being doubly inked when necessary.

THE UNIVERSAL.—Hundreds of these machines were in use in the United States before they were offered here. They are exceedingly strong and well-fitted, and the inking and distribution are quite equal, if not superior, to any yet made. Unlike the "Cropper," the form is *stationary*, and the platen upon which the paper is placed is forced forward to a perpendicular position and parallel to the form to give the impression.

The inking arrangements consist of a series of iron drums, situated on the top of the machine, and the distribution is aided by several rollers possessing a side motion to and fro. The rollers are fixed into a small spring frame, and are carried over the surface of the form by an arm working in a cam on the side wheel, and are so arranged that the form may be inked once, twice, or any number of times to each impression. The great strength of this machine enables the printer to work heavy engravings, and we have seen

some really first-class cut-work, equal to that produced at the ordinary platen machine, turned out by the Universal.

The largest size manufactured will print a half medium sheet, but when large or heavy forms are laid on it is advisable to use steam instead of the treadle for driving. In fact we should in all cases advise steam power to be used for these machines, which can be run up to a speed of 1,000 to 1,200 impressions per hour, but as they are somewhat

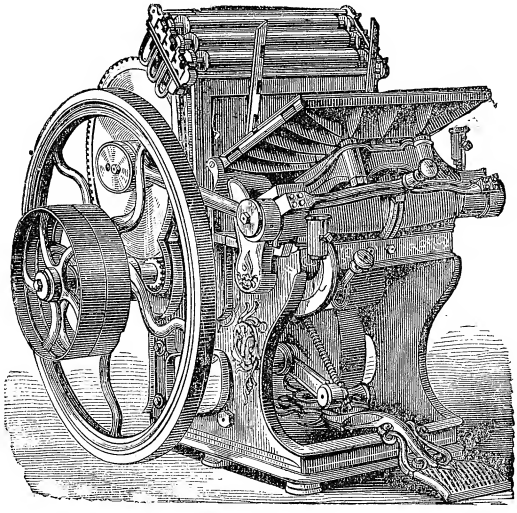

Fig. 64.—The Universal.

heavy in construction it is not advisable to drive the larger size at a speed exceeding 750 copies per hour. Messrs. Coddington & Kingsley were the original owners of this machine, but it has passed into the hands of Messrs. Hopkinson & Cope, who are now the sole proprietors.

THE LIBERTY machine is made by Mr. F. M. Weiler, of New York (late Degener & Weiler), and was introduced into this country through the agency of Mr. James Salmon, of Manchester. It has now stood the test of several years'

experience, and has given satisfaction wherever it has been adopted, being both simple and strong, with capital distributing and inking arrangements. It is capable of performing excellent work of all descriptions, from the

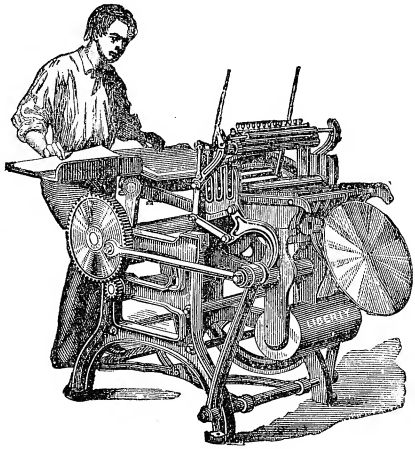

Fig. 65.—The Liberty.

trade card to rule work, which latter can be laid on without fear of a slur of any kind. A boy can print from 1,000 to 1,250 per hour, which speed can be increased if desired by the application of steam-power.

THE BREMNER.—After considerable experimenting, Messrs. Harrild have succeeded in placing before the trade a treadle-machine capable of holding its own among the many successful ones now in use. It is solid in build and construction, also well fitted, and is adapted to print any class of work. The inking parts are well arranged, and the distribution is perfect. The speciality of this machine is that the platen is locked, securing a "dwell" on the impression, and preventing the possibility of a slur. Like other treadle platens, the boy can prevent an impression

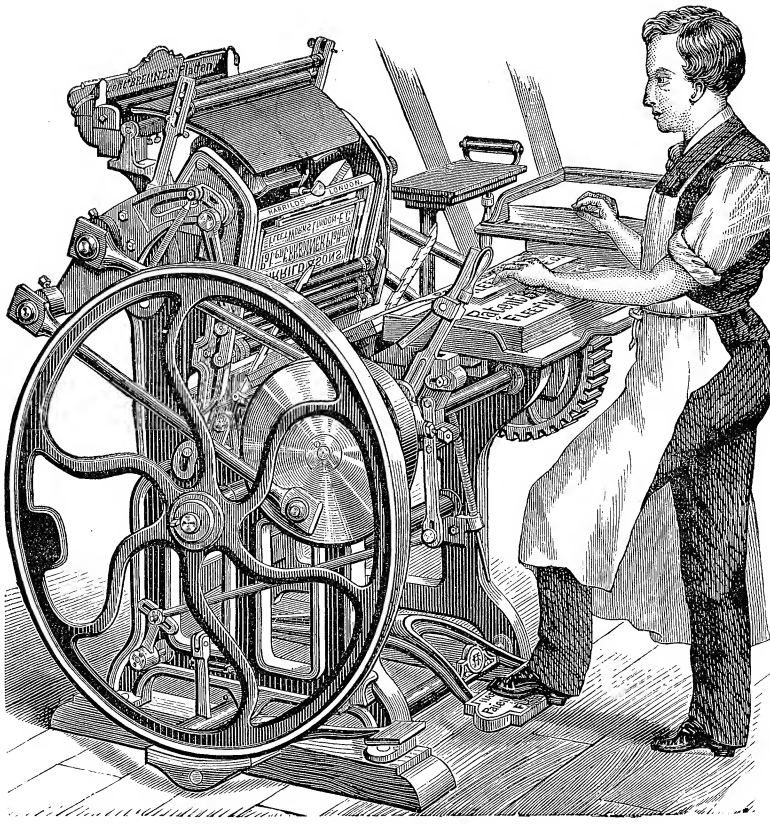

Fig. 66.—The Bremner Treadle.

from being taken in the event of a sheet being laid askew. By means of a self-acting brake connected with the striker this machine can be stopped instantaneously, which may be considered an advantage.

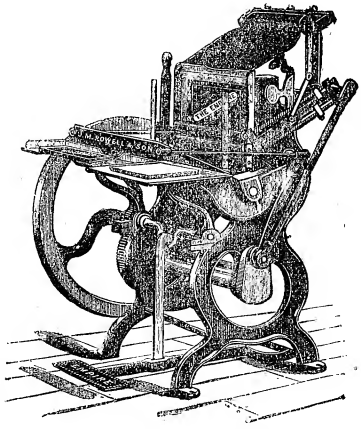

Fig. 67.—The Empire Platen.

THE EMPIRE PLATEN has been recently introduced by Messrs. Powell, the distinctive features being its simplicity, cheapness, and strength. The circular ink disc has been adopted with an addition at the lower part, practically making it square at the bottom. The distribution is good, and the machine is capable of working heavy forms. The largest size will print a demy folio.

THE "CAXTON" TREADLE PLATEN MACHINE.—Messrs. Furnival have secured the patent rights of the "Caxton," which, like the original "Gordon," comes from America, and although constructed on the same principle as most other machines of its class, possesses many very excellent points which will commend it.

The bed of this machine is stationary, and great strength is imparted by a series of substantial ribs at the back. The

chase is dropped from the top between two grooves, one on either side. This simple and admirable arrangement obviates the necessity of movable clamps, and also renders the placing and removal of the form alike a safe and quick process.

An important feature is the remarkably small amount of motive power required for driving. This is to a great extent due to the manner by which the impression is obtained. At the end of the driving-shaft is a pinion, which drives a large cog-wheel underneath. To this latter is attached an arm, which works a large cam at the side, in conjunction with a powerful toggle-joint at the back of the bed. The power is thus obtained by indirect means, and consequently the strain when the impression is given is comparatively trifling.

The table is constructed in a somewhat novel manner. Immediately under the surface is a wedge-frame. By a simple arrangement of adjusting the series of wedges by a single set-screw the impression can be regulated to a nicety. The impression can also be thrown off at any part of the stroke by a lever at the side working in this wedge-frame. The table works upon a substantial hinge at its base and is perfectly parallel with the form when thrown off.

Unlike other machines, a vibrator is provided which also acts as a distributor, and which never touches the face of the type. The inkers are fixed in a separate frame, and the whole (three in number) cover the entire face of the form. That the ink may not be taken up unevenly, raised bearers are fitted on each side of the revolving disc which serves as the ink-table. These prevent the rollers touching the slab excepting in the widest part, and therefore the ink is taken by the whole length of the rollers. The fingers which hold the sheet are fixed in a groove at the base of the table, and can be loosened and adjusted in any position by means of a small handle at the side which works an eccentric. This we consider to be a decided improvement, as in cases where these are fixed by set-screws they are liable to work loose; besides which, the mode generally adopted is a matter of more difficulty than in the above arrangement.

The ductor is provided with a multiplicity of set-screws,

that the supply of ink may be regulated to a nicety; and by the removal of a small screw in the side frame the ratchet-

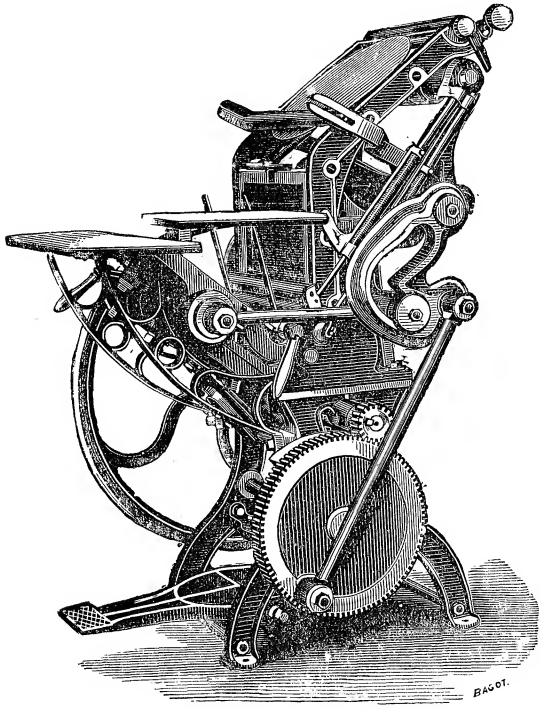

Fig. 68.—The Caxton Treadle Machine.

wheel can be made to miss one, two, or three teeth, as desired. To aid the distribution the disc is moved round one-third of its circumference between every impression.

Every portion of the "Caxton" platen is well balanced, to which is due, in a great measure, the regularity of its motion. At the back of the table a balance-weight is fixed, as also to the end of the roller-frames. Although substantially built, it is not encumbered with a needless quantity of metal. The shafts are all made of steel.

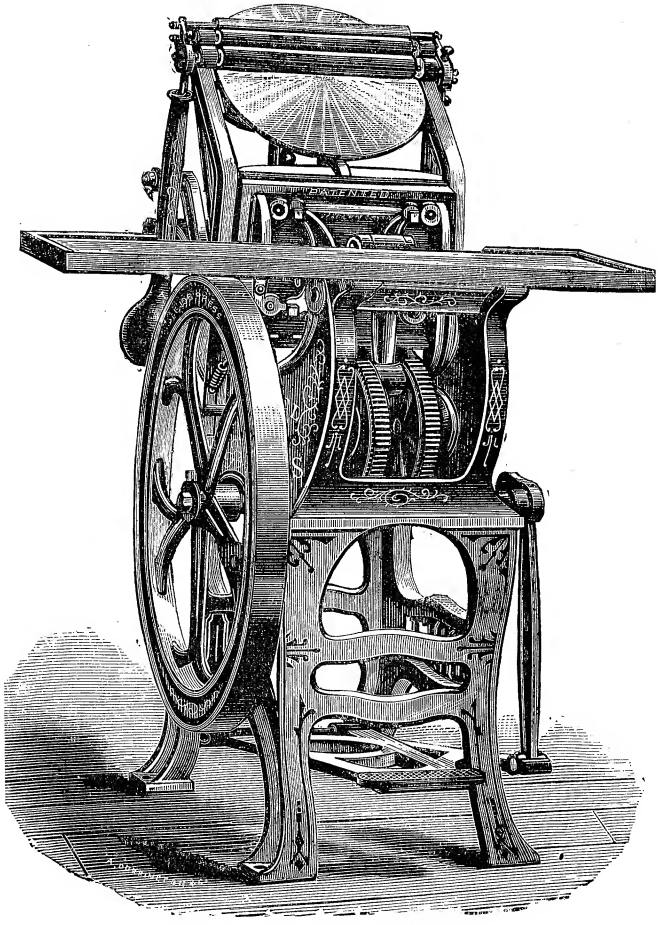

Fig. 69.—The Model.

Publicity was first given to the MODEL printing-press at the late Caxton Exhibition. The machine is very well made, and is now being extensively used by jobbing printers.

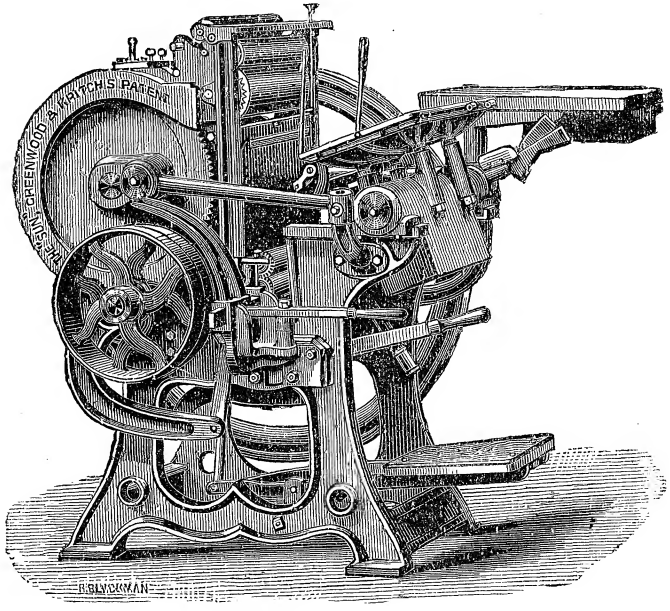

Fig. 69*a*.—The Sun Platen.

THE SUN PLATEN resembles somewhat the "Universal" in appearance, but it is perhaps heavier in construction. Special attention has been paid to the inking apparatus, which consists of revolving cylinders with independent wavers. This, together with the locking arrangement of the bridge and platen, specially adapts this machine for cut or other heavy work. Three rollers entirely cover the form. These inkers are fixed in a frame, to which a perpendicular motion is imparted by a cam in the usual manner.

*

The Sun platen is manufactured by Messrs. Greenwood and Batley, of Leeds.

The INVICTUS PLATEN, manufactured by the Birmingham Machinist Co., is to be highly commended for its ingenious and novel construction. The body is made in a cylindrical form, one-third, however, being flat. This portion really forms the bed upon which the form is secured. Nearly the whole of the surface of the cylinder is used for the ink-table. The ductor is placed at the back in the ordinary position. But with this, the similarity between the inking apparatus of the Invictus and other platen machines ends. Above and below the ductor are two rollers, round which travels a wide indiarubber band or apron. This constantly presses against the ductor and receives a continuous supply of ink. In a moveable frame is fixed a set of five inking-rollers. The centre one, however, is larger than the rest, and alone touches the ductor apron, thus supplying the ink surface with ink. By means of cams the whole series of rollers are made to traverse the form between every impression, the centre one being kept above the surface of the type, however, by a bearer on the side of the type-bed. This centre roller possesses a side motion to and fro, which facilitates the distribution of ink. The platen is forced to the surface of the form perfectly square, and is moved back almost to a horizontal position again to receive the sheet.

When alterations, &c., are required to be made in the form, by moving a lever the type-bed can be brought to the top, thus answering the purpose for an imposing surface.

Its general arrangement may be understood by reference to the diagram. A is a cylinder, part of whose circumference is cut away, forming the plane surface B for the type; 1, 2, 3, 4, 5, are rollers, all of which traverse constantly round the cylinder and across the type in the direction of the arrow. The rollers 1 to 4 take ink from the cylinder and deposit it upon the type. The roller 5 does not touch the form, but takes ink from the endless apron D, and distributes it upon the cylinder; this roller 5 is formed with a screw upon its surface, which acts like ordinary waver rollers. The apron D is supplied

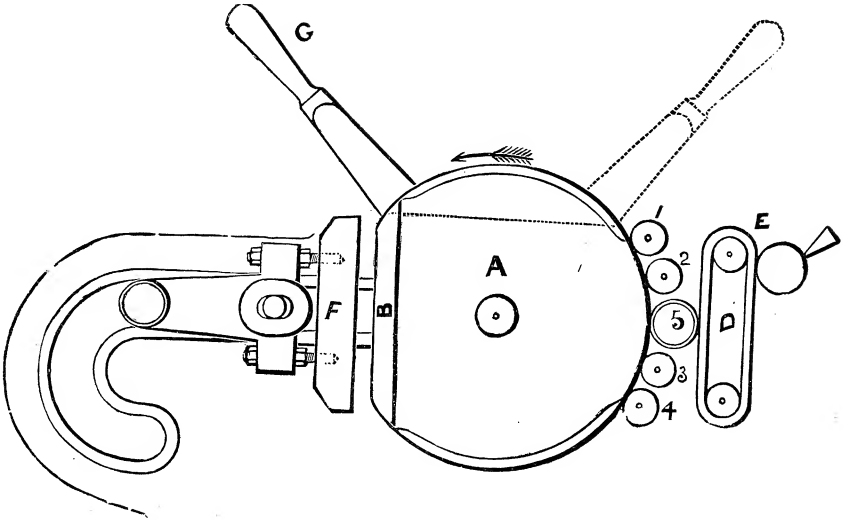

Fig. 69*b*.—Diagram of Invictus Platen Machine.

A, Cylinder.
B, Type-bed.
D, Ductor-band or Apron.
E, Ductor.
F, Platen.
G, Platen Lever.
1, 2, 3, 4, 5, Rollers.

The dotted lines at top show position of type-bed when moved by lever F.

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with ink by revolving in contact with the ductor-roller E. The platen F is brought up to the form perfectly square with the type, and is turned back nearly flat to receive the sheets to be printed; this movement is accomplished without the aid of cams. A throw-off and impression movement is connected with the platen. Means are provided for stopping and starting the machine instantly without stopping the fly-wheel.

The "SIMPLISSIMUS" is another platen machine which is adapted to the printing of small jobs. It is worked solely by hand; the inking, printing, &c., being performed by the one operation of depressing the handle. The impression is obtained by the application of the elbow joint or toggle, so that little force is required in the working. The printing can easily be accomplished by the left hand, the right being occupied by laying-on and taking-off. The later machines are provided with a lifting head. The bed may, therefore, be used as an imposing surface when necessary, which is sometimes an advantage.

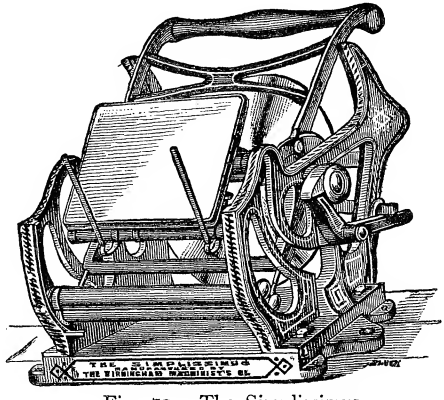

Fig. 70.—The Simplissimus.

In consequence of the demand for this machine, new and improved patterns of it were made, an ink-ductor being added, and the numerous testimonials in their favour speak highly of their merits.

The making-ready on all the above machines is a very simple matter, and can be safely intrusted to an apprentice with but little experience. Several sheets of paper are fixed on to the platen, being fastened in position by a slight iron frame. The form can be easily and securely fixed in the horizontal bed by means of the clamps and screws. After underlaying (if the form be composed of plates) the overlay can be placed upon the platen, upon which an impression must have been previously pulled, and after running up colour, regulating the ink-supply, and putting another clean sheet over the making-ready, all is ready to proceed.

The ductor is regulated by thumb-screws at the back, and little trouble will be caused in the distribution, as this has been carefully studied in all. We have found the patent composition peculiarly adapted for use on these machines, to which also the Lanham Patent rollers would be especially suitable.

In fixing the above machines care should be taken that they are bolted to an independent frame secured to the floor, as steady motion is absolutely necessary to ensure good work.

We must call attention to an ingenious Combination Machine made by Messrs. Newsum, Wood, & Dyson. This is admirably adapted to commercial printers, as it will with slight alteration print either from stone or type. Though not a platen, it is capable of producing good work. The cylinder is provided with a tripping motion, and the rollers can be lifted off the stone or type to facilitate the running up of colour, &c., in making ready. Fitted with the Lanham rollers the time taken in the necessary alteration from litho to letterpress is reduced to a minimum, change of rollers being thus rendered unnecessary. This machine is fitted with a taking-off apparatus without tapes.

PART IV.

ROTARY NEWSPAPER MACHINES.

CHAPTER XXI.

General Remarks on the Construction, Management, Capabilities, and Use of Rotary Machines.

AS we mentioned at the commencement of this work, it is not our intention to notice the Fast Newspaper Machines at the same length as those used in magazine and fine-art printing. We therefore confine ourselves to a description of the salient points of the several machines now in most favour at various English newspaper offices.

In regard to the qualifications of the manager of Rotary machines it may be remarked, that although a knowledge of making ready cuts, &c., is of course generally desirable, it is to a certain extent superfluous in the case of a newspaper machine-minder. What is most required of him is that he should be methodical, clear-headed, and, above all, expeditious. It is a great advantage if he is a practical mechanic, as his duties are nearly as much allied to that profession as to that of printing.

Owing to the speed at which rotary machines are driven, slight difficulties frequently arise which require the experience of a practical engineer to deal with them. A short delay is always a serious matter, consequently facilities should be available to speedily remedy any mishap. In addition to keeping a staff of mechanics, most newspaper offices have duplicate machines ready for emergencies. A short experience will, however, soon enable the machine-minder to discover the weakest part of the machine, and duplicate wheels, bolts, &c., should be kept in stock, in order that a breakage may be readily repaired.

