年

第 5 卷

第 4 期

工程

第五卷 第四號

民國十九年八月

中國工程學會會刊

THE JOURNAL OF
THE CHINESE ENGINEERING SOCIETY

VOL. V, NO. 4 AUGUST 1930

中國工程學會發行 總會會所：上海寧波路七號 電話 一九八二四
每冊三角預定全年四冊定價一元每冊郵費本埠二分外埠五分國外一角八分

工程

中國工程學會會刊

季刊第五卷第四號目錄 ☆ 民國十九年八月發行

總編輯 周厚坤　　總務 楊錫鐐

本刊文字由著者各自負責

插圖: 孫多頤先生遺像
由柏林至南京攝影電報

正文:
中國工程師之使命……程文勳……463頁
國產製造油脂之標準及其實用試驗法(待續)……張雪揚……466頁
論實業及擬發展我國電氣事業之辦法……朱端節……480頁
油頁岩工業及撫順頁油岩……胡博淵……492頁
Fundamentals of a Strowger Automatic Telephone System……郁秉堅……497頁
京滬漢三市改裝自動電話之經過……莊智煥……505頁
A discussion of Future Electric Industry in China……桂銘新……511頁
Road Asphalt Specifications……周厚坤……517頁
工業館改建工業博物院之芻議……張可治……522頁
威斯汀好斯推進工廠實習概況……陳宗漢……526頁
Direct Generation of A. C. Current at High Voltages ……Sir. Charles A. Parsons……530頁

通信欄:
開立方捷法……劉增冕……545頁
折毀漢明屯發電廠磚烟突記事……陳宗漢……546頁

附刊:
美洲分會附刊(第一期)……547頁

中國工程學會發行

中國工程學會會章摘要

第二章　宗旨　本會以聯絡工程界同志研究應用學術協力發展國內工程事業爲宗旨

第三章　會員

(一)會員　凡具下列資格之一由會員二人以上之介紹再由董事部審查合格者得爲本會會員

(甲)經部認可之國內外大學及相當程度學校之工程科畢業生幷確有二年以上之工程研究或經驗者

(乙)曾受中等工程教育幷有六年以上之工程經驗者

(二)仲會員　凡具下列資格之一由會員或仲會員二人之介紹並經董事部審查合格者得爲本會仲會員

(甲)經部認可之國內外大學及相當程度學校之工程畢業生

(乙)曾受中等工程教育幷有四年以上之工程經驗者

(三)學生會員　經部認可之國內外大學及相當程度學校之工程科學生在二年級以上者由會員或仲會員二人之介紹經董事部審查合格者得爲本會學生會員

(四)永久會員　凡會員一次繳足會費一百元或先繳五十元餘數於五年內分期繳清者爲本會永久會員

(五)機關會員　凡具下列資格之一由會員或其他機關會員二會員之介紹並經董事部審查合格者得爲本會機關會員

(甲)經部認可之國內工科大學或工業專門學校或設有工科之大學

(乙)國內實業機關或團體對於工程事業確有貢獻者

(八)仲會員及學生會員之升格　凡仲會員或學生會員具有會員或仲會員資格時可加繳入會費正式請求升格由董事部審查核准之

第四章　組織　本會組織分爲三部(甲)執行部(乙)董事部(丙)分會(本總會事務所設於上海)

(一)執行部　由會長一人副會長一人書記一人會計一人及總務一人組織之

(三)董事部　由會長及全體會員舉出之董事六人組織之

(七)基金監　基金監二人任期二年每年改選一人

(八)委員會　由會長指派之人數無定額

(九)分　會　凡會員十人以上同處一地者得呈請董事部認可組織分會其章程得另訂之但以不與本會章程衝突者爲限

第六章　會費

(一)會員會費每年國幣五元入會費二十元　(二)仲會員會費每年國幣三元入會費六元

(三)學生會員會費每幣國年一元　(四)機關會員會費每年國幣十元入會費二十元

中國工程學會職員錄

（會址上海甯波路七號）

歷任會長

陳體誠(1918—20)　吳承洛(1920—23)　周明衡(1923—24)　徐佩璜(1924—26)

李垕身(1926—27)　徐佩璜(1927—29)

民國十八年至十九年職員錄

董事部

凌鴻勛　南京鐵道部　　陳立夫　南京中央執行委員會祕書處

李垕身　南京鐵道部　　吳承洛　南京工商部

徐佩璜　上海新西區楓林路市政府參事室　　薛次莘　上海南市毛家弄工務局

執行部

(會長)胡庶華　吳淞同濟大學　　(副會長)徐恩曾　南京建設委員會祕書處

(書記)朱有駪　上海新西區楓林路公用局　　(會　計)李　俶　上海徐滙滙交通大學

(總務)楊錫鏐　上海甯波路七號楊錫鏐建築事務所

基金監

惲　震　南京建設委員會　　裘燮鈞　杭州大方伯浙江省公路局

各地分會

上海分會　(會　長)　黃伯樵　上海新西區楓林路公用局

(副會長)　薛次莘　上海南市毛家衖工務局

(書　記)　王魯新　上海九江路22號新通公司

(會　計)　朱樹怡　上海四川路215號亞洲機器公司

南京分會　(委　員)　吳承洛　南京工商部　　薛紹清　南京中央大學工學院

胡博淵　南京農礦部

蘇州分會　(委　員)　魏師達　蘇州吳縣建設局

北平分會　(幹　事)　王季緒　北平西四北溝沿189號王寓

天津分會　(會　長)　李書田　唐山交通大學土木工程學院

(副會長)　嵇　銓　天津良王莊津浦路工務處

(書　記)　顧毅成　天津西沽津浦機廠

(會　計)　邱凌雲　天津法界拔柏葛鍋爐公司

武漢分會　(會務委員)石　瑛　武昌武漢大學　　陳彰琯　漢口工務局

(書記委員)孔祥鵬　武昌建設廳　　朱樹馨　武昌建設廳

(會計委員)繆恩釗　武昌武漢大學建築工程處

青島分會　(會　長)　林鳳岐　青島膠濟路四方機廠

杭州分會	(書　記)	嚴宏淮	青島公用局
	(會　計)	孫寶墀	青島膠濟鐵路工務處
	(會　長)	張可治	杭州浙江大學工學院
	(副會長)	陳體誠	杭州浙江省公路局
	(書　記)	茅以新	杭州裏西湖三號杭江鐵路局
	(會　計)	楊耀德	杭州浙江大學工學院
	(幹　事)	吳琢之	杭州浙江省公路局
太原分會	(會　長)	唐之肅	山西太原育才鍊鋼廠
	(副會長)	董登山	山西軍人工藝實習廠計核處
	(文　牘)	曹煥文	山西太原山西火藥廠
	(庶　務)	郗三善	山西大學校
梧州分會	暫告停頓		
濟南分會	(會　長)	張含英	濟南山東建設廳
	(副會長)	于皞民	濟南山東建設廳
	(書　記)	宋文田	濟南山東建設廳
	(會　計)	王尙才	濟南膠濟路工務總段
瀋陽分會	(會　長)	張潤田	瀋陽北甯鐵路港務處
	(副會長)	王孝華	瀋陽兵工廠
	(書　記)	余稚松	瀋陽東北大學
	(會　計)	胡光熹	瀋陽東北大學
美洲分會	(會　長)	張乙銘	526 W. 123rd St., N. Y. C.
	(副會長)		
	(書　記)	陶葆楷	67 Hammond St., Cambridge Mass. U.S.A.
	(會　計)	李嗣綿	Room 905, 105 Broadway, N. Y. C.

委員會

建築工程材料試驗所委員會

委員長	沈　怡	上海南市毛家街工務局		
委　員	徐佩璜	上海新西區市政府參事室	薛次莘	上海南市毛家街工務局
	李垕身	上海福熙路成和邨605號	徐恩曾	南京建設委員會祕書處
	支秉淵	上海甯波路七號新中公司	顧道生	上海福州路九號公利營業公司
	裘燮鈞	杭州大方伯浙江省公路局	黃伯樵	上海新西區楓林路公用局

工程教育研究委員會

委員長	金問洙	江灣復旦大學		
委　員	楊孝述	上海亞爾培路309號中國科學社	戴　濟	上海法界邁爾西愛路永慶坊一號
	茅以昇	鎮江江蘇省水利局	陳茂康	唐山交通大學
	張含英	濟南山東建設廳	梅貽琦	清華大學駐美監督處

周子競　上海亞爾培路 205 號中央研究院
李熙謀　杭州浙江大學工學院
程干雲　江灣勞動大學
阮介藩　上海法租界環龍路志豐里四號
譚伯羽　吳淞同濟大學
鄭肇經　青島港務局
陳懋解　南京中央大學
筧遠倫　北平清華大學
徐佩璜　上海新西區楓林路市政府參事室
陳廣沅　天津西沽津浦機廠
許應期　上海徐家匯交通大學
孫昌克　南京建設委員會
俞同奎　北平北平大學第一工學院
鄒恩泳　上海新西區楓林路公用局
李昌祚　上海西愛咸斯路 55 號
唐藝青　長沙湖南大學
徐名材　上海徐家匯交通大學

會員委員會

委員長　黃炳奎　上海高廊橋申新第五廠

委　員　上海 徐紀澤　南市十六浦荳市街恆吉巷五號
上海　黃元吉　愛多亞路38號凱泰建築公司
南京 徐百揆　蚌埠市政籌備處
蘇州
杭州 朱耀庭　工務局
北平
天津 邱凌雲　法界拔柏葛鍋爐公司
濟南 張含英　山東建設廳
青島 王節堯　膠濟路工務處
武漢 孔祥鵝　湖北建設廳
廣州 桂銘敬　粵漢鐵路株韶段工程局
山西 唐之肅　太原育才鍊鋼廠
瀋陽 張潤田　北寧鐵路港務處
美國 薛楚書　500 Riverside Drive, New York City.

經濟設計委員會

委　員　徐佩璜 上海新西區楓林路市政府
朱樹怡 上海四川路215號亞洲機器公司
胡庶華 吳淞同濟大學
張延祥 安慶安徽全省公路管理局
李　儆 上海徐家滙交通大學

編譯工程名詞委員會

委員長　程瀛章　上海梅白克路三德里 639 號

委　員　張澤翔　廣州光樞中國電氣公司
尤佳章　上海寶山路商務印書館編譯所
馮　雄　上海寶山路商務印書館編輯所
徐名材　上海徐家匯交通大學
張輔良　上海福開森路 378 號中央研究院社會科學研究所
孫洪芬　北平南長街 22 號中華教育文化基金董事會
藍春池　上海膠州路大夏大學
錢昌祚　南京中央陸軍軍官學校航空隊
林繼庸　江灣俞涇廟大南製革廠
鄒恩泳　上海新西區市政府公用局
葛敬新
李伯芹
胡衡臣　南京建設委員會
錢福謙
吳欽烈　南京軍政部兵工署

工程研究委員會

委員長　徐恩曾　南京中央黨部
主任委員　胡博淵 南京農礦部
化工組主任委員　徐鳳石 南京工商部
土木組主任委員　許心武 南京復成橋導淮委員會

電機組主任委員　惲蔭棠 南京建設委員會　機械組主任委員　鈕甸受　南京交通部技術委員會

委員　鍾兆琳 上海徐家匯交通大學　委員　周坤厚　上海福州路一號德士古火油公司

礦冶組主任委員　楊公兆 南京農礦部　建築組任委員　齊兆昌　南京金陵大學建築部

委員　吳稚田 上海九江路六號沙利貿易司公

建築條例委員會

委員長　薛次莘　上海南市毛家街工務局

委　員　朱耀庭　杭州工務局

徐百揆　蚌埠市政籌備處

許守忠　青島工務局

薛卓斌　上海江海關五樓滬浦總局

李　鏗　上海圓明園路愼昌洋行

本會辦事細則起草委員會

委員長　薛次莘　上海南市毛家街工務局

委　員　張延祥　安慶安徽全省公路管理局

徐佩璜　上海新西區楓林路市政府

徐恩曾　南京建設委員會祕書處

惲　震　南京建設委員會

職業介紹委員會

委員長　朱有褰　上海新西區楓林路公用局

委　員　馮寶齡　上海圓明園路愼昌洋行

徐恩曾　南京建設委員會祕書處

職業介紹審查委員會

委　員　化學工程　徐佩璜　上海新西區楓林路市政府

徐名材　上海徐家滙交通大學

建築工程　薛次莘　上海南市毛家街工務局

裘燮鈞　杭州大方伯浙江省公路局

橋梁工程　馮寶齡　上海圓明園路愼昌洋行

許貫三　上海南市毛家街工務局

電氣工程　鄭葆成　上海新西區楓林路公用局

機械工程　支秉淵　上海甯波路七號新中公司

水利工程　朱有褰　上海新西區楓林路公用局

無線電工程　王崇植　青島工務局

土木工程　朱有褰　上海新西區楓林路公用局

道路工程　鄭權伯　青島港務局

鐵路工程　洪嘉貽　杭州平海路 37 號

材料試驗委員會

委員長　王繩善　上海徐家滙交通大學

委　員　康時清　上海徐家滙交通大學

盛祖鈞　上海徐家滙交通大學

科學咨詢處

常務委員長　徐佩璜　上海新西區市政府參事室

常務委員　胡庶華　吳淞同濟大學

裘維裕　上海交通大學

黃炳奎　上海高郎橋申新第五紡織廠

周厚坤　上海外灘德士古火油公司

支秉淵　上海甯波路七號新中工程公司

孫多殖先生遺像

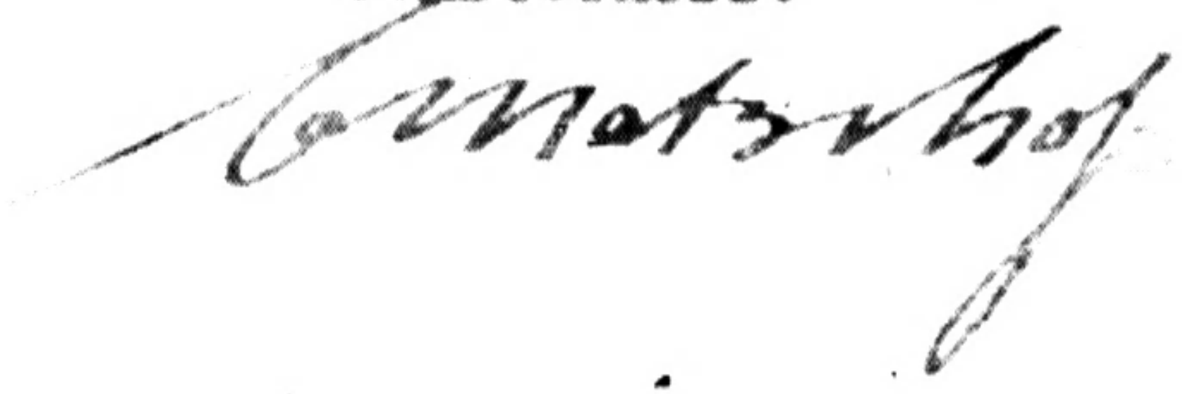
孫君景蘇傳略

沅福柴

君諱多頫號景蘇.其先爲安徽壽縣望族.祖秋潭先生,父次青先生,俱任清爲縣令,所至有聲.次青先生故名孝廉,嘗主各校講席,門下稱盛,君生於清光緒中,思想新穎爲文踔厲風發,往往數千言,不能自休.年十六,入揚州民立學堂此爲君受新教育之始.君聰明好學,成績冠儕輩,諸教習交相稱許.其後肄業蘇省鐵路學堂,南京上江公學,文辭,科學,益見進境.繼入交通部工業專門學校,卽前南洋公學.治土木工程科,畢業後,交通部派滬杭甬鐵路實習.旣調周襄及株欽鐵路從事測量,自西安,道漢中,入川,逼歷險阻,見聞日廣,術亦大進.繼供職於交通部,技術委員會.旋上海濬浦總局任以工程書記,謹愼從公,勞績優異.先後十一年,漸擢升至濬工科副工程師之職,民國十九年五月卅日晨間,君偕濬工科職員五人,攜現欵二萬餘元,至第一工作處海蝎挖泥船旁.發放工資.正在解囊之始.突有盜輪踪至,躍上劇盜九人,持盒子砲,手鎗,開火轟擊,受傷者共五人,而君獨以彈中咽喉登時殞命,哀哉!君天性厚重,處世接物,藹然有仁者之風,親友得其資助者甚衆.聞君死,識與不識,均同聲嗟悼,以爲天之報善人者,何其酷也!君時年始四十.妻姜氏.有子三人女二人,俱幼.

Die in der Zweiten Weltkraftkonferenz vereinigten Nationalen Komitees haben mit grosser Freude von der wundervollen künstlerischen Adresse mit den Grüssen und Glückwünschen des Vereines Chinesischer Ingenieure Kenntnis genommen. Sie erwidern diese mit dem Ausdruck aufrichtigsten Dankes für die verständnisvolle und tatkräftige Unterstützung, die die chinesischen Teilnehmer der Konferenz zuteil werden liessen. Der Verein deutscher Ingenieure sendet den chinesischen Ingenieuren seine herzlichsten Grüsse.

C. Matschoss.



由柏林至南京之攝影電報(譯文見後)

此電報係由德國工程學會主任麥脫蓄司博士所發,經柏林,南京間得力風根西門子客羅洛斯式之無線電傳圖影設備,而傳致本會全人者,此報傳遞時間,僅四分半鐘云.

電報內容如下:

本屆第二次世界動力會議各國代表團,對於中國工程學會所致動力會議之祝辭,非常欣佩.彼等對於中國方面給與動力會議之援助,及中國方面所派代表之出力,十分感謝. 德國工程學會敬祝中國工程學會進步發展.

麥脫蓄司謹啓

中國工程師之使命

著者：程文勳

本屆日本開萬國工業會議，各國著名工程師，技術家，參加者頗多，雖討論的問題甚少，會議不免屬於形式，但送會的論文中，有價值的很多，有好多論文，是關於工程師本身『說是社會上最重要的物質文明進步，完全靠着工程師發明，歐戰時發明更多，所以各國近來對工程師的地位，日益尊崇』．此次會議中，有人提議，聯合萬國工程界，組織一大規模團體，猶之政治問題，有國際聯盟會議．此項提案，經議決由各參加人員，先回本國組織，再於下屆會議討論萬國結合辦法．瑞典工程師恩斯德姆 Enston 有一文論『工程師之職務』，立意尤爲深切．兄弟今天選擇這個題目，大都取意於恩君之文，再參酌吾國情形，加以發揮．

工程師又稱爲技術家，在西文原意，係多才多藝之人，其地位在社會之重要，既如上述．恩君云『經此次會議之後，希望各國工程師更加增自重之觀念』．此語是要他增加責任心，並不是要傲慢世俗，妄自尊大，因明白責任，便是謙遜．吾國以前以『士』列四民之首，而范文正公爲秀才時，便以天下爲已任，亦卽此意

工程師既負增進人生之幸福，其第一重要任務，須開闢交通：交通爲文化所繫，從古民族，均沿江河而蕃衍，次則沿海岸，均得交通捷便之故．（卽如吾國之文化，發源自黃河流域，漸移於長江流域以及沿海）．科崙布尋獲美洲，貫通重洋．自蒸汽動力發明，輪舟之於海洋，鐵路之於大陸，效用益偉．近則汽車，飛機，更足以飛渡重山，以補鐵路之所不及．此外電報，電話，無線電，尤足發揚文化，貫通各種民族固有之發明，開未來之新智，闢交通上之新紀元．

第二重要任務,在保持及發展固有之生產:工業上的生產力量,終要保持,或設法增進,方足以改良人類之生活程度.人以舒適爲幸福,過度之舒適,便是奢華.所以奢華與幸福,原無絕對之區別,要視個人之經濟狀況爲斷.(昔時帝皇寶座雖加盛飾,實一硬板凳,遠不如今日彈簧椅之舒適;此雖例外,但足證使人舒適,必藉科學之進步).大致奢侈品是價貴的,所以富人用以享受之品,貧人祇能目爲奢侈品,而不敢問津.儉固美德,然必儉到若何程度,亦難得一適當之標準.物質文明發達之旨,在人人能多得享受,然此非生產增多,價值低廉不爲功.工程師之任務,在能使各種工業出品,成本低廉,庶用者可以普及.

自發明機器以代人工,出品多而價值漸低.機器廠中各雇用工人所做之工作早定有分工之制,近年美國退拉氏,又研究煉鋼廠運鋼工人動作之多寡,並泥水匠砌牆動作之多寡,設法減少,以增進其成績,此卽所謂科學管理法.今日福特廠製造汽車,所用工人,每日工作之時間少,工價貴,而成本反輕,實藉特種管理之法.其製造汽車用 Conveyer 循環旋轉機,懸掛工作之品,工人都站立一定地點,不必移動,用機械規定工作之品,(車件)移至某處,卽應由某種工人於若干時間以內,做某種工作,設或某處工人,不按時勤作,則時間一滿,其品卽移至第二步工作之處,不能强其等候也.科學管理法之精意,不外(一)濟經時間,(二)經濟材料,(三)免去枉費之工作.苟能隨時隨事,於此三點注意,則出品之成本可減.成本輕,售價自廉,售價廉,銷路方足普通,使奢侈之品,改爲實用品,人人得以享受.觀乎美國置有汽車之人極多,當工人者亦得自備汽車以代步,而吾國則中人之家,尙屬難能,可想見矣.

工程師重要之工作,便是研究.研究天地間之眞理,並支配方法,以求進步,精使生產之品,日益增多,價值日益低廉,並求種種新發明,以造福社會,此種務神,堪稱爲文化之進步.

工程師於工業界中,具有領導工人之責任,應時之求,增進所屬人員之幸福,同事相處,尤當具公開誠實之情感,時時交換經驗及智識,以求共同之利益,至個人之利益,有時雖犧牲而不辭,處事忠實,不貪一時利益之工程師方謂之智,反是謂之愚蠢,愚蠢者於經濟上必難有所成就.總之,治工業之最要者,在具有高尚之志願及辦事之精神.

中國現謀建設,發展工業,兄弟以爲多非難事,而最難者爲『人』之組織.人謂中國人好作弊,好作首領,鄙意此係政無軌道,故有此種現象,尚非國民之惡劣根性.佛法無我,而今人則惟我主義充溢社會,此實爲國民之惡劣根性.惟其有我,則名也,利也,權也,勢也,均我所欲也,俾進之心,貪得之念,種種慾望,均由此而起.惟我主義盛,便難成大組織,無大組織便難成大事業.普通之人,但咎政局不定,百業不振,然執政之人,來自民間,以惟我主義之國民,即時局平靖,亦難成大業.試觀機關也,工廠也,商店也,其內部無不有爭權奪利之事.由小合併而給合成大業者,在所罕有.大事業中,因傾軋而分裂者,却所恒見,又何咎乎在上者?