Great and rapid strides have of late been made in the

improvement of fast newspaper-machines, leading to the introduction of the principle of printing from the continuous roll of paper, and the purely rotary machine, without much wear-and-tear, and with comparatively little attention, will now perfect from 8,000 to 22,000 sheets per hour.

All that is required in the making ready of ordinary newspapers is that the stereo plates should be fairly level in thickness; and they are now cast so accurately as to give little trouble to the machine-minder. Underlaying is nevertheless sometimes required. In consequence of the great wear the rollers are subjected to, they used to frequently get out of order, especially in hot weather, when, if not carefully watched, the composition would fret or burst, causing serious delay. The patent composition was introduced to meet this difficulty, being less affected by the temperature. The Lanham patent "Victory" rollers have recently been used with great success, and as their surface is both firm and elástic, they are a boon in all newspaper offices.

Care must be taken that the impression upon the edges of the plates is not sufficiently great to cut through the paper, as this is often the cause of the latter breaking in its course through the machine, being weakened by the perforations; besides which nothing looks so slovenly in a newspaper as the heads or sides of a page being severed from the margin.

The paper is perhaps the source of the greatest anxiety, for if it is not made of sufficient strength, or is unequal in substance, it will not withstand the constant and sometimes uneven tension. The resistance offered by the weight of the reel is counterbalanced in a great measure by the nicety with which the spindle round which it is rolled is adjusted; but it is necessary to see that the bearings are well lubricated, to prevent any dangerous strain from this cause.

The operation of renewing the reels of paper is a very simple process, as in the majority of instances the supports are placed so near the ground that with the assistance of a crowbar the fresh roll can be placed in position in two minutes at most. In fact, we have seen this performed on

a Prestonian under a minute, including the pasting of the end of the new roll to the finish of the last. In some instances a double set of supports is supplied, so that one reel is always in readiness for attachment.

Various methods are employed for wetting the roll of paper. A corrugated drum, the invention of Mr. Colley, is in some instances employed; a plain drum in others; while in some a number of jets of water are thrown upon the paper while the reel is being unrolled, which is performed by the machine itself. The latter plan seems to be the most effective.

During the last few years many engineers have turned their attention to the production of Rotary Machines. The large ten-feeder Hoe enjoyed for some considerable time the reputation of being the quickest machine, but it required many hands to work it, and laboured under the disadvantage of only being able to print on one side at a time. The sheets delivered to the taking-off board therefore only represented half the number of perfect copies. The introduction of the two-impression cylinders and the reel of paper soon superseded the original Hoe, for besides dispensing with the layers-on and takers-off, its net production was at least 50 per cent. greater. In addition to this, the lay and register could not possibly be defective, whereas on the Hoe the register was dependent on the lay when perfecting.

It may also be stated that less space is required for their erection, and the driving-power necessary is considerably reduced. Indeed, their unqualified success leads us to hope that at no distant time we shall be enabled to print good cut-work on the same principle. It seems to us that it only requires the type-cylinders to be of adequate circumference in order that the electros of engravings may be bent without injury to the work. Together with this, there should of course be sufficient distribution. Mr. Ingram, proprietor of the *Illustrated London News*, in conjunction with his manager, Mr. Brister, has recently constructed a machine on this principle, and it has, we are told, fulfilled the great hopes that were entertained of its ultimate success. Of course, this class of machine would only be useful for the print-

ing of long numbers, but there are so many illustrated periodicals now published which circulate above 100,000 weekly, that we believe a really successful and relatively cheap machine would speedily be adopted.

The principal and most successful of the Web Machines in use in England are the Walter, Hoe, Victory, Prestonian, Northumbrian, and the Marinoni. Of the above, the Walter is the most expensive, the new Hoe costing nearly as much. The Marinoni and Northumbrian are the most economical in point of cost. The Whitefriars, originally introduced as a two-feeder perfecting-machine, has lately been constructed to print from the reel, and this machine is now made in such a manner as to admit of its being fed from the reel or by feeders, the alteration being speedily effected.

It would be invidious to select any of the above as being superior to the rest. We have found that each machine is strongly recommended by every office where it is used, and as arrangements for wetting, cutting, and folding are fitted, or can easily be fitted, to all, the question of superiority really resolves itself into which machine can produce the greatest number of copies per hour.

CHAPTER XXII.

The Hoe and the Northumbrian Rotary Machines.

BEFORE the introduction of the purely rotary machine, the large six and eight feeders of Messrs. Hoe's construction were universally adopted in the production of daily newspapers. The first erected in Europe was made for the Parisian paper *La Patrie*. We believe this to have been only a four-feeder, and capable of printing 4,000 copies per hour on one side. The inventor saw, however, that by increasing the number of feed-drums and the size of the type-cylinder, the number produced could be proportionably multiplied, and in a short time these machines were made with as many as ten feeding-drums. As the large cylinder

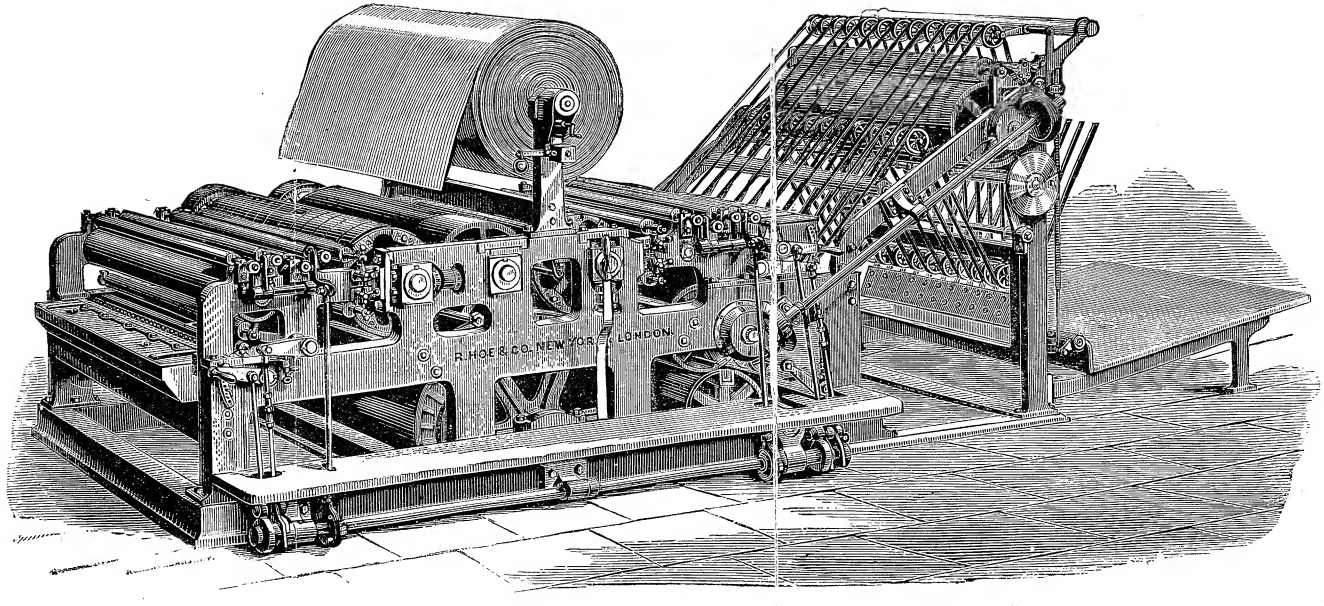

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Fig. 71.—The Hoe "Web" Perfecting Machine.

made 1,000 revolutions per hour 10,000 copies were printed in that space of time, but, as before mentioned, on one side only. The first machine started in England was erected to print *Lloyd's Newspaper*. Shortly after this the *Times* ordered two, the stipulation being imposed that they should be built by an English firm. Sir Joseph Whitworth was selected by Messrs. Hoe, but in consequence of the gradual adoption of their machine, Messrs. Hoe soon found it necessary to erect a factory in this country for the purpose.

The great space required for their erection, and the multiplicity of hands necessary in their working, rendered them, however, very expensive machines, and immediately upon the introduction of the reel they were discarded. The inventor of the first Hoe machine certainly deserves great credit, as it undoubtedly led our modern engineers to turn their attention to the rotary principle. Added to this it was simple in construction, and consequently rarely out of repair, two qualities readily appreciated by the newspaper printer.

The enterprising makers of the Hoe machine, however, were not to be left behind, and in 1873 they made their purely Rotary Machine, which was speedily introduced into this country, the first one singularly enough, as in the case of the previous machine, being erected to print *Lloyd's Newspaper;* similar machines are now also used in the *Telegraph*, *Standard*, and *Daily Chronicle* offices. We may mention that four of the Hoe Rotary have been erected to print the *Liverpool Mercury*. These latter machines were made in New York.

Though in appearance it is somewhat similar to other rotary machines, it differs in many material points. The roll of paper is placed immediately above the type-cylinders, which are fitted in a horizontal frame. The second impression-cylinder is three times the diameter of the first, and, unlike the latter, which is parallel with the type-cylinder, lies underneath. The advantage of having this cylinder larger is soon apparent, as it will be noted that the impression is given on three different portions, so that it obviates, to a certain extent, the set-off. The size of

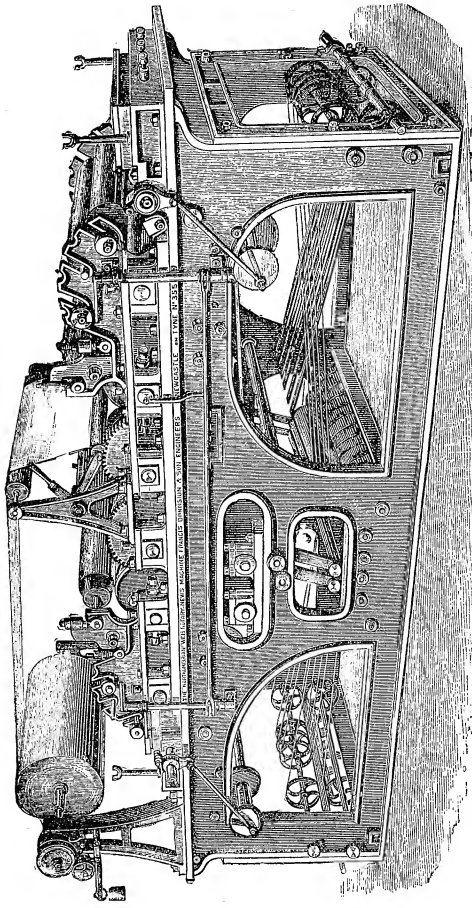

Fig. 72.—The Northumbrian Rotary Machine.

the machine is as follows: Length, 19 ft.; width, 8 ft.; height, 8 ft.

The sheet, after having been printed by the inner form, passes under the cylinder to the outer, and thence between two cutting-cylinders, which are the same in diameter as the type-cylinders. The knife does not completely sever the sheets, a process which is effected by a separate series of tapes, which travel faster than those on the main portion of the machine, and drag the sheet away from the succeeding one, placing a regulated space between them. The sheets then travel over a drum having a slightly greater circumference than the length of the paper, and when nine or any desired number of sheets are gathered they are directed by a switch down the flyers, and are deposited on the taking-off board. A plan for dividing the sheets into quires has been adopted in Messrs. Lloyd's. Upon the delivery of every 27 sheets (which is the regulation quire of *Lloyd's*) the table is slightly moved by means of cams to the right or left, as may be most convenient; consequently the quires can be easily and quickly separated as required.

The inking apparatus to each type-cylinder consists of two drums parallel with each other, and they are each provided with a series of vibrators and wavers. These are placed in the horizontal side-frame on the same level as the type-cylinders.

Speed.—The machine prints upon an average 14,400 perfect sheets per hour, and it is unnecessary to say that the fitting is in every respect exact.

Folding-machines can be fitted when required.

As is the case with all the rotary machines, a complete stereo foundry is specially supplied.

THE NORTHUMBRIAN ROTARY.—This machine is the invention of Messrs. Donnison, a firm of printers' engineers, of Newcastle, and is better known, perhaps, in the North of England than amongst London printers. It is used in printing the *Edinburgh Evening News*, *Sunderland Daily Post*, and the *Dundee Evening News*.

It consists of six cylinders arranged parallel to each other in a horizontal frame, those at each end being used

for the distribution of the ink. Next to the ink-drums are placed the type-cylinders, the impression being given by the two centre ones. The paper is placed at either end of the machine above the cylinders on standards, and when one is exhausted the other can be quickly attached. Thus little time is lost in re-starting. The paper passes horizontally from the reel over a roller directly above the centre of the machine, then on to the first impression-cylinder, and from thence to the second. It is then conducted to the cutting-cylinders beneath, when, by means of an oscillating frame or divider, it is directed alternately into sets of delivery-tapes on either side. The sheets are then struck down to the taking-off boards by means of flyers. The latter necessarily have a rapid motion, but as they only rise the fifth of a right-angle they perform their work steadily and satisfactorily.

The ductors are placed behind the ink-cylinders, which are each provided with three wavers.

An improvement is to be noted in this machine in the unwinding of the reel, which is assisted by a small roller placed directly above and working upon the inner form cylinder. By this the drag is considerably reduced, the small roller mentioned performing the work which is mostly done by the cylinders as the impression is taken.

Size and Speed.—A machine large enough to print the *Times* measures 14ft. by 5ft., and about 5ft. 6in. in height. As there is no gearing below the base of the frame no pit is required. The average speed is about 9,000 perfect copies per hour.

CHAPTER XXIII.

The Marinoni and the Victory Rotary Machines.

MESSRS. MARINONI'S first newspaper machine erected in England was made for the *Echo* in 1868. It was a six-feeder, and differed from other machines of its kind inasmuch as it *perfected* the sheet. It was certainly a great success, as each layer-on fed 1,500 copies per hour, the net product for the six boards being 9,000 double

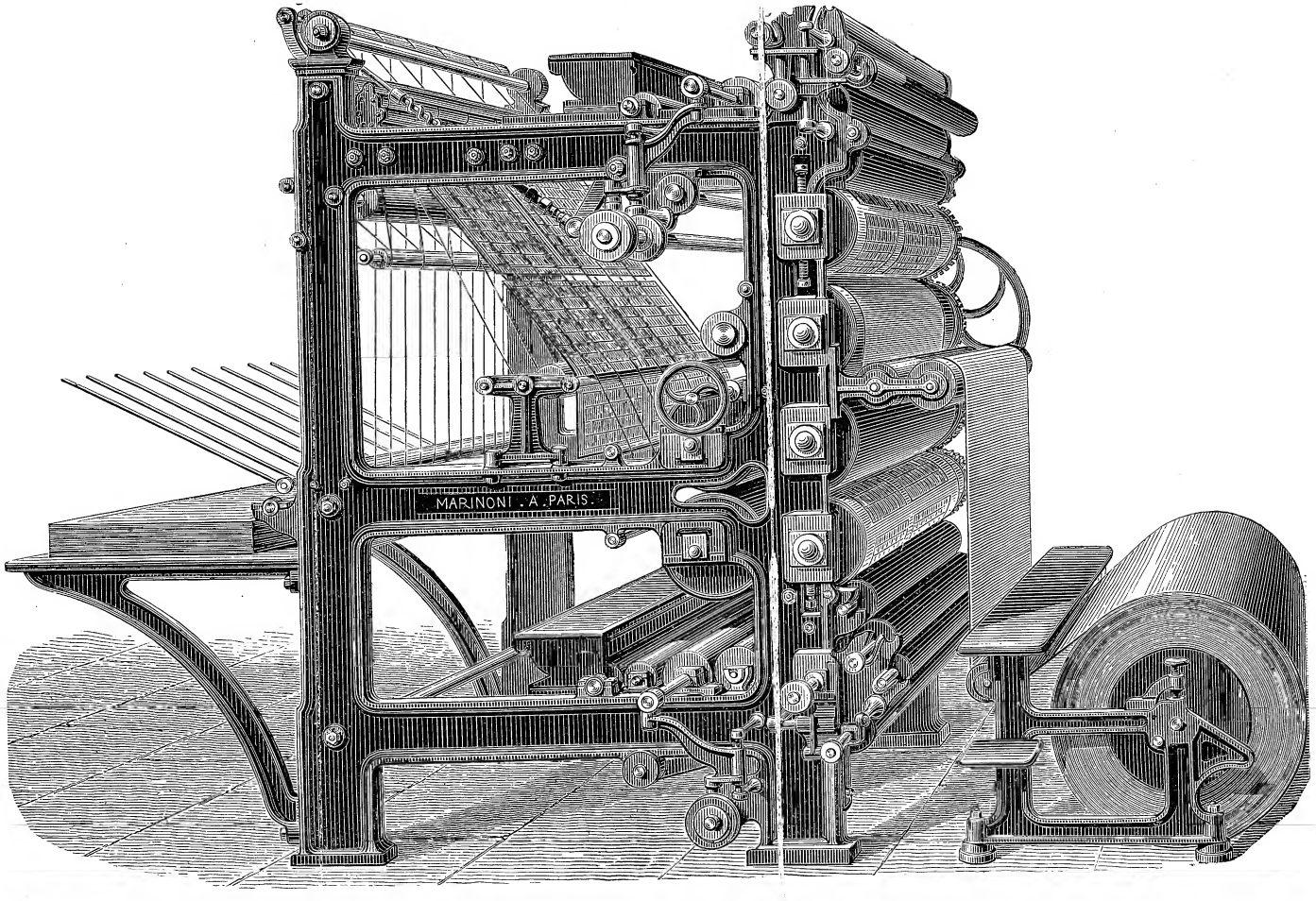

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Fig. 74.—The Marinoni Rotary Machine.

sheets, but in reality 18,000 perfect copies of the *Echo*. The sheets were taken off by flyers, of which there were four sets. The great success of the rotary method, however, soon induced Messrs. Marinoni to turn their attention to a machine constructed on that principle, and they speedily eclipsed their former efforts. The Marinoni Rotary machine was put up first for the *Echo* in place of the six-feeder originally erected. There are several now at work in London, the more recent having been supplied to the *Globe* and *Dispatch*. This latest introduction is not only to be com-

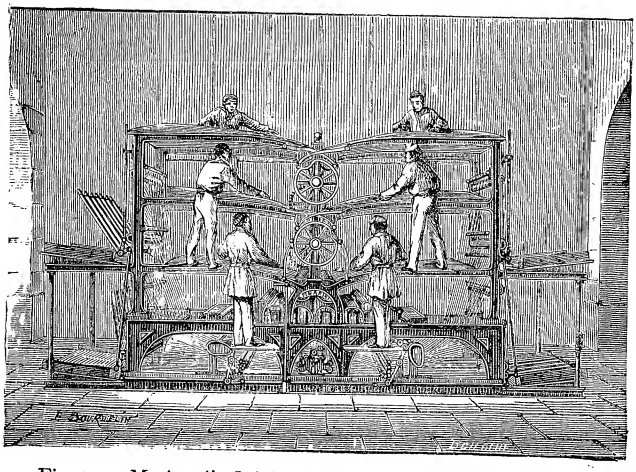


Fig. 73.—Marinoni's Original Six-Feeder Perfecting Machine.

mended for the rapidity with which it prints, but also for its compactness and general finish. It does not occupy much more space than an ordinary perfecting-machine, and its construction is extremely simple.

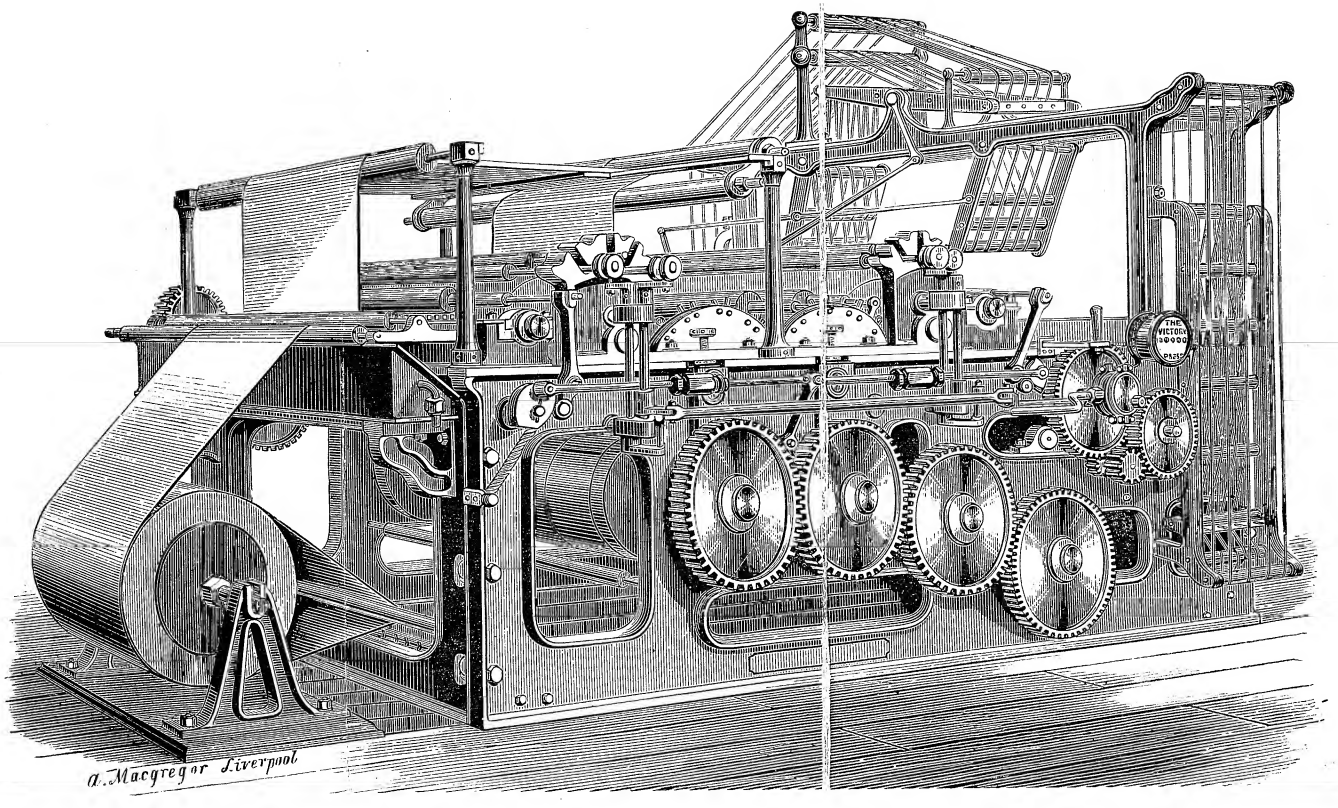
It consists of four cylinders arranged immediately above each other, the two centre ones being used for the impression, the plates being fixed on the top and bottom cylinders. The ductors are situated near the plate-cylinders, which are each provided with sets of rollers, the wavers having a side motion imparted by eccentric cams. Only one set of flyers

is used, but it will be seen that the sheets could not be deposited sufficiently quick if the sheets were taken singly. A very ingenious and similar mode to that used on other rotary machines is adopted. The sheets are collected together on two "gathering-drums," and when five sheets are gathered a set of tapes on a vibrating-frame moves out and directs them down on the flyers, which deposit them on the taking-off board.