青年學子,以惟我主義之陶冶,出校之後,不能俯就社會致難立足.資本之家,亦以惟我主義之濡染,不能羅致人才,以改進其事業,更見萬難之人,任務過繁,不能專一,亦惟我主義有以致之也.兄弟此次在日本參加萬國工業會議,見各國之工程師,均白髮蒼蒼,終其生以研究學問.回顧吾國代表,類皆風塵中人,奔走衣食者,故對於研究學問,言之足滋慚汗.諸君皆工程專家,在今日物質進化之世界,當爲社會上第一流人物.鄙意欲求中國工業之發展,必先由各工程界挺身而出,打倒惟我主義,陶冶國民根性,固當經一番嚴格訓練,應自小學起但受過高等教育之人,自已刻苦修養,亦足移風易俗,不識諸君,以爲何如?

國產製皂油脂之標準及其實用試驗法

著者：張雪楊

溯自近世工業革命以還，凡百製造，皆由小規模之手藝，羣趨於大規模之機械化，質與量既並重，而效率尤特別關要。故於原料，半製品，出產及副產物等局部之科學管理，莫不首貴試驗，而須有一定之標準，藉資比較，所謂失之毫釐，謬以千里，此歐美各國所以有標準專局之設立以釐訂之者也。我國自逖清末葉起，即漸有建樹近世工業基礎之傾向。惜頻年變亂，內憂外患，在在皆足阻其滋長。迨革命政府奠都南京，工商部乃首先奉行　總理實業救國政策，而有發展全國各種基本工業之大計劃，同時並有工業法規之編纂，與夫劃一度量衡制度法令之頒布，誠屬當務之亟。不過建設伊始，萬端待舉，全恃中央獨擎，焉能一蹴而幾，奏功於瞬息，幸地方行政機關及學術團體亦有鑒於此，故年來成立各種檢驗研究機關多所。惟彼此分工，各事專業，缺少聯絡而乏統計上之價值。以故工程學會本研究之精神，作實地之調查，曾以屬於化工範圍之編訂國產材料各種常數表，及確定國產材料各種標準試驗法，與一般的常數之比較上優劣問題，見委於予。顧自維淺薄，安敢有所貢獻。不過以製皂油脂一項，類皆國產。且有桕油一種，則係中華特產，而爲他國所無。近年出口之鉅，駸駸日上，幾有與桐油並駕齊驅之勢。所試既多，乃彙列其結果而平均之。雖不能即據此爲標準，但亦足爲釐訂標準常數之一助。尚望諸同志更進而匡正之，則幸甚矣。

油脂之種類固多，但除桐油及亞麻子油等極少數之乾性油外，餘皆適用於製皂。茲擇十八年度一年中在五洲固本廠關於各種製皂油脂之試驗結果，分類彙載於次。其試品悉取原樣，不加任何處置，藉存其眞，而便於實地工作，故與一般書藉上所載自不能不有所出入焉。

(一) 常數彙錄

(甲) 桕油

桕油或稱皮油,係由烏桕種子外皮製得.烏桕屬大戟科Euphorbiaceae植物學名Stillingia Sebifera Russ.爲落葉喬木,葉卵形而尖.夏日開黃花.結實至八九月而熟.實外部蔽以樓褐色殼.熟後此殼破裂現扁圓形種子三粒.種子外面裹以白色蠟狀脂肪層.其內又有硬殼,殼內有淡黃色核仁.清油或梓油 Stillngia Oil卽由此仁壓榨所得者也.清油爲一種極佳之乾性油,設壓榨得法,不難與桐油爭一日之短長.烏桕爲我國特產,山陽平澤,沿江溫煖之區,無不產之.就中以四川東部,湖北西部及江西,湖南,安徽,浙江爲尤盛.入秋霜葉楓紅,極寒豔之致.落木後纍纍滿樹者皆桕子也.待桕子採下,則蒼幹枯枝,連岸遍野,又別饒逸趣.吾國山水畫中,固數見不鮮.而曾有溯江而上之舟行者亦類能道之也.大約烏桕生長四年後始結實.平均每樹結實四五十斤,可產油二十餘斤,依現在市價每擔二十圓計算,則每樹每年可獲四圓.如此大利所在,焉得不竭力提倡,庶國計民生兩有裨益,又豈特防止水患點綴風景而已哉?

牌號或來源	水分	雜質	鹼化數	融點	游離脂肪酸	酸數	碘數	試驗日期
萬順豐	0.43%	0.25%	217.7	41°C	2.26%	4.49	——	1-12-29
荊州蘇城	0.19%	0.20%	214.8	41°C	5.36%	10.66	——	1-13-29
向春和	0.30%	0.23%	211.1	40°C	6.36%	12.62	——	1-14-29
益豐	0.32%	0.10%	211.1	40°C	7.19%	14.31	——	1-14-29
恆生銓	0.28%	0.20%	216.0	39.5°C	6.20%	12.34	——	1-14-29
蘇城	0.04%	0.26%	211.1	39°C	2.96%	5.89	——	1-14-29
林瑞豐	0.68%	0.25%	200.6	39°C	7.61%	15.15	——	1-14-29
義成春	0.34%	0.21%	212.6	41°C	3.38%	6.73	——	1-14-29
志成	0.74%	0.25%	211.1	40.5°C	3.38%	6.73	——	1-14-29
同興茂	0.34%	0.22%	218.0	41°C	5.08%	10.05	——	1-14-29
永茂協	0.35%	0.12%	216.6	39°C	4.79%	1.54	——	1-14-29
蘇城	0.40%	0.28%	212.[illegible]	38.5°C	7.70%	3.37	——	1-14-29

牌號或來源	分水	雜質	鹼化數	融點	游離脂肪酸	酸數	碘數	試驗日期
洽成永	0.12%	0.10%	218.1	39°C	3.38%	6.73	——	1-17-29
洽成永	0.03%	0.13%	218.0	41°C	2.26%	4.49	——	1-30-29
萬順豐	0.15%	0.10%	212.7	40°C	2.82%	5.61	——	2-21-29
方協和	1.10%	0.05%	207.2	43°C	3.81%	7.57	——	2-25-29
孫洪疇	0.13%	0.02%	206.6	41°C	2.54%	5.05	——	2-23-29
洽成永	0.24%	0.11%	207.2	39°C	1.69%	3.37	——	3- 3-29
同源	0.36%	0.06%	208.0	42°C	2.82%	5.61	——	3- 6-29
裕美成	0.22%	0.15%	208.9	38°C	7.47%	14.87	——	3- 9-29
裕昌元	0.24%	0.07%	211.2	40°C	4.79%	9.54	——	3- 9-29
和合	0.31%	0.07%	206.7	40°C	3.38%	6.73	——	3- 9-29
恆生銓	0.27%	0.30%	213.2	41°C	3.53%	7.01	——	3- 9-29
恆興長	0.24%	0.35%	212.8	41°C	4.23%	8.41	——	3- 9-29
蘇城	0.27%	0.15%	212.8	41°C	1.69%	3.37	——	3- 9-29
熊正興	0.04%	0.41%	213.8	39°C	1.27%	2.53	——	3-14-29
丁和記	0.05%	0.15%	212.4	39°C	1.41%	2.81	——	3-14-29
洽成永	1.18%	0.30%	215.2	38°C	2.82%	5.61	——	3-15-29
朱大順	0.52%	0.13%	208.5	38.5°C	10.01%	19.92	——	3-15-29
同發源	0.36%	0.16%	208.0	41°C	2.82%	5.61	——	3-15-29
洽成永	1.80%	0.61%	206.7	40°C	4.51%	8.98	——	3-18-29
金華	1.08%	0.13%	212.4	41°C	6.63%	13.18	——	3-20-29
大有	1.54%	0.14%	202.4	39°C	4.09%	8.13	——	3-19-29
永順	0.20%	0.27%	204.4	40°C	1.69%	3.37	——	3-19-29
高壽記	0.59%	0.33%	203.3	40°C	1.97%	3.93	——	3-19-29
德順	0.08%	0.20%	210.1	40°C	3.53%	7.01	——	3-23-29
朱大順	0.05%	0.19%	208.9	41°C	2.82%	5.61	——	3-23-29
穗源	1.40%	0.36%	206.3	41°C	4.51%	8.98	——	3-28-29
穗源	1.48%	0.27%	214.2	41°C	2.82%	5.61	——	3-28-29
王隆昌	0.27%	0.19%	203.5	42°C	6.63%	13.18	——	3-30-29
怡和	0.12%	0.09%	205.8	41°C	2.54%	5.05	——	3-30-29
義記	1.78%	0.31%	215.6	40°C	4.23%	8.42	——	3-30-29
王恆豐	2.56%	0.32%	205.8	42°C	2.40%	4.77	——	3-30-29
合興	2.02%	0.27%	207.2	42°C	3.53%	7.01	——	3-30-29

牌號或來源	水分	雜質	鹼化數	融點	游離脂肪酸	酸數	碘數	試驗日期
吉昌仁	0.28%	0.37%	207.2	40°C	6.06%	12.01	——	3-30-29
茂林春	0.09%	0.19%	205.8	42°C	9.45%	18.79	——	3-30-29
大道生	0.19%	0.21%	210.0	42°C	3.05%	6.17	——	3-31-29
同興盛	1.07%	0.09%	207.2	38°C	15.23%	30.29	——	3-31-29
和順祥	1.37%	0.04%	200.9	41°C	9.17%	18.23	——	3-31-29
永順福	0.12%	0.18%	210.0	40°C	2.82%	5.61	——	3-31-29
永順興	0.03%	0.12%	203.5	42°C	2.68%	5.33	——	3-31-29
宏榮發	1.77%	0.26%	202.3	42°C	4.51%	7.95	——	3-31-29
李長興	0.18%	0.15%	209.3	40°C	8.58%	17.67	——	4- 4-29
長順和	0.20%	0.12%	209.3	40°C	3.95%	7.85	——	4- 4-29
德順正	0.09%	0.26%	207.9	40°C	5.08%	9.60	——	4- 4-29
洽成永	3.17%	0.32%	204.4	43°C	4.89%	9.32	——	4- 6-29
洽成永	2.37%	0.25%	206.8	41°C	8.74%	17.34	——	4- 6-29
洽成永	0.19%	0.20%	211.8	40°C	2.68%	5.33	——	4- 6-29
天成亨	0.84%	0.32%	210.4	39°C	9.31%	18.51	——	4- 7-29
保合	0.25%	0.11%	205.1	40°C	7.47%	14.87	——	4- 7-29
李恆裕	2.31%	0.40%	206.9	41°C	6.35%	12.62	——	4- 9-29
裕美成	0.12%	0.26%	203.0	39°C	4.79%	9.54	——	4- 9-29
裕興	0.12%	0.22%	207.2	40°C	2.96%	5.89	——	4- 9-29
大有	0.62%	0.32%	210.4	39°C	10.15%	20.19	——	4- 9-29
洽成永	0.35%	0.12%	211.4	40°C	3.67%	7.29	——	4-13-29
洽成永	0.11%	0.14%	210.0	40°C	3.53%	7.01	——	4-13-29
徽昌	2.24%	0.42%	198.8	41°C	6.35%	12.62	——	4-15-29
徽昌	1.68%	0.21%	203.0	42°C	5.22%	10.38	——	4-15-29
童純甫	2.35%	0.15%	200.2	41°C	2.82%	5.61	——	4-15-29
全丈	0.12%	0.18%	210.0	42°C	1.83%	3.65	——	4-18-29
同興久	0.21%	0.18%	210.7	42°C	2.82%	5.61	——	4-18-29
童純甫	10.44%	0.17%	199.5	43°C	3.38%	6.73	——	4-18-29
徽昌	19.77%	0.22%	192.5	41.5°C	5.01%	9.96	31.72	4-18-29
徽昌	16.32%	0.61%	189.7	42°C	4.94%	9.82	29.93	4-18-99
胡發祥	0.07%	0.29%	201.7	39.5°C	1.83%	3.65	——	4-26-29
徽昌	15.89%	0.41%	180.3	41°C	4.37%	8.70	31.81	5- 5-29

牌號或來源	水分	雜質	鹼化數	融點	游離脂肪酸	酸數	碘數	試驗日期
徽　昌	16.98%	0.36%	178.9	42°C	4.44%	8.84	29.63	5- 5-29
三　星	0.02%	0.22%	204.0	40°C	2.12%	4.21	——	5-10-29
荊　州	0.71%	痕 跡	207.2	40°C	4.23%	8.42	33.75	5-12-29
徽　昌	12.89%	0.43%	——	——	——	——	——	5-12-29
徽　昌	10.58%	0.40%	——	——	——	——	——	5-12-29
荊　州	0.15%	0.28%	204.3	40°C	2.12%	4.21	——	5-26-29
穗　源	2.31%	0.14%	201.7	41°C	5.59%	11.50	——	6-14-29
沈鳳章	0.14%	0.26%	211.4	40°C	3.03%	7.01	——	7-31-29
恒春元	0.17%	0.24%	211.3	40°C	3.17%	6.03	——	8-13-29
恆春元	0.20%	0.27%	211.4	40°C	1.97%	3.92	——	8-13-29
同　源	1.31%	1.45%	204.1	42C°	5.36%	10.66	——	8-15-29
同　源	2.57%	0.33%	208.0	39°C	4.79%	9.54	——	8-15-29
同　源	4.11%	0.24%	207.5	40°C	6.63%	13.18	——	8-18-29
同　源	2.79%	0.33%	207.4	40°C	5.08%	10.10	——	8-18-29
同　源	0.63%	0.34%	207.4	40°C	12.69%	25.25	——	8-19-29
同　源	1.18%	0.26%	206.9	41°C	2.40%	4.77	——	8-19-29
同　源	0.85%	0.26%	213.1	42°C	6.91%	13.75	——	8-21-29
同　源	0.05%	0.25%	211.4	41°C	3.95%	7.85	——	8-21-29
同　源	0.19%	2.24%	212.7	41°C	3.81%	7.57	——	8-21-29
萬順豐	1.24%	0.34%	207.0	41°C	3.67%	7.29	——	9- 8-29
萬順豐	0.11%	0.23%	205.4	41°C	2.68%	5.33	——	9-13-29
萬順豐	0.02%	0.18%	201.3	41°C	2.54%	5.05	——	9-13-29
萬順豐	1.54%	0.29%	195.9	40°C	4.05%	9.26	——	9-13-29
萬順豐	0.66%	0.23%	204.6	40°C	5.50%	10.94	——	9-13-29
天泰昌	0.16%	0.18%	206.2	40°C	5.08%	10.10	——	9-17-29
和生祥	0.18%	0.29%	205.6	39..5°C	3.38%	6.73	——	9-17-29
和生祥	0.28%	0.27%	210.2	40°C	3.67%	7.29	——	9-21-29
天泰昌	0.03%	0.24%	211.1	39°C	3.10%	6.17	——	9-21-29
同泰祥	1.48%	0.54%	201.8	40.5°C	11.99%	23.84	——	9-25-29
謙泰益	1.09%	0.38%	201.4	39°C	4.51%	8.98	——	9-25-29
潤記泳	0.11%	0.26%	205.1	39°C	4.23%	8.42	——	9-27-29
胡愼遠	0.08%	0.35%	213.4	39°C	4.23%	8.42	——	9-29.29

牌號或來源	水分	雜質	鹼化數	融點	游離脂肪酸	酸數	碘數	試驗日期
謙泰益	0.13%	0.28%	210.5	38°C	3.24%	6.45	——	9-29-29
同興	0.15%	0.35%	212.2	39°C	4.09%	8.13	——	9-29-29
鼎春	0.45%	0.32%	210.0	38°C	5.50%	10.94	——	9-29-29
同發源	0.64%	0.26%	219.8	40°C	4.09%	8.13	——	10- 2-29
恒昇	0.44%	0.28%	217.8	39°C	6.99%	12.90	——	10- 4-29
陳復興	0.46%	0.41%	219.8	38°C	4.51%	8.98	——	10- 4-29
同發源	1.14%	0.28%	214.2	39°C	3.37%	6.73	——	10- 4-29
金華	0.04%	0.35%	218.4	39°C	5.36%	10.66	——	10- 4.29
吉和祥	1.58%	0.46%	215.6	39°C	8.18%	16.27	——	10- 4-29
元利昌	0.37%	0.36%	212.8	40°C	3.38%	6.73	——	10- 4-29
萬順恒	0.92%	0.35%	203.0	39°C	3.53%	7.01	——	10- 4-29
福興	0.33%	2.26%	214.2	39°C	8.74%	17.39	——	10- 4-29
金華	0.51%	0.28%	215.6	39°C	8.18%	16.27	——	10- 6-29
洽成永	1.75%	0.35%	210.0	40°C	6.63%	13.18	——	10- 8-29
同源	0.12%	0.31%	196.0	39°C	4.23%	8.41	——	10-15-29
同發祥	0.32%	0.39%	218.4	39°C	5.64%	11.22	——	10-18-29
慶祥興	0.32%	0.46%	197.4	39°C	5.22%	10.38	——	10-18.29
蘇城	0.12%	0.32%	191.8	38°C	3.17%	6.31	——	10-19-29
温州	0.10%	0.31%	207.2	39°C	5.36%	10.66	——	10-20-29
荆州	0.09%	0.28%	210.0	38°C	2.54%	5.05	——	10-20-29
金華	2.66%	0.27%	207.6	39°C	5.36%	10.66	——	10-20-29
同源	0.82%	0.36%	207.6	38°C	5.78%	11.50	——	10-20-29
同源	0.32%	0.29%	217.0	39°C	3.81%	7.57	——	10-27-29
洽成永	0.60%	0.36%	214.2	39°C	5.92%	11.78	——	10-27-29
洽成永	0.63%	0.43%	212.8	39°C	8.32%	16.55	——	10 27-29
洽成永	0.47%	0.38%	214.2	39°C	2.54%	5.05	——	10-27-29
洽成永	0.10%	0.28%	210.0	40°C	3.95%	7.85	——	10-27-29
萬順豐	0.07%	0.25%	214.2	40°C	3.53%	7.01	——	10-27-29
萬順豐	0.50%	0.37%	215.6	39°C	6.63%	13.18	——	10.27-29
萬順豐	0.27%	0.36%	203.0	39°C	3.10%	6.17	——	10-27-29
穗源	2.57%	0.45%	210.0	39°C	5.22%	10.38	——	10-30-29
萬順豐	1.25%	0.33%	208.2	38°C	2.96%	5.89	——	10-30-29

牌號或來源	水分	雜質	鹼化數	融點	游離脂肪酸	酸數	碘數	試驗日期
萬順興	0.01%	0.24%	212.8	39°C	2.12%	4.21	——	11- 3-29
萬順興	0.03%	0.37%	207.2	38°C	1.97%	3.93	——	11- 3-29
李恒裕	1.67%	0.48%	214.2	38°C	10.72%	21.32	——	11- 3-29
萬順豐	0.66%	0.27%	208.4	39°C	5.81%	11.55	——	11-30-29
萬順豐	0.02%	0.50%	204.3	39°C	7.15%	14.21	——	11-30-29
萬順豐	0.07%	0.18%	206.0	40°C	3.68%	7.15	——	11-30-29
程達記	3.53%	0.25%	207.2	40°C	4.23%	8.42	——	12-13-29
平均值	1.37%	0.27%	208.2	40.1°C	4.66%	9.28	31.37	
最低值	0.02%	0.00%	178.9	38°C	1.27%	2.53	27.63	
最高值	19.77%	1.45%	219.8	43°C	15.23%	30.29	33.75	

綜計以上所試柏油,共一百四十七樣.牌號紛岐,來源不一,故其平均值當必近似.各常數中在製皂上最關重要者自屬鹼化數一項.其平均值爲208.2.惟此數係含有平均水分1.37%及雜質0.27%(合計共有外物1.64%)之試品所有之平均值.設二者均爲零,即純粹柏油,則其鹼化數由推算而知當爲211.67也.碘數爲乾性油試驗中最重要之一項.此處以時間問題,故未全行試驗,僅於特種貨樣及有待考核時時間或行之而已.

上列結果與Allen氏所測得之融點36°—46°C,鹼化數179—203,碘數23—38,及Lewkowitsch氏之融點43°—46°C鹼化數200.3,碘數32.1—32.3相較,亦差不甚鉅耳.

(乙) 牛油

牛油Beef Tallow各地皆有,而品質隨處不同.南方多水牛,北地多黃牛,但農家恃以作耕種之具者則南北皆一也.法律既有禁宰耕牛之明文,而禮俗又以牛爲大牲,非逢祭祀不殺.因此牛油之產量遂亦不多.惟漠北游牧之邦,與夫信奉回教者廣播之區反是.牛羊則爲重要肉食,而油脂之用於製蠟燭也由來已久,一如長江以南各省之利用柏油者然.迨海禁大開,歐風東漸.我國

人民始稍稍知牛之爲用不僅限於耕種祭祀而已.牛肉既清潔而易於消化,牛乳復滋補而有益衛生.牛皮因製革術之進步而爲用愈廣,而牛油更緣苛性鈉電化製造方法之成功,其需要之驟增,尤有一日千里之勢.他如牛痘漿,又爲防止天花之唯一血清,推而至於一切牛乳棚中之製作物,如牛乳油,牛乳酪及冰激冷等,亦莫不飛越重洋而來,飽我素嗜猪味之華人口腹,且漸有奪席之概.於是通商大埠,乃始有乳牛食牛之蓄養,深望各地農民而能羣起遍營之,非但財用可足,而間接嘉惠於民族體格,公共衛生,豈淺鮮哉?牛油與飼牛之食料,及所在地之氣候,亦有極大之關係.大抵東北多飼以荳餅,故所產牛油,特別豐腴.北地氣候乾燥,所產亦佳.輒堅潔而呈魚卵狀結晶,此爲上品.至於南方所產,或取自水牛,油量既少,兼以氣候溫濕之多雨,故所含水分多而腐敗易.加以商人不顧道德,時以有機雜質混入.且有以低價之礦物油摻入,或調和漆油及棉花子油,而施其魚目混珠之伎倆者焉.雖然,天產有限,工業之需求無窮,不得已自不得不設法補救.如人造脂肪,即藉氫化鎳之接觸作用,使鯨油或其他流動性之荳油棉花子油等,經氫化而成,惟此硬化油不得即謂之曰牛油無疑.其理如 Margarin 之不得稱爲牛乳油,及糖精之不得稱爲甘蔗糖,正復相同.可恨我國一般無知商人,祇圖近利而無遠大計劃.故此種重要之工業,僅於十年前曇花一現於南通州,迨喬公物化竟成絕響,可不惜哉?