In order that any creases caused in the wetting may be taken out, the paper is conducted between two smoothing-rollers prior to printing, as in other machines of this principle. Beyond a man to lift the sheets from the taking-off board no labour is required, except the placing of the reels of white paper as they are exhausted. As the paper is placed on supports which stand on the floor, this is a matter of but a few moments.

To one of the Messrs. Marinoni's latest machines erected at the *Globe* office has been fitted a folding-machine. This necessitates a slight alteration in the manner of taking off. The gathering-drums are dispensed with, the sheets after having been cut passing horizontally between tapes under two folding-knives, which strike them down between a set of rollers, after which the last fold is administered by another knife having a side motion. The folded sheet then passes between smoothing-rollers, and is duly led to a box; and so great is the rapidity at which the sheets are delivered that it takes one boy's constant work to empty the receptacle. The average speed is 10,000 perfect copies per hour.

THE VICTORY ROTARY MACHINE was invented by Messrs. Duncan & Wilson, of Liverpool, and can, perhaps, boast of as large an amount of patronage as accorded to any web printing-machine. It is employed by many of the provincial newspapers, and the one erected for the *Globe* newspaper, which has been running for some considerable time, has given the fullest satisfaction, as certified by the testimonials from the proprietors of that evening paper. We are assured that there are at present upwards of fifty-four Victory printing and folding-machines in work at the present time.



To face p. 145.] Fig. 75.—The Victory Rotary Printing and Folding Machine.

The first was erected to print the *Glasgow Star* in 1870, but considerable improvements have been made in various details since that time.

The roll of paper is supported on low brackets, and on being unwound is immediately wetted by a patent apparatus, which consists of a perforated pipe from which fine jets of water are directed against the side of a long narrow trough. This has the effect of dispersing the spray, which evenly damps the paper without soddening it. After this it passes between two rollers and over a board, which helps to smooth it before printing. The paper is then directed down between the inner-form plate and impression-cylinders, and is printed from the outer form by being passed directly to two similar cylinders.

The inking apparatus consists of large revolving drums, round which are fixed a series of vibrating-rollers. The ink is supplied in the ordinary manner by vibrators.

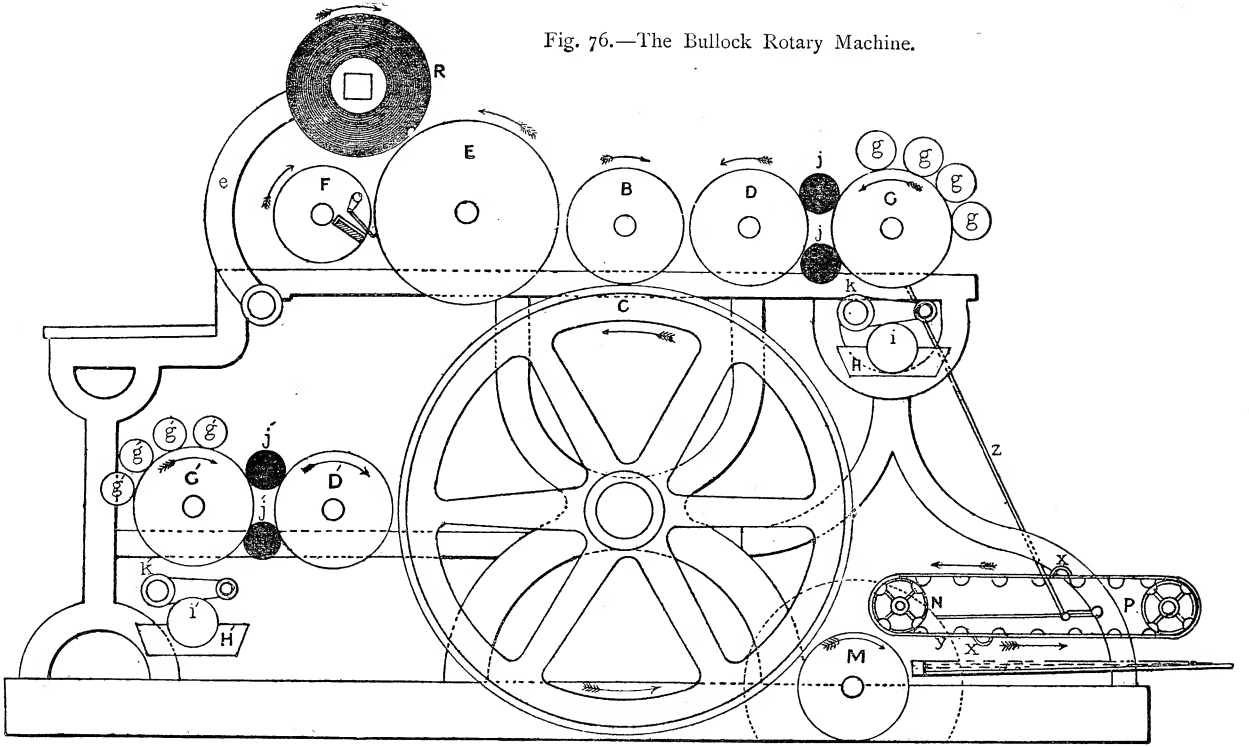
One of the specialities of the Victory machine is the folding apparatus attached. Immediately the paper leaves the outer-form cylinder it is cut lengthwise, and the paper here receives its first fold, after which, in the case of the *Globe*, which is printed in duplicate, it is cut in half by a circular knife. The remaining fold is then given to each of the papers, when they pass through separate small smoothing-rollers, and are delivered by a kind of rocking motion at the top of the machine.

The weight of the Victory is about 10 tons; its length, 18ft. 7in.; breadth, 7ft.; and height, 6ft. 10in.

With the Victory machine is supplied a complete stereo apparatus, peculiar to the machine.

In some respects this machine has been made to accomplish more than any other yet invented. One has been sent to New York, by which, after the printing is performed, the sheets are folded and the back pasted. A duplicate machine, driven by gearing from the larger, prints a wrapper, which is conducted by means of tapes to the folded sheet; and a pamphlet is actually delivered printed, folded, and bound in a neat cover by the same machine. Can a machine be expected to perform more?

Fig. 76.—The Bullock Rotary Machine.



CHAPTER XXIV.

The Bullock and the Ingram Machines.

THE Bullock machine was the invention of the late Mr. William Bullock, of Philadelphia, and was completed in 1865. It was claimed by the inventor to be the first really automatic printing-machine ; but it is not in our province to enter into the controversy, as doubtless other makers would dispute its right to be considered the original. As we have mentioned before, all rotary machines are more or less like each other, and necessarily so, the main principle being in all cases the same.

Unlike the machine of more recent construction the paper is cut into proper lengths before receiving the impression, thus necessitating the use of grippers.

The roll of paper (R), after having been wetted by the corrugated drum, is placed on the brackets, e (Fig. 76), and passes between the cylinders, E and F, the latter being provided with a knife fitting into a slot on the cylinder, E. Immediately the sheet is severed from the roll it is seized by a set of grippers on the latter cylinder, and is taken by the impression-cylinder, B, and passes in the direction of the arrow down to the large cylinder, C, receiving the impression from the inner form type-cylinder, D. It is then seized by the cylinder, C, and carried to D′, where the outer form is printed. The perfected sheet is still held by the large impression-cylinder until it reaches M, which takes it and delivers it to the set of belts, y, the grippers on which carry it above the taking-off board, t. Between the fly-belts, which are made of india-rubber, are placed a set of flyers worked by the rod z from a cam on the shaft of the distributing-cylinder, G. This cam is constructed so that when the sheet has travelled a given distance in the direction of the arrow forces the sheet down on to the board, t. The opening and shutting of the grippers are governed by a series of cams placed within the circuit of the belts. In order that the belts may work with the required regularity lugs or cleets are fastened on the under side, which fit into the wheels at either end.

The ductors (i, i',) are placed immediately under the distributing-cylinders, G, G', and the ink is conveyed by the vibrators, K, K'. The wavers (of which there are four to each form) are situated round the top, G, G', and have a side motion to insure perfect distribution. The supply of ink to the type is continuous, the inkers resting on the ink-drum, G, G', and the type-cylinder, D, D'.

The advantages claimed by the maker of this machine are, that it is simple in its operation,—tapes being dispensed with,—and that it occupies but comparatively small space. That the absence of tapes is a boon we admit, but this merit is counterbalanced by the numerous grippers, no less than seven sets being required for this machine. It is a well-known fact that grippers are apt to give a deal of trouble, especially on fast machines, and a stoppage consequent upon a slight derangement would be, indeed, a serious matter in the production of a daily newspaper with limited machinery at disposal. Tapes wear, and frequently break, but the removal is but the work of a few moments, whereas a slight difficulty with the mechanism connected with the gripper would possibly involve a long delay. On the whole, therefore, we prefer the use of tapes to grippers; but it would not be advisable to adopt the former when the sheet is separated from the roll *before* printing, as tapes on extra-fast machines are sometimes liable to travel unequally, which might cause defective register.

While speaking of the cutting of the paper before the printing, we may mention that by this means it is possible to use common paper, as there is no possibility of its breaking in its course through the machine, there being no tension.

A machine similar in construction to the above is also made as a two-feeder, and has been some time in use in printing the *Field*, &c. This machine is singularly successful, and capable of printing 4,000 perfect copies per hour. It is also suited for book-work and cut-work, owing to the size of the impression-cylinders and the excellent inking arrangements.

The space required for the erection of a Bullock, *Times'* size, is only 11ft. by 6ft. The guaranteed speed is 10,000 per hour.

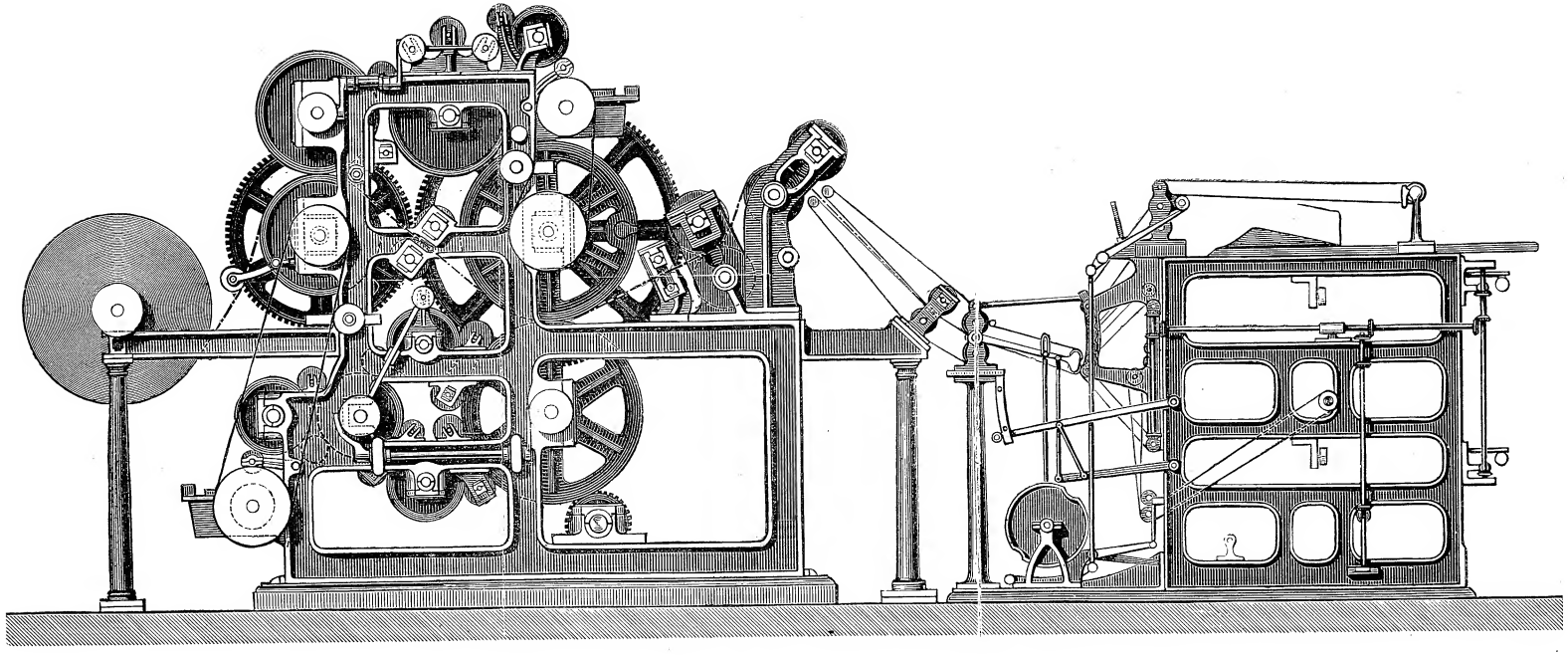


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Fig. 77.—The Ingram Rotary Printing and Folding Machine.

THE "INGRAM" ROTARY MACHINE.—We are convinced that the time is not far distant when the majority of Illustrated Magazines, at least those magazines which boast of a large circulation, will be printed on web rotary machines. The first step in this direction is undoubtedly entitled to be claimed by the inventors of the Whitefriars, which machine was speedily followed by the "Ingram."

The peculiarity of the "Ingram" machine lies in the outer form plate-cylinder being sufficiently large to admit of three duplicate sets of plates being laid on. The advantage of this arrangement is that owing to the increased diameter of the cylinder the plates are curved in a very slight degree, thus overcoming the objections of the possible widening of the spaces between the fine lines in the cuts, which is urged against machines where small cylinders are employed. It will also be seen that to every revolution of the impression-cylinder three copies are printed. The inner form-cylinder is of less diameter, taking two sets of plates; and it therefore travels one-third faster than the outer. This is of little consequence, as cuts are rarely placed in the inner form, and hence the length of "dwell" at the point of contact matters little.

The distribution of ink on this machine is almost perfect. The ink is transmitted over a series of drums, and finally carried to the main inking-surface. Four inkers rest both on the form and the inking-drum, so that the supply of ink is continuous.

The paper passes directly from the reel to the outer-form cylinder, and from thence down to the inner, immediately after leaving which a perforation is made by means of a small drum and knife between every perfect sheet. The paper is then conducted into a distinct series of tapes, travelling at a greater speed, which tear the sheet at the point at which it is perforated. The detached sheet is then carried to a switch, which directs it into a two-feeder folding-machine, and it is then delivered folded on to its board.

The switch and folding-machine can be instantaneously thrown out of gear when required, and the sheets are then delivered unfolded on the taking-off board in the ordinary way.

This machine is only adapted for long numbers, as some time is necessarily spent in the making-ready of the outer form, which of course takes three sets of overlays, while the inner takes two. Added to this five sets of plates are required instead of two, as on the other machines.

The speed at which the "Ingram" prints the *Illustrated Penny Paper*, for which it was specially constructed, is 7,000 perfect copies per hour, and the quality of the work is in every way satisfactory.

The machine was originally started in 1876, since which time it has worked uninterruptedly without anything having occurred to mar its undoubted success.

Messrs. Middleton are the makers, and we have rarely seen a finer specimen of engineering work. Messrs. Harrild manufacture the folding apparatus which is attached.

CHAPTER XXV.

The Walter Press and the Prestonian Rotary Machine.

PRIOR to 1814 all newspapers were produced by hand, and to Mr. Walter, the father of the present proprietor of the *Times*, belongs the honour of having first applied steam to newspaper-printing machinery. Before the date mentioned, the circulation of papers was very limited, to a large extent in consequence of their having to be printed at hand-presses, their production being consequently slow and expensive, added to which only comparatively small forms could be printed. On the 29th November, 1814, the *Times* was first printed by steam at the rate of about 1,100 impressions per hour.

In 1816, Kœnig, who made the first machine for the *Times*, improved it so far as to enable it to produce 2,000 impressions an hour. Messrs. Cowper & Applegath improved again on this model, and in 1827 made a machine for the *Times* capable of printing 6,000 sheets per hour on one side. In 1857 the leading journal adopted the American Hoe ten-feeder, which gave about 20,000 impressions per hour on one side of the sheet. This machine as we have before mentioned employed ten layers-on.

The present Mr. John Walter, not being satisfied with the produce of the large cylinder Hoe, for some considerable time experimented upon a machine which should not only surpass in speed those in use, but would feed, wet, and take off the sheets automatically. Assisted by Mr. J. C. Macdonald, the manager, and Mr. J. Calverley, the chief engineer of the *Times* establishment, after four years' hard work and anxious experiment the present machine, known as the Walter Press, was perfected, and in 1866 it was patented. Although several improvements have been introduced in the minor details of the machine since that date, the general principle remains the same.

It will be noticed that nearly all the rotary machines now in use are made upon the same principle as the Walter, varying of course in the arrangement of the details, but leaving little doubt as to which was the original.

The roll of paper is placed at the end of the machine upon two standards. It is put in position in the same state as when delivered by the makers—perfectly dry. Each reel contains sufficient paper to print about 5,500 sheets of the *Times*, and weighs nearly 800 lb.

The paper passes over a tension-roller, and then over and under two damping-cylinders. The latter, which are covered with blanket, are hollow, and perforated. These cylinders are filled with sponge, absorbing the water which is injected through pipes introduced through the axle. The rapidity of the revolutions forces the water through the blanket which damps the paper. In order that the water may not remain on the surface, the paper after being wetted passes between rollers of the same diameter as the damping-rollers, and they press the moisture into the texture. This has been simplified in the machines of recent construction by the substitution of two steam damping-cylinders. To prevent any drag in the printing, the paper is then conducted between two small rollers, the surfaces of which travel at the same speed as the impression-cylinders. The plate and impression-cylinders are arranged one above the other, the top and bottom ones carrying the plates, those in the centre being used for impression. The paper

passes over and under the centre cylinders; the side of the paper being thus reversed in the operation. In order that no perceptible set-off may occur, a large surface-drum of the same diameter as the second impression-cylinder works in contact with the latter, removing the ink which accumulates on the blanket. The ink thus removed is again taken by a small absorbent roller, working flush with the metal cylinder.

After the paper has been printed on both sides it passes directly to the cutting-cylinder. The sheets are not entirely separated, being still joined by two narrow strips. The paper is then directed up a series of tapes, which travel faster than the cutting-cylinder. At a somewhat greater distance from the cutting-cylinder than the length of the sheet are placed two small rollers, which tear the complete paper from the next following. The sheets are then conducted between two rollers, and by a dividing motion are directed perpendicularly down a series of tapes, of which there are two sets, to receive the paper alternately when the flyers strike them down to the board on either side.

In order that the sheets may not be torn as they are deposited by the necessarily quick motion of the flyers, the fingers of the latter are bowed in the middle, forming a point at the end.

Each form is supplied with a separate inking apparatus, and consists of two large distributing-drums, which are fed from the ductor by composition vibrating-rollers, some of which have a side motion to aid the distribution. The inking drums of the outer form, &c., are placed parallel with the plate-cylinder, and the inner form is supplied from underneath. We may mention that the ink is stored in a cellar or well below, and pumped into the ductors.

Speed and Dimensions.—The average speed of this machine is 12,000 perfect copies per hour. It is about 19 feet long, 6 feet wide, and 7 feet high.

In order that the machine may be as perfect as possible, a *folding* apparatus has been constructed which can be attached without involving any material alteration in the delivering apparatus. The folder, which is necessarily in

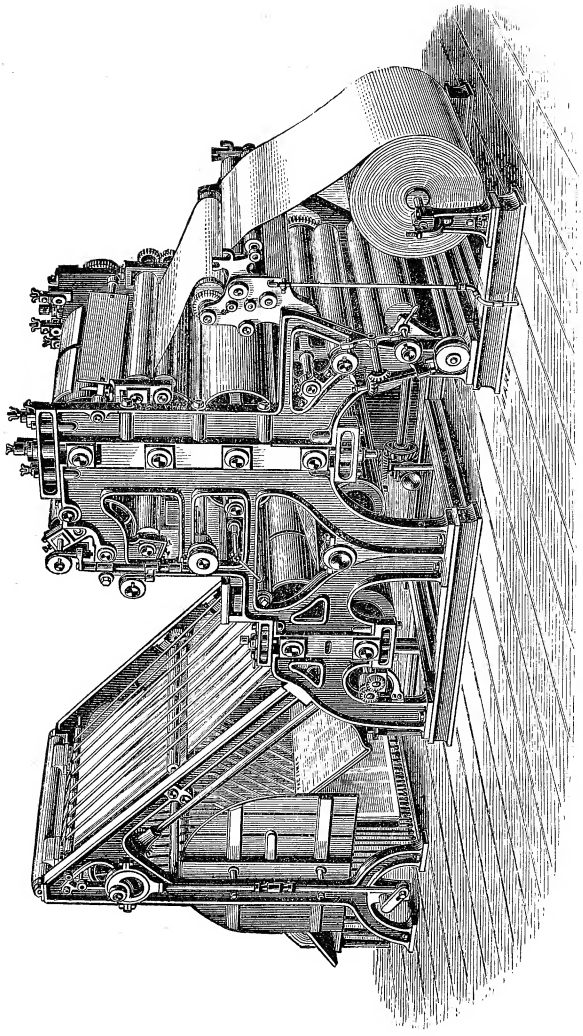

Fig. 78.—The Walter Press.

duplicate to keep pace with the rapid printing, is placed at the end of the machine below the swing-frame, and the sheets are conducted to it by tapes working horizontally. When the back or centre of the sheet arrives in position a knife descends, forcing the sheet between two rollers of the folder, the first fold thus being made. The sheet is then carried between another set of rollers, and by means of a knife similar to the first, but placed vertically and working longitudinally, the second fold is made. The third and fourth folds are given in a like manner.

THE PRESTONIAN ROTARY MACHINE.—The inventor and maker of this machine is Mr. Joseph Foster, engineer, of Preston, from which town the machine derives its name. It may be classed with the most successful of web-printing machines. The principle of the machine differs from all others, being capable of printing from either type, stereotype plates, or both combined, which may be considered a decided advantage. Although several important provincial papers have adopted the "Prestonian," this machine was almost unknown in London until the proprietor of the *Standard* had several erected, and which are now mostly used for the evening edition.

The sectional illustration will illustrate the principle of the Prestonian:—The type cylinders, A and B are placed parallel to each other, horizontally fixed in bearings on substantial framing, and are about 3 ft. 6 in. in diameter. It is this large size that admits of moveable type being used, which is of great advantage in the case of a paper where items of news are frequently inserted. The forms T T are easily accessible to the workman. Adjacent to each type-cylinder are the four impression cylinders, 1, 2, 3, 4. The web of paper W is first printed by the inner form cylinder A. As the form occupies only one-fourth of the circumference of the cylinder A, at each revolution four successive impressions are made. The paper passes to the outer form cylinder B, and is perfected on the impression cylinders 5, 6, 7, and 8, in a similar manner. The drums between each impression cylinder are simply carrier rollers, for the paper to pass round. The

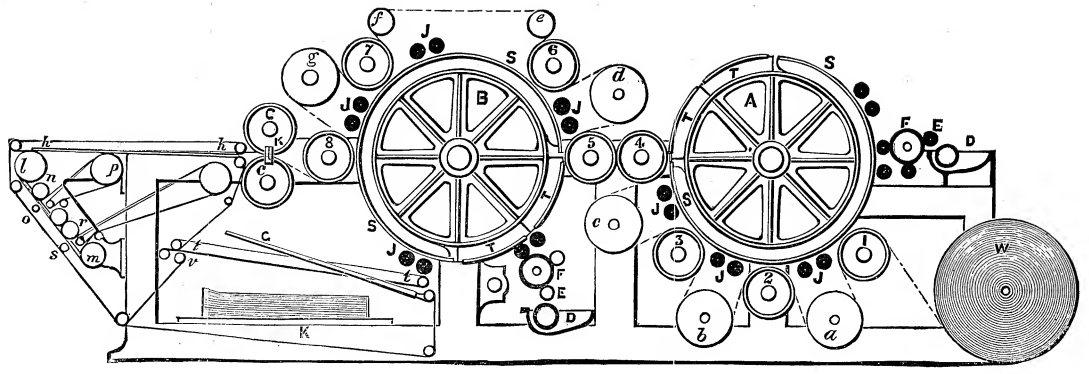

Fig 80.—Sectional view of the Prestonian Rotary Machine.

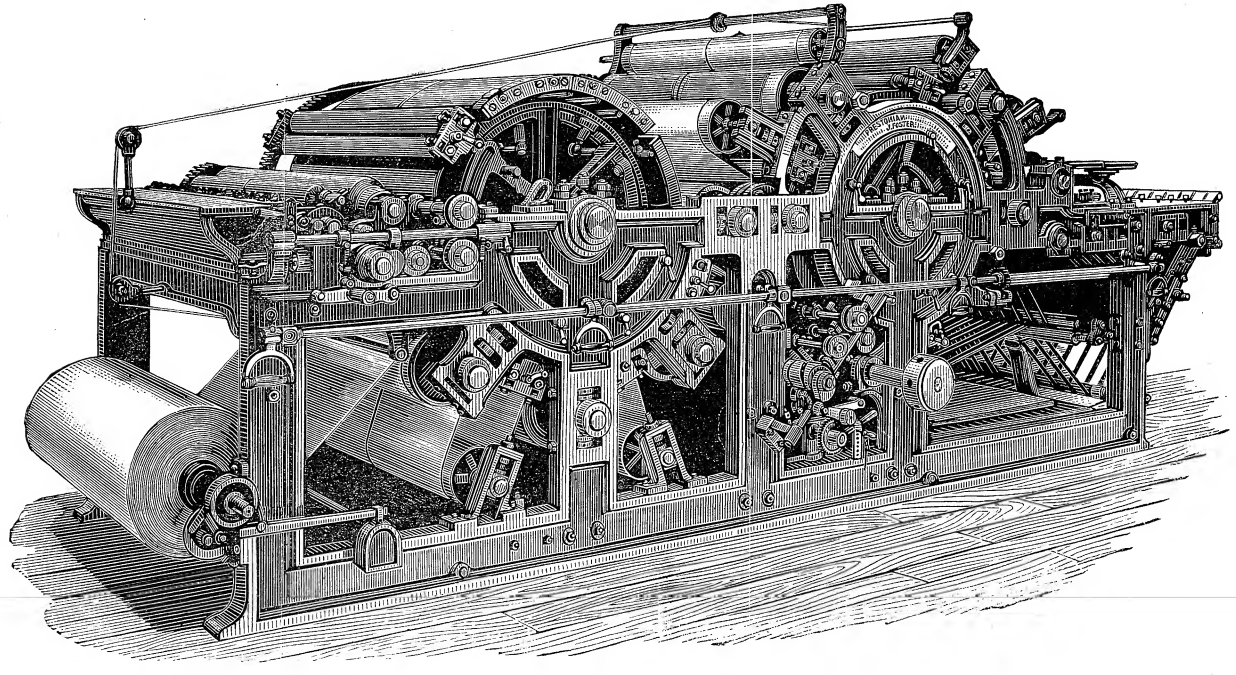

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Fig. 79.—The Prestonian Rotary Machine.

web of paper now being printed on both sides, passes between the two cutting cylinders C C, and is perforated across its entire breadth, when on reaching the roller *l*, which is driven a little quicker than the web of printed paper, it is severed at the points of perforation. The sheets are deposited by the flier G, on to the receiving-board K, by means of rollers *m*, *n*, *r*, *p*. The ink is contained in the ductors D, being distributed on the cylinders F, as well as upon that part of the type cylinders not occupied by the forms S S.

Amongst the latest improvements in the "Prestonian" may be mentioned the folding machine. The methods of giving the folds to the paper by web printing and folding machines, varies considerably. By this machine the sheets are carried by tapes from the cutting cylinders C C, over a pair of folding rollers. When in position for giving the correct fold, a metal knife secured to a pair of arms worked by a reciprocating shaft, pushes the paper into the revolving rollers, giving it a first fold. The paper is then carried to a second, third, and fourth pair of folding rollers, and treated in a like manner by the folding knives.

Speed.—This machine can perfect as many as 12,000 to 14,000 copies per hour, with an open delivery, and from 10,000 to 12,000 copies per hour, folded up complete.

FARMER'S WEB PRINTING-MACHINE. — The peculiarity of this machine consists in its being supplied by two separate reels of paper at the same time, although no extra plates are required, thus considerably facilitating the net production. The reels of paper are placed on an independent frame at one end of the machine, one above the other, together with the necessary damping arrangements. It will be noticed from the diagram that the whole of the working parts are singularly compact and well-arranged, all being in view and within reaching distance, which must be considered a great advantage. The impression and type-cylinders (of which there are three), together with all the inking apparatus, is supported in one small frame. Two of the impression-cylinders are parallel to each other, but

twice the diameter of the type-cylinders, which are placed immediately underneath.

The paper travels from the reel almost horizontally to the top centre of the middle frame, when it is conducted by a series of tape bars to the inner-form cylinder, and from thence immediately to the outer. After the last side is printed the paper passes to the cutting and gathering-frame. By an ingenious arrangement, which can be regulated at will, the sheets after being cut are collected in parcels of one dozen, when the whole receives a fold in the centre and runs into a single trough. This is also done on the "Hoe," but in an altogether different manner, as will have been seen from the description of that machine. There can be no doubt that this plan is of great assistance in the publishing office.

The paper is damped by being passed through two india-rubber rollers, which are supplied with the regulated quantity of moisture. This appliance is also peculiar to this machine.

A novel arrangement is adopted in the construction of the ductor. A series of shallow rings is cut in the iron roller, and as the knife presses closely to it, no ink can find its way to the vibrator, excepting in the cavities. The supply is therefore always the same. Any desired quantity, however, may be regulated by special cams. The rollers can be adjusted by thumb screws, and the exact pressure of every roller upon the surface of the form thus regulated.

The machine is estimated by the maker, Mr. Farmer, to produce 20,000 copies per hour.

As will be seen from fig. 89, it is singularly compact in its construction. There is no underneath gearing, and the whole is fixed upon a substantial iron bed-plate, which to a great extent prevents vibration.

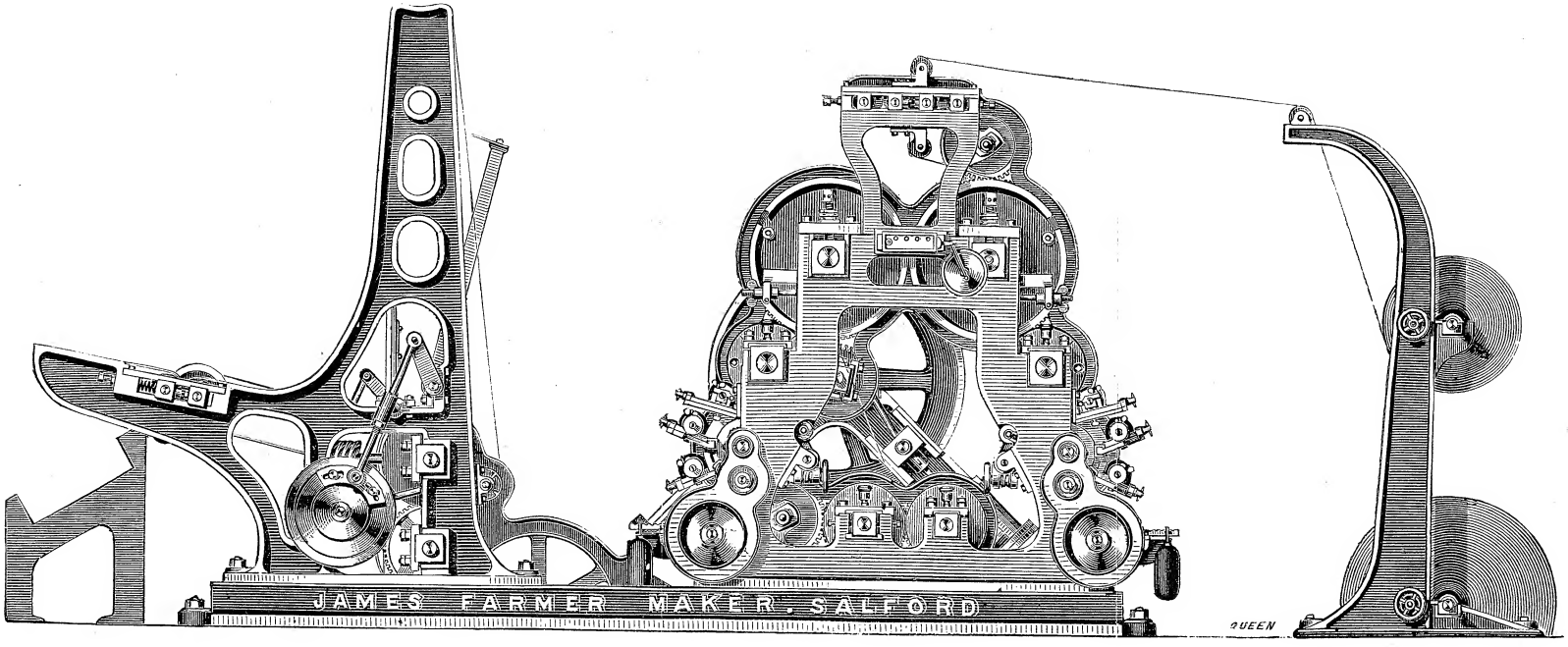

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Fig. 81.—The Farmer Rotary Machine.

CHAPTER XXVII.

The "Whitefriars" Rotary Machine: its Origin, Principles of its Construction, Speed, and Capacity.—The "Wharfedale" Rotary Machine.—Messrs. Nelson and the Introduction of the Rotary Machine.

THIS machine is the joint invention of Messrs. Pardoe and Davis. The first machine of the kind was erected to print the *Weekly Budget*, and its success was so decided that the inventors were encouraged to further efforts, and these resulted in such improvements as enabled them to print ordinary illustrated periodicals, the facilities afforded by curved electros having removed the chief difficulty of printing engravings by the rotary process. The economy in the cost of working this machine in the case of long numbers is unquestionable, and being of somewhat light construction it takes but little power to drive.

The "Whitefriars" derives its name from the "Whitefriars Printing Works," at which one of its inventors is machine superintendent.

The "Whitefriars" is especially adapted for printing ordinary periodicals, with or without cuts. It consists of four cylinders arranged round a semicircular frame. The two centre drums are used for the impression, while the outside cylinders receive the plates, which are either cast or bent in a curvilinear form. The laying-on boards are directly above the cylinders, and by means of a drop-bar and tapes the sheet is passed over and under each impression cylinder and carried underneath to the flyers, of which there are two sets, one for each feeder. The inking arrangements, though simple, are effective, a large distributing-drum being employed in addition to a series of wavers. The form is inked by four rollers, each of which is self-supplying and works directly from the ink-drum.

The apparatus for fastening the plates on the cylinder is so constructed that forms of various sizes can be printed, which renders the machine additionally useful.

Capacity and Speed.—The machines now in use will print a sheet as large as 44 inches by 54. The movements

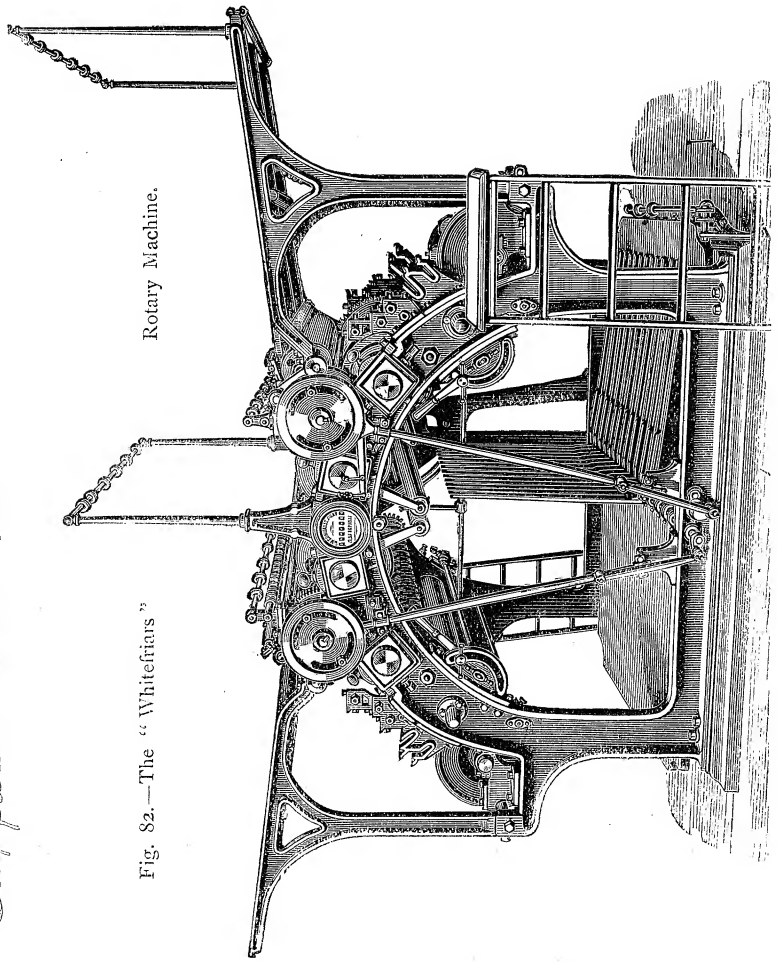

Fig. 82.—The "Whitefriars" Rotary Machine.

throughout being entirely rotary, the number of impressions that can be printed is limited only by the speed at

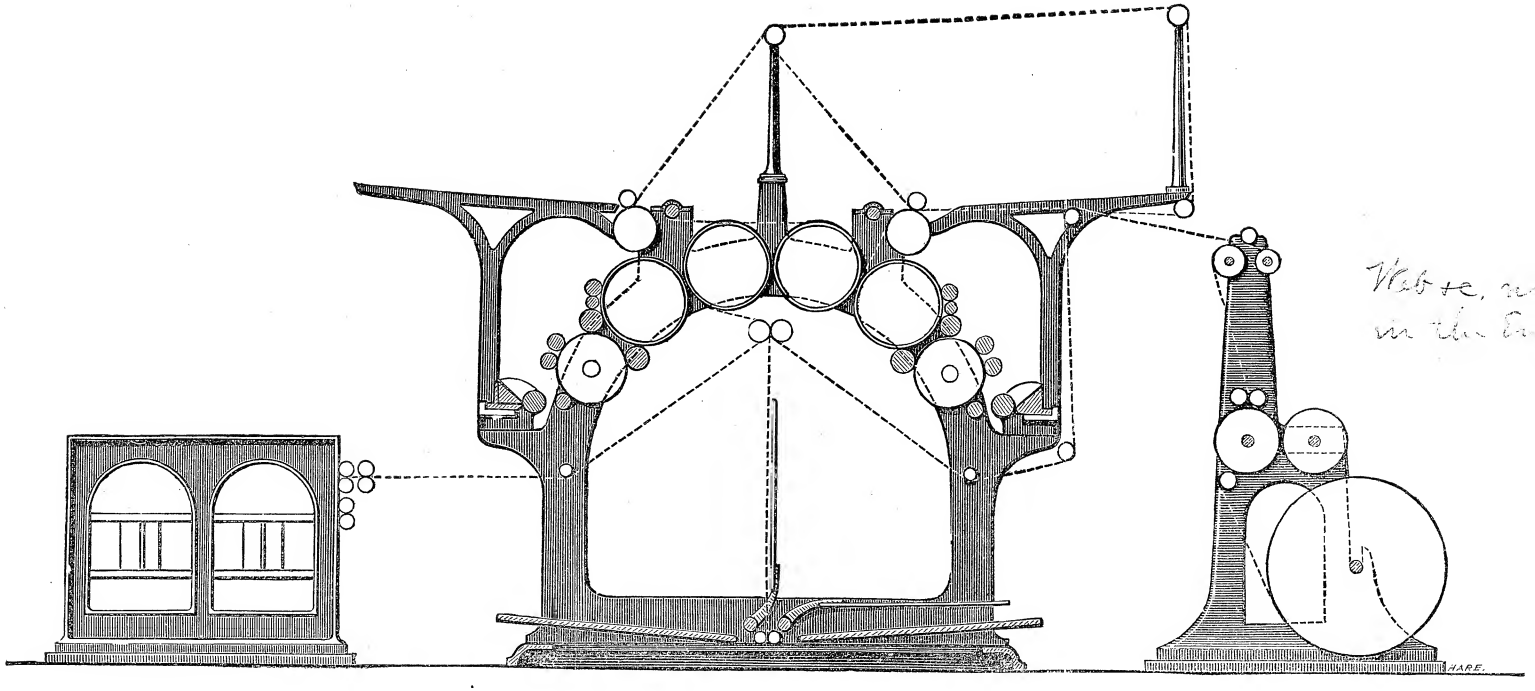

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Fig. 83.—Sectional view of the "Whitefriars" Perfecting Machine,
Showing the Reel and Folder attached, or as a Two-Feeder when disconnected.

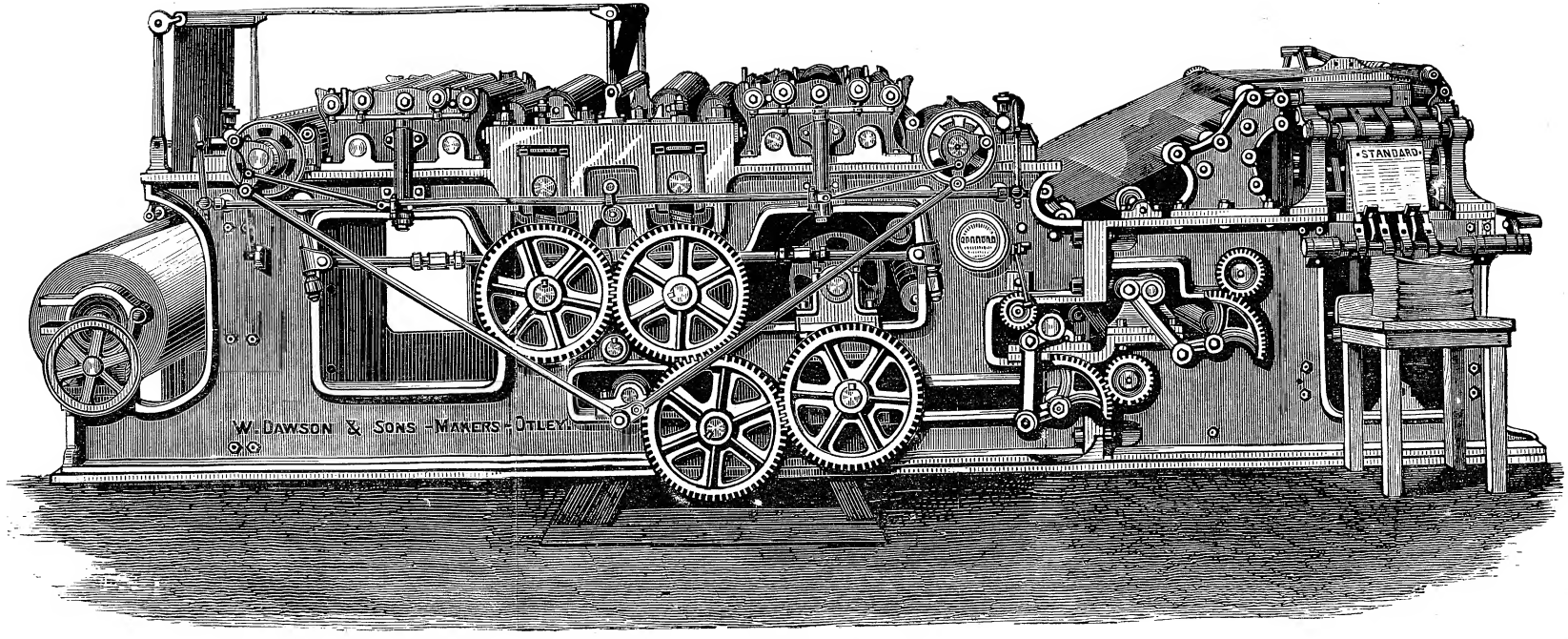

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Fig. 84.—Dawson's New Web Rotary "Wharfedale."

which the layers-on can feed in the paper. The usual number produced is about 4,000 impressions per hour.