牌號或來源	水分	雜質	鹼化數	融點	游離脂肪酸	酸數	碘數	試驗日期
德　茂	0.85%	0.35%	204.4	44°C	5.54%	11.22	——	1- 2-29
廣　和	2.49%	0.30%	207.9	44°C	10.15%	20.20	——	1- 3-29
庚　興	7.89%	0.55%	204.3	45°C	10.15%	20.20	33.64	1- 4-29
庚　興	7.96%	0.23%	201.9	44.5°C	14.06%	27.77	——	1- 4-29
同　源	0.13%	0.12%	209.0	38.5°C	3.67%	7.29	——	1- 5-29
同　源	5.11%	0.73%	207.8	47°C	14.57%	28.26	——	1- 6-29
同　源	5 34%	0.67%	200.5	47°C	15.44%	30.72	——	1- 6-29
庚　興	4.94%	0.20%	207.2	47°C	5.08%	10.05	——	1- 7-29

牌號或來源	水分	雜質	鹼化數	融點	游離脂肪酸	酸數	碘數	試驗日期
庚　興	5.32%	0.30%	200.8	46°C	7.46%	14.87	——	1- 7-29
元　亨	1.83%	0.02%	194.6	47°C	1.13%	2.24	——	1-13-29
李裕順	0.95%	0.20%	207.0	45.5°C	2.68%	5.33	——	1-13-29
庚　興	2.17%	0.20%	204.5	45°C	1.97%	3.93	——	1-13-29
李裕順	0.98%	0.25%	200.1	46°C	4.09%	8.14	——	1-13-29
德　茂	1.20%	——	——	——	——	——	——	1-14-29
德　茂	5.35%	0.48%	202.8	44°C	6.49%	12.90	——	1-14-29
德　茂	0.50%	0.53%	208.7	41°C	2.82%	5.61	——	1-14-29
德　茂	9.14%	——	——	——	——	——	——	1-17-29
無　錫	7.81%	0.81%	200.0	46°C	17.79%	31.42	——	1-17-29
庚　興	9.83%	0.30%	197.0	46°C	8.46%	16.83	——	1-30-29
庚　興	9.55%	0.78%	208.5	45°C	8.04%	15.99	——	1-30-29
同　源	3.48%	0.75%	201.7	46°C	11.99%	23.84	——	2-18-29
同　源	9.09%	0.72%	200.0	45°C	2.82%	5.61	——	2-18-29
同　源	6.80%	0.67%	200.1	45°C	6.06%	12.06	51.30	3- 3-20
同　源	0.56%	0.06%	207.5	43°C	3.53%	7.01	61.17	3- 3-29
同　源	1.33%	0.35%	205.3	47°C	1.55%	3.04	——	3- 6-29
裕　豐	1.63%	0.21%	200.2	44°C	9.73%	19.35	39.56	3-12-29
同　源	3.53%	0.57%	198.5	44°C	8.74%	17.39	56.90	3-15-29
同　源	4.08%	0.42%	201.0	45°C	5.64%	11.22	——	3-20-29
大　茂	0.99%	0.20%	204.6	43°C	5.92%	11.78	——	3-22-29
大　茂	1.42%	0.10%	203.9	43°C	7.05%	14.03	——	3-22-29
李裕順	1.55%	0.21%	200.5	45°C	7.61%	15.15	——	3-24-29
大　茂	0.50%	0.13%	205.8	43°C	6.35%	12.62	——	3-24-29
同　源	4.69%	0.45%	196.0	45.5°C	6.35%	12.62	——	3-27-29
同　源	5.57%	0.32%	194.6	45°C	5.64%	11.22	——	3-27-29
大　茂	1.41⅝	0.12%	201.6	44°C	1.97%	3.93	——	3-30-29
大　茂	0.83%	0.10%	195.3	44°C	2.12%	4.21	——	3-31-29
大　茂	1.63%	0.33%	202.7	43°C	3.53%	7.01	——	4- 7-29
萬順豐	6.90%	0.94%	194.6	45°C	6.35%	12.63	51.80	4-10-29
大　茂	2.11%	0.84%	196.0	43°C	7.20%	14.31	——	4-10-29
大　茂	1.19%	0.07%	205.1	46°C	7.98%	15.85	——	4-18-29

牌號或來源	水分	雜質	鹼化數	融點	游離脂肪酸	酸數	碘數	試驗日期
大　茂	1.63%	0.61%	194.9	47°C	4.51%	8.98	——	4-26-29
大　茂	0.70%	0.23%	195.2	44°C	3.10%	6.17	——	5- 4-29
大　茂	0.29%	0.22%	197.5	43°C	6.35%	12.62	——	5-16-29
大　茂	0.52%	0.31%	194.7	43°C	7.05%	14.03	——	5-19-29
大　茂	0.50%	0.32%	198.2	43°C	5.92%	11.78	——	5-26-29
同　源	4.41%	0.82%	188.7	44°C	9.02%	17.95	——	6- 6-29
同　源	3.82%	0.57%	190.8	44°C	10.15%	20.20	——	6- 6-29
同　源	4.14%	0.51%	190.8	44°C	15.23%	30.29	——	6-26-29
同　源	6.76%	0.26%	173.4	44°C	11.00%	21.88	——	6-26-29
蚌　埠	3.80%	0.32%	196.0	47°C	8.88%	17.67	——	7-27-29
蚌　埠	3.81%	0.46%	201.6	47°C	12.97%	25.31	——	7-27-29
李炳發	0.35%	0.35%	207.2	46°C	1.41%	2.81	——	7-31-29
李炳發	0.50%	0.43%	207.0	46°C	5.96%	11.78	——	7-31-29
蚌　埠	6.24%	0.41%	185.0	47°C	11.70%	23.28	——	8- 2-28
蚌　埠	2.80%	0.40%	193.5	47°C	8.60%	17.11	39.87	8- 6-29
蚌　埠	2.60%	0.36%	195.7	47°C	9.82⅝	19.64	——	8- 6-29
蚌　埠	5.40%	0.41%	192.2	47°C	13.25%	26.37	——	8- 7-29
蕭綏記	1.67%	0.43%	203.1	47°C	9.56%	19.01	——	8-14-29
蕭綏記	3.53%	0.36%	202.3	47°C	8.74%	17.39	——	8-15-29
同　源	2.32%	0.47%	207.6	47°C	9.02%	17.95	——	8-21-29
蚌　埠	2.83%	0.67%	195.9	46°C	13.11%	26.09	——	8-31-29
繼昌祥	3.89%	0.42%	191.1	46°C	11.28%	22.44	——	9-17-29
繼昌祥	4.15%	0.46%	195.8	46°C	13.40%	26.65	——	9-24-29
繼昌祥	3.53%	0.41%	200.4	46°C	10.01%	19.92	——	9-24-29
繼昌祥	4.77%	0.43%	188.7	46°C	14.81%	29.45	——	9-24-29
萬順豐	2.38%	0.36%	194.8	46°C	8.60%	17.11	——	9-29-29
萬順豐	2.19%	0.43%	204.4	47°C	8.60%	17.11	——	70- 6-29
蕭綏記	4.28%	0.46%	201.6	46°C	10.72%	21.32	——	10-13-29
同　源	5.06%	0.76%	190.4	46°C	18.19%	36.18	53.94	10-13-29
同　源	1.93%	0.29%	200.0	47°C	6.77%	13.46	——	10-13-29
繼昌祥	2.37%	0.45%	200.2	46°C	8.46%	16.83	——	10-15-29
繼昌祥	2.09%	0.57%	205.8	46°C	7.47%	1487	——	10-15-29

牌號或來源	水分	雜質	鹼化數	融點	游離脂肪酸	酸數	碘數	試驗日期
張竹記	4.33%	0.36%	204.4	47°C	13.68%	27.27	——	10-17-29
張竹記	1.45%	0.36%	204.6	44°C	1.41%	2.80	——	10-19-29
蕭綏記	2.83%	0.37%	205.8	45°C	9.59%	19.07	——	10-20-29
孫德源	1.13%	0.46%	190.4	44°C	1.41%	2.81	——	10-20-29
同源	1.38%	0.35%	200.2	45°C	4.23%	8.42	——	10-20-29
同源	3.13%	0.46%	207.2	46°C	12.97%	25.81	51.51	10-25-29
德茂	1.18%	0.45%	205.6	44°C	3.67%	7.29	——	10-27-29
無錫	6.27%	0.77%	198.8	44°C	20.45%	40.67	——	10-29-29
沈增記	1.10%	0.36%	200.2	45°C	4.09%	8.13	——	10-29-29
德茂	3.00%	0.43%	200.2	44°C	9.87%	19.64	——	10-29-29
顧福記	0.15%	0.48%	202.8	46°C	1.83%	3.65	——	10-29-29
李裕順	0.44%	0.35%	207.2	46°C	2.40%	4.77	——	10-30-29
李裕順	7.43%	0.45%	200.2	45°C	20.59%	40.95	——	10-30-29
泰森永	1.11%	0.25%	198.8	45°C	4.51%	8.48	——	11- 2-29
沈增記	1.40%	0.36%	202.8	46°C	3.81%	7.57	——	11- 2-29
沈增記	1.28%	0.44%	197.4	45°C	6.06%	12.06	——	11- 5-29
沈增記	1.40%	0.37%	184.8	46°C	4.23%	8.42	——	11- 5-29
沈增記	6.22%	0.36%	187.6	46°C	33.56%	66.76	——	11- 5-29
費興發	0.30%	0.64%	205.5	46°C	1.83%	3.65	——	11- 6-29
李裕順	1.01%	0.45%	201.4	45°C	1.55%	3.09	——	11- 6-29
費興發	0.48%	0.45%	193.2	45C°	2.68%	5.28	——	11- 6-29
童泰昌	0.82%	0.29%	207.2	44°C	3.67%	7.29	39.07	11- 7-29
德茂	11.16%	0.38%	204.4	44°C	21.43%	42.64	50.88	11- 7-29
德茂	11.71%	——	——	——	——	——	——	11- 7-29
德茂	15.45%	——	——	——	——	——	——	11- 9-29
德茂	3.79%	0.49%	193.2	44°C	31.73%	63.11	——	11- 9-29
李裕順	0.55%	0.47%	204.2	46°C	1.13%	2.24	——	11- 9-29
沈增記	0.93%	0.23%	201.4	44°C	3.38%	6.73	——	11-10-29
沈增記	1.57%	0.30%	205.6	44°C	7.05%	14.03	39.56	11-10-29
同源	1.94%	0.38%	200.0	45°C	14.38%	28.61	——	11-10-29
德茂	9.50%	0.55%	184.8	43.5°C	28.48%	56.66	——	11-17-29
德茂	4.61%	0.48%	204.4	44°C	31.16%	61.99	——	11-17-29

牌號或來源	水分	雜質	鹸化數	融點	游離脂肪酸	酸數	碘數	試驗目期
大　茂	0.64%	0.26%	204.2	43°C	12.13%	24.12	——	11-17-29
同　源	1.60%	0.24%	203.0	44°C	18.05%	35.90	——	11-17-29
李裕順	8.46%	0.53%	200.2	43°C	26.37%	52.45	35.43	11-17-29
繼昌祥	1.31%	0.46%	187.6	44°C	7.61%	15.15	——	11-17-29
李裕順	0.91%	0.35%	201.6	43°C	6.91%	13.74	——	11-17-29
童泰昌	0.30%	0.45%	204.2	44°C	3.24%	6.45	——	11-21-29
德　茂	2.37%	0.43%	205.6	43°C	11.84%	23.56	——	11-21-29
大　茂	1.24%	0.38%	205.8	42°C	11.99%	23.84	——	11-21-29
李裕頓	0.22%	0.22%	200.0	43°C	2.26%	4.49	——	11-21-29
同　源	2.45%	——	——	——	——	——	——	11-21-29
申昌裕	5.89%	0.45%	204.4	45°C	25.10%	49.93	59.82	11-22-29
童泰昌	0.69%	0.46%	201.4	43°C	4.65%	9.26	——	11-24-29
童泰昌	5.61%	0.00%	184.2	43°C	5.37%	10.68	——	11-24-29
童泰昌	0.35%	0.55%	200.0	43°C	4.37%	8.70	——	11-27-29
張竹記	5.19%	0.45%	208.6	45°C	24.32%	49.37	——	11-27-29
泰森永	2.00%	0.36%	202.8	43°C	2.82%	5.61	——	11-27-29
大　茂	1.01%	0.35%	208.0	42°C	8.74%	17.39	51.41	11-28-29
李裕順	1.68%	0.46%	203.2	44°C	4.94%	9.82	44.81	11-28-29
沈增記	1.95%	0.24%	196.4	43°C	3.05%	6.07	——	11-30-29
張竹記	4.77%	0.71%	181.3	45°C	18.01%	35.82	——	12- 3-29
李裕順	0.83%	0.63%	204.2	43°C	6.35%	12.62	——	12- 6-29
童泰昌	0.28%	0.35%	205.6	46°C	0.28%	0.56	——	12- 6-29
陸紹泉	2.40%	0.64%	205.6	43°C	7.33%	14.59	——	12- 7-29
松大仁	0.48%	0.34%	202.8	42°C	0.14%	0.28	——	12- 7-29
童泰昌	0.51%	0.54%	208.5	43°C	7.05%	14.03	——	12-10-29
大　茂	0.64%	0.15%	208.6	42°C	10.09%	19.07	——	12-10-29
同　源	2.33%	0.35%	205.8	46°C	6.06%	12.06	——	12-13-29
童泰昌	2.34%	0.57%	208.6	42°C	2.68%	5.33	——	12-13-29
同　源	1.00%	0.45%	204.4	46°C	3.24%	6.45	——	12-15-29
同　源	2.42%	0.58%	208.8	47°C	5.22%	10.38	48.36	12-15-29
泰森永	2.51%	0.34%	201.4	44°C	3.10%	6.17	——	12-15-29
同　源	3.94%	0.30%	203.0	45°C	2.11%	4.27	——	12-19-29

牌號或來源	水分	雜質	鹼化數	融點	游離脂肪酸	酸數	碘數	試驗日期
德　茂	7.91%	0.36%	197.4	46°C	14.66%	29.17	45.82	12-19-29
童泰昌	0.21%	0.33%	207.2	43°C	1.97%	3.93	——	12-20-29
泰森永	1.83%	0.24%	207.0	44°C	1.27%	2.52	——	12-20-29
繼昌祥	2.50%	0.46%	201.4	46°C	7.30%	14.59	——	12-21-29
李裕順	2.59%	0.78%	207.0	43°C	3.24%	6.45	——	12-21-29
李裕順	1.42%	0.23%	200.0	42°C	3.59%	7.13	——	12-21-29
同　源	2.32%	0.31%	207.2	46°C	2.40%	4.77	——	12-21-29
同　源	1.49%	0.27%	205.6	45°C	3.24%	6.45	——	12-21-29
大　通	3.71%	0.35%	207.2	45°C	2.26%	4.49	——	12-22-29
張竹記	2.30%	0.26%	209.8	44°C	10.86%	21.60	——	12-22-29
大　茂	2.25%	0.31%	200.2	42°C	19.60%	38.99	——	12-23-29
同　源	3.93%	0.50%	205.6	44°C	9.45%	18.49	70.61	12-23-29
同　源	1.23%	0.34%	200.0	46°C	1.27%	2.54	——	12-23-29
德　茂	17.45%	11.41%	144.2	47°C	18.05%	35.90	——	12-25-29
大　茂	0.65%	0.35%	200.2	42°C	6.49%	12.90	——	12-24-29
同　源	2.53%	0.38%	207.0	45°C	3.10%	6.17	——	12-27-29
大　茂	1.47%	0.25%	203.0	42°C	20.59%	40.95	——	12-27-29
同　源	2.60%	0.26%	204.2	43°C	10.86%	21.60	——	12-29-29
童泰昌	1.50%	0.34%	207.0	43°C	3.67%	7.29	——	12-29-29
同　源	4.32%	0.25%	203.0	43°C	5.92%	11.78	——	12-29-29
同　源	0.50%	0.36%	209.8	43°C	3.81%	7.57	——	12-29-29
同　源	4.92%	0.28%	205.6	49°C	74.73%	148.73	——	12-29-29
同　源	1.98%	0.43%	200.0	43°C	10.29%	20.48	——	12-29-29
沈增記	1.05%	0.44%	201.2	45°C	3.24%	6.45	——	12-30-29
童泰昌	0.14%	0.48%	200.0	43°C	2.96%	5.89	39.27	12-30-29
朱銀綏	1.41%	0.46%	208.1	43°C	5.50%	10.94	38.01	12-30-29
童泰昌	1.79%	0.33%	208.4	46°C	8.52%	17.95	——	12-30-29
廣　成	3.25%	0.27%	208.6	49°C	85.31%	169.70	——	12-30-29
平均值	3.05%	0.47%	200.7	44.7°C	9.23%	18.33	48.18	
最低值	0.13%	0.00%	144.2	38.5°C	0.14%	0.28	33.64	
最高值	17.45%	11.41%	209.8	49°C	85.31%	169.70	70.61	

以上試驗爲數一百六十四.牌號雖較柹油略少,但品質異常複雜.色澤白黃棲黑無不具備.按牛油原屬一種混合脂肪,故其中難免有贋品摻入.著者曾以棉花子油與漆油對和而一如常法試驗之其結果爲

品　名	水分	雜質	鹼化數	融點	游離脂肪酸	酸數	碘數	試驗日期
混合脂肪	0.49%	0.04%	195.7	45°C	2.73%	5.42	72.10	12-20-29

細考各數大致與牛油之平均值相近,惟碘數獨大耳.由是逆推,凡碘數過大之各樣,卽不能不有懷疑之處焉.次核其平均鹼化數爲200.7,苟計算至純粹牛油,則應爲20[illegible].0?.與柏油之平均鹼化數相差,極有限耳. Allen 氏關於牛油之測定爲融點38°—50°C 鹼化數 193—198 碘數 33—48.證以上述結果,頗稱脗合.

(待續)

本刊啟事

徵稿　本刊爲吾國工程界之惟一刊物,同人等鑒於需要之急,故力求精進,凡會員諸君及海內外工程人士,如有鴻篇鉅著,闡明精深學理,發表良善計劃,以及各地公用事業,如電氣,自來水,電話,電報,煤氣,市政等項之調查,國內外工業發展之成績,個人工程上之經營,務望隨時隨地,不拘篇幅,源源賜寄,本刊當擇要刊登,使諸君個人之珍貴,成爲全國工程界上之南針,本刊除分酬本刊自五本至十本外,幷每期擇重要著作數篇,印成單行本若干,酬贈著者,以答雅誼.

推銷　凡海內外各機關,各學校,各書局欲代銷本刊者,請函致本會事務所上海南波路七號接洽是荷.

總務　楊錫鏐啓

論實業及擬發展我國電氣事業之辦法

著者：朱瑞節

著者曾在國內工廠實習，後進英國電機製造廠做工，兩相比較，深感欲以實業救國，應羣起臥薪嘗膽，不恥下層工作，痛除一切舞弊。爰作此篇，願吾同志指教之，共勉之。

(一) 人才；制度；賞罰。

(二) 實業分析：物質與人工。

(三) 我國實業不振之三大原因：

(甲) 學問與經驗之不調和，而洋行得以操縱一切。

(乙) 資本，智識，勞工，三界無合作之精神。

(丙) 國風日奢，生產不增，上下相賊，到處舞弊。

(四) 發展電氣事業之三步手續：

(甲) 調查時期。

(乙) 與外商合作製造時期。

(丙) 獨立製造，研究改良時期。

(五) 各時期需要之人才與其訓練方法：

(一) 人才，制度，賞罰

制度由人定，賞罰由人行，是以制度之不良，賞罰之不明，皆歸罪于人。天下更不多不良之制度，而多執行之不妥：不多不明賞罰之人，而或被威武所屈，或爲私利所誘，賞罰因此亂行。茲願舉例以證之，譬如鐵路運輸，機車之能力有限，橋樑之載重有度，負行車之職者，有限掛車輛之權，制度無不當，乃行于我國，則其弊無窮。他若戮盜于市，衆皆鼓掌而呼曰該死，明盜之結果如是，而

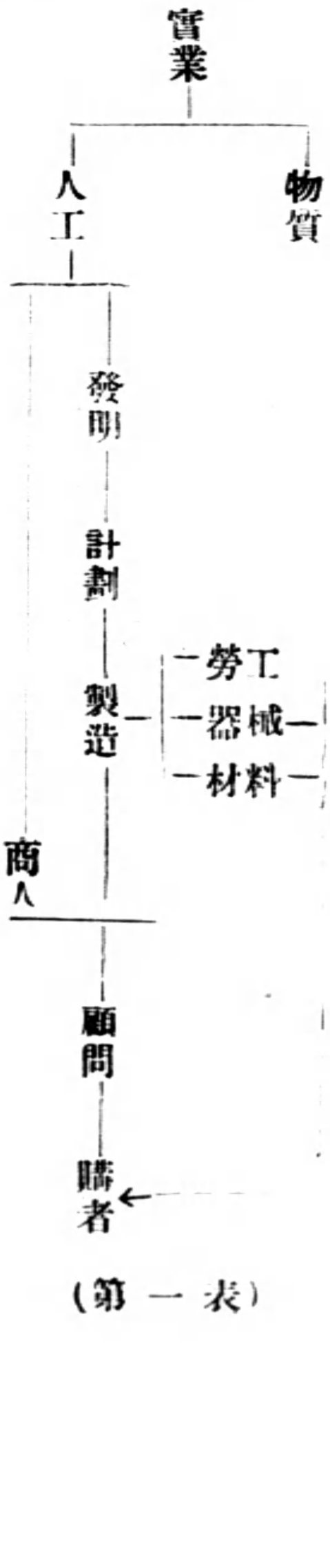
暗盜之禍國害民,爲惡萬倍,何反不罰耶?于是消極者信宗教善惡報于後世之理,積極者圖革命改造之工.奈消極不問,而督促無人,國風愈下.除惡不盡,則以暴易暴,使後人而復恨後人,談救國而禍人民者,欲求雪恥救國,其可能乎?嗟夫!人無不知廉恥也,人無不欲方正也,然人亦莫不趨名利而遠禍患.是以爲惡者,亦見其利而未見其禍耳.今之社會,剝奪者可享物質之幸福,正直者反難以生存,無怪人人不欲放棄剝奪之機會,而背正直之天良.假使善惡因果,可以立刻證明,則天下之民,皆爲善矣.蓋爲善而有利,則人人爲善,爲惡而有利,則人人爲惡,宗教談死後之報,不足以奪今生之利,良知良心,終不能敵環境之迫,* 是以惟有執權管理者,審制度,明賞罰,以導民入規也.吾工程人才之訓練,豈僅技術上之學問與經驗哉?竊察我國人民,重私情,忽公事,而畏結怨于小人,小人乃得以用計,有以嚴勵手段,整頓圖治者,人或袖手坐視,或且非其不近人情,國家之危,至此莫甚.再觀外國,人心未必良善也,惟社會風俗,重規則,守秩序,一介不取,一介不與,此卽足以防舞弊,而小人不能得志矣.願我國負治人之責者,無論其所轄範圍之小大,賞罰以公,行事以規,毋畏結怨于小人,莫待人行而後行,要見義勇爲,以救國之將亡,則人之問題,可先解決,然後從物質上工作,無往而不順矣.