The type cylinders of the machine can be slightly moved backward or forward by means of adjusting screws placed inside, so that if the overlay should be accidentally placed too high or too low the defect may be remedied without the removal of the blanket. The "Whitefriars" can also be used as a one-sided machine, and is well-adapted for working the inner form of, say, a newspaper or illustrated publication of large circulation.

The "Whitefriars" is also made to print from the continuous roll of paper, as well as by sheets fed in the ordinary way. From the reel as many as 8,000 copies per hour can be produced, and a great advantage claimed is that the alteration from one method of feeding to the other can be made in a very short space of time. Several of these machines have now been working successfully for some time.

THE "WHARFEDALE" ROTARY MACHINE. — Messrs. Dawson, the well-known makers of the Wharfedale single-cylinder machine already noticed, have also invented a newspaper rotary machine. Like several others it is very compactly arranged, nearly the whole of the parts being within reach, an advantage which cannot be over-estimated. Although not specially built to print engravings, the inking-arrangements are singularly good, each form being provided with two distributing cylinders, over which travel rollers having a reciprocity motion. The ductors are also fitted with a knife, the entire length of which can be evenly adjusted by a single screw; this is, we believe, an American invention.

There is nothing in the arrangement of the impression and plate cylinders that calls for special attention, the travel of the sheet, of course, being nearly the same in all machines.

After printing the sheet is perforated by a serrated knife, and passes into a folding-machine, which delivers two copies at a time. This folding-machine is of much smaller construction than others in use, and has been patented by Messrs. Dawson.

The first machine was erected for the proprietors of the *Bradford Observer*, and is capable of printing and folding about 9,000 copies per hour.

We are indebted to Mr. Samuel Bremner for the following facts in connection with the introduction of the Rotary machine. The idea of printing from the continuous reel of paper and curved plates originated with Mr. Thomas Nelson, of the well-known firm of Nelson & Sons, Edinburgh.

For the Exhibition of 1851 that gentleman constructed a working model of a rotary machine for printing book-work. It was worked, and produced about 10,000 copies per hour. The reason the idea did not at that time take a practical shape, was in consequence of the inventor considering that it was not capable of printing sufficiently well for book or magazine work, and its adaptability for newspapers seemed for the time being to have been entirely overlooked.

The model above referred to was solely constructed at Messrs. Nelson's establishment. The paper was made by Messrs. Cowan & Co., to whom therefore belongs the credit of having first made the continuous reel.

We saw the plate that was affixed to the model, the following being the inscription on same—"Nelson's double-cylinder steam printing-machine for printing in the web, and cutting into sheets. 10,000 sheets per hour printed on both sides. Thos. Nelson, jun., Edinburgh."

We are pleased at being able to make the above known, as so many years have now elapsed, and the rotary machine has become one of the necessities of the age. Although various modifications and improvements have been made by different engineers, the fact remains the same, that all rotary machines are constructed on the original principle, and we are only doing justice to Mr. Thomas Nelson in calling attention to his undoubted claim as the original inventor.

Further particulars may be obtained by those interested, in the Jurors' Report of the Exhibition of 1851, p. 198.

CHAPTER XXVI.

Taking-off Appliances, Wetting-Machines, etc.

The Eclipse—Dryden and Foord's—Mark Smith's and Marinoni's Taking-off Machines — Henderson's Roller-Washer — Wetting Machines.

BEFORE leaving the portion of this work devoted to Printing-Machines, we must draw especial attention to the following successful labour-saving appliances :—

The "Eclipse" Taking-off Apparatus.—This is the joint invention of Mr. John Esson, the maker, and Mr. Ovens, of the Chilworth Press. It is especially suited to the Wharfedale machine, in which case a slight iron frame fitted with a series of adjustable tape-pulleys, is fixed immediately above the impression cylinder. One set of tapes is made to run completely round the impression-cylinder, while at the point at which the grippers are made to release the sheet, an independent series of endless tapes joins the set before mentioned. On the off-side of the cylinder-frame is erected a short slide, which opens the grippers and releases the sheet into the tapes. The independent set of tapes is driven by a band from a pulley fixed to the driving-shaft, inside the fly-wheel. The pulley is made in cones, so that the speed of the tape-bars can be regulated to suit the thickness of paper. The sheet is shot out from between the discharge bars, which are driven at a greater relative speed than the cylinder. No stiffener is necessary, the sheet being conducted on to the board without requiring assistance in any way. The taking-off board is fixed so as to slope slightly towards the ductor. At the end is a long wooden stop against which the sheets are propelled. On either side are movable iron guides, sufficiently high to admit of their taking a ream of paper.

The apparatus is simplicity itself, and there is really nothing in its construction that calls for special mention. The sheet is received immediately after leaving the form by the tapes. The gripper-bar is opened by the slide before

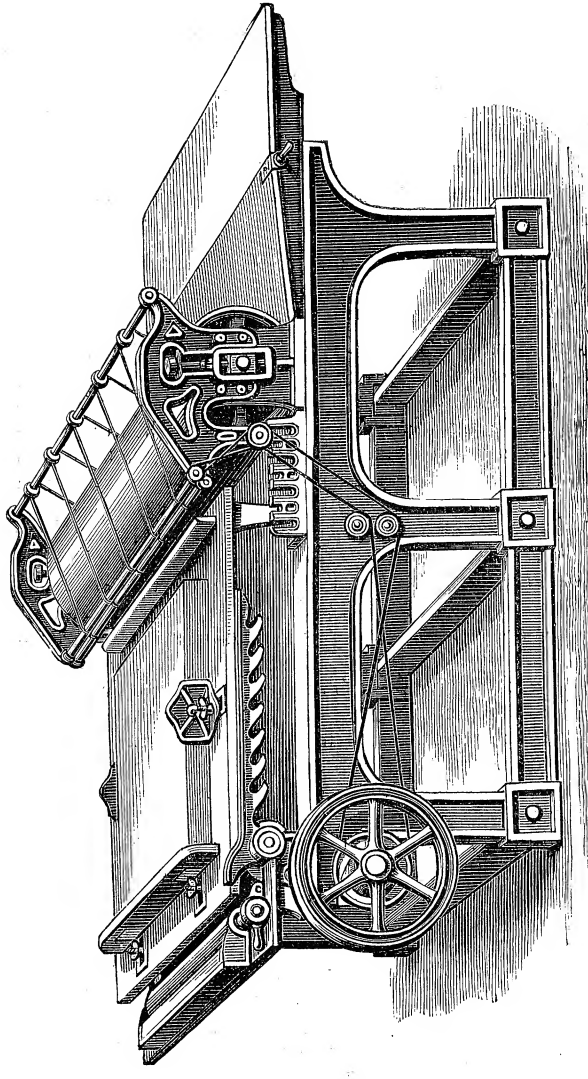

Fig. 85.—The "Eclipse" Taking-off Apparatus.

mentioned, and the paper is carried at an increased speed to the discharge-bars and thrown on to the inclined board between the side and bottom guides. The mechanism being but slight, the maker is enabled to supply the "Eclipse" Taking-off Apparatus at a very cheap rate.

MESSRS. DRYDEN & FOORD'S NEW TAKING-OFF APPARATUS.—We have much pleasure in recording the success of a simple and ingenious taking-off apparatus introduced by the above firm. Unlike any of its predecessors, this apparatus is eminently adapted for perfecting machines, where comparatively little space is at disposal. The sheet immediately on leaving the outer form cylinder passes through a series of thin steel smoothing-rollers, driven by the machine-tapes in their return. The last roller, however, over which the sheet passes is made of wood, and is slightly greater in diameter. This is driven by a thin band from the second register-drum above, and consequently travels at a much slower speed than the steel rollers. Above the wooden roller is suspended a drop-bar. This falls on to the sheet just before the end of the latter leaves the cylinder. The sheet is thus held firmly by the bosses, and is allowed to pass on to the laying-on board at a comparatively slow speed. At the side of the taking-off board (near the inner-form cylinder) is a stop, which arrests the sheet when it leaves the drop-bar arrangement.

In order that the sheet may not double up in its passage, a "stiffener" is employed. This consists of two bars, the upper one being provided with small grooved wheels, and the lower with indiarubber washers fitting exactly in the grooves. These form a gutter, as it were, in the sheet, and impart to thin paper a stiffness which enables it to pass on to the board without impediment. The taking-off board rests upon springs, and hence becomes slightly depressed as the paper accumulates.

The application of a taking-off motion to the perfecting machine may be considered an invention of considerable importance. The space at command being very limited, the adoption of flyers was out of the question. The room

required for the fixing of Messrs. Dryden's taker-off is absolutely *nil*, and at a first glance it would not be noticed

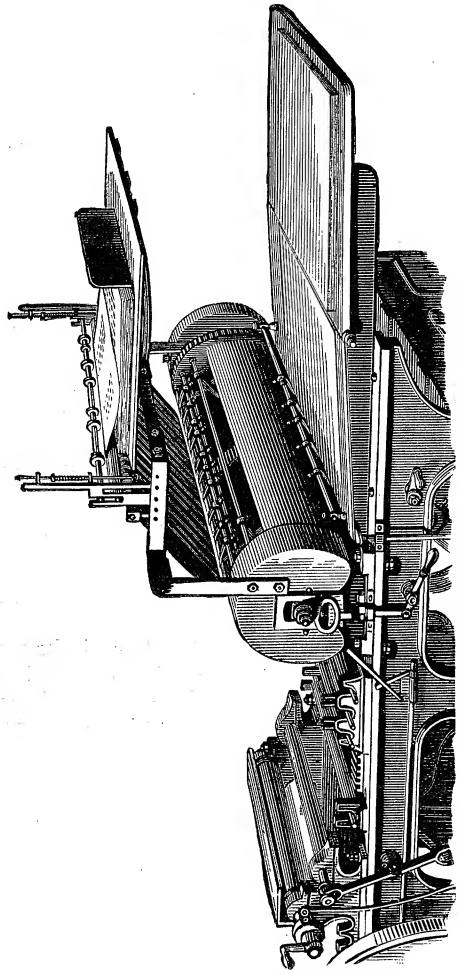

Fig. 86.—Dryden & Foord's Taking-off Apparatus.

that there is any additional fitting applied to the machine.

The same firm also constructs a taking-off apparatus for single-cylinder machines (fig. 86), the peculiarity being that the sheets are delivered on a board above the layer-on. This leaves the form entirely free, and obviates long stoppages, which the removal of the ordinary taking-off board involves when it is necessary to clean the form or remove the rollers, &c.

MARK SMITH'S taker-off (fig. 85), manufactured by Mr. James Salmon, of Manchester, is to be highly commended

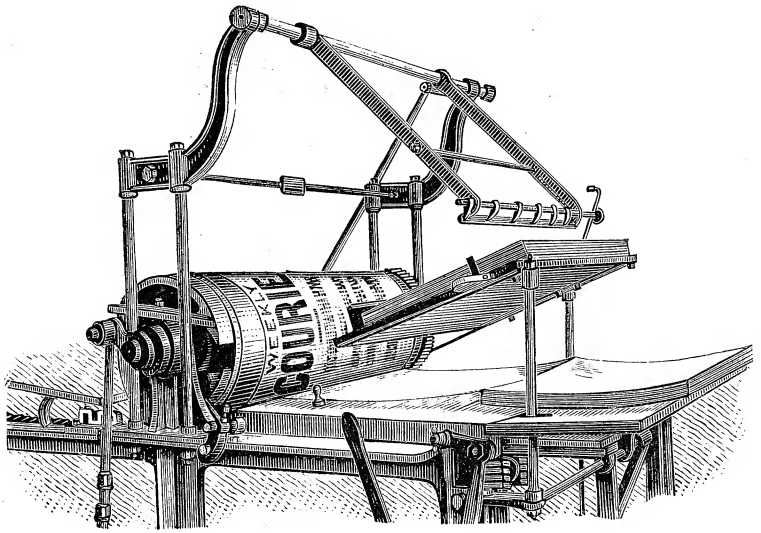

Fig. 87.—Mark Smith's Taking-off Apparatus.

from the fact that no tapes are employed. It merely consists of a light frame fitted above the cylinder. This frame is provided with a set of grippers, which after every impression descend and lift the sheet off the cylinder, depositing it evenly on the taking-off board. The apparatus is simple in its action, and the numerous approving testimonials speak highly in its favour. It is only adapted, however, for Wharfedale and Tumbler machines.

MESSRS. MARINONI, of Paris, have fitted to their Anglo-French machine a taker-off (fig. 88), which deposits both the printed and set-off sheets on the same board. In the centre of the take-off board are two sets of flyers standing upright—one set working down toward the cylinders, while the other moves, of course, in the contrary direction. A double set of tapes is employed in the machine, one each for the white paper and the set-off sheet. These are delivered by separate rollers at the top of the flyer, one on each side of the frame, and the momentum imparted carries the paper down in a vertical direction on their respective flyers. A rotary knife is also fitted at the top of the frame which cuts the printed sheet in half. This knife can be thrown out of gear when not required.

HENDERSON'S ROLLER-WASHING MACHINE.—In printing establishments where there are a number of machines employed, the economy effected by the use of the roller-washing machine is unquestionable. The cleansing of rollers by the side of the machine on which they have been used is a practice much to be condemned, although it is largely practised. A corner of the room should be specially devoted to the purpose, or better still, a small room well drained. Sheet iron will be found a capital material for flooring, as it is easily kept dry and clean, and unlike wood or stone, will not become injured by the constant dropping of the roller ends.

Henderson's Roller-Washing Machine occupies but little space, and is both compact and effective. It really consists of three wooden cylinders, all revolving one way. Immediately above each is supported a long wooden stop of the same length as the cylinder. These stops are moveable, and can be lifted by levers in front of the machine. The dirty roller is placed on the first cylinder, the action of which causes it to revolve, pressing against the stop. It is then brushed over with a strong solution of ley from a small trough at the side. The friction caused by the rotary motion aided by the strong potash, entirely removes the ink from the surface. The first lever is then pulled and the roller travels on to the top of the second cylinder. Im-

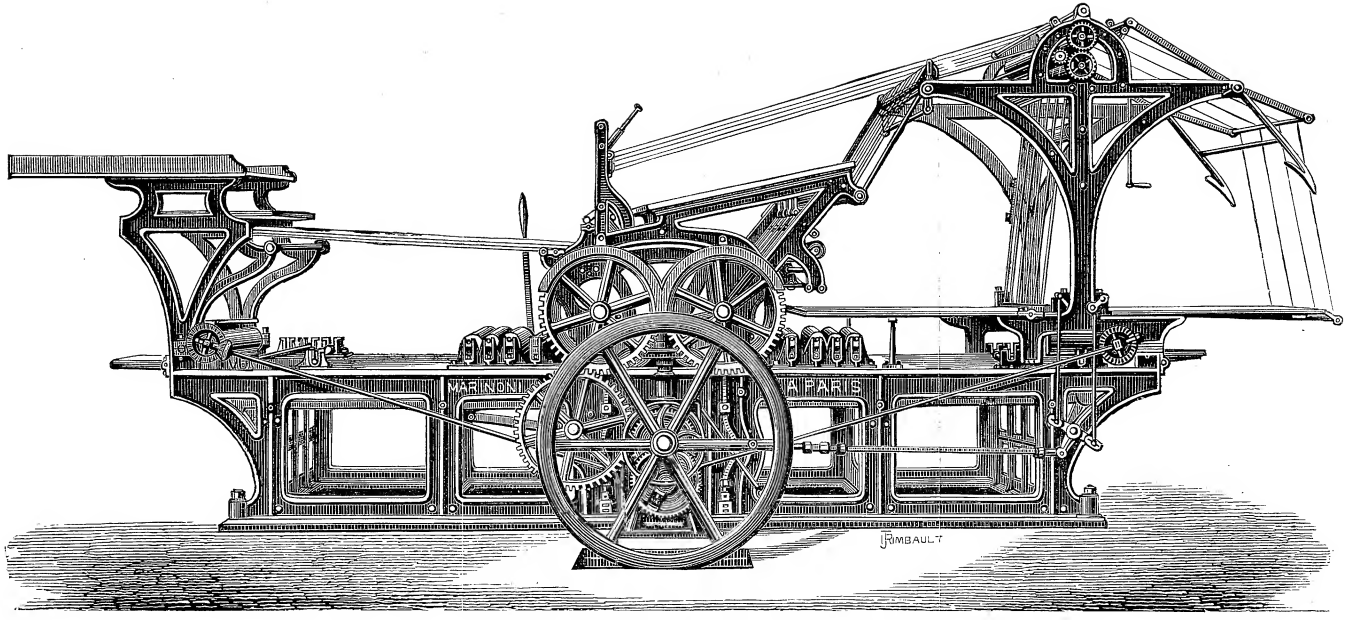

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Fig. 88.—Marinoni's Anglo-French Machine, with Patent Taking-off Apparatus.

mediately above this a water pipe is fixed, having perforations along its entire length. This washes off the ley from the surface of the roller. The second lever again allows the roller to travel to the third cylinder, the stop above which entirely removes the moisture from the surface. The roller after this falls into a shallow wooden trough, when it is fit to be wiped down by the hand, and stacked ready for use.

The great advantage of this machine is that two boys can in the same time easily perform the work of a dozen, added to which, the rollers are not so liable to suffer from careless handling. The printing-machines may thus be driven to the actual time of leaving off, when two boys can lift the rollers from each, wash them and have them ready for use in a very short space of time, thus effecting a considerable saving on every machine.

Although it is necessary to drive this apparatus by steam, as the cylinders must travel at a somewhat quick speed, but little actual power is required.

WETTING-MACHINES.—We have already referred to the machines employed for wetting the reel of paper, and must now call attention to those specially constructed for damping separate sheets. Various appliances have from time to time been devised, but the one most in favour consists of an iron trough, in the centre of which revolves a large wooden cylinder covered with felt. Five thin rollers are fitted round the large one, which carry a series of endless bands. The trough itself is half filled with water, so that every portion of the cylinder is immersed in turn as it is revolved. The sheet or sheets of paper are fed in between the tapes, taken round the cylinder, and passed through the water, being delivered at the other side. The machine may either be turned by hand or steam power. As many as thirty reams per hour can be wetted by this means, two boys only being required. But little space is necessary, and the sloppy mess incidental to the operation of wetting is obviated.

Another capital appliance consists of an arrangement somewhat on the same principle as the shower bath. A square tank sufficiently large to cover the largest sheet of

paper to be wetted, is fixed above the head of the operator. The bottom of the tank is usually made of zinc, and perforated with small holes. The supply of water to the tank is regulated by a ball-cock. The water is allowed to fall through the perforations every five seconds, affording time for the wetter to take the required number of sheets from a stack at his side and place the same upon the heap immediately underneath the tank. The fall of the water is regulated by a chain or thin band, worked by an eccentric on the nearest revolving shaft.

Where this appliance is adopted it is advisable to protect the legs of the operator by large boards sloping inwards. It is also necessary that a well or drain be under the paper to carry off the water, which may be pumped up to the tank again, if the well be used.

It will be found an excellent plan to provide a truck, or flat board on four small substantial wheels, upon which to lay the paper being damped, otherwise some trouble will be experienced in its removal when the heap becomes large. The whole may then be wheeled out of the way, and remain till in a fit condition for use.

A man is able to wet about 110 reams of quadruple demy in a day by the above appliance. Messrs. Harrild & Sons are the makers.

PART V.

ENGINES AND BOILERS.

CHAPTER XXVII.

BEAM AND HORIZONTAL ENGINES.—Table Engines—Fixing Engines—Economising of Fuel—Water-Heaters—The Hancock Inspirator—Boilers—Hints concerning their Management—Improving the Draught of the Furnace. — GAS-ENGINES—Advantages — The "Otto"—The "Eclipse"—The "Bisschop"—The "BACKUS" WATER MOTOR.

IT has frequently been a matter of dispute as to which steam-engine is the best adapted to the driving of printing-machines. Unlike most other machinery, that used in printing requires, above all things, perfect regularity of motion, especially in the case of cut work. We have, after considerable experience, no hesitation in giving our preference to the beam-engine, particularly for the working of Anglo-French and bookwork machines. The large fly-wheel, which is generally attached, together with the reciprocating motion of the beam, almost always ensures regularity of the stroke, and the stoppage of a machine does not affect the speed to such an extent as on those engines where the fly-wheel is driven direct from the piston.

It is desirable in all cases that the power of the engine should be at least 3-horse in excess of that which the machines are calculated to require. If the engine be too small for the work to be performed, or the governors inaccurately adjusted, the work on perfecting-machines is sure to be in bad register. This is particularly noticeable in the case of Anglo-French machines.

Driving ordinary platens from the same shafting as other machines is unadvisable, as the power required to give the flat impression (by means of the crank motion) is so great,

that the shock is apt to check the engine, this is partially obviated when a counter-shaft is used. The above applies equally to the driving of rolling-machines, excepting the Heim and the Gill, which require uniform power.

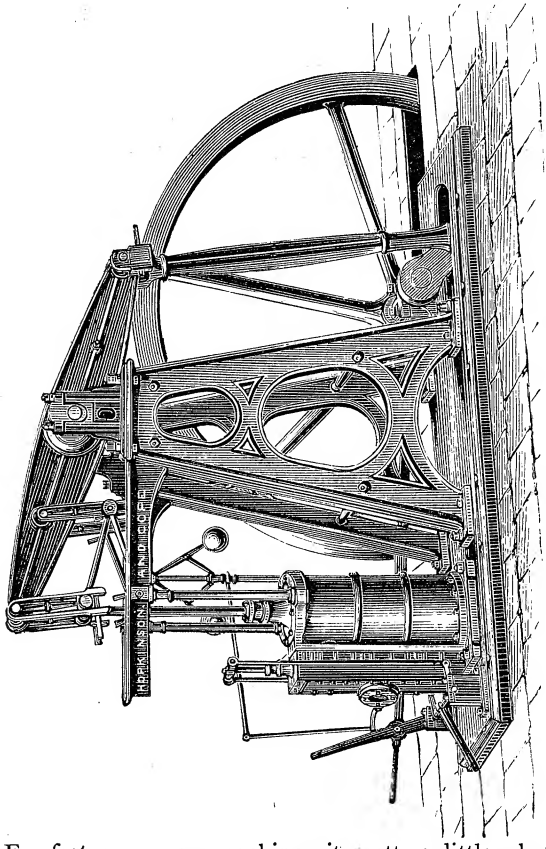


Fig. 89.—Beam Engine.

For fast newspaper-machines it matters little what kind of engine is employed, as a slight variation in the speed is of small consequence in such cases.

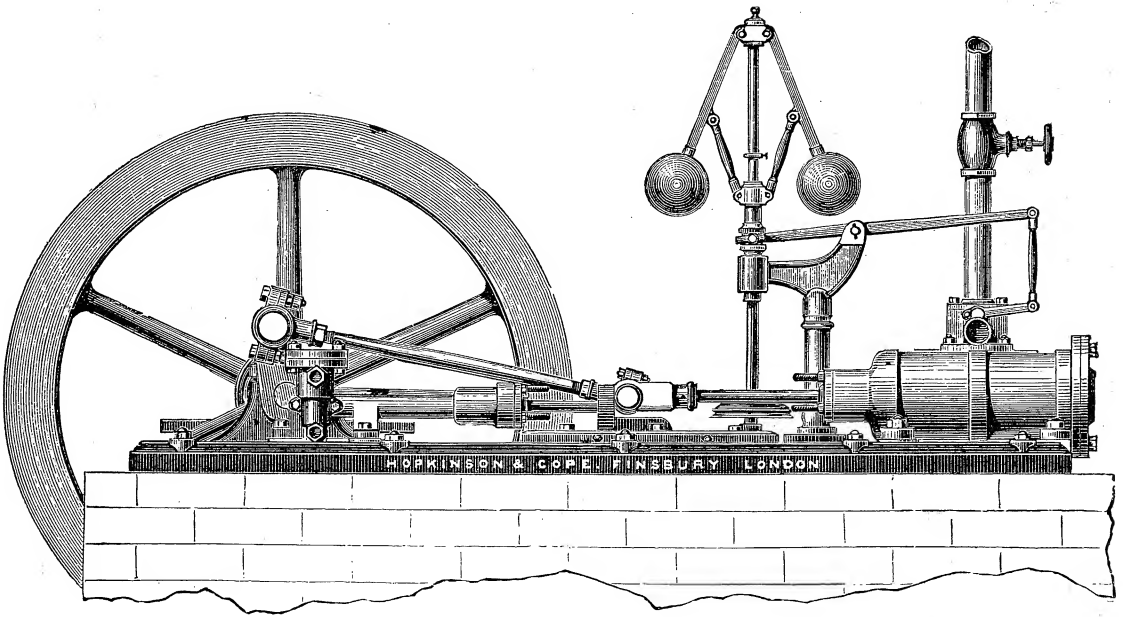


Fig. 90.—Horizontal Engine.

The reason, we believe, that horizontal and table engines are so common in printing-offices is because they take up less room, and space is a great consideration in most cases. Added to this they are more economical, both as regards price and in consumption of fuel. It is estimated that the beam-engine consumes about one-sixth more fuel than the horizontal.

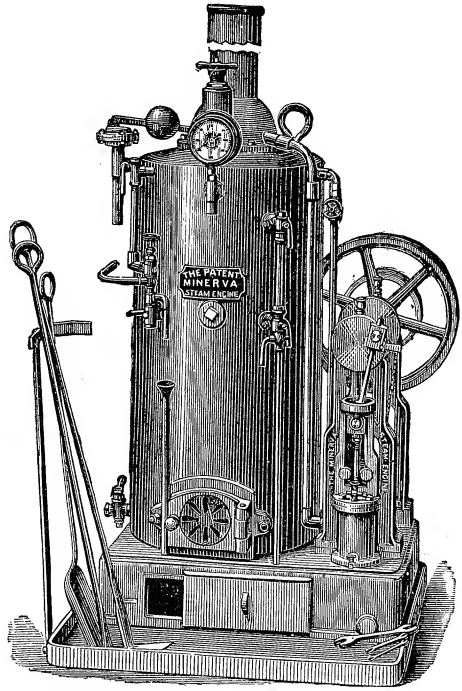


Fig. 91.—Engine and Boiler combined.

Both engine and boilers should in all cases be placed in a room apart from the machinery, otherwise the heat will affect the rollers, and is also extremely unhealthy for the workmen.

Fixing engines on a wooden floor or to a wall should be

avoided. We know of several thus secured, but they have never given entire satisfaction. The vibration, besides being injurious to the nerves, is in the case of old buildings positively dangerous. It is always advisable to have the engine and boilers very close together, in order that the live steam may not have far to travel. The steam-pipes should be thickly coated with non-conducting composition, so that no condensation can take place from the cold atmosphere during its transit.

As the cost of fuel in printing-offices is a large item, considerable attention has been turned with a view of economising its consumption. The admission of cold water into the boiler immediately reduces the temperature of the steam, and consequently the pressure. Water-heaters, more or less successful, have been invented, the waste steam being utilised for heating purposes. The great objection to this mode of heating the water is, that the back pressure of the exhaust on the piston greatly interferes with the normal power of the steam. The exhaust should be allowed to escape freely, or the loss will be about 3 to 5 lb. of the net pressure. Added to this, when the steam is directed into a tank of water intended for the boiler, a certain amount of grease and oil used in necessary lubrication is carried with it, and returned to the boiler in the water. Continually passing through the pipes and engine this is liable to clog or otherwise interfere with the free action of the valves. By the use of the *Hancock Inspirator* this can be overcome. The Inspirator is capable of drawing cold water from a depth of 25 ft. and throwing it into the boiler at a boiling point, which is accomplished by directing the super-heated steam from the steam-box to the apparatus, when it is diverted to a point where it meets the cold water. The latter is drawn from the well by the creation of a partial vacuum at the point above named. The space allowed for the mixing of the steam with the water is so small that the latter becomes heated to boiling point, being forced at the same time into the boiler. This apparatus serves both as a pump and water-heater, and as there are no valves to become corroded or otherwise injured, it is highly to be commended. In the Inspirators of the latest construction the

entire operation is controlled by the mere movement of the lever, as shown in fig. 92.

While at work it has no tendency to reduce the pressure of the steam,—in fact, the gauge will rise without extra

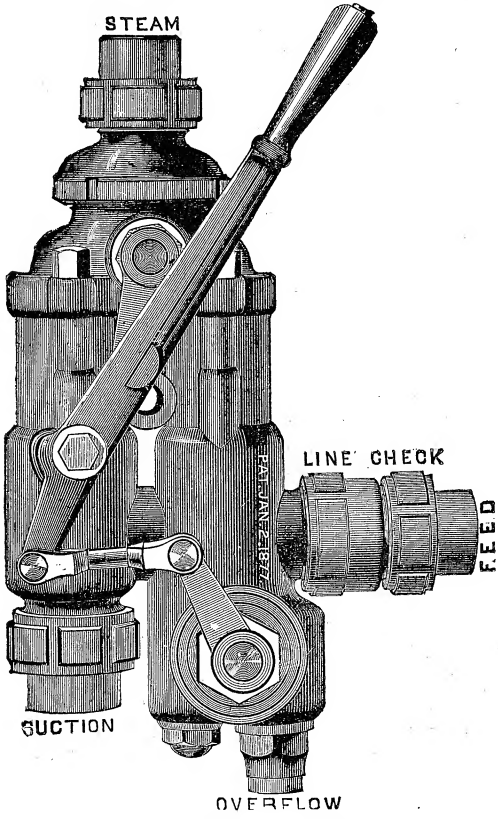


Fig. 92.—Hancock Inspirator.

stoking while the operation is in full force. The amount of water delivered to the boiler can be regulated at pleasure by means of cocks governing the entry of the steam and

water. We are able to state that the saving effected by the use of this apparatus may be fairly estimated to be from 15 to 20 per cent. The appliance is exceedingly small, and can be fitted in a few hours.

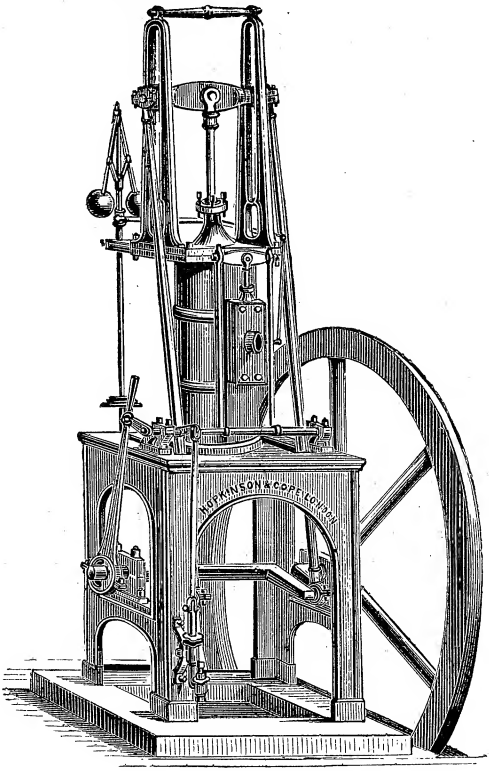


Fig. 93.—Table Engine.

The boilers mostly in favour are the Cornish tubular, which from their construction present to the fire and heated gases a very large surface. The furnaces themselves are made in one or two large tubes running through the centre

of the boiler, and at the extremity are several pipes which present an additional surface to the heated air and exhausted gases as they travel from the surface of the fires. Around the under side of the boilers the flue is conducted, so that before the main shaft is finally reached nearly all the heat from the smoke, &c., is utilised.

Boilers should be examined and cleaned out at least twice a year. Although the incrustation arising from more or less impure water may, to a certain extent, be prevented by the judicious use of various fluids and compositions, it is necessary that the accumulated sediment be removed. The valves in connection with the steam-pipes should also undergo periodical inspection. We may mention a case that might have ended in a great destruction of life and property from neglect of this precaution. We were shown the pressure gauge of a boiler (about ten years old) registering 100 lb.! the safety-valve having been weighted, and this immense pressure failed to drive a 6 horse-power table-engine at its proper speed. The reason assigned for weighting the valve was that either the valve itself or the gauge was out of repair. We immediately advised the drawing of the fires, which was fortunately done without delay. The gauge was tested and found correct, and it was eventually discovered that a plate had become so misplaced as to prevent the steam from escaping through the feed-pipe to the engine. Fearing that the boiler might have suffered from the abnormal pressure, the boiler inspector was sent for, and with a hammer he completely smashed one of the lower plates. The boiler was declared unsafe, and removed.

The position selected for the erection of boilers should be perfectly dry. If damp exist, the boiler-plates will become corroded, and will quickly be eaten away. We have known cases in which large new tubular boilers have had to be entirely reset in consequence of not sufficient precautions having been taken to keep the damp away when they were originally built in.

Many methods have been tried to improve the draft of furnaces, and perhaps the most simple, and consequently the plan generally adopted, is the steam-blast pipe in front.

The steam is led from the boiler in a pipe of about $\frac{1}{4}$ in. bore, and is either directed above the surface of the fire or under the fire-bars. Unless the draft is positively bad, and some method is absolutely necessary to cause a greater draft, we do not advise the application of steam. We have known the plates under the furnace to peel to the extent of $\frac{1}{16}$ in. in nine months, caused by oxidization. In addition to this, the dust is blown into the bottom of the flue (instead of falling through the bars) and causes a periodical stoppage. A bad draft is certainly a great calamity, but can only be really remedied by the reconstruction of the flues, &c.

In concluding these remarks, we would draw attention to Livett's new method of setting boilers, by which most important economic results are secured.

GAS-ENGINES.

OF late, engines driven entirely by the medium of gas have been brought to a great state of perfection, and are singularly adapted for the driving of a limited quantity of machinery. The economy in their working is unquestionable, as they can be started at a moment's notice at full power, whereas in the case of the steam-engine a large amount of fuel is required to raise the pressure of the steam to the necessary point; but a trifling supply of water is required; and to the above advantages may be added the fact that the expense is only incurred while the work is actually being done. No stoker is required, and really little or no attention is necessary. Messrs. Nelson, of Edinburgh, use gas-engines for driving the whole of their machinery, and we believe they have found them more economical than the employment of steam. They are seldom out of repair, and it must be confessed that this is a great point in their favour.

The "Otto" Silent Engine (Fig. 93) is one of the most successful. It is constructed somewhat after the pattern of a horizontal engine, but the cylinder appears abnormally large. The gas is admitted by means of a slide valve. The piston draws by suction into the cylinder a proportion of air

which, together with the gas, is compressed by the return of the piston, the ports having been closed by the slide. At this point a small opening is made, which admits a lighted jet of gas, and immediately causes an explosion, thus giving the piston the necessary momentum. The exhaust gases are forced through the pipes on the return of the piston, previously to a fresh supply of gas and air being supplied. The advantage of this arrangement is that both the gas and the air, upon the introduction of the flame, expand prior to the explosion taking place, thus rendering the motion of the piston more regular than would otherwise be the case. The engine is capable of being worked up to as many as

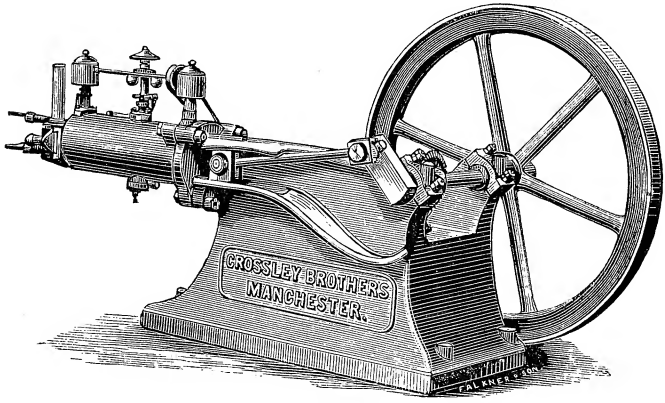


Fig. 94.—The "Otto" Silent Gas-Engine.

160 revolutions per minute, as the cylinder is enclosed in a water jacket, and it is kept cool by the circulation of a continual fresh supply. The oiling of the cylinder is performed automatically, and a sufficient quantity is drawn into it when required. This renders the engine perfectly safe, as it is impossible for the piston to fire and so become fixed in the cylinder.

The gas-engine the "Eclipse," made by the well-known firm of Simon & Son, of Nottingham, differs from the last described, both in action and appearance. In addition to

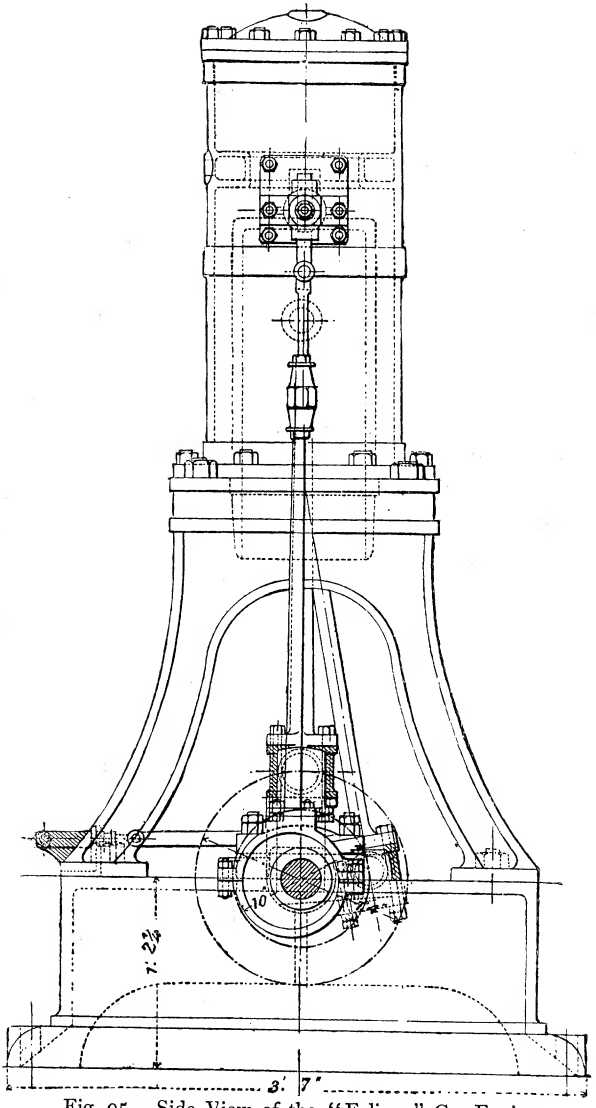


Fig. 95.—Side View of the "Eclipse" Gas-Engine.

gas, steam is also used. In the annexed diagram it will be seen that it somewhat resembles the ordinary table-engine, the cylinders being inverted and the stroke consequently vertical. Two cylinders are employed, A and W, each being provided with cranks working the main shaft G. The gas and air are admitted through the pipes K and F to the chamber L. It is at this point that the admission of the explosive element is regulated by the governor O. The gas and air are drawn into the chamber L by a vacuum created by the descent of the piston B. The gases are passed from L through the spring valve M, which is closed on the return of the piston C. The gas being thus compressed is driven into the chamber Q, into the passage R, through the valve S, and port T, to the chief cylinder W. At the point T is fixed some wire-gauze. A portion of the gas from the cylinder A is led by a pipe through R to the other side of the gauze and at this point kept ignited. As is well-known, the gauze is too fine to admit of the light igniting the main body of gas in R, which only explodes when it reaches the other side of the gauze at T. A continual combination is thus kept up which acts upon the main piston *b*. The return stroke forces the exhausted gases through *d* and the valve *e* to the exhaust-pipe.

The cylinders are each surrounded by a water jacket (N N *n n*) which communicate with each other and also with the body of water at *h* above the main cylinder.

The continual explosions render the cylinders extremely hot, and the heat is communicated to the water in the jacket. Added to this the spent gases pass over the tubes &c., of *h*. This soon raises the water to boiling point, and the steam is conducted through a pipe and slide-valve to the cylinder W, where it assists the gases in working the piston.

The "Eclipse" professes to possess several advantages over other gas-engines, and no doubt the utilization of the steam economises the consumption of gas, and to a considerable extent prevents great dryness in the cylinder caused by the gas explosions, which necessitates incessant lubrication. The size mostly in demand is of 4-horse power, but they are made as large as 8-horse power.

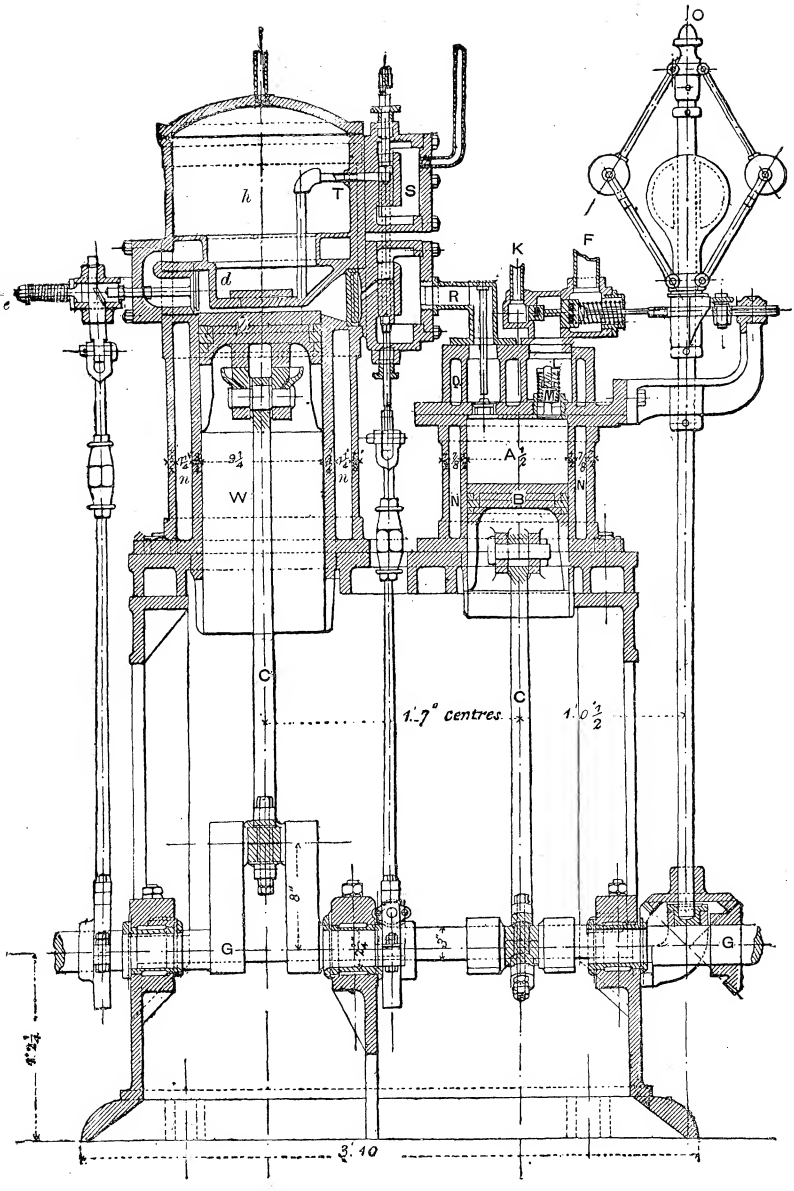


Fig 96.—Sectional View of the "Eclipse" Gas Engine.