*編者按　至誠爲善者,終其身必得善報,但同時須諸惡莫作,以塞其漏,否則一方作惡,一方行善,不過扯直,其效力自等於零耳.

(二)實業分析:物質與人工

造物不言,而至公正.人類之所以異于禽獸者,由觀察而起奇心,從奇怪而動思想,思想之精華,合而成理論,化而爲學術,是以發明偉人,可謂造物之信徒,而代其言所不言也.人吾 從事工程事業,終日與造物爲伍,無時無地,必須服從其公正自然之理.苟有疏忽,則立受損失:若順其道,則無往不利.不然,則理論不必講,經驗不足貴,而物質文明之進步,何從而來耶?物質以其大者而

觀,則地球不過空中一星耳,以其小者而觀之,則鐳銖之微,不知含多少原子.化而爲原子,合而成萬物,變化天然之物,使人類得用增進生活幸福者,謂之實業.是以實業者,物質與人工之結合耳.物質既不增不減,不生不滅,則實業之進步,全視吾人之工作.不事經營,而欲提高生活;不勞心力,而求生存;有此理乎?所謂人工者,其先必由困難好奇或需要而有發明,因困難而發明者,黃帝被蚩尤迷途,而創指南車其例也.因好奇而發明者,牛端見物下降,而定動體之理屬之.因需要而發明者,在我國史上,伏犧,神農,燧人,有巢,皆是也.而近世人類之需要日奢,此種發明,亦隨之增加.既有發明,次言計劃.蓋發明之範圍,在定原理,立制度,成機械;其如何應用,如何佈置,則因地異,因時而變.所謂凡事預則立,不預則廢,計劃者,即此意也.計劃既定,然後談製造;計劃無定,則製造期間,中途變更,費工傷材;計劃不妥,則實用期內,或不附所需,或發生危險,是以計劃工作,不可不愼也.再進則爲製造,試觀第一表.製造更分勞工,器械,材料三項.勞工指直接用人力或器械將材料工作者,其手藝精良者,亦須計劃而勞心,其未經訓練者,多勞力之責任.俗云勞心者使人,勞力者使于人.物質文明進步以來,勞力之責,漸屬於機械.而人不勞心,將無以立足,平民教育,可不努力哉?至于器械材料,爲已成之物品,如第一表中,將虛線連至購者,上推其原,仍不出物質與發明.



(第一表)

如此循環,實業爲物質與人工之結合,可以證明.而物質爲造物所賜,本無價值,經人之工作,而各有代價,亦可想見矣.造成之物,按正當之手續,應受商場之支配,于是商人究供求之理,通運輸之法,爲造者購者之媒介.是以經濟原理,亦由實業發端,工商之關係如是,從

事于實業者,對于經濟學識,豈可忽哉?蓋來實業之發達,製造者之衆多,購者不得不愼其選擇.蓋商人爲營業競爭,利益所關,無不忠其所代理之廠家,對于購者,鮮有適當之勸告.於是于購者與商人之間,又有顧問在也.俗云,購物商諸內行,此內行者,卽顧問也.爲顧問者明應用,善計劃,知製造之難易,孰悉各廠之出品,各地之情形,而代購者計劃選擇,可得完滿之結果,其工作亦至要也.物品至購者,或消費,或復爲器械,或材料,而終歸于消費,消費與生產,其平均出于自然,其數量爲人工之代表,其結果爲社會之幸福,實業之目的在提高吾人之生活,其成功全由于工作也明矣.

茲願再將英國某廠製造渦輪之預算例第二表而論之,以切事實:

名　目	售價之百分數
直接工資	22½
材　料	22½
工廠雜費	30
營業費	15
淨　利	10

(第二表)

(1) 直接工資:　凡勞工之可歸于製造一指定之物品者皆屬之.由以前同樣或相似出品之工作單,推算而得.

(2) 材料:　購入材料,無論一釘之微,苟非自造者皆屬之.由計劃之需要,定其量;市價之高低,決其數.

(3) 工廠雜費:　包括製造權費,資本利息,廠房設備,機器之消耗,折舊,保險等,及一切不能劃歸于製造一指定物品之薪金工資,從預算一年中之產額而分派之.

(4) 營業費:　廣告,出版,交際,各處樣子間,事務所之薪工雜費皆屬之.

(5) 淨利:　按表若預算與決算同,則得一十之利.查直接工資,與材料兩項,雖預算較易,然工作不愼而傷材料者有之;重要材料,于工作中途,發現劣點供者祇能賠償原料,已費之工,無從收回.且工廠雜費,占最大部份,全由預算一年中之產額而定.是以營業發達,則每件之工廠雜費減輕,其結果爲增加淨利,減低售價.反之則損失虧本,從事實業,可不愼歟?

購者除此而外,尙須付運輸傭金等費,且不之論,再察第二表,工廠雜費,與

營業費兩項,當成本之半,較之我國從前之家庭工業,祇有人工與材料,則對工廠雜費,與營業費之能否減輕,可令人注意矣.吾人既知製造廠之一切開支,全由購者分任其責,則對于規模宏大之廠家,可否信任;及擴充工廠,有無限止;皆重要之問題也.蓋自機器代人勞力,而有工廠;其所製造之物品,愈巨大複雜,需人材愈多,器械愈精,工廠雜費乃愈大.是以此種費用之增加,使造昔日之所不能造者,並減省直接人工,不足以起鷙.營業費爲鼓勵購者,以增加產額,即可減各件之工廠雜費,亦不可以爲大.是以規模宏大之廠,常占優勝者,所費大而分任者亦多.若以昔日之家庭工業爲之,或不能製造,即有可造者,其人工之增加,必數倍于用機械而有組織之工廠雜費及營業費也.欲減輕此兩項費用.惟有聯合同業,採標準出品,與分工之制.發端于美國,盛行一時,然至今有供過于求之現像,是以擴充當有限止,論者有謂其制度之不良,吾不信也.並以爲發展我國實業,亦當採取其法,惟擴充之時,應謹愼考慮耳.

(三)我國實業不振之三大原因

(甲)學問經驗之不調和,而洋行得以操縱一切: 用者不必造,造者不自用;用者專其用,造者專其造;此之謂分工專門,近世實業之發達,人類之進化,強國強種之由來也.雖然造吾所能造,而思用者之便利;購吾所欲用,而不知造者之難易;則造者必失其業,用者必傷其金,此供求相應之理,而負計劃建設事業者,更介乎造者用者之間;有精通學理,而不能勝任者,經驗之不足也;有積數十年之親自操作,雖天資過人,勤勞獨出,而見題束手者,學問之缺乏也.此果我國目前之情形,而爲實業不振之一大原因矣.竊觀國中購置機器,常爲洋行所操縱,佣金得隨購者之所欲,而貨物則聽洋行所支配.當事者以爲外人道德之高,決不我欺,既省聘請顧問之費,又可得從心所欲之佣;而彼外人則正笑我私利之重,學識之淺,可得而任意調度;於是存貨多而式舊者,

飾新而來,退貨劣而無主者,混雜以進.勢所不免.欲其開誠佈公,忠于購者,按余在國外觀察所及,不能信也.願我國人毋過自卑而尊人.須知燧人取火,而熱力生.黃帝作舟車,而機械創始.造指南針,而電學發端.土木遠始有巢.水利興自大禹,而外書不傳,豈不因其後裔不肖,智者雖有發明,祕而不傳,國政輕視物質,民間守舊不進,由來久矣.時至今日,雖未爲亡國奴,然普通人之生活狀況,較之歐,美各國,不可同日而語矣.竊常以工程師比醫士,則洋行爲藥房.以工程問題商諸洋行,猶疾病之不請醫士開方,而向藥房購藥,其果可以想見.雖然,吾知洋行本不欲操縱其事,奈購者缺乏智識,又少學問經驗並長之才,致以全權委之耳.是以凡抱實業救國之志者,學問經驗尤當並重也.

(乙) 資本,智識,勞工,三界無合作之精神: 欲早耕而暮獲,見利淺而不善用人者,我國之資本家也.好逸惡勞,趨勢利而不務實事者,我國之智識界也.欺詐弄巧,以維持地位者,我勞工界之匠目也.惟普通工人,終日勞動,而生活最苦,可謂仰不愧,俯不怍之神聖矣.是以國家至此,受痛苦者無罪,而在上者作惡.願投資于實業者,當知才學有專門,經營須時日,所謂良梓人者,不受主人之限止,合則就,不合則去;自古帝皇尚尊賢而重士,欲求資本之生利,應聽專家之計劃.以匠目代工程師者,所省之薪金,萬不足以抵損失.以工程問題,委于洋行者,私佣雖豐,後患無窮.欲利厚而虐待勞工者,勞工亦有以罰之.智識界爲資本生利,助勞工謀生,不可順資本家之所欲而奪勞工之利益,亦不應聽勞工之放肆,而使資本受損失;不勤勞不知工作之艱難,何以能盡管理之責,勝計劃之任.不得資本家之信任,爲匠目所愚弄者,禍亦自取,可不醒歟?至于勞工之匠目,須知機械複雜,誰不能動其一二,令起變化,使人難以接手.然此種行爲,在具有學問經驗者,何足爲懼.此後應課工程教育之改良,(參閱各時期需要人才與其訓練方法一段) 若有志於上進,當求學問以補其不足,豈可弄巧欺人哉?凡吾勞工,其知民生之艱,由于列強經濟侵略,抵制外貨,提倡國貨,全賴國中有較廉之人工.將來實業發達,勞工生活,自必提高,欲

速則勞資分裂,危險實甚.是以資本之不易召集,人才之用非所學,勞工之生活艱難,皆出此資本,智識,勞工三界之無合作精神,而爲我國實業不振之又一大原因也.

(丙) 國風日奢,生產不增,上下相賊,釀處舞弊: 夫人心不足,大演之理,其出邪徑而險速者,爲賊,爲盜,爲內亂,此軍閥政客以人與人爭,禍國害民,所以滿其不足也.至于學者窮究深思,發明原理,以供人之利用,或利用得法,而造成機械.以滿人類之所欲,此人與物爭,物質文明之所以進步,亦不知足之現像也.是以天下之變,皆由于不知足者,其爲軍閥爲政客,則民化爲兵丁盜賊,走險而冒死.其事發明,與實業,則民化爲工匠藝員,安居樂業.然則禍民者,不知足,興國者,亦不知足;國家對于不知足者,應如何注意,勉其興國,止其禍民,則普及教育,改良社會,不可緩也.奈察國風日奢,而生產不增,以致人心不足之氣,日益澎漲,走險無勇,建設無能,于是化爲舞弊,造成不公開之社會.此又爲異邦所少見,而亦中國實業不振之一大原因也.

他若關稅之保障,以及別種政治問題,論者既多,而本篇目的,在工程界之自身覺悟,其希望于他人者,不暇及之矣.

(四) 發展電氣事業之三步手續

(甲) 調查時期: 我國實業不振之原因旣詳,請進而言發展我國電氣事業之辦法.擬分三種時期,依次進行,可否實行,尙希執政當局,與負工程之責者,予以敎正.其初曰調查時期.吾國交通不便,而各地匠目,皆有派別,守舊排外,調查困難,可以想見.然無切實之調查,萬難言改進,此則工程當從實事求是,非空談所及者也.方今民智未開,國家應負調查之責,則權力所及,事半功倍.對于各地電廠員司工匠,妥爲開導,解釋利害,聲明目的,毋使疑及奪權剝利,選派工程人才,親往各處實地調查.茲將所擬組織與經費等,詳解于下.

按表組織,定名爲全國電氣事業調查隊,直轄于建設委員會,其工作可先

員司薪水表

員司	人數	月薪人數	附註
土木工程師	1	$ 300	有工廠築建之經驗與學問
機械工程師	2	600	有各種原動機之經驗與學問
電機工程師	2	600	有發電廠輸電線路之經驗與學問
測繪員	2	300	助各工程師
渦輪司機	2	240	經驗宏富能修能用
蒸汽機司機	1	100	〃
內燃機司機	1	100	〃
鍋爐匠	1	100	〃
攝影員	1	100	
冲洗員	1	100	
小工	4	160	兼測地夫
總數		$ 2700	

每年經費表

名目	每年經費	附註
薪水	$ 32,400	詳員司薪水表
雜費	12,000	膳宿顯影材料等在內
儀器工具之消費折舊與利息	5,600	測量儀器電錶汽錶等
總數	$ 50,000	

在江,浙兩省交通便利各處進行.出發以前,令各地建設局或地方政府,先向電廠接洽,毋使誤會,而調查隊職員,以勤勞,耐苦,廉潔,爲最要.立誓以救國爲目的,所到各處,務于最短期間,完其工作,不帶遊歷性質,不受電廠任何供給.倘有舞弊,建設委員會當加以嚴罰,使不能立足于中國工程界上.每到一廠,務詳細調查,試驗各機效率,考察線路設備,究其利害,告以應興應革事宜.按調查隊之人數愈多試驗是易,然儀器工具等,多則費大難運.少則試驗不準.

是以先在交通便利之處舉行,俾得調動靈快,而對于各種電廠性質,先有查考,然後推及全國各地,則赴交通不便之處,所需儀器工具,或竟缺乏材料,可先妥爲預備.約計須時三年,共經費十五萬元.所得結果,分述于下:

(1) 由調查所得各地人口.出產,交通,負荷增加線,機器之新舊等,可推算將來之需要.

(2) 由各廠之設備,各地之氣候水性,經過觸電等情形,可定電廠規則,適合我國情形之材料規定,選擇機器之要點,爲將來擴充及開辦之參考.

(3) 由試驗結果,可增高電廠効率,改正各種錯誤.

(4) 採取各處所用中文專門名詞,著成完全中文之調查報告,推銷全國,名詞得以審定而歸統一.

(5) 可得人才缺乏之量,與支配失當之處,而定訓練人才之方法.

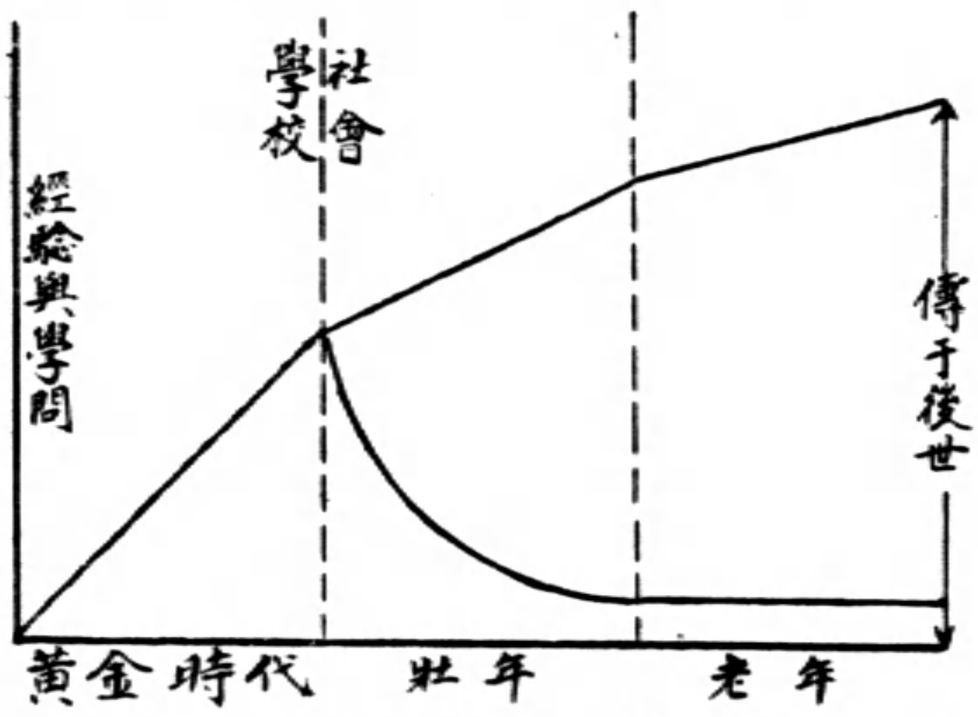
方今我國百廢待興,善爲政者,應視事之緩急,支配經費.想此實地調查之工作,誠爲當務之急,則其費用豈成問題哉.按上數端,最足注意者,爲由確實之調查,而得將來之需要.依此即可進而爲第二時期工作,曰

(乙) 與外商合作製造時期: 近來各國電氣事業之發達,可謂一日千里,然其在本國,必有極點;過此則供過于求,製造範圍,苟難擴充,而其對于國外貿易,非努力不足以維持其出產速度.是以我國將爲各國競賣之商場.若能外以關稅爲保障,內有較廉之人工,而以我國地大物博,將來電業之盛,可以想見,外商必願投資于我國,我政府亦應鼓勵外商與我合作,蓋工程人才之訓練,非由學識經驗並重不可.我國人在外留學者,不過略窺學理.實習者,終日與勞工爲伍,重要之處,黃色者何能問徑.且材料等種種問題,至爲複雜.欲其速成易舉,當出此計,而專門人才,乃可漸漸訓練成功.預計十年以後,不難收回,而入

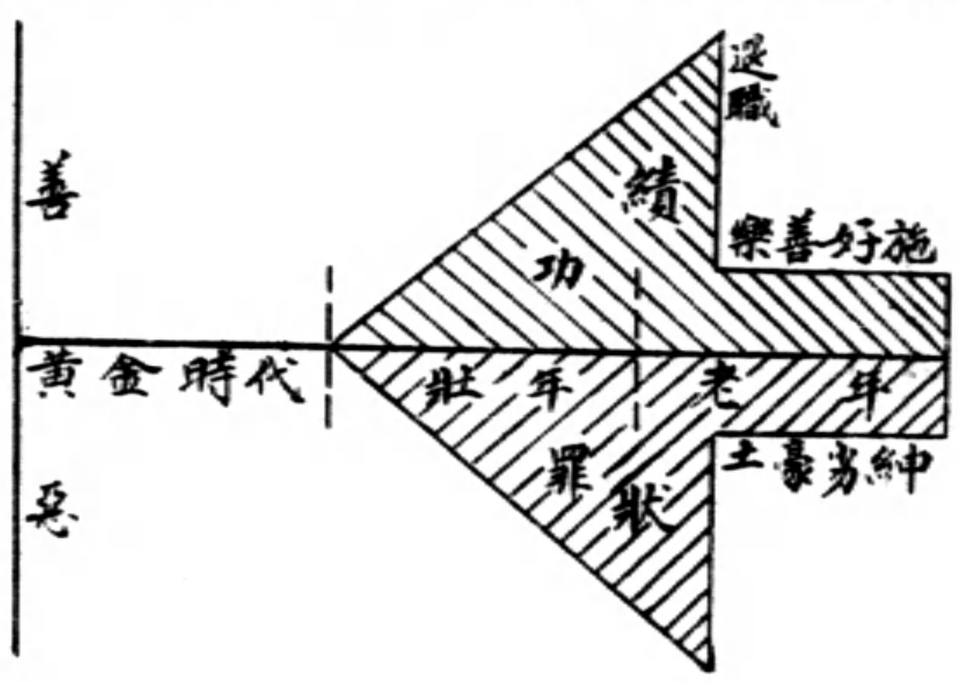
(丙) 獨立製造,研究改良時期: 我國電氣事業始脫依賴然後努力前進,豈可限量.是則吾工程界所望者也.

(五)各時期需要之人才與其訓練方法

人生之變化無窮,有初好學而後怠惰者:有本荒唐而後奮發者;有先爲惡而後覺悟者;有始光明而入昏亂者;其情境之複雜,誠難描寫.下例兩圖,略表



圖一　學如逆水行舟不進則退



圖二

人生所經之途,各舉二種情形,其實曲折上下,決非簡單若是要不出此理耳.試觀圖一,在黃金時代,學問與時並進.及入社會,向上者得經驗,增學問;向下者茸廢之速,實可警人.學問與經驗增加之率,常隨年齡而減低,是以壯年及老年之線平,表明黃金時代之可貴也.次及圖二,假定學校生活,無能爲惡,無人爲善.及與社會接觸,小人得志,則罪惡日深;君子當道,則立功漸高;其成績各以面積計.而第一圖中學術之傳,則當量其高度也.

英雄爲時勢所造成,人才因需要而產生,原近來國中無線電之發達,可以知之矣.是以國家教育人才之方針,當視需要而變更.方今學術之繁,書籍之多,有志之士,欲用其才,而所學不附所需者,誠可嘆也.我寶藏富足而實業落後之中國,政局既定,建設事業,莫不待舉,所需人才之範圍,豈有限止.然察歐美各國,發明製造,一日千里,回顧我國,則購者不知其貨,用者不明其法.以致三相電流,用其二相者有之.(見工程四卷四號甫寧電燈整理之成功及方法)塞汽錶之管,毀試驗之器者,在國中工廠,不知其數.是當調查期內,最要人才,在如何維持,如何購置.請將其訓練方法,分述于下:

(1) 工程教育,與其他文學等之性質不同,應分兩種時期,在學校之時,授以基本學理,實習時期,補以各種經驗,有學問與經驗,方可負責任.是以外人注重實習,待遇全同工人;與我國之一紙空文,從此不加管束,亦不辨別勤惰,選擇錄用,相去遠矣.是願國中無論國有或私立工廠,須知學者負改造建設之責,應補足其所缺乏之經驗,不可不以誠意督促.蓋人經困難而發奮,受管束而上進者,十之八九也.學者當明學校畢業,成功僅及其半,不足以自大.要習勞工之生活,莫爭待遇之優良.明乎是則工廠與學校,可以聯合,而人才之訓練,庶得其法.國家應令全國發電廠負訓練電機實用工程師之責,由學校將每屆畢業生,分派各廠工作,滿期給予證書,方得在電氣業界,負工程之責.

(2) 聰明志氣,受之天性;教育機會,限于環境.各國工程人才,非皆自學校出身.我國工程落于匠目之手,禍患至此,其反動將棄匠目而以學者代之,則匠目之欺詐弄巧,保障更嚴,學者與勞工之合作難行.施學者以實習,而不補勞工以教育,使聰明有志者,無以發展,而成貴族式之工程教育,非所宜也.竊察外國設立夜校,獎勵學金,使人人皆有求學之機,尤至善也.願我人急起效之,從事編訂中文工程課本,以普及勞工智識.其富有經驗之匠目,一經智識貫輸,眼界自開,而樂知經驗之所以然,未使不能勝重任,豈可因其不爲學校出身,而限止其地位哉?

(3) 外人以機械輸入,雖不願告以製造計劃,維持保護之法可得問也.機器之改良進步,多由用者經驗而來.是以創辦購置,當由專家審定,經建設委員會批准而行.其價值較大者,應由公司選派人員,赴外實習,探其製造方法,查明維持保護之策,以歸國在該公司服務數年爲合同.

調查期畢,實用工程師而外,當注意計劃製造工程師之訓練.與外商合辦電機製造廠成立之初.上級職員,是屬外人.吾人應握管理之權,擇才赴外與在廠訓練,同時並進,漸將外排拆,至于完全收回之地步.他若國中材料之研究試驗,至此可求實用,而當盡力擴充矣.閱者或謂外人預料及此,豈肯與我

我合作.茲特以英國茂偉電機製造廠爲證.方二十年前,創辦之初,人才資本,皆是美國西屋公司,今則全歸英人.現我國資本人材,皆難自辦,借助他山,外人得一時之利,我人樹永久之基.吾不恐外人之不願與我合作,而慮吾人之不能克苦勤勞,以達收回之期,其共勉之矣.

在完全自造,研究改良之時.學者始可各就性之所近,專一門以求高深.國家對于是種人材.乃得利用,而應竭力鼓勵.否則我國學術,將永遠步人之後,安能與世抗衡,爲民族爭光,爲國家爭榮,高深人才,用武之時也.今之用人者,常嘆人才缺乏而負材者又恨用非所學.亦未勢非但求不應之理耳.

國外工程新聞二則

(一)土西鐵道通車:—　聯貫土耳其斯坦與西比利亞鐵路,已於本年四月二十三日全部竣工,二十八日上午九時,在伊亞耶布拉克舉行盛大通車典禮,參與者有勞農政府代表,各國大使館代表,及新聞記者.此鐵路之建築,乃俄國三大事業之一.完成後,不特交通便利,運輸迅速,卽產業之開發,商業之興盛,均與俄土兩國,有莫大之關係云.

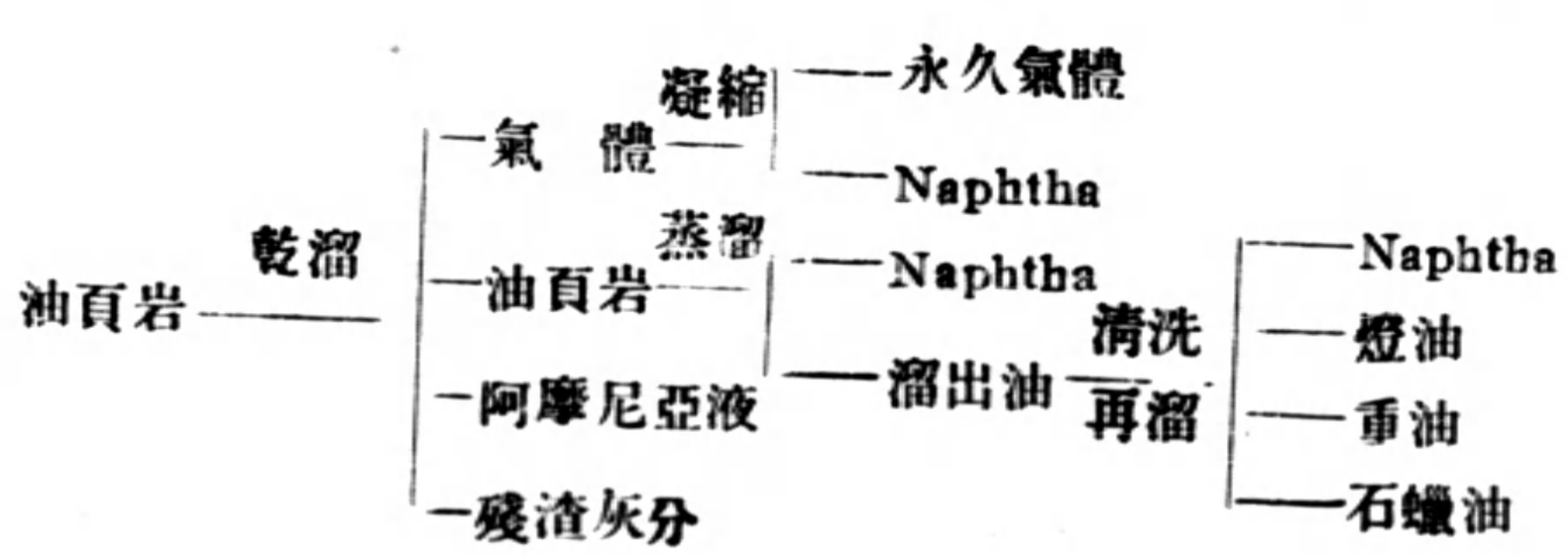
(二)北海運河工竣:—　接通阿姆斯特丹與北海之運河,費荷幣一千八百萬盾,於十年內造成,最大商船,可由北海經此運河直達阿姆斯特丹,乃世界極大之工程.本年四月二十九日,荷女皇舉行伊穆登新閘門開幕禮,機紐一轉,閘門遂開,水道大臣演說,謂此工程之完成,係荷蘭技師,與荷蘭進取家共同之努力,可爲荷蘭國民魄力之紀念物云.

油頁岩工業及撫順頁油岩

著者：胡博淵

(一) 緒言

世界石油之需要,日甚一日,而世界石油儲量,則固有限,以美國爲世界最著名之產油國,按現在之消耗率,據專家之報告,亦僅足十七年之開採,即告罄盡,故專仰來源於天然產出之礦油,終有供不應求之一日,而探索油田以外之新油源,遂成近代工業界一最緊要問題矣.惟環顧已發明之代用品中,其儲量豐富,並適於工業的提油之用者,莫如油頁岩.英國蘇格蘭,於七十年前,即已盛用此物,以煉巨額之石油.最近美國坎拿大及瑞典等處,亦正在積極進行之中.我國油田雖不甚多,但油頁岩之儲量固甚豐富.已知者如遼甯之撫順,及熱河之凌源,皆產此物.前者之儲量,達五十五億噸,所含原油,約當美國石油總儲量四分之一,堪稱東亞希有富源,所惜撫順煤礦,久歸日人經營,而此項鉅大利源,遂亦連帶被佔矣.油頁岩(Oil Shale)含有一種稱爲Kerogen之瀝青質,與普通油田地方之含油頁岩不同,乃完全不含有液狀石油之粘土頁岩也.其色黑褐有光澤,比重普通在一·七五左右,若將此物加以乾溜,可得頁岩油 Shale Oil. 此油雖可即作燃料重油之用,但一般均依處理礦油之方法,以製各種石油製品,其處理方式之一,略如次表所示:

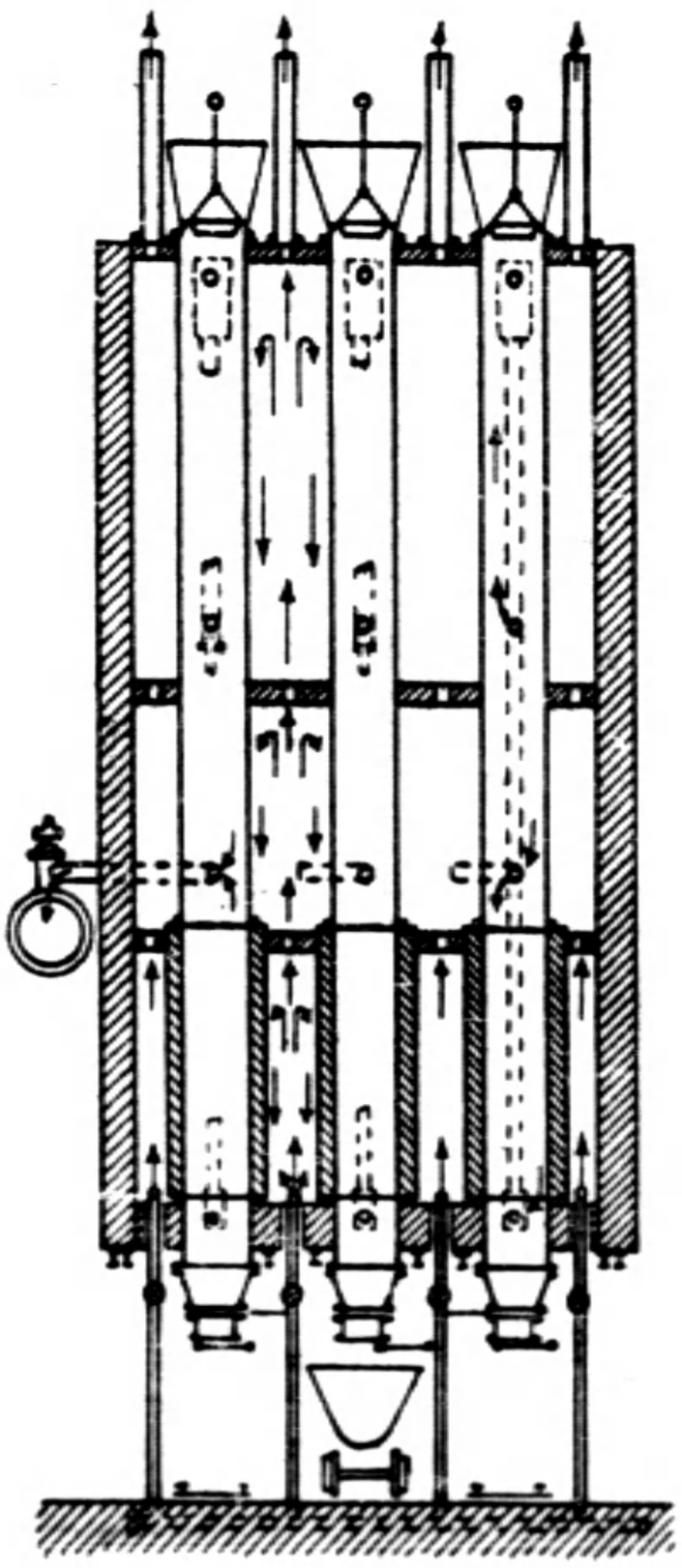


(二)蘇格蘭式提油裝置

蘇格蘭之油頁岩,作層狀產出,層厚一・五呎,其採掘法與採煤相同,鑛夫二人每日可採八噸,其平均成分如次:

水　分	○・四六%	固定碳	五・四五%
揮發分	二三・二五%	灰　分	七○・八五%

提油工場設置乾溜煉爐,(Retort)凝縮機,(Condenser)撒水摩洗機,(Water Scrubber)撒油摩洗機,(Oil Scrubber)汽油精煉裝置,(Gasoline plant)蒸溜釜及硫酸鍰工場等.所採取之油頁岩.最初用碎機擊成二吋左右之大小,然後裝入煉爐中,煉爐形狀略如下圖所示:



煉爐作直立圓筒形,上半部爲鑄鉄製,下半部由火磚砌成,其外週爲烟道包圍,乾溜時可將乾溜油頁岩所得之氣體,導入烟道下部,使作燃燒,而漸上升,以自外部加熱煉爐.

煉爐上部,備有原料裝入口,油頁岩由此口漸次降下,最初在上部被加熱,至攝氏三七○——四八○度,然後來至下部,而被加熱至攝氏七○○度,又在下部吹入水蒸汽,使固定碳生成一養化碳,或二養化矽,並令其與氮氣化合,以便形成阿摩尼亞,NH_3 油頁岩每隔六小時裝入一次,在爐內經過十八小時,然後由下部之排出口取出.

乾溜所得之氣體,由裝入口稍下之鉄管導入凝縮蛇管(Condensing Coil)內,使受冷却,藉使氣體中所含之石油,及阿摩尼亞液,凝縮分

離.然後用排送機(Exhaus'er)吸取此氣,先用撒水摩洗機,加以洗滌,使氣中殘存之阿摩尼亞,形成液體,而被析出.次導此氣入於撒油摩洗機,將殘存氣中之最輕汽油,用重油洗去,然後更將此氣導入烟道內,作煉爐燃料之用.

由凝縮機及摩洗機中所分離之頁岩油,及阿摩尼亞液,可更在分離器內使兩者分離,將頁岩油蒸溜,以製各種製品,其阿摩尼亞液亦須行蒸溜,使成氣體,並用硫酸吸收此氣,製成硫酸銨,以供作肥料之用.

由一噸油頁岩之溜出油,(Once run Oil)及硫酸銨收得量,約如次表所示:

產地	溜出油收得量(加倫)	溜出油比重	硫酸銨收得量(磅)
蘇格蘭 Baoxburn Curly Seam	26.7	0.861	39.4
蘇格蘭 Baoxburn Grey Seam	23.7	0.877	39.0
蘇格蘭 Dunnet Shale	30.0	0.883	25.0
美國 Colorado	16.2	0.903	7.6
美國 Utah	25.2	0.902	5.3
美國 Wyoming	16.4	0.900	60

(三)撫順油頁岩

撫順油頁岩,位於主要煤層之上,厚約四十呎,儲量約達五十五億噸,其含油量平均爲百分之六,所含原油,約達三億噸.其成分,據栗原鑑司博士化驗所得者,略示如次:

	上等油頁岩	中等油頁岩	下等油頁岩
水分	2.95 %	2.59 %	2.69 %
揮發分	24.46	17.64	15.89
固定碳	4.72	3.59	1.94
灰分	67.64	76.68	80.10

民國十三年,南滿鉄路公司,爲決定撫順油頁岩之工業的價值起見,曾運上等油頁岩二五〇噸,中等油頁岩二五〇噸,共計五〇〇噸,至蘇格蘭,在Oak-bank 工廠,作大規模之營業試驗.其試驗成績如次:

由一噸原料收得之量

原　料	頁岩油(加倫)	粗汽油(加倫)	硫酸銨(磅)
上等油頁岩	17.02	2.30	30.03
中等油頁岩	11.59	1.20	29.71

又用此時所得之頁岩油,及粗汽油,在試驗室,行製品實驗之結果,則如次表所示:

(A) 頁岩油精製得

精製品	由上等原料頁岩油之收得量(%)	由中等原料頁岩油之收得量(%)
燈　油	40.14	38.56
C・八三五油	2.19	0.75
中間油	13.25	15.69
輕機油	4.23	4.48
機　油	7.86	9.66
石　蠟	8.32	5.78
殘　油	0.83	0 57
精製殘油	0.95	0.93
合　計	77.70	76.69

(B) 粗汽油精製得

精製品	收得量
Motor Naphtha	81.51
Napbtha	9.83
殘　油	2.57
合　計	93.91

南滿鉄路公司,當最初施行油頁岩乾溜之際,曾擬用蘇格蘭式提油裝置提油.其後經種種研究之結果,因用該式裝置,乾溜剩餘之殘渣中,尙殘存多量之油質,故已決定採用內燃式乾溜裝置.曾築四十噸乾溜煉爐一座,於十五年一年間,實行試驗,其結果甚爲圓滿.故由十六年四月起,已以八百五十

萬日金之預算,實行第一期工程計劃,預定二年內建築四十噸乾溜煉爐一百座,於竣工後,每日得處理四千噸之油頁岩,每年可獲原油五萬四千噸,硫酸銨一萬八千噸,粗石臘九千四百噸,及 Pitchcoker 四千九百噸.現在業已築成煉爐八十座,聞於年內,卽可開爐提油云.

又內燃式乾溜法,係於乾溜爐之下部,另設瓦斯發生爐, Gasproducer 使乾溜殘渣落入此爐內,生成發生爐瓦斯,更將其導入乾溜爐內,利用其顯熱,以乾溜油頁岩,然後再與乾溜所得之含油氣體,共同流出爐外,以備提油.其特點在能用劣質之撫順油頁岩,乾溜提油,而不需使用任何補助燃料也.

最新會員錄已出版

本會對於會員通訊地址,力求準確,以期消息靈通,接洽便利,會員錄自去年第七次重印以來,不過一年,其中變更,已不勝枚舉.故特詳細校訂,修正重印,現已出版,分寄各會員.然人數逾千,散處各地,本會辦事人員,雖竭力設法校正,終不免有遺漏錯訛之處.會員諸君,如有未經收到,或發現其中錯處者,請卽函知上海甯波路七號本會辦事處可也.

FUNDAMENTALS OF STROWGER AUTOMATIC TELEPHONE SYSTEM

史端喬式自働電話之述略

By B. J. Yoh （郁秉堅）

General. An automatic telephone system is one in which the calling party is enabled, without the aid of an operator, to complete a call through remotely controlled switches. The Strowger's Step by Step system is the one most widely used in the world. It accomplishes selection of a called line by successive stages—or steps—which correspond to operations performed by the calling subscriber, known as dialling. These dialling operations consist of the manipulation of a dial which is part of the subscriber's apparatus in addition to the transmitter, receiver and ringer.

Before studying the description of the apparatus employed, the requirements to be satisfied by the automatic system should be considered. First of all, when the subscriber lifts his receiver he must be provided at the exchange with a circuit to the automatic apparatus which will later respond to the impulses he dials. Secondly, when the subscriber has sent impulses he must be connected to the line whose number he has dialled. Thirdly, When the called line is found and is disengaged the called subscriber's bell must be rung. Fourthly, when the called subscriber answers the telephone, the ringing current must be disconnected and talking current supplied. Fifthly, while the conversation is in progress the lines connected together must be rendered engaged to other calls and safe-guarded against interference. Sixthly, while the calling subscriber replaces his receiver both subscribers must be left free to make or receive calls and the apparatus restored to normal so as to be available for use on further calls. Seventhly and lastly, when one subscriber calls another whose line as engaged the calling subscriber must receive a distinctive engaged signal to acquaint him with the fact.

The Dial. The dial and its mechanism may be seen from Figs. 1 and 2. To make a call, the calling party first lifts the receiver and listens for the "dial tone" which is a distinctive buzzing sound. This indicates that the equipment at the central office is ready to receive the call. He then inserts his forefinger into one of the holes in the dial through which the first figure of the required number appeares, and turns the front disc of the dial in a clockwise

Fig. 1. The Dial with Number Card.

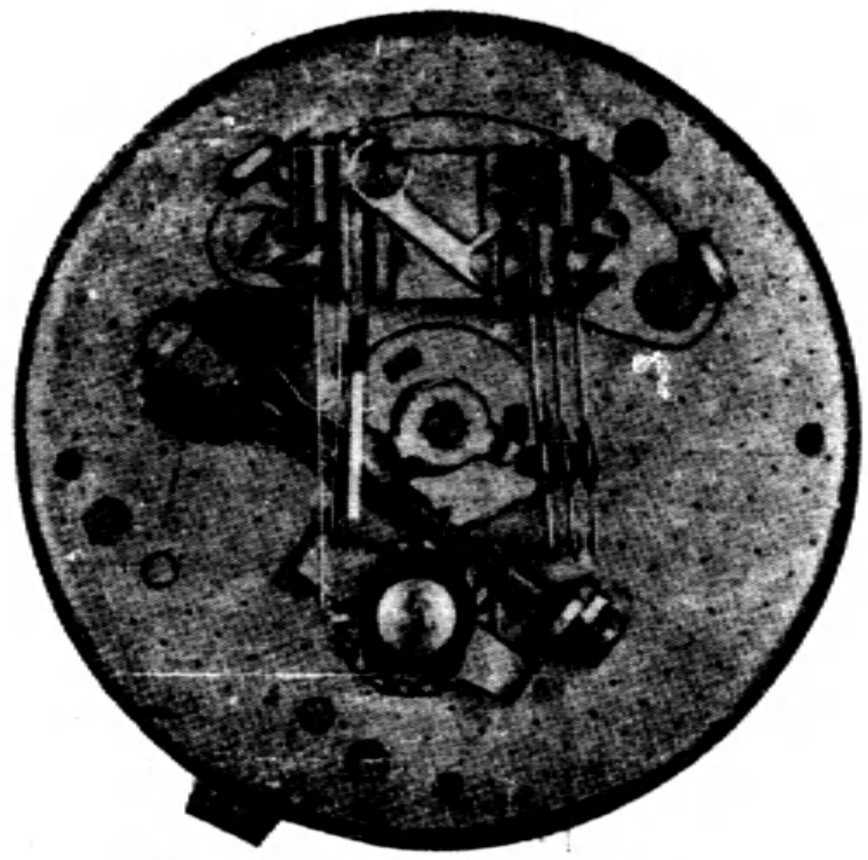


Fig. 2. The Mechanism of the Dial.

direction until the finger strikes the finger stop. The disc is then released and, whilest being driven back to its original position by a main spring located within the dial, disconnects the subscriber's line a certain number of times corresponding to the digit shown on the number plate near the hole into which the forefinger was inserted. This operation is repeated for each digit of the number called. The dial is arranged so that the disconnections occur on the return journey of the dial, not on the forward journey, in order that the system may be rendered reasonably independent of any peculiarity in dialling on the part of the calling subscriber, such as hesitation in the middle of a digit. In order to avoid trouble which would accur if the dialling circuit included the variable resistance of the transmitter, and also to avoid annoyance to the subscriber from clicks in the receiver, it is usual to switch the speaking apparatus out of circuit during dialling.