The BISSCHOP GAS-ENGINE will be found useful to those requiring limited motive power, and to whom the original cost of an ordinary gas-engine is an object. This engine, the invention of a Frenchman, is made of one-man-power and upwards, so that the turning of a machine by

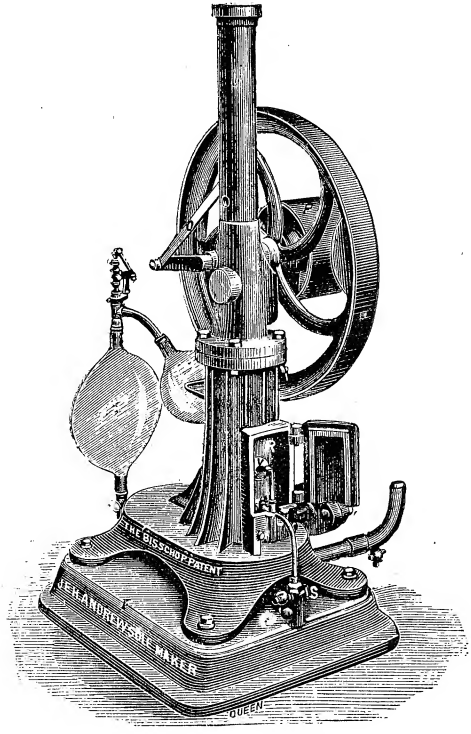


Fig. 97.—The " Bisschop " Gas-Engine.

manual labour will henceforth become a thing of the past. This simple and singularly compact contrivance appears at first sight to be only composed of three castings, the bed, vertical cylinder, and the extended slide for the piston

guide. The amount of gas consumed in its working is so small that any ordinary gas-meter is sufficient for the necessary supply. The gas passes from the feed-pipe into a large elongated indiarubber reservoir, and thence into another of smaller dimensions, where it is accumulated for use. This is to prevent any undue strain upon the meter, and to ensure a continuous and sufficient supply of gas. The gas enters the cylinder at the bottom in conjunction with air, and the latter passes through a perforated plate. When the piston arrives to about the third of its stroke, a slide opens and admits a gas flame, which causes the explosion. This flame is situated at the side of the cylinder, and a small supplementary jet immediately underneath is also kept alight, so that should the force of the explosion blow out the igniting flame it is immediately relighted. The rigger being very small and the fly-wheel rather large, considerably assists in equalising the motion.

One remarkable fact in connection with the Bisschop Engine is that it requires no attention whatever while in work, neither the piston nor the slide-valve requiring any oil or grease. It may be driven for almost an indefinite period, it being on record that on one occasion an engine ran continuously for 47 consecutive days and nights without supervision of any description.

The speed can be regulated to a nicety by a simple feeding appliance, its nominal rate being about 120 revolutions per minute.

Unlike some other gas-engines no water is required, and the space necessary for its erection is trifling. It is estimated that the cost of driving a one-man-power engine, capable of working say a demy or double-crown Wharfedale, is only one halfpenny per hour; and when we mention that the price of an engine of the above power is only £25, further commendation seems unnecessary.

In addition to the economical advantages before enumerated, gas-engines can be fitted in places where it is impossible steam could be applied, and the space required is very limited. Thus no extensive alterations are necessary for the building of foundations, &c., neither is fire insurance affected by their use.

THE "BACKUS" WATER-MOTOR.—A formidable rival to gas-engines is the "Backus" motor—rightly named, as it can hardly be called an engine—which is entirely driven by water, and by such a small quantity, considering the power obtained, that it may justly be deemed a remarkable invention.

It really consists of an almost round iron box, being slightly elongated at the under side, and the whole is supported on slight iron rods bolted to the floor. The principle of its construction is somewhat after the ordinary water-wheel; that is to say, at regular and close intervals around the shaft inside the box are fixed metal plates, so made as to present to the jet of water a comparatively large surface. A water-pipe about 1 inch in diameter is attached to the motor almost at the bottom of the rim, and the stream of water strikes directly down upon the plates extending from the shaft. The jet of water at the entry-nozzle is remarkably small, ranging from one-sixteenth to one-quarter of an inch, according to the size and estimated power of the motor. Immediately under this entrance-jet a receptacle is attached, so that as soon as the water has struck the plate or vane it is allowed to escape, thus preventing any after-resistance.

That no foreign matter may accumulate in the discharge-nozzle and obstruct the flow, a diaphragm with perforations is fixed in the main feed-pipe. This can be easily examined and cleaned when desired.

One of the most important points connected with this motor, and which adds considerably to its efficacy, is the absence of all actual mechanical parts which in themselves would require a percentage of the power. Thus no power is wasted in the driving, there being but the one shaft upon which the wheel rotates, and to which the driving-pulley is attached. The series of plates and supporting-spokes on the shaft renders the wheel itself sufficiently heavy and well balanced to answer the purpose of an ordinary fly-wheel. The driving-rigger on end of shaft is extremely small, and greater regularity of motion is thus ensured.

As it is necessary that the supply of water should be continuous, it must be laid on from the main, and be of the greatest possible pressure. This latter varies con-

siderably in districts, as also at different periods of the day; but it may be said that the average force exerted is about 35lb. to 45lb. At this pressure a 2-horse power motor makes about 400 revolutions per minute. This great speed, of course, considerably adds to the net power of the apparatus, especially when we take into consideration the smallness of the rigger. The expense of driving varies, but the water consumed by a $1\frac{1}{2}$ or 2-horse power motor is about 355 gallons per hour, and will cost upon an average less than 4d. per hour, supposing the water to be charged at 8d. per 1,000 gallons. In places where a large quantity of water is used this will be considerably reduced, as it is

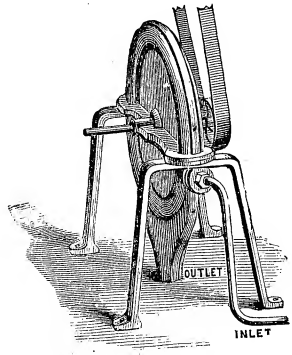


Fig. 98.—The "Backus" Water-Motor.

supplied on a sliding scale, ranging from 6d. to 1s. per 1,000 gallons.

The above we know to be slightly in excess of the cost of driving a gas-engine, but we must at the same time bear in mind the advantages that may be urged in favour of the water-motor. The room taken up is inconsiderable, a 2-horse power motor requiring space of about 2 ft. wide by 3 ft. long. In the fitting it is inexpensive, as a water-pipe from the main, together with a discharge-pipe, is all that is necessary. The absence of heat in its working is a great advantage, as in small offices the motor can be fixed in any desired position, no inconvenience being caused by

warmth or smell. Again, it cannot get out of order, and consequently no repairs will be necessary; while it requires no attention whatever, and is always ready and perfectly noiseless.

Another recommendation is the smallness of the original cost. A 30-in. motor, which at a pressure of 40 lb. is capable of driving, say, two Wharfedales, a Cropper, and a cutting-machine, costs about £30; and, as we have before explained, the fittings and alterations necessary for their erection are both few and inexpensive. As in the case of gas-engines, expense is only incurred while the machine is in active use, as in the majority of cases the water is carried through a meter.

With 60 lb. pressure the manufacturers state that they can supply a motor equal to 6-horse power; but it would, we think, be almost impossible to obtain water in the ordinary way at such a great and uniform pressure.

The "Backus" motor is eminently adapted for use in small printing-offices for the driving of a few machines; and stationers will also find it equally useful for the working of cutting-machines, &c. Long before these water-motors were introduced into this country they were thoroughly established in America, where they are held in high esteem.

PART VI.

THE WAREHOUSE.

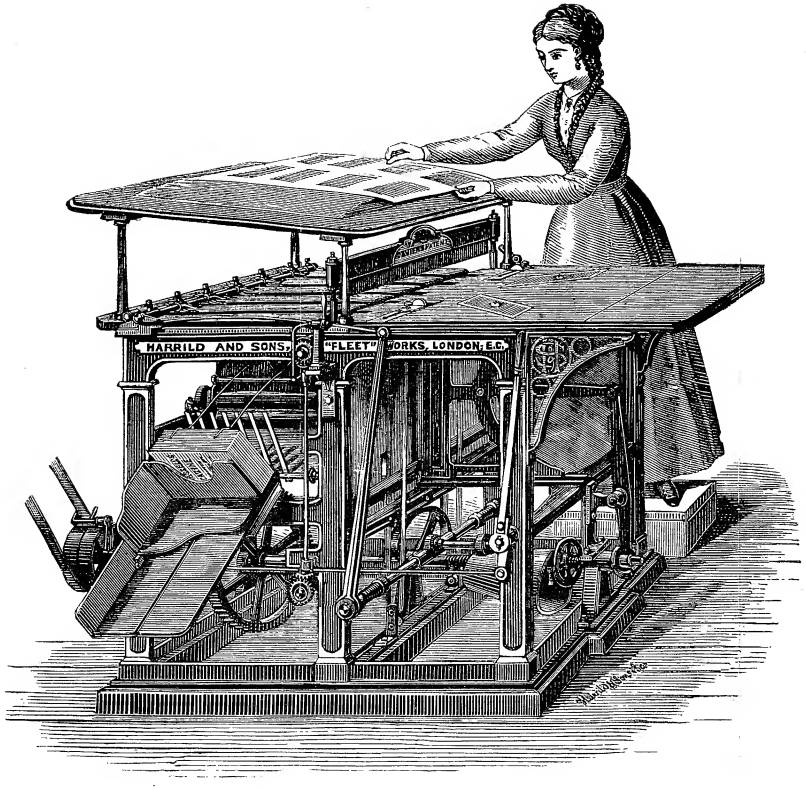
CHAPTER XXVIII.

FOLDING-MACHINES AND THEIR CONSTRUCTION.—The Duties of the Warehouseman — Drying of Work—The Drying-Room—Pressing and Rolling — Screw Presses — Hydraulic Press—The Boomer and Boschert Press—Cleaning Work—Rolling-Machines—The Zinc Plates—Gill's Hot-rolling Machine—Heim's Rolling-Machine—Glazed-boards—Cutting-Machines–Furnival's–Harrild's—Lawrence's—The "Diamond"—Howe's Gathering-Machine.

MUCH labour and ingenuity have been at various times expended in rendering the Folding-Machine as perfect as possible, and the result has been in every way satisfactory. They are now manufactured to give any number of folds, and the precision with which the operation is performed quite equals the work done by hand. Occupying little space, and requiring but trifling power to drive, they are now almost an indispensable piece of mechanism in a printing-office. A great saving is effected in the folding of newspapers and periodicals by their use, both in space, time, and cost. One girl can easily feed into the machine 1,200 or 1,500 sheets per hour, and as the paper is only momentarily handled in the feeding in, there is less probability of the sheets being soiled during the process of folding.

Amongst the most successful folding-machines are those made by Messrs. Harrild, Messrs. Simon & Son, of Nottingham, Messrs. Hopkinson & Cope, and Messrs. Lawrence Brothers, and the number in use is a sufficient guarantee of their utility and economy. Almost every London binder has one or more in work, and they are rapidly becoming more general.

The mechanism is extremely simple, and the sheet is in sight during the whole operation. The paper is laid to a



To face p. 186.] Fig. 99.—Folding Machine.

front mark, or placed upon points, and is seized by a series of grippers which drag it immediately under a blunt knife, The latter descends on the centre of the back, forcing the sheet between two rollers, by which it is pressed, thus folding the sheet exactly in half. By means of tapes it is then conducted in a vertical direction, until it is in the position for the next fold, when another knife, having a horizontal motion, forces the sheet between the second set of rollers. In like manner the paper is carried through the machine until it has received the necessary number of folds, when it is deposited in a small trough, which is emptied at intervals.

With but little ingenuity the folding-machine may be fixed to almost any printing-machine. It really resolves itself into the carrying of the sheet from the delivery-board by means of tapes, and driving the folder at the same relative speed as the printing-machine. Up to the present time, however, folding-machines have only been added to rotary printing-machines,—the Hoe, Victory, "Ingram," and the Marinoni, the latter being the last to adopt it.

The proper arrangement of the WAREHOUSE is of more importance than most printers acknowledge. This part of an office is generally supposed to be the non-productive,—a department upon which the less bestowed in labour and space the better. When the cost of a job is estimated, it is very seldom that the expense of counting, drying, pressing and packing up is taken into consideration. Composition, paper, and print are the items which are calculated. As is well known, the expense of warehousing is a considerable addition to the total cost, especially when the whole is done in a proper manner.

The warehouse, or that portion of the printing-office used in the clearing and packing-up of work, must be both light and dry. Counters should be erected in the lightest positions for this purpose. When gathering is done, a considerable amount of bulk-room is required. This can be economised, however, by the use of Howe's gathering machine, to which we shall refer hereafter.

Above all things, cleanliness should be insisted upon. Clean work is deposited in all directions, and if dirt or dust

is allowed to accumulate, many sheets will be spoiled, and in the case of short numbers, will possibly render the delivery deficient of the proper amount.

If the warehouse is situated above the machine-room, it is a good plan to have a small lift, say capable of holding two or three reams of paper, with an automatic reversing gear. The work can then be deposited in the machine-room by single reams, and lifted out by the counter in the warehouse above. This will save expense as well as spoilage by careless porterage.

Although a small matter in itself, the chief warehouseman should be a fair caligraphist. The neat labelling of work is always characteristic of careful packing, besides which the clearness and precision of delivery-notes favourably impresses a customer. Printed labels, however, are much to be preferred.

Although badly-printed work can never be made to look well by any amount of drying, pressing, or rolling, the finest machine-work may be speedily spoiled by carelessness or inexperience on the part of the warehouseman. Much spoilage is caused by set-off while printing, and work is also spoiled by the same cause even after it has left the machine-room. This is owing to various causes, the most prolific perhaps being the pressing of the sheets before they have been properly dried. Work on highly-glazed paper must be so stored after leaving the machine as to prevent any undue pressure. If it is piled up, ream upon ream, the sheets will be spoilt, as in rolled paper the ink lies upon the surface, the paper being too hard to allow of the ink being absorbed, as in the case of ordinary printing.

Various means are employed in the drying of work, the quickest and most effective being by hot air or steam pipes. The room chosen for this purpose should be entirely constructed of brick or other material, to lessen the possibility of an accident from fire. The work is generally hung upon a kind of wooden frame having cross bars at stated intervals. These frames are hooked upon iron bars, and are so loosely hung that they can be shifted along any portion of the supporting rods. Thus a large number of these drying-frames can be pushed close to one another in a com-

paratively small space, as they are filled with sheets. The work should be hung in quantities of about half a quire, but this must be regulated by the description of work, the time that can be allowed, and the heat applied. It is never advisable to allow the temperature to become too high. Cut work is sure to suffer, the ink being liable to turn to a brown hue, and if the paper is hard in texture, and extra pressure has been put on at machine, the utmost difficulty may be experienced in entirely taking out the marks of the impression even by the hydraulic press. The temperature of the drying-room should be about 100° or 120°.

In offices confined for space the work is often hung on poles stretching across the warehouse near the ceiling. Although this is frequent, it is objectionable from various reasons. The sheets are apt to become soiled from the necessarily long exposure, and the danger of fire is greatly increased. Besides this, the warehouse lacks that appearance of tidiness which ought to be a characteristic.

Superfine cut work must be dried by cold air. This is of course a much slower process than by the hot room, and takes a great deal of space. Horizontal racks, erected one above another, are best suited for this purpose. Not more than two or three sheets should be laid together, in order that they may be properly exposed. If the cuts are exceptionally heavy the set-off sheets should remain in till the work is partially dry, when they can be run out.

Before the work is pressed it must be thoroughly dry. This can be easily tested by putting a piece of white paper on the text and rubbing down with the nail. If the work is insufficiently dried, the glaze-boards will be so soiled that they cannot be again used until thoroughly cleaned, a long and unpleasant job. This is supposing that the sheets have been put in singly; but if two or three have been placed together between two boards the probability is that the whole will be entirely spoilt by set-off.

The pressing of partly-dry work, though practised to a great extent, is a very reprehensible practice. The set-off is avoided by the slight pressure, but no matter how smooth the sheet may appear when taken from the boards, the impression will surely reappear as the work gets dry. When

time is all-important, Gill's Hot-rolling Machine may be used with advantage.

Before rolling printed work the ink must be thoroughly dry. If this is not the case it will smash or spread, and the work will present a blurred appearance. The rollers will also become soiled and the work spoilt. In rolling work great judgment is necessary in the application of the pressure. It

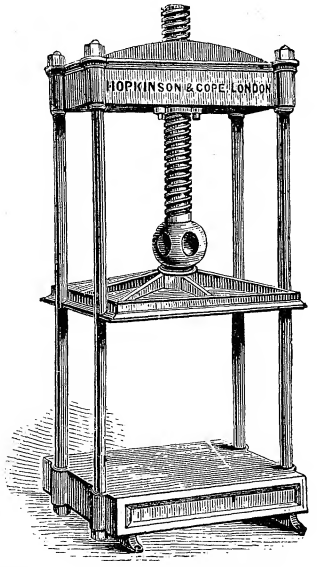


Fig. 100.—Screw or Standing Press.

should be remembered that this process always thins the sheet, even when comparatively slight pressure is applied. All papers are not adapted to rolling, especially when esparto has been used in its composition. Tiny yellow specks will appear on the surface and altogether spoil the general appearance of the work. Again, though paper may feel thick, and when held to the light appear perfectly clean and white, when rolled it may possess dull grey spots all over the

surface. Common papers should never be rolled, and it is as well to advise the stationer when paper is to be subjected to this process. Work is sometimes printed in quadruple and cut up prior to pressing. When this is the case,

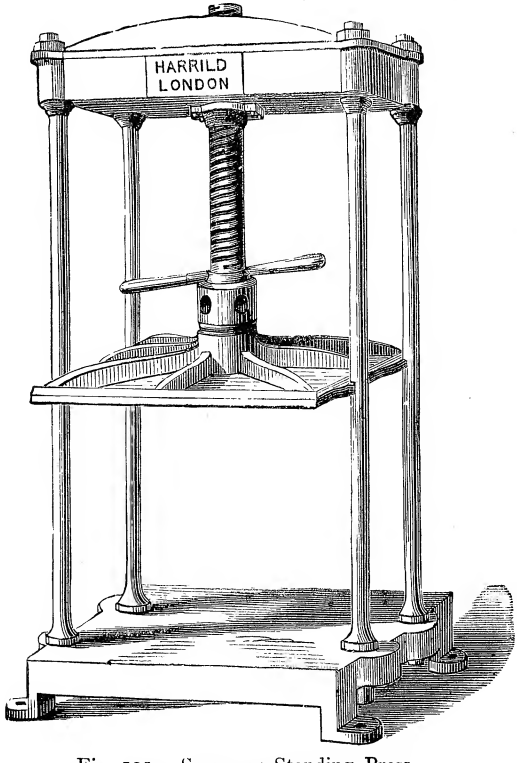


Fig. 101.—Screw or Standing Press.

great care should be taken that the ink be dry, especially on cut-work, or it is liable to set-off from the pressure exerted in the cutting machine.

Although screw-presses are still used, it is impossible

to obtain from them that pressure which is necessary in the proper finishing of work. Of course we except the Boomer and Boschert press, which although worked by a screw, is assisted by powerful knuckle joints and is as serviceable as

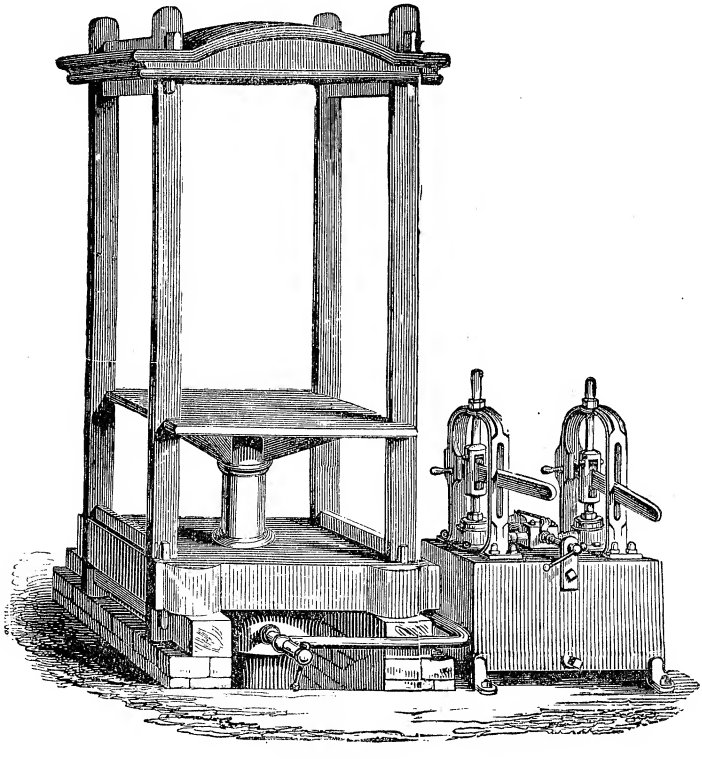


Fig. 102.—Hydraulic Press and Pumps.

the average hydraulic. Hydraulic presses suitable for printers are made of various sizes up to quadruple-demy, and can either be pumped up by steam or hand power. When a number are used it is advisable to work the pumps by steam.

This is mostly done by an eccentric fixed to the shafting. A single pipe can be made to supply any number, by having a joint at every press fitted with a screw valve, which can be opened or shut at will.

We would in all cases recommend that the Hawkins' Hydraulic Gauge be attached to the pumps. By means of this useful instrument the exact power exerted is always marked, and in case of the cylinder bursting or the head breaking, it is at least satisfactory to know the pressure exerted at the time. This is the more necessary when steam-power is used.

With careful usage the hydraulic press seldom requires repair, as there is nothing in its construction that is liable to much wear, excepting the leather washers. The duration of time these last can hardly be stated, as it depends, firstly, upon the quality of the material used, and, secondly, upon the power exerted and the amount of work done. We have known them last in good condition for two years, and also to require renewing in as many months. The leather itself is inexpensive, but the table and ram have to be lifted from their positions, which of course involves some amount of labour.

The Boomer and Boschert press is, as we have before stated, almost as powerful as the hydraulic. The power is obtained by a pair of knuckle joints working on a horizontal screw, and the pressure exerted is only limited by the power applied in driving. It is made for either hand or steam, and is eminently adapted for either the pressing of printed sheets or damp paper. The guaranteed pressure is from 15 to 600 tons, according to the size and construction. The Boomer and Boschert press accommodates as much work as a hydraulic, and less time is taken in the actual working, which is some consideration.

A great point in favour of these presses is that they cannot yield to pressure, as is sometimes the case with the hydraulic. The latter will sometimes be found to have given considerably after having been pumped up some little time. The Boomer press also is not liable to get out of repair; in fact, several are now in use that have been erected several years, and in no case have they given

trouble. This is, to a great extent, owing to their simplicity of construction.