Principal Switches. Three distinguished types of Strowger switches are generally in operation one after another, when the subscriber lifts his receiver and sends impulses by dialling. They are:

1. Pre-selector or Line Switch.
2. Group Selector (For Exchange over 100 Lines).
3. Final Selector or Connector.

A typical trunking diagram of a four figure system, having line switch, first group selector, second group selector and final selector or connector. is shown in Fig. 3.

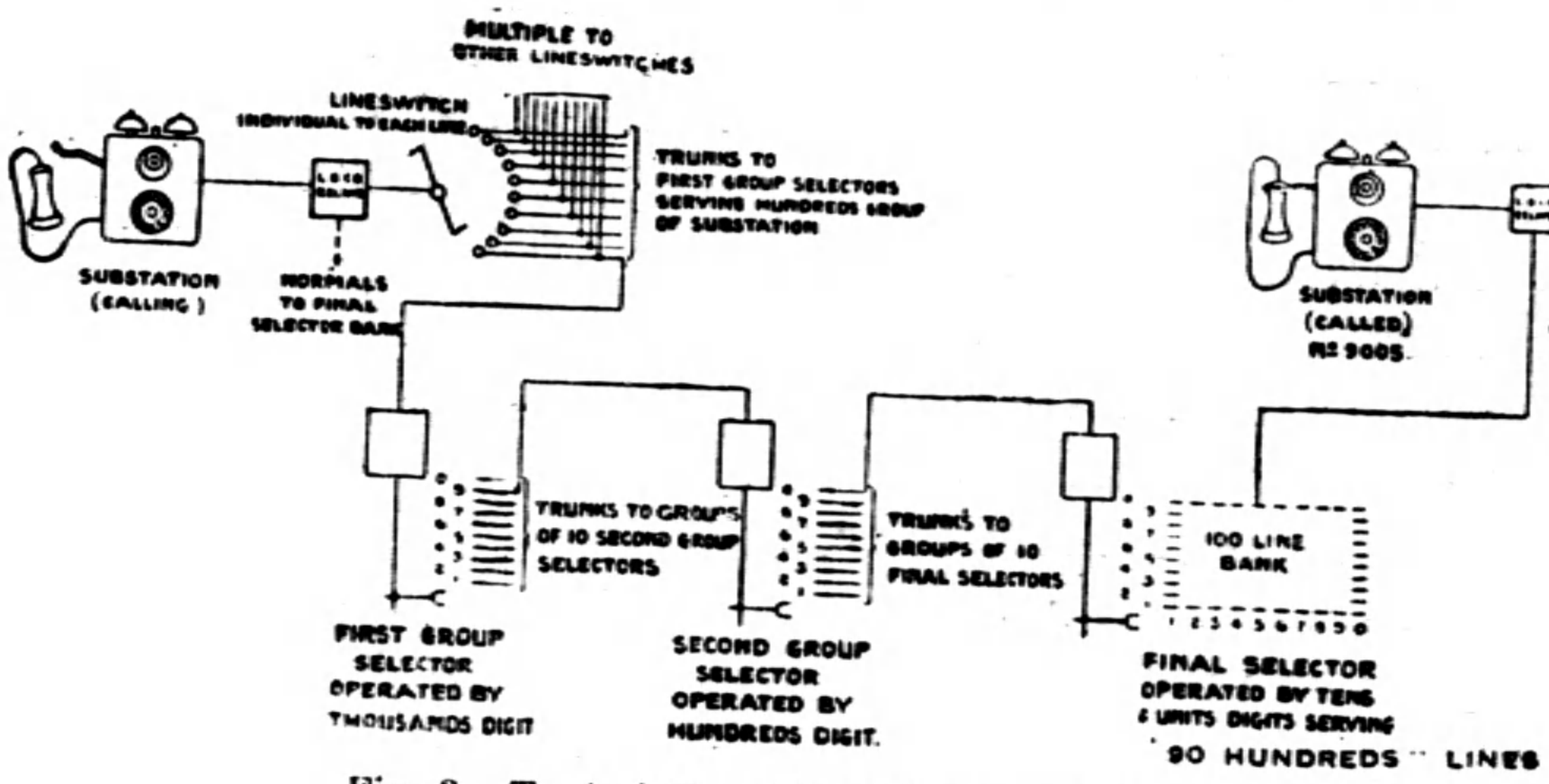


Fig. 3. Typical Trunking Diagram of Four Figure System.

Line Switch. It is an non-numerical switch, attached to the subscriber line, as shown in Fig. 3, which connects the line to a trunk leading to an idle selector. This is to avoid the necessity for having an expensive selector associated with each line.

There are two types of line switches in use in Strowger system; the plunger type or Keith line switch (Fig. 4), which requires a common trunk selecting mechanism for each group, and the rotary type line switch (Fig. 5), having individual control.

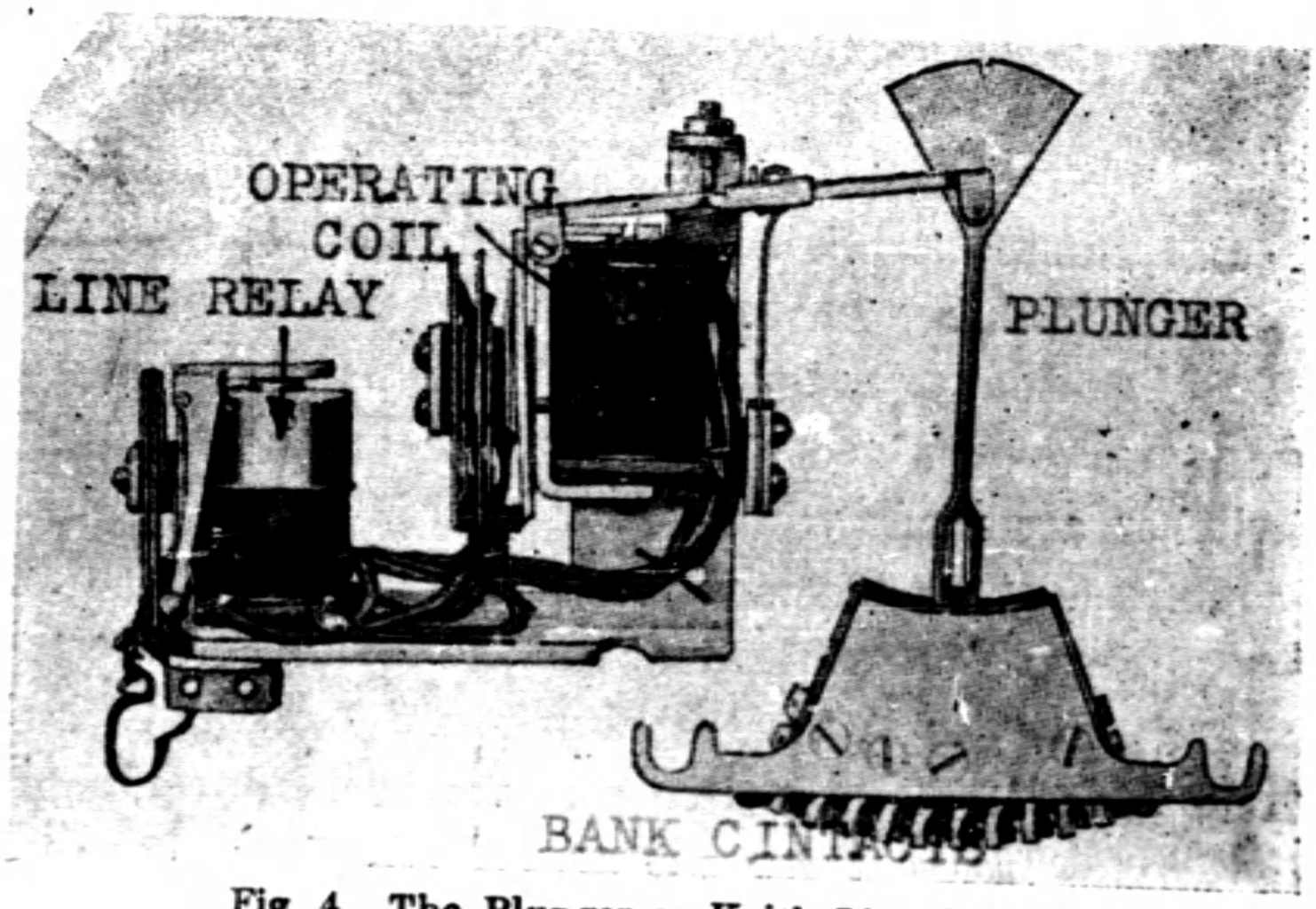


Fig. 4. The Plunger or Keith Line Switch.

The plunger line switch consists of a line relay, and an operating coil which actuates an armature carrying a plunger. When the switch is operated the end of the plunger engages the trunk contact bank, where it causes connection between the terminals of the calling line and those of the trunk that the plunger was resting opposite at the time. The position of the plungers of each group is controlled by a mechanism known as a master switch, whose duty is to keep the plungers of all idle line switches pointing opposite the contacts of an idle trunk. When a call is made on any line, the plunger of that line switch is disengaged from the master switch, which immediately moves all of the remaining idle plungers until they rest opposite an idle trunk. The plunger line switch is thus preselecting in operation; that is, the trunk is selected before the receiver is lifted from the hook.

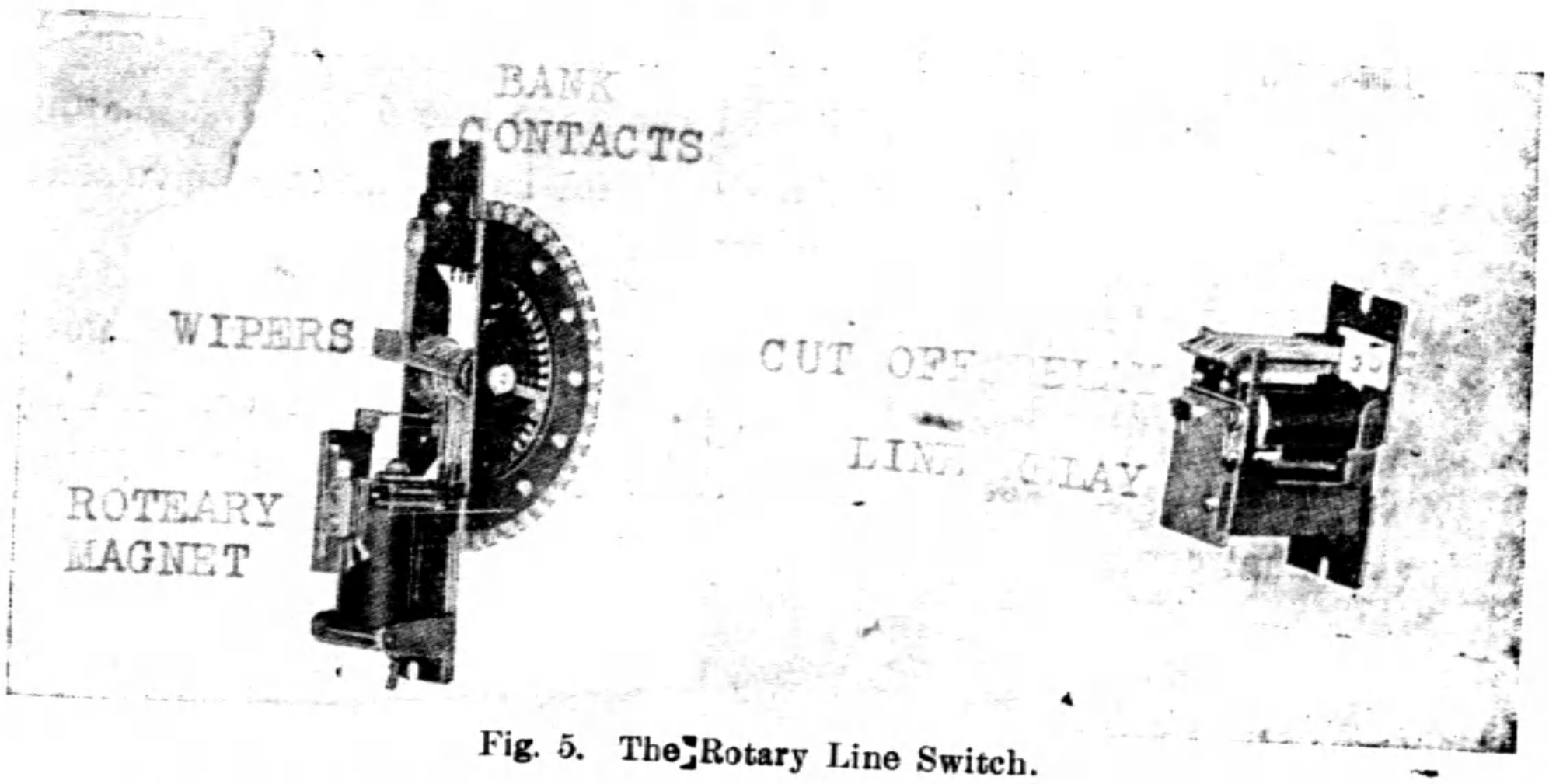


Fig. 5. The Rotary Line Switch.

The rotary line switch is a more recent development and was first used in the Orleans Exchange, France. It has been adopted as a standard type in England, Germany and Japan. It eliminates the master switch and permits larger trunk groups and a more flexible arrangement. The bank of rotary line switches are made with both 25 and 50 sets of contacts. At present the 25 contact bank is the most commonly used. There are two kinds of rotary line switch, the "Non-homing" and the "Homing", the mechanism and contact bank of the former is illustrated in Fig. 5 together with the associated Line and Cut-off Relays. Each switch consists of bank-contacts, double end wipers and a driving magnet for rotary movement, working in conjunction with its line relay and cut-off relay. The number of wipers may be four—

negative, positive, meter and private—or five—negative, positive, meter, private and normal private. The positive and negative wipers are in the talking circuit during the conversation. The private wiper is used for searching an un-engaged trunk and safe-guarding it against interference. The normal private wiper gives guarded homing feature in homing type rotary line switch.

Group Selector. Group selectors are in existance when the exchange has more than 100 Subscribers. Its vertical motion is controlled by dialling while the rotary motion is automatic. It is used for selecting trunk and extending line circuit through to next switch. It switches wipers on first idle trunk, and overflows busy when all trunks are engaged. It holds preceding switch or switches until the trunk is extended. The dial tone is provided from this switch.

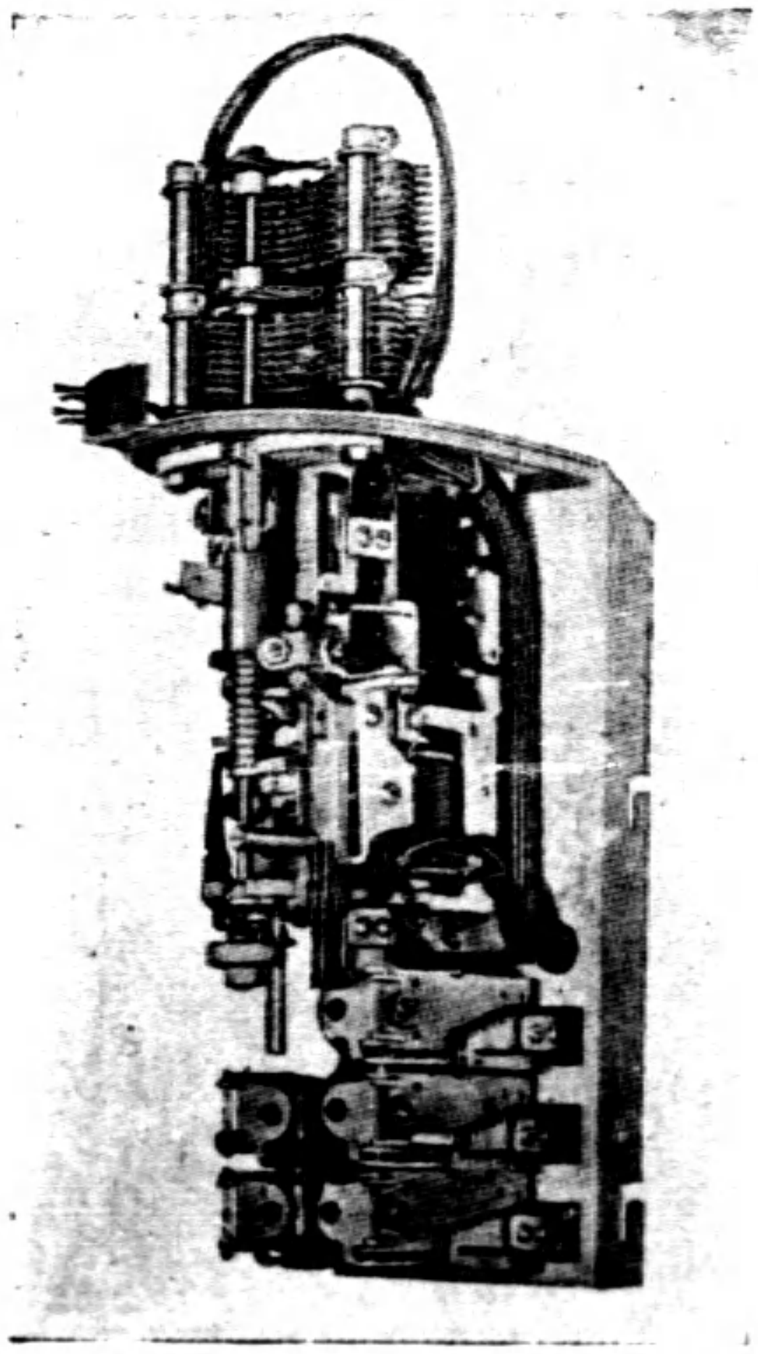


Fig. 6. The Group Selector.

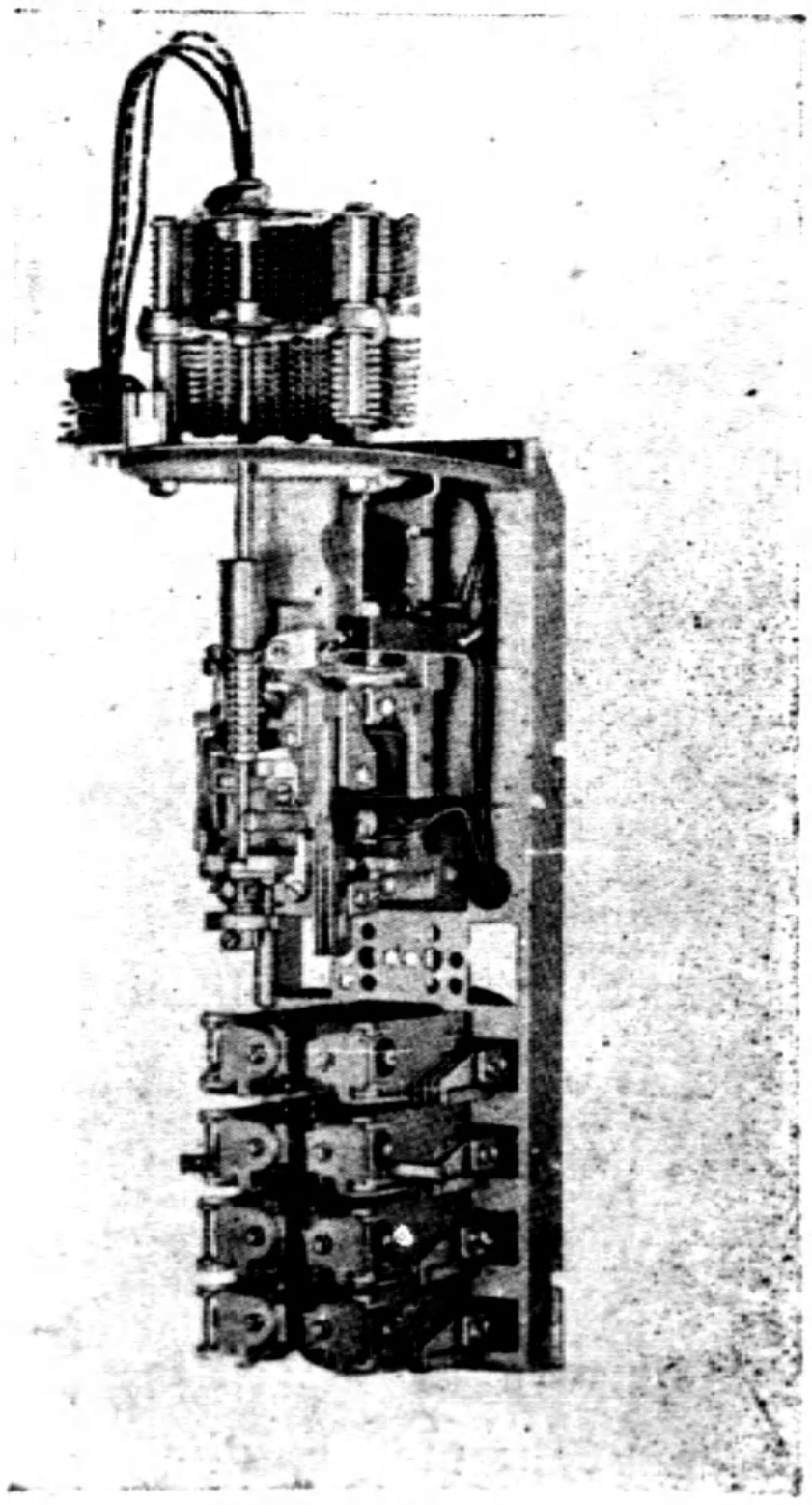


Fig. 7. The Connector.

Each selector consists electrically of a set of relays (Line or Impulse Accepting Relay, Release relay, Vertical movement relay, Switching relay or relays and Auto rotary impulse relay), a set of magnets (Vertical, Rotary and Release), contact-springs, line and private banks and wipers. The 10-level 10-trunk group selector has one line bank while the 10-level 20-trunk type has two line banks, making its private bank with the contacts in pairs, and arranging the circuit so that as the wipers rotate over both the banks at the same they hunt idle trunks and seize the first one found, whether it be in the upper bank or the lower one. When a small exchange or a small office in a multi-office exchange needs for more than one level or trunks to a certain destination, the multi-level group selector can be used. It requires horizontal-chain relays, one for each trunk in a level, vertical relays, one for each level and a vertical wiper and bank in addition to the ordinary type.

Connector. Final selectors or connectors (Fig. 7) have practically the same switch mechanism as group selectors. As soon as this switch is engaged by the pre-selector and group selectors, it executes both vertical and rotary movement under the control of calling device. It holds all preceding switches, and gives busy tone if the called subscriber is engaged and prevents intrusion on busy line. It gives ring-back tone to the calling subscriber whilst the called subscriber's bell rings. It feeds talking current to both calling and called subscribers. The connector is released when the last party hangs the receiver up, while all the preceding switches are controlled by the calling party only.