Cleaning Work.—Although the work should be delivered

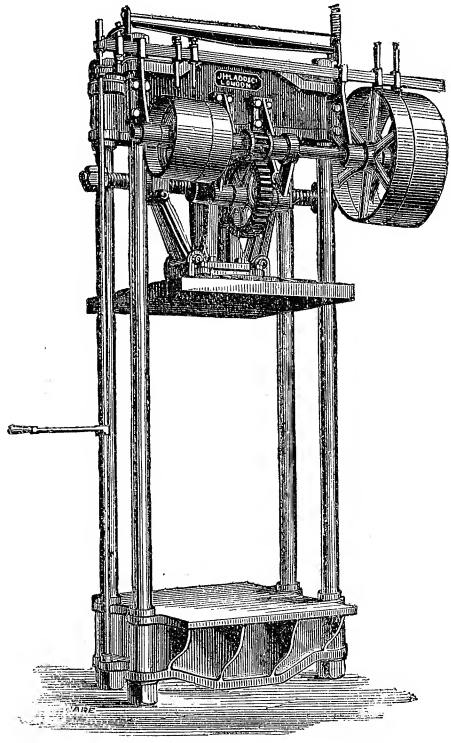


Fig. 103.—Boomer and Boschert Press for Steam-power.

from machine perfectly clean, this is not always the case. Small "blacks" are frequently present, caused by catches or high furniture. When the paper is somewhat thick in substance very fine glass or sand paper may be used. But

when thin this cannot be done, or the paper will be rubbed into holes.

Plate paper is very liable to soil, and if the work be very choice it is advisable to examine every sheet. Any dirty marks caused by careless handling, &c., can be cleaned off either by stale bread, ink-eraser, or india-rubber. In all cases the above should be used as little as possible, as they take the gloss off the paper wherever applied.

For putting-in and taking-out the work from the glazed-

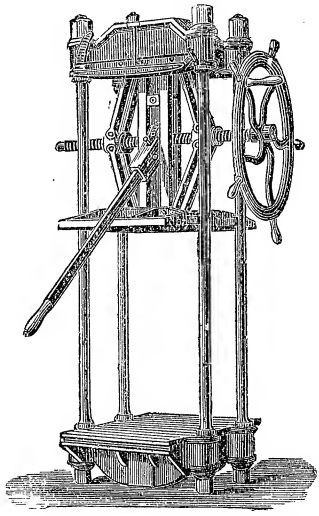


Fig. 104.—Boomer and Boschert Press, with Lever for Hand-power.

boards, benches should be provided amply large enough to take the largest-sized sheet that is likely to be pressed. If the paper hangs over the bulk, the edges will either be soiled or torn by the boy. Several persons may work together along the same counter; but we would advise the most careful to be selected for the lifting of the glazed-boards. These are expensive, and more damage is done to them in this process than in the placing and removal to and from the press.

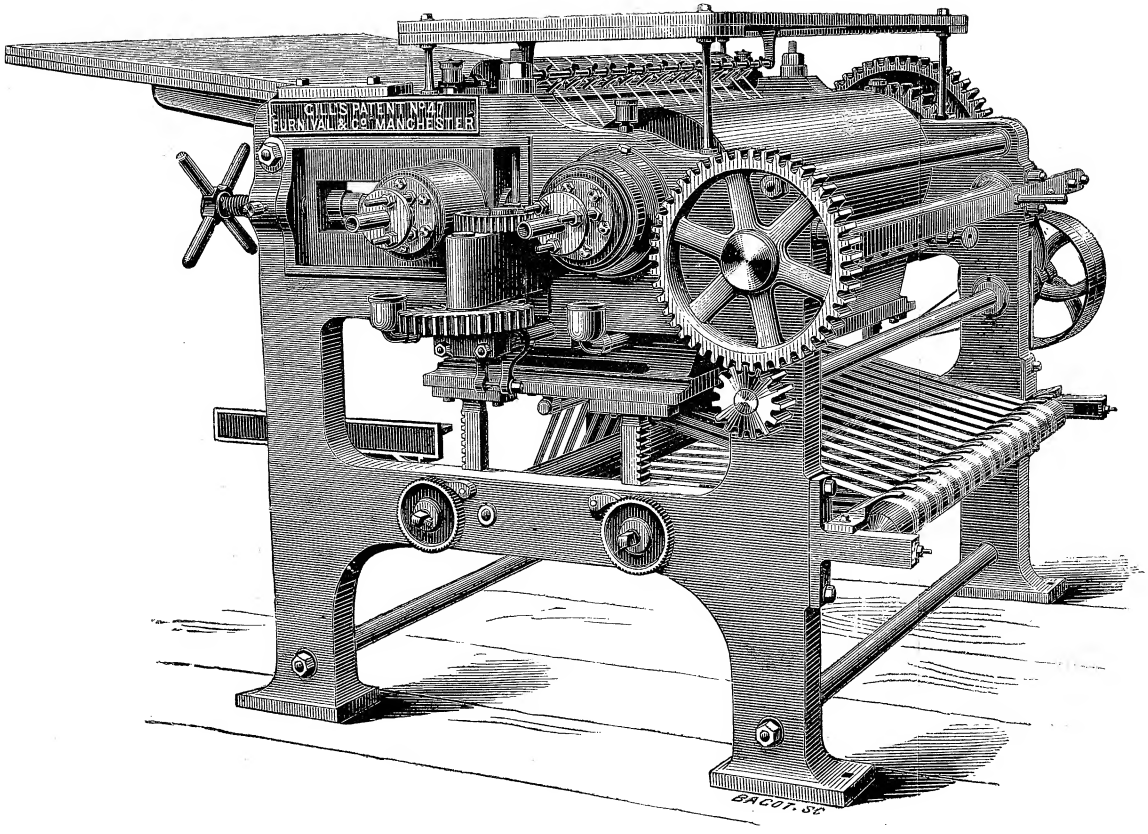
Large pieces of wood should be placed on the counter, against which the work may be evenly laid. This will save ultimate knocking-up, which unless carefully done damages the edges of the sheets.

The ordinary rolling-machines are gradually being superseded by those in which the sheet is passed directly between the cylinders, as in the Gill and Heim machines. The great expense of the zinc-plates used in the old machines certainly militates against them, besides which the power required for driving is incomparably greater. If both ends are worked, four or six boys are required, whereas in the new machines two are sufficient. The zinc-plates should be kept for a certain sized sheet, otherwise the paper is apt to become marked.

We have found it advisable to carefully examine paper rolled on zinc plates, in consequence of the liability of the plates to peel and leave pieces impressed on the paper. If these are not discovered before printing, serious batters will occur.

Paper is generally wetted prior to rolling, which softens the texture and thus renders it more liable to take a surface, and fits it for immediate printing. If it is allowed to stand too long after rolling it will become hard and tinny, and more trouble will be experienced in the printing.

GILL'S HOT-ROLLING MACHINE is now largely used for the rapid finishing of work direct from the printing-machine, and has been considerably improved since its original introduction. It dries and presses or rolls the sheet in one operation. The cylinders are made of polished steel, and a small steam-pipe passes through the centre of each. It is only necessary to admit the steam for a quarter of an hour twice a day, as they are very thick and retain the heat thus imparted for a considerable time. The cylinders are cleaned by means of a long pad filled with scraps of sponge underneath each. This pad is laid in a long trough filled with lye, and presses against the under part of the rolls, removing all the ink that may have adhered from the sheet. As the hot rollers cause a slight evaporation, the troughs have to be occasionally supplied with lye, which is poured into a funnel-shaped receptacle, and carried to the pad trough.



To face p. 196.] Fig. 105.—Gill's Hot-rolling Machine.

The rolls are finally wiped or cleaned by a long strip of india-rubber, which presses lightly against the surface. Thus the cylinders are cleaned and wiped after each sheet is rolled. The accumulation of ink deposited in the trough by the pad should be periodically removed, or the cylinders are liable to become soiled.

Although not suitable for superfine cut work, in consequence of the application of sudden heat, which has a tendency to discolour the ink, it is eminently adapted for all kinds of general and jobbing printing, wrappers to books, &c. The pressure can be regulated by powerful horizontal screws, so that the paper can be rolled, if ordinary care be used, without being thinned. The later Gill machines have a larger box for the steam in the middle of the cylinders than at the sides. This was found necessary to counteract the tendency for greater expansion at the ends. The great demand for these machines speaks of the universal favour in which they are held.

From 1,000 to 1,500 sheets per hour can be dried and surfaced by Gill's Hot-rolling Machine, and we may add that the power required in the driving is very small, the whole of the motion being purely rotary.

HEIM'S ROLLING-MACHINE may be considered one of the most important of modern improvements in the preparation of paper for machine. It consists of four cylinders placed parallel above each other, the two centre ones being coated with compressed paper and the top and bottom of polished steel. The paper is fed into the machine at the top and passes between the cylinders, being surfaced on both sides by the steel cylinders. About 1,000 sheets per hour can be rolled with the aid of two boys, and there being no jar, as in the case of the zinc plate process, the driving power is reduced to a minimum. The pressure is regulated by weights placed on the end of powerful levers. This rolling-machine is not adapted for printed work, as the paper cylinders would be liable to absorb the ink and cause a set-off.

GLAZED BOARDS are made of various sizes and thicknesses. Although they are more expensive we would advise the purchase of the thicker make, as the thin ones are liable to become quickly torn or otherwise damaged. Cheap boards

should be avoided, as they are frequently of uneven thickness, and if great pressure is placed upon them in the hydraulic press a serious break may occur. We believe that the heads of many presses have been broken from this cause.

The CUTTING MACHINES now manufactured are so uniformly excellent that little difficulty will be experienced in selection.

Messrs. Furnival have for years made this class of machine a speciality, and their latest application of the overhead gear has greatly increased their deserved popularity. Their guillotine cutting-machine has a very quick return, and is both powerful and accurate. It is peculiarly adapted to the cutting of gummed or enamelled paper, and there is little fear of "steps" or of making a loud report, which is common to some machines. A self-clamping apparatus is also fixed, which greatly facilitates the work.

Messrs. Harrild also make splendid machines of this description, which bear a high character for excellence throughout the trade.

We must not forget to call attention to the "Victory" Cutting-Machine, manufactured by the well-known firm of Messrs. Salmon, of Manchester. This machine can be fitted with the oscillating, circular, and diagonal movements of the knife, which prevent to a great extent the possibility of pieces being torn out of the back in the cutting. It is, therefore, particularly suitable for bookbinders.

The latest cutting-machines have, however, been made altogether on a different principle. The loss of time involved in determining the position of the cut by screwing down the clamp, the manner lately universally adopted, is altogether discarded. In Messrs. Furnival's machine this is accomplished by the clamp itself, which is easily moved to the position it will occupy during the descent of the knife by levers underneath the table, which can be worked by the foot. A balance-weight being fixed to the levers, it is automatically raised to its original position when the foot is removed.

This is altogether independent of the arrangement which fixes the clamp when the work is ready to be cut. The

paper is really held by pressure exerted by heavy iron weights dropped into a pair of parallel bars, acting as levers, at the back of the machine. As these weights can easily be adjusted, the pressure exerted by the clamp can of course be regulated.

The levers are governed by a bell-crank on the end of the shaft driving the wheel which moves the knife. The crank is attached to a movable steel bar, having an opening almost its entire length, and in this runs a small tumbler attached to the frame holding the weights. By this means the levers are allowed to govern the pressure, as when the clamp can fall no lower on the paper, the tumbler on the arm attached to the lever-bars merely travels upwards in the slot before mentioned. On the return of this arm, however, it lifts the weights, and the clamp rises from off the paper.

Thus it will be seen that the machine has its work, as it were, divided, instead of, as in some other machines, having but to raise the knife when the cut is made. Thus, when the knife descends, the clamp is being lowered simply by the action of the weighted frame; but immediately the cut is performed, the clamp together with the weights are lifted by the slotted arm attached to the bell lever.

The absence of cams is to be highly commended, as the tumblers and shapes are apt to wear in consequence of the repeated strain. The irregularly-shaped wheel, peculiar to Messrs. Furnival's machines, is used in conjunction with a steel arm for working the knife. The action of the machine is very rapid. Riggers are dispensed with, the fly-wheel being constantly in motion—a patent self-clamping friction-apparatus being adopted. This arrangement is a great improvement over the ordinary clutches, as it saves time and avoids the jar.

The DIAMOND MACHINE is both quick and powerful. Its peculiarity consists in its being self-clamping, the over-head gearing thus being rendered unnecessary. Another improvement is the "Trial Knife," which by pressing the knob above in the centre, marks exactly the place where the knife will fall. The fly-wheel is constantly in motion, and possesses a clamp which fits into a similar one on the driving-shaft. The whole is set in motion by the foot of the operator, and upon

the former being lifted, a spring immediately disengages the clamps and the machine becomes stationary. It is an American invention, but the patent right is possessed by Messrs. Hazell, Watson, & Viney, for whom Messrs.

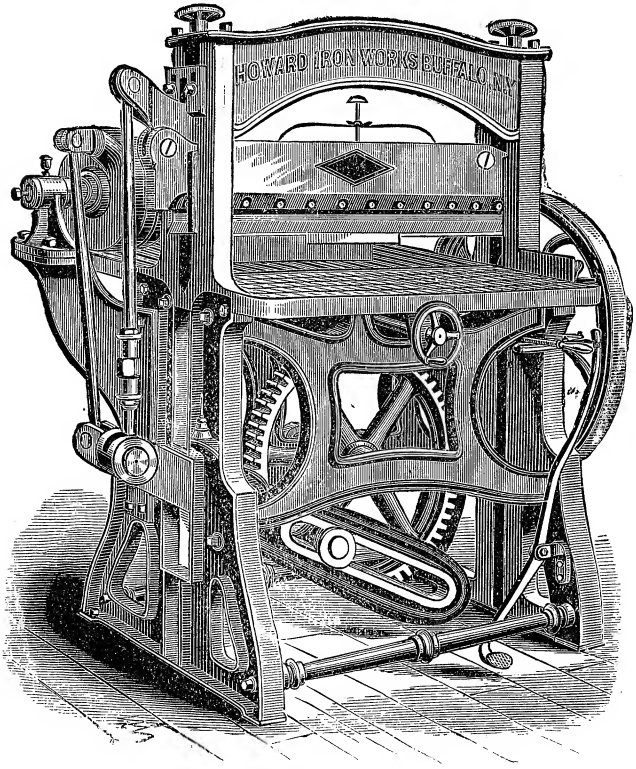


Fig. 106.—The Diamond Cutting Machine.

Middleton make the machine. It is somewhat expensive; but the agents profess that it is capable of doing more work than any other in the market.

Another American machine is supplied by Messrs. Lawrence, which is excellent in every particular, and is more economical in its cost. It differs from all other machines, inasmuch as the cut is made *upwards*. The front part of the table gives as the thick portion of the knife ascends. The edge of the knife lies flush with the surface of the table, which enables the position of the cut to be settled to a nicety. This machine is peculiarly light and simple in its build, but nevertheless sufficiently strong to perform all that may be required. It has a very quick return, and this, coupled with the facility with which the paper can be adjusted for cutting, enables it to perform more than the average quantity of work.

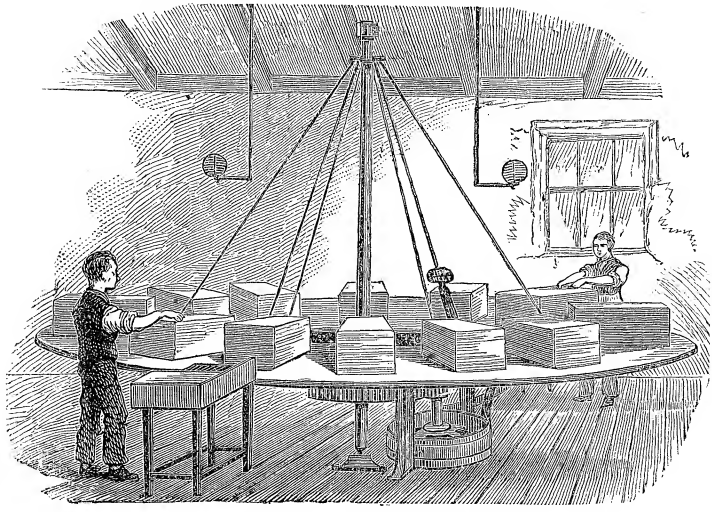
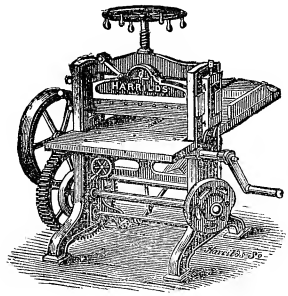


Fig. 107.—Howe's Gathering-Machine.

HOWE'S GATHERING MACHINE. — As many publishers insist that volumes shall be delivered by the printer collated in perfect books, we may call attention to the above addition

to the appliances of the warehouse. It somewhat resembles in appearance the roundabout, so common at fairs, and consists of an upright centre pillar reaching from the floor to the ceiling. A wide table is fixed round, about 2 feet from the ground and supported by iron rods to the main pillar. The sheets are laid on this table in consecutive order, and the boys are placed near the edge and facing a small table. As the machine moves slowly round each boy takes a sheet, and if the whole of the work be laid on the round table a perfect copy will be collected at every revolution. This can be increased by multiplying the number of operators; and, in fact, with twenty boys as many perfect copies may be collected at every revolution. It requires but little power to drive, and the motion is conveyed to the centre pillar by the ordinary bevel wheel. The inventor is Mr. Howe, the manager of Messrs. Eyre & Spottiswoode's, Bible Printing-office, at Shacklewell.



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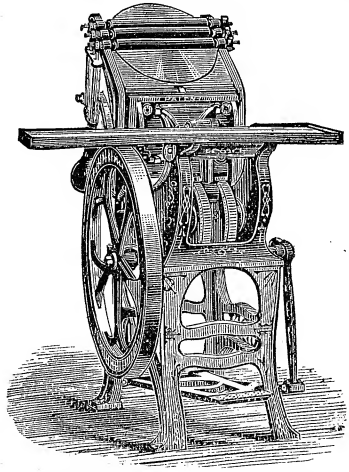
Ink Duct for No. 5 or 6 .. .. .. £2.

* Will be ready in June, 1880.

Usual accessories with Treadle Machines.

SPECIMENS AND CATALOGUE POST-FREE.



Patentees and Manufacturers,

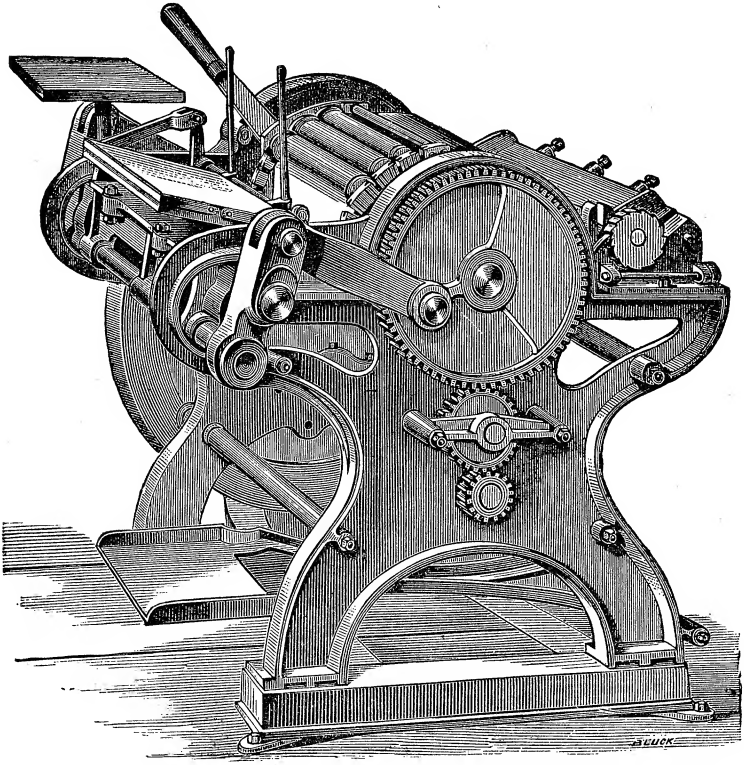
C. G. SQUINTANI & CO.

GENERAL PRINTERS' BROKERS,

3, LUDGATE CIRCUS BUILDINGS, LONDON, E.C.

THE "INVICTUS"

PLATEN MACHINE, FOR FOOT OR POWER.



The "INVICTUS" PRINTING-MACHINE has immense Inking and Distributing power, with means for controlling the same. Parallel impression. New and improved Throw-off and Stop motions. Novel and effective Revolving Bed for correcting form without removal from press. Simplest, most powerful, and effective Platen Press yet invented. Full particulars of

THE BIRMINGHAM MACHINISTS' COMPANY,

INVENTORS, PATENTEES, AND SOLE MANUFACTURERS.

GREAT QUEEN STREET WORKS, BIRMINGHAM.

THE "FARMER"

ROTARY WEB PRINTING AND FOLDING

MACHINES,

Adapted to any size of Newspaper.

These Machines will Print, Fold, and Deliver 8-page Newspapers, at a speed of **10,000** copies per hour.

THE "FARMER" ROTARY WEB PRINTING

MACHINES,

With Open-Sheet Delivery, will deliver Newspapers in batches of dozens, or any other desired number, at a speed from **10,000** to **12,000** copies of 8-page, or **20,000** to **24,000** copies of 4-page, Newspapers per hour.

THE "FARMER" ROTARY DOUBLE WEB

PRINTING MACHINE,

Constructed with either Open-Sheet Deliverers or Folders. Speed—**20,000** to **24,000** copies of 8-page Newspapers, or **40,000** to **48,000** copies of 4-page Newspapers per hour.

The "FARMER" ROTARY WEB PRINTING-MACHINES are rendered very compact by being solidly built on a strong iron bed-plate.

They include "**Patent**" **Damping** and **Inking** arrangements, and are driven by a Double-Cylinder Diagonal Steam-Engine, attached direct, which dispenses with all strap connections and affords the Pressman entire control over the speed of the Printing-Machine.

FOR FURTHER PARTICULARS APPLY TO

JAMES FARMER,

ADELPHI STREET IRON WORKS,

SALFORD, MANCHESTER.