Besides those fundamental switches as mentioned above, Automatic Impulse Repeaters are introduced in out-going trunks from one office to another. The purposes of a repeater are as follows: Ground the release trunk to permit the use of two-wire trunks between offices; supply talking current to the calling station from the home office; repeat impulses to the distant office.

Adjustment and Testing. The adjustment of an automatic switch of the Strowger type may be divided into two parts, the relay adjustment and the adjustment of the motor magnets. Each relay is adjusted to a definite

armature stroke with a fixed residual air gap. The amount of contact of each spring with its mate is likewise fixed by the position of the armature when the contact takes place. These distances are measured with thickness gages placed between the armature and the pole of the relay. The spring pressure of the contact springs of a relay is measured by the operating and non-operating currents. The final performance of a switch is tested by being operated under line conditions which are worse than any imposed by commercial use.

Standard impulse machines used in adjusting the central office switches may be in portable form with carrying case, in which are mounted all necessary resistances and capacities and means for making all changes in conditions required to "vary" any switch so that it will be tested under variations of resistance, capacity and speed greater than those ever experienced in receiving impulses from a subscriber's station.

As a result of the constant aim on the part of Strowger engineers to eliminate as far as possible, the human element, both as regards the establishing of connections as well as maintaining the apparatus in a perfect condition, the Strowger Automatic Routiners have been designed. These routiners are arranged to perform "routine tests and inspections" on the particular unit of Strowger equipment for which they are designed.

Trunking and Grading. The methods of trunking and grading are among the chief factors in the success of the automatic system. They covers the means of determining the amount of plant required in the exchange to carry the expected traffic, the best means of arranging that plant, of rearranging it when the traffic changes in total value or in distribution, and also, the measurement of traffic overflows. There is ample scope for investigating the subject from both the theoretical and practical standpoints.

In the investigation of traffic problems for proper trunking and grading, the bases are the mathematical theory of probabilities and matters of personal experience and opinion. The busy hour calling rate, the average time taken for a call, the probability of lost call and the load distribution on different stages of switches are chiefly considered.

Power Plant ant Supervisory Scheme. Like manual exchanges, the power plant of an automatic switchboard central office generally consists of one storage battery, two ringing equipments, two battery charging equipments, one power switchboard and one supervisory cabinet.

The proper scheme for supervission in an automatic exchange enables the attendants to inspect and clear the fault, if there is any, within the shortest time as possible. It consists of supervisory relays, coloured lamps and alarming bells for operation and indication.

Telephonic Transmission. So far as telephonic transmission is concerned, there is practically no difference between manual and automatic systems. The problem of increasing the range and reducing the cost of the telephone has been studied for over 40 years. The introduction of microphonic transmitters, the application of hard drawn copper wires and the improvement in receivers may be considered as the first stage of progress. In order to eliminate transmission losses and to make their lines efficient for long distances, the introduction of Coil Loading, Cable Balancing, Thermoinic Valve Repeater and Phantom Circuits makes the whole situation possible and practical. It will be quite possible to telephone from any one point to any other in the whole world.

Conclusion. In this paper, only a very general idea about the Straight Strowger Automatic System is given. For detailed informations, references should be made in a series of standard books and publications concerning this subject.

京滬漢三市改裝自動電話之經過

著者：莊智煥

(一)改裝之原由

科學進步,日異月新.以電話機件而論,由磁石式一進而爲共電式,再進而爲自動式.我國電話事業,視歐美各國,已爲落後;城市電話全國祇六九,〇八五號,長途電話祇一四,一六〇里(見附表),急起直追,猶恐望塵莫及,倘仍苟且因循,必致電話事業,永無發展可言.值此訓政建設時期,普設全國市內及長途電話以便利交通,尤爲當務之急.然一方固當力求擴充,一方則各大都市原有電話裝置之改良,亦屬要圖.

溯自國都既定,人口驟增,政商事務,日益紛繁,原有電話設備,既覺不敷,機件又已陳舊,與其再添舊機,孰若改裝自動.滬,漢兩地,華洋雜處,方言不一,接用電話早感困難,且上海租界電話,已有一部份改用自動新機,華界仍用舊機,未免相形見絀.武漢電話,除武昌局被焚,迄未恢復原狀外,漢口局則機額久滿,亟待擴充.此京,滬,漢急需改裝自動電話之情形也.

附表一

(1)部辦市內電話

地點	程式	容量	地點	程式	容量
北平	共電式	一九,四〇〇	天津	自動式	九,〇〇〇
	磁石式	五四七		共電式	三,六〇〇
武漢	共電式	四,五八〇	首都	共電式	二,八〇〇
	磁石式	五二〇		磁石式	三〇〇
上海	共電式	二,〇〇〇	青島	自動式	三,〇〇〇
	磁石式	九八〇			
蘇州	共電式	二,〇〇〇	鎮江	磁石式	五〇〇
揚州	磁石式	四〇〇	蕪湖	又	六〇〇

烟台	磁石式	五八〇	太原	磁石式	五〇〇
保定	又	五〇〇	吉林	又	六〇〇
長春	又	四〇〇	蚌埠	乂	三〇〇
九江	又	一五〇	沙市	又	一〇〇
鄭州	又	三〇〇	洮南	又	二〇〇
	自動式	一二,〇〇〇號			
	共電式	三四,三八〇號			
	磁石式	六,二九七號			
	共計	五二,六七七號			

(2) 部辦長途電話

地點	距離里數	話線種類	回線數目
平津	二四〇里	四二百磅銅線	一六回線
		半銅半鉄	四
津奉	一,三一〇里	四二百磅銅線	二回線
吉長哈	六九〇里	二百磅銅線	四回線
濟青	八二〇里	又	二回線
京滬	六七〇里	二二百磅銅線	二二回線
		甯錫 滬錫 一	
京蘇	一八〇里	八號鉄線	一回線
話線共計長	一四,一六〇里		

(3) 民營電話公司

公司名稱	程式	容量	公司名稱	程式	容量
常熟電話公司	自動式	四五〇	武進電話公司	共電式	八〇〇
無錫電話公司	共電式	一,〇〇〇	廈門電話公司	共電式	六〇〇
太倉電話公司	磁石式	四〇〇		磁石式	三〇〇
泰興電話公司	又	五〇	海門海聰電話公司	磁石式	二一〇
高鄲電話公司	又	一五〇	崑山電話公司	又	二〇〇
江陰電話公司	磁石式	四五〇	溧陽電話公司	又	一〇〇
盛澤電話公司	又	二〇〇	徐州電話公司	磺石式	一〇〇
			淞陽電話公司	又	二〇〇

南潯電話公司	磁石式	一五〇
嘉興中興電話公司	又	三五〇
松江電話公司	又	三〇〇
泰縣電話公司	又	二〇〇
四明電話公司	又	一,三〇〇
硤石捷利電話公司	又	二四〇
温州東甌電話公司	又	三〇〇
紹興電話公司	又	五〇〇
海甯斜川電話公司	又	一八
平湖永通電話公司	又	三〇
常德常敏電話公司	又	二〇〇
漳州通敏電話公司	又	三〇〇
張家口電話公司	又	八〇〇
歸綏電話公司	又	四〇〇
滄縣電話公司	又	一〇〇
	自動式	四五〇
	共電式	二,四〇〇
	磁石式	一三,五五八
	共計	一六,四〇八號

南通大聰電話公司	磁式石	五七〇
崇明通利鄉村電話公司	又	一〇〇
杭州電話公司	又	二,五四〇
吳興電話公司	又	五〇〇
吳興雙林鎮電話公司	又	五〇
定梅電話公司	又	二〇〇
嘉善電話公司	又	一〇〇
蕭山電話公司	又	
海寧電話公司	又	五〇
袁花四定電話公司	又	五〇
廣達電話公司	又	六〇
宜昌清新電話公司	又	二〇〇
豐鎮電話公司	又	一〇〇
包頭電話公司	又	二〇〇

(二)機式之決定

自動電話之發明最早,應用較廣者,當推步進式,(即史瑞喬式)美,英,德,日諸國多採用之.歐戰前後,電話學者,孜相研究,於是機式倍增,其中以於轉式(即機動式之一種)爲最著.法,比,荷,瑞諸國多採用之.茲將兩式主要同異各點,略分述之.

(甲)大略相同諸點:

(一)用戶所裝機件,各傳音器,收音機,號數轉盤器等及其運用法大致相同.

(二)從用戶至話局,線路材料及設置無大殊異.

(乙) 主要不同諸點:

(一) 步進式機每部係壹百號,旋轉式機每部則爲二百號.

(二) 步進式局內機件端賴用戶,由轉盤所轉號數,依照十進數位次第選接,卽可通話.旋轉式機件轉動之速度,與用戶處之轉盤速度不同,所需號數,須先至登記器,再傳達至各項選接機件,方可接通.

(三) 用戶所需號數,在步進式,則與機上所轉到之號數相同.在旋轉式,則先經一度更改,故與機上所轉到之號數不同.

(四) 步進式機件之動作,端賴用戶之轉數.旋轉式機件之動作,則由另置之小電動機行使之.

是故步進式與旋轉式,從技術方面觀察,固多所不同;從利弊方面研究,則各有長短,卽歐,美先進,亦各執一詞.交通部爲此曾多方審查,再三研討,乃根據下列四項理由,爲京,滬,漢各地電話,採用步進式之決定.

(一)各步進式機件較爲簡單,故障礙不易發生,而維持亦較便利.現在部轄各局工人,對於機械智識,尙屬粗淺,均以採用機件簡單之程式爲佳.

(二) 步進式無論用戶多至百萬,少至數百,均能經濟適用.旋轉式則僅適宜於萬號以上之大城,否則卽不經濟.京,滬,漢各話局,將來雖均可超過萬號,惟目前尙非其時,均以採用多寡咸宜之程式爲佳.

(三) 步進式祇在使用時費電,通話少時費電亦少,故用電較省.旋轉式則無論通話之多寡,全數機器,終日旋轉不息,費電自然較多,機件亦易損壞.

(四) 步進式電話用法較便,故用戶使用時不易錯誤,且其接通較便,故每次通話所需時間較短,局內機器常可敷用,而不能接通之電話亦可較少.

(三) 各局原有之設備及通話記載

京,滬,漢三局之原有設備及通話記載如下:

附表二

局名		機式	容量	平均每日每線用話次數	平均每線忙碌小時內用話次數	平均每次通話時間
首都電話局	城內	共電	二,〇〇〇	二六·六二四	二·〇九八	一六〇秒
	下關	共電	八〇〇	三二·五九七	二·九七五	一六〇秒
	浦口	磁石	二〇〇			
	浦鎮	磁石	一〇〇			
上海電話局	南市	共電	二,〇〇〇	二〇·三一〇	一·五〇〇	一二〇秒
	閘北 (一)	磁石	四八〇	一五·二七〇	一·二〇〇	一三一秒
	閘北 (二)	磁石	二〇〇			
	江灣	磁石	一〇〇			
	吳淞	磁石	一〇〇			
	南翔	磁石	一〇〇			
武漢電話局	漢口特別區	共電	四,三〇〇	一九·三〇〇	一·九三〇	
	漢口華界 (一)	磁石	四〇			
	漢口華界 (二)	磁石	八〇			
	漢口華界 (三)	磁石	一〇〇			
	武昌	磁石	四〇〇	二三·五〇〇	二·五〇〇	
	漢陽	共電	二八〇	九·〇〇〇	一·四〇〇	

(四)各局改裝之規定及機料價格

本部根據上述之記載,得各局改裝之規定如下:

附表三

局名		預定最大容量	現裝容量
首都	城內總局	五,〇〇〇	三,〇〇〇
	下關分局	二,〇〇〇	一,〇〇〇
	北分局	二,〇〇〇	一,〇〇〇
上海	南市總局	六,〇〇〇	三,〇〇〇
	閘北分局	五,〇〇〇	一,五〇〇
	浦東分局	一,〇〇〇	三〇〇
武漢	漢口總局	八,〇〇〇	四,〇〇〇
	漢口分局	八,〇〇〇	三,〇〇〇
	武昌分局	四,〇〇〇	一,五〇〇

上表所列南京之北分局,上海之浦東分局,均須添設.其南京原有之浦口,浦鎮,兩分局,及上海原有之江灣,吳淞,南翔三分局,則暫仍舊狀,均未列入.至武漢原有之漢陽分局,則撤銷之,該處電話由水線直達漢口.

京,滬,漢三處改裝自動電話所需機件及線料,均係美國自動電器公司承售.茲將各該處與天津,青島改裝之價格,以美金計算,比較如下:

地點	號數	機件價目	線料價目	工程人員監工費	總價	每線機件價目
首都	5,000	450,000	250,000	30,000	730,000	90.0
上海	4,800	241,000	303,000	26,000	570,000	*58.6
武漢	8,500	562,000	335,000	29,000	930,000	66.1
青島	3,000	146,000	——	10,000	156,000	48.7
天津	9,000	956,000	——	37,000	993,000	106.2

*上海機件價目,係以用戶話機作三,〇〇〇具計算.若以四,八〇〇號計算.則機件價目,應爲二八二,〇〇〇美金.

貨價之高低,原不僅根據材料,工價,及利益三項,運輸之距離,商家之競爭,亦復所關非淺.且自動電話機件之多少,隨當地通話次數與通話時間而定,故每線價目亦因之而不等.大概吾國人接聽電話,多假手僕役,各機關團體尤甚.其結果,則平均通話時間加增,即機件不能不加多.首都之機關,較其他各市爲多,故平均通話時間亦較多.每機價目之加多,此亦一因也.滬,漢二市電話訂購在後,各商家競爭較劇,遂使我政府得有廉價之機件,實堪欣慰.現在各市拆卸之共電式機件,擬加以修理,運裝較小都市.依照交通部既定計劃,逐步推進,則五年之內,全國應有五萬號自動電話之增添,各大都市長途電話之聯接.電訊交通,當有可觀之發展與便利也!

A DISCUSSION OF THE FUTURE ELECTRIC INDUSTRY IN CHINA

By M. S. Kwei (桂 銘 新)

It is a well extablished fact that in countries where the fruits of materialistic civilization are being enjoyed, the extent of electrification of industries requiring electro-mechanical or electro-chemical applications serves as dependable barometer of the nation's economic progress. When viewed in this light, the United States, endowed by nature in her vast potential wealth, her people excelling in organization of intensive productive enterprises, hold an undisputed lead among civilized nations of the globe. The advanced nations of Europe, such as England, Germany, France and Switzerland, though having accomplished much in pioneering work in the practical application of scientific methods, have yet to attain a plane of economic enlightenment on a par with that of the United States.

Before entering into a discussion of the importance of an electric industry in China during the next few years, it would be well to examine the conditions in the United States. Inasmuch as China and United States possess many similarities as regards potential wealth, area of the land, climate and to a less extent the total population. The marked difference between the two countries stands out clearly when a study is made of the economic welfare of two peoples. In the United States mechanization of productive industries has almost completely replaced ancient manual methods. Both physical effort and skill have been transferred to machines under perfect human control. In the operation and regulation of these mechanical contrivances, electricity plays no small part.

That the extent of electrical application is indicative of a community's economic welfare may be gathered from a study of the following figures. The domestic consumption of electric energy has increased steadily from year to year in the United States, hand in hand with the increase in population and as progress is being made in selling more and more electric service to territories heretofore unexploited. The average cost of energy for domestic purposes is extremely moderate. This is accomplished through the intelligent employment of gigantic units of high thermal efficiencies and further economy in capital investment resulting from inter-connecting the various main sources of

supply. The following tabulation shows the actual kilowatt-hour consumption per year per capita and the average unit cost of energy as supplied to domestic users in the principal cities:—

City	KWH. Cousumption per year per capita 1925	1926	1927	Ave. Cost in Cents per KWH.
Boston	388	417	426	——
Buffalo	672	734	743	3.38
Philadelphia			408	6.58
Washington, D.C.			503	6.08
Chicago	499	516	537	5.12
Cleveland	500	525	547	——
Detroit	470	519	544	4.72
Milwaukee	408	456	469	5.23
Seattle	400	690	1286	——
Spokane	547	612	676	4.25

On examination of the above figures, one will be struck with the cheapness of the energy made available to the general public, though it entails great expense to pay for metering, billing and service to customers etc. The cost of energy for industrial loads is even lower; this may vary from a quarter to one half of the rate charged for domestic use. It will be noticed that the rates at Buffalo and other industrial centers such as Detroit, Chicago etc, are lowest, whereas in territories lacking in industrial development, notably Washington, D. C. and to some extent Philadelphia, the rate charged for domestic service is highest. The proximity of a large industrial load greatly influences the cost of energy to domestic users. However, Buffalo owes its extremely low rate to the extensive Niagara Power Development in its vicinity.

The electric industry in China, if it may be called such, cannot be said to have as yet emerged from its embryo stage. Excluding several haphazard electric lighting installations at Peking, Tientsin, Hankow, canton and other smaller cities on the East coast and in the south, which are but of a few hundred kilowatts capacity, China can hardly boast of a modern electric power station of large size. The Municipal Electric Power and Light Plant in Shanghai, though being the largest in the Orient, is unfortunately of foreign owner-

ship. The total kilowatt-hour consumption for domestic use in the United States in the year 1928 was some 8,489,000* corresponding to a population of about 100,000,000 people. This gives an average domestic consumption of about 84.89 K.W.H. per year per capita. If in future, China should have her electric industries as fully developed as the United States, with her population of over 400,000,000 souls, the annual consumption will amount to the neighborhood of four times this quantity, or about 33,956,000,000 K.W.H. At an average cost of five cents per K.W.H. charged for electric service, this will be an annual electrical business of $1,697,800,000, which is for energy only exclusive of amount involved in appliancees and motor sales, and possible maintenance costs.

In spite of tremendous handicaps, the future of China's electric industry appears comparative bright. Her wealth in mineral resources, particularly in the form of coal, is not inferior to that of the United States. Having been supplied with an abundance of cheap labor, she will soon be able to produce electric energy at a cost equal to, if not less than in the latter country. When future hydro-electric power is consistered, the potential wealth of the upper reachest of the Yangtzee and other rivers cannot he neglected. Men who are responsible for the nation's economic reconstruction program should not overlook the fact that electric industrial development is as vital to China's progress as the building of railways, highways, radio and telegraph stations, air ports, water supply systems and flood control undertakings. The electric industry is the nucleus around which all other productive enterprises are centered. This cannot be more evident than to observe the intimate relationship which exists between electric power and the various large industries in the United States. A specific instance may be taken for comparison by noting that in the Detroit industrial load area, the predominating products being motor cars, 68.5 per cent of a total electric output is supplied to industrial uses, and only 31.5 per cent of this is employed for lighting and domestic appliances. The daily load on the Detroit Edison Company's electric system is in the neighborhood of 531,000 kilowatts during peaks. Some idea of the vast number of related industries which owe their existence to the availability of cheap electric power may be obtained from the following tabulation of important products:—

---

*"Electrical World," Dec. 21, 1929.

Motor vehicles, commercial and passenger
Motor vehicle bodies, and parts
Chemicals, chemical preparations
Manufacture of machinery
Printing and publishing
Meats and meat products
Engines, internal combustion
Foundry products
Drugs and pharmaceutical products
Brass goods
Bread and bakery products
Iron and steel
Machine tools
Stoves and heating appliances
Electric appliances and supplies
Paints and varnishes
Refrigeration Units, electric
Cigars, tobacco
Paper and paper products
Lumber, millwork and wood products
Beverages
Metal specialties
Dairy products
Leather Goods etc.

When an analysis of the load of the Niagara Falls Power district is made, and even greater portion of the total output is furnished to the electro-chemical and other industrial plants of size.

In the heart of the Yangtzee valley, particularly the region near Hankow, Wuchang and Hanyang or the Nankng dstrict, electric power stations of larger dimensions should now be contemplated. Since larger installations are conducive to lower unit cost and increased reliability of service, greater effort should be made to combine all smaller independent installations into a large group. The inefficient and minor power stations now existing, which supply the textile industries, local lighting plants, government telegraph and radio stations and self-contained electic service to hotels and department stores etc. should be all pooled together to form one efficient and

modern power supply system. As most electric lighting plants in China usually remain inoperative until the time for turning on lights, pooling of energy sources will result inevitably in advantages inherent to increased diversity of connected loads and a possible betterment of load factor. In many localities, it will enable the power plant to operate on a twenty-four hour basis, which will encourage use of industrial power as is the case in the United States.

The comparative backwardness of China's industrial development may be traced to many causes which are somewhat deeply felt. These may be named as follows: 1. natural conservatism of the people, 2. lack of capital, 3. scarcity of scientifically-minded or technically trained personnel in the higher governmental positions and lastly, 4. frequent disruption of peace from selfish political party leaders, with its attending evils that invariably reflect unfavorably upon the nation's economic welfare and trade. Allowing that a stable government can be maintained, the investment of people with capital may be easily induced to assist in a program of intensive reconstruction. It is the hope of the writer that the government should take concerted action in the actual encouragement of home industries and the utilization of electric energy wherever possible. As long as the leaders have steadfastly resolved to take this important step, there are numerous native industries in which electricity can be advantageously utilized. Its application will either bring about an increase in production or an improvement in the quality of the product. The existing native industries in which electricity is destined to play an important part are as follows:—

Paper mills
Textiles, cotton and silk products
Lumber mills
Tanning industry
Manufacture of leather goods, shoes, bags, etc.
Manufacture of vegetable products, bean cake etc.
Wood oils, Tung oil, ground nut oil, crushing and refining
Minerals, extraction and manufactures thereof.
Antimony, tin ingots
Medical products
Domestic manufacture of sundries for native consumption, etc.

Contrary to the opinion that is often entertained by the uninformed, the judicious application of electricity does not produce unemployment of China's laboring masses, but it will rather increase the lattitude of unskilled workers who havenot been capable of contributing their share to the community heretofore, except as human "beasts of burden." In short, the employment of electricity in industry general results in increase of productivity of the community and improvement of its economic welfare. It is now the time for the authorities who are in charge of the welfare of each community to follow a definite policy. Encouragement in the use of electricity and installation of medium sized but efficient power plants should be started. Improvement or enlargement of the existing stations in the principal cities will be another important step.

For a city the size of Nanking, with a future population of at least about 1,000,000 souls by the end of the next few years, a steamelectric power station of approximately 50,000 kilowatts may be contemplated granting that all important industries in the surrounding districts are thoroughly electrified. At a unit cost of $125 per kilowatt of intalled capacity, a plant of this size will cost no more than 6,250,000. A portion of this sum will be sufficient to commence the project. The fixed charges on such a plant at 15% will not be more than 936,000 per annum. Of course, the transmission and distribution equipments will cost a similar amount. The government may see fit to finance such a project and it can also take it under control. An alternative will be to make this a private enterprise, to be sponsored by leading citizens of the community, with the rates for energy under the supervision of the government. Other electric generating stations of similar dimensions may be established in a dozen or more other localities sufficiently close to independent fuel sources. The modernizing effect of these enterprises will soon react favorably either directly or indirectly upon the livelihood of the adjacent populace.

Before concluding, the writer wishes to point out that the application of electric machinery by China to her native industries will ultimately come despite all prevalent handicaps. In order to reach the same plane in industrial development as other nations have already attained, and to accomplish this in the minimum of time, the employment of electricity offers the only solution towards bridging the gap that has existed between her economic prosperity and that of the other industrial nations.

SPECIFICATIONS FOR ASPHALT CEMENT

By H. K. Chow (周 厚 坤)

Asphalt as a road building material is finding greater favor every day. In America, for the twelve large cities, up to Jan. 1, 1926, the proportions of different road surfaces are as follows:

Asphaltic Types	54.6%
Stone Block	14.9%
Macadam, Gravel & others	13.3%
Brick	12.8%
Portland Cement Concrete	2.7%
Wood Block	1.7%
	100.0%

Since then the proportion for Asphalt has steadily increased.

The advantages of an asphalt road surface are:

(1) Low abraision factor, and therefore dustless.

(2) Water-proofness, on account of both monolithic and water shedding properties.

(3) Ease of opening up, and repair, a factor of considerable importance in city pavements where public utilities make use of the streets.

(4) Its over-all economy, i.e., lowest combined first cost and maintenance charges.

In China, this material is also coming into general use in large cities like Shanghai, Hankow, Canton, Tsingtao, Tientsin, Peiping, Mukden and Dairen. Minor cities such as Hanchow, Chinkiang are also turning to it partly for appearance. Increasing interest is therefore manifested by all city engineers in this road material. Unfortunately, Asphalt is a comparatively new material, and its properties are not so well understood as other road materials. Books on the subject are both expensive and scarce. Much of the latest technical information are in the hands of few consulting road engineers, the refiners and the marketers of the product, and are not available to the public. The result is that most purchases are made on the basis of

brand names, ill-advised recommendations, or in other haphazard unscientific way. Add to it the inexperience in its application and you get a real unsatisfactory job at the end of its use.

The writer now proposes to present a series of articles on asphalt and its application. The following is the general specification for Asphalt Cement for road work. It is sufficiently broad to cover most of the products on the market but narrow enough to exclude certain brands which are either especially susceptible to temperature changes (i.e. unstable under summer heat), or lack in ductility in freezing weather.

A. Specifications for Asphalt Cement

Impurities. — The asphaltic cement shall contain no water, decomposition products, granular particles or other impurities, and it shall be homogeneous.

Ash passing the 200-mesh screen shall not be considered an impurity but if greater than 1%, correction in gross weights shall be made to allow for the proper percentage of bitumen.

Specific Gravity. — The specifi gravity of the asphaltic cement shall not be less than 1.000 at 77°F.

Fixed Carbon. — The fixed carbon shall not be greater than 18%.

Solubility in Carbon Bisulphide. — The asphaltic cement shall be soluble to the extent of at least 99% in chemically pure cabon bisulphide at air temperature and based upon ash Free material.

Solubility in Carbon Tetrachloride. — The asphaltic cement shall be soluble to the extent of at least 98.5% in chemically pure carbon tetrachloride at air temperature and based upon ash free material.

Melting Point. — The melting point shall be greater than 128°F. and less than 160°F. (General Electric method).

Flash Point. — The flash point shall be not less than 400°F. by a closed test.

Penetration. — The asphaltic cement shall be of such consistency that at a temperature of 77°F a No. needle weighted with 100 grams acting 5 seconds shall not penetrate more than 9.0 nor less than 5.0 millimeters. Sellers should also be required to submit penetration figures at 32°F, 200 grams,

1 minute; at 115°F, 50 grams, 5 seconds. For asphaltic cement containing ash, 0.2 millimeter may be added for each 1.0% of ash to give the true penetration.

Loss by Volatilization. — The loss by volatilization shall not exceed 2%, and the penetration after such loss shall be more than 50% of the original penetration. The ductility after heating as above shall have been reduced not more than 20%, the value of the ductility in each case being the number of centimeters of elongation at the temperature at which the asphaltic cement has a penetration of 5.0 millimeters. The volatilization test shall be carried out essentially as follows:

Fifty grams of the asphaltic cement in a cylindrical vessel 55 millimeters in diameter and 35 millimaters high shall be placed in an electrically heated oven at a temperature of 325°F. and so maintained for period of 5 hours. The oven shall have one vent in the top I centimeter in diameter, and the bulb of the thermometer shall be placed adjacent the vessel containing the asphaltic cement.

Ductility. — When pulled vertically or horizontally by a motor at a uniform rate of 5 centimeters per minute in a bath of water, a cylinder of asphaltic cement 1 centimeter in diameter at a temperature at which its penetration is 5 millimeters shall be elongated to the extent of not less than 10 centimeters before breaking. The lowest temperature at which ductility becomes zero should also be submitted by the seller.

B. Epitome of the Purposes ot Certain Specifications for Asphaltic Cement

Impurities are a measure of the with which the asphaltic cement has been refined and handled. Usually the presence of impurities in large quantities indicates a poor grade of asphalt. Water as an impurity would act as diluent and would cause foaming in the kettle. Ash or mineral matter is not considered an impurity if it is a natural constituent of the asphaltic cement, but the mix and cementing value must be figured on the bitumen alone.

Specific Gravity of the asphaltic cement should be over 1.000. The advantage of a specific gravity more than 1.000 is that there will be less tendency for water to float out the asphaltic cement. The specific gravity is raised by the presence of mineral matter. Asphaltic oils of a penetration satis-

factory for paving purposes always have a specific gravity greater than 1.000. Paraffin base oil and air-blown products usually have a specific gravity less than 1.000.

Fixed Carbon is a measure of the chemical constitution of an asphalt to some extent. Certain types of asphalt such as Mexican have naturally a constitution that yields a large amount of fixed carbon. Fixed carbon is largely used for determining the source and uniformity of an asphalt. Fixed carbon is not free carbon, but includes free carbon, which is ordinarily absent in asphaltic cements.

Solubility in Carbon Bisulphide is a measure of the purity of an asphaltic cement. The cementing value, other things being equal, is proportional to the carbon bisulphide solubility. Any carbonaceous material such as coal tar or pitch is detected by the carbon bisulphide solubility test.

Solubility in Carbon Tetrachloride is very nearly the same as the solubility in carbon bisulphide. It is claimed that an asphalt having more than 1½% difference in the solubility in carbon bisulphide and carbon tetrachloride has been subjected to excessive heat in refining.

Melting Point is the temperature at which the asphaltic cement will flow readily. The melting point desired is dependent upon the mixture. If the amount of fine dust in the mineral aggregate is low, the asphalt should have a melting point higher than the highest temperature to which the pavement is subjected.

Flash Point is a measure of the amount of volatile hydrocarbons that are present in the asphalt and its readiness to decompose by heat.

Penetration is a measure of the consistency of the asphaltic cement. It is merely a quick, convenient test for checking up numerous individual samples. The penetration is expressed in degrees and in accordance with the method of the American Society for Testing Materials, each degree representing 1-10 of a millimeter or 1-250 of an inch. The penetration, then, is the number of degrees that a No. 2 A.S.T.M. needle when weighted with 100 grams will pass vertically into the asphaltic concrete at a temperature of 77 F. (25 C.) in 5 seconds. The penetration to be desired will depend upon the climate, the nature of the traffic, the grading of the mineral particles, the amount of voids, the amount of compression attainable, the ductility and cementing strength of the asphaltic concrete and the amount of dust filler.

Loss by Volatilization is a measure of the amount of light hydrocarbons that are present in asphalt and is also a measure of the tendency of an asphalt to oxidize and to lose its ductility and penetration. Asphaltic cement which has no ductility after this volatilization test will not be satisfactory for paving purposes.

Ductility is the measure of the ability of an asphaltic cement to expand and contract without breaking or cracking. The same asphalt at a higher penetration should have a higher ductility, so all ductility tests should be based on a certain definite penetration regardless of the temperature, or should be based upon a temperature of 32 F. Ductility is also a measure of the cementing strengh.

Viscosity is a measure of ability of the asphaltic cement to impart plasticity and malleability.

Engineering News

World's Largest Arch Bridge is Nearly Finished — The largest arch bridge in the world, which British engineers are building over the harbor at Sydney, Australia, is nearing completion. This impressive piece of engineering spans a channel 1,670 feet wide and rises above water level to seventy-five feet higher than the summit of Saint Paul's Cathedral. The two ends are about to be joined and are now only inches apart. Each weighs 14,000 tons net. Despite this huge weight, they are within an inch of alignment and the width of the gap is exactly as calculated by the designer over two years ago.

After the two halves have been joined next week the work will begin of placing a floor on the bridge to carry four lines of railway, a fifty-seven feet roadway and two footways. The work is being done by Dorman Long and Company, engineers, of Middlesborough, and the cost will be nearly £6,000,000. Nearly 60,000 tons of steel, eighty per cent of which was made at Middlesborough is being used.

工業館改建工業博物院之芻議

著者：張可治

浙省近數年來，對于建設事業，異常努力，去夏又舉辦西湖博覽會，搜羅宏富，世界聞名，尤足使全浙人民，一新耳目。治以猥才，蒙李振吾館長任以工業館幹事之職，乃亦得躬與斯會之盛，誠幸事也。會期五月，各地來會者踵相接，觀摩參攷，其獲益何可計哉？顧盛會不常，瞬已閉幕，匪特人民，將失此良好提倡實業，啓發智識之機關，即會中宏壯之建築，與完美之設備，廢置亦殊可惜。故治不揣冒昧，建議當局，俟閉幕後，將工業館改建爲工業博物院，幸邀允可。惟工業博物院，與工程學實有莫大之關係，茲特揀抄原呈，投登本刊，以請教于國內工程界諸位先進也。

世界愈文明，則事物愈複雜，而其歷史上所遺留之發明與發現亦愈多。但人類因受生活之逼迫，與環境之支配，往往不得不專精一藝，以圖存于現代分工合作之社會。故吾人之智力，每致受一種畸形之發展，而學校教育，則又限于地位，厄于經濟，教授則祇憑書本，實驗則缺乏機會，故青年學子，每患以耳代目，尙空談而忽實際，是誠現代教育家所引爲深慮者也。惟其如是，故各國之政府，及文化機關，每亟亟于博物院，展覽會，博覽會及通俗演講會之設立，以圖灌輸充量之常識，並維持文化于不墜，制至善，意至良也。

顧博覽會之規模，每苦過于浩大，其所耗費又必過鉅，苟國家非遇有特殊之慶典不能辦也。展覽會之範圍較小，其費用亦輕，且無論工業，農業，教育，藝術皆可隨時隨地，分別舉辦之。惜其會期短者，只有數日，長者亦祇有一二月，其籌備期間，每苦短促，布置每欠周密，誠難收普遍之效也。通俗演講，正犯空談之弊，亦無足取。惟博物院，係帶永久之性質，其于物品之搜羅也，不必亟亟，

而可以隨其經濟能力之嗇充,與夫徵集機緣之良慳,以爲緩急.其于院內之陳列與布置也,則分門別類,旁徵博引,解剖之,烘托之,連貫之,尤以爲未足,則加以說明,補以圖案,助以模型,務期雅俗共賞,少長咸宜,而使其增長知識,于不知不覺之間.故在歐美各國城市,無論大小,莫不各有博物院也.

博物院有以自然科學名者,有以藝術或考古名者,有以軍事或工業名者,其名稱不同,其性質各異,惟其以啓發民智爲目的則一也.自然科學,上極洪荒,遠窺星辰日月,近察鳥獸蟲魚,草木花卉,地脈河流,使民衆認識人類在宇宙間所處之地位,並了解天人合作之奧旨,故各國以設立自然科學博物院者爲尤多.第二十世紀,乃應用科學昌明之時代,歐美各國之興盛與幸福,幾莫不以工業爲基礎.其機器之靈巧,交通之迅速,工程之偉大.與夫社會組織之複雜,實爲亘古所未有.故吾人處今之世,必須明瞭乎聲光電化之原理,與其在實用上無窮之變化,庶行事不致迂緩,思想不致落後.況夫科學之爲物,更非一成不變,則尤必賴乎人類之努力,以繼續發揚而光大之.然則提倡應用科學,灌輸工業常識,實爲今日之要圖,而不可忽視者也,故工業博物院尚焉.

工業博物院之歷史甚短,且各國之已設立者亦甚少,惟各國現已感覺人民對于工業常識需要之急切,而努力以從事之矣.工業博物院之範圍,極爲廣大.舉凡衣食住行所用之工具事物,與其由最初發明,以迄臻于實用之過程,及其所依爲根據之理論,莫不蒐集採納,以充陳列.至其所分門類,則係依其應用之程序,而爲先後,茲請將工業博物院應具之內容,約略表列于下:

(一) 採礦工程　內分礦層,礦井,礦室,礦用機械,保安設備,及礦石整理方法等類.

(二) 冶金工程　內分冶爐構造,冶廠設備,普通冶金,及冶鐵鍊鋼等類.

(三) 金屬工作　內分金屬之熔,鑄,煅,拉,壓,軋,剪,鋸,鑽,車,銼,鉋,磨,拋,點,銲等

各項工作,及金屬性質之測驗,與改良等類.

(四) 原動機　內分人力,風力,水力,潮力,浪力,蒸汽力,與氣力等原動機;蒸汽機,及分汽鍋,往復機關,汽渦輪,龍頭,機關等目;氣力機,又分瓦斯機關,油機關,提士機關,瓦斯渦輪等目.

(五) 代步工具　內分人力與馬力之車輛,自行車,汽車,街車,火車等類.

(六) 道路工程　內分上古道路,中古道路,近世道路等類,鑽山工程,地道工程,亦屬之.

(七) 軌道建築　內分平地軌道,爬山軌道,鐵索軌道等類,鐵路所用之信號,與保安設備,亦屬之.

(八) 橋梁　內分天然橋梁,木橋,石橋,索橋,鋼筋橋,鋼橋等類.

(九) 河海工程　內分測量器具,建築機械,水流控製方法,塘壩,閘提,運河等項工程海岸信號等類.

(十) 造船　內分原人用船,帆船,舵船,蒸汽機船,汽油船,仗艦,潛艇,渡船,郵船,貨船,航海儀器,船塢構造及設備,救生設備,及船用機械等類.

(十一) 航空　內分天然飛行,人工飛行,飛機,飛船,氣體流動學,航空用具等類.

(十二) 物理　內分空間重量與時間之測量,固體力學,流體力學,波浪與震學動之原理,熱,光學,聲學,音樂等類.

(十三) 電學　內分靜電動電,電磁感應,電流,有線電,無線電等類.

(十四) 化學　內分古代化學,中古化學,近代化學,物質構造化學,工業製藥學,滋養科學,釀酒等類.

(十五) 工程材料　內分木,石,泥土,磚,瓦,水泥,石灰,紙張等材料之製造與

應用,及最近關于材料研究之工作.

(十六) 市政　內分房屋與街市,自原人時代以迄現代逐漸進化之狀況,工廠房屋,辦公房屋,私人住宅,室內光線,用水,取暖,避暑,溝渠排洩,公園設備等類.

(十七) 陶瓷　內分磁器,陶器,玻璃,搪磁之應用製造及試驗等類.

(十八) 電機工程　內分發電機,馬達,變壓器,蓄電器,測電表,電力輸送,中央發電廠之一切設備等類.

(十九) 纖維工業　內分棉,麻,絲,毛,苧,草等原料品之應用,人造纖維品之數用紡紗,棲織,針織,氈毯,刺綉,縫紉,印花,染色等工作,與其所用之機械等類.

應(二十) 仿印工業　內分抄寫,印刷,電刻,雕鐫,照相,曬圖等項工作之歷史與現狀,及其所用之機械等類.

難者曰,工業博物院之需要固急矣,奈其規模過大,需費過鉅,何毋乃心有餘而力不足乎?答者曰,唯唯否否,語云,爲山者必因邱陵;又云,雖有滋基,不如待時,是蓋言成事者,必須有天時與地利也.今者,西湖博覽會籌備經年,會期數月,集天下之精華,攬湖山之全勝,非惟中國所罕有.實亦萬邦所希逢,若于閉會之後,選擇各館之出品,聚于一處,加以整理,添具說明,妥爲陳列,工業館之機械,特種程列所之模型,農業館之農具,絲綢館之圖案,率皆出類拔萃,是則工業博物院內容備矣.工業館新建館屋,倚山臨湖,地位優越,建築宏固,面積廣大,且馬達線,蓄水池,自流井,水塔,自來水等裝置,甚爲完備,是則工業博物院之院址有矣.陳列品與院址既具,則開辦費可以不用矣.院務管理,只需一二幹事而已.是其經常費亦極省矣.至于陳列品之補充,固需經費,然當省欵支絀之時,盡可緩辦,是則臨時費亦不成問題矣.故工業館之改建工業博物院,實具莫大之便利,蓋其所費雖微,而其收效則大也.邦人士其不以斯言爲河漢耶?盍興乎來!

維司丁好司推进工廠實習概況

(Westinghouse Steam Turbine)

著者：陳宗漢

維司丁好司推进,以前在該公司之東璧工廠製造.歐戰期內,始於費城南十英哩,建立專廠;一九一八年,各種汽力機之製造,悉遷於此,今稱南郊工廠.該廠前濱德拉瓦河,後臨數家鐵路幹線及費城與澈斯特間之電車線,交通甚便.廠址面積頗大,現有斜E字形廠,小推进廠,火車用黑油機廠,推进葉片廠,翻砂廠,發電廠,公事房各一棟,隙地尙多.全廠職工共約二千五百人,每週工作五日,每日九時三十六分.

斜E字形廠係四廠相連成左斜E字形.其三橫廠各稱一號二號三號廠,一號廠製造推进汽缸及凝汽器,二號廠製造大推进輪軸,三號廠銲接鋼鐵,惟後二者餘地甚多.其相當於E字直畫之廠,則爲全廠最忙冗最擁擠最重要之部分,推进汽缸及輪軸之嵌鑲葉片,離心力抽水機之裝配,各種汽箱汽門之配合,汽嘴之製造,輪軸之試平衡,大牙輪之裝配與修磨,以及一千馬工率左右以上乃至十萬馬工率之推进之全部裝配與荷重試驗,咸萃於此.

小推进廠係製造,裝配幷試驗大約一千馬工率以下之推进,大推进之零件亦多在此製造.火車用黑油機,原亦在此廠佔用一小部分,最近則另遷於就已廢之打鐵廠現改造之新廠.推进葉片廠有割片機各種衝壓機銑葉機;又葉模之製造,葉胚之鍛冶,亦在此.翻砂廠規模頗大,大推进之汽虹,與凝汽器之外殼,均在此鑄造.發電廠僅有小推进發電機三部,均一千五百啓羅瓦德上下,幷不常用,因廠中動力用電由費城電力公司購買;鍋爐則常供蒸汽,備試驗推进用.

此廠實習學生有數種:一爲南貴工廠自設之大學畢業生科,實習期限一年,分派在工廠或公事房各若干時;一爲東璧工廠派來之大學畢業生,爲期僅月半至二三月不等,大都均在工廠;一爲寒暑假短期實習之大學畢業生或肄業生.平均同時約共有學生二三十人,工作及待遇,大都相同.畢業生起初六月工資每小時五角,六月後增爲五角半,肄業生工資略少.廠中設有學務處專員一人,管理學生工作及課務.

學生工作部分,普通爲凝汽器,抽水機及大小推进之裝配部,推进輪軸平衡部,推平試驗部,黑油機部等.各種製造部與葉片廠,鮮有學生實習.惟學生如欲考察各種製造手續及方法,可向工頭取得允許,隨意往各部分觀察.至於工作,裝配部較忙,學生須實地操作,所得亦較多.平衡及試驗諸部則較閒.

學生入廠時,卽由學務處發給各種推进,凝汽器與加煤機之樣本與說明書多種,幷問題一本,內有關於大推进,小推平,凝汽器及加煤機之問題四種,每種有問題五六十至百餘不等.學生須在家參閱各種說明書,預備問題答案.但遇工作不忙時,可向工頭取得允許,持書往學務處閱看.如有凝難,可隨時請教學務專員或往廠中詢問工頭或監工員.每星期二及四兩日上午十時半至十二時,在學務處上課兩次,有工程部之工程師主講,學務專員亦在旁襄助.將每種問題依次令諸生解答,有欲討論或問難者,可儘量提出.每種問題須數次始能講完.每種畢後,舉行試驗一次,收卷記分,均甚認眞.又平時問題中有關於計算者,亦須算出交卷.每換一種問題,主講員亦改由該種機器之工程師擔任.四種問題共須二月半之時間,始能完畢.因學生時常調動,新陳代謝,故諸課周而復始.(加煤機之設計與製圖均在此廠,製造則另在他處.又牙輪舊爲諸課之一,今已廢置聞不久將增黑油機課一種).

此廠平時無中國學生,今夏則同時有顧毓琇,馬德建及作者三人.顧君係暑假實習,馬君及作者則由東璧工廠派來.

此廠所製各種機器之種類及構造,非本文範圍所及,惟維司丁好司之推

平與凝汽器較他家特異之點,請舉其一二.就推迸言,(一)調速器舊有遠心調速器及遠心與油力幷用之調速器二種.近年來則後者已廢用而代以專用油力之調速器,現在每分鐘千八百轉之推迸,尙仍用遠心調速器,而每分鐘三千六百轉之推迸,則均用油力調速器.(二)輪軸與汽缸合口間之密封,他家大部用炭質塡料圈,維司丁好司則用輪擊水作墊.就凝汽器言,(一)銅管四周,均留隙地,蒸汽得以輻湊流入,可使凝水溫度幾與蒸汽相同.(二)凝水箱內有密封裝置,可除去凝水內所含空氣.此外特點及足供研究者尙多,如有專習此科,作者甚願與之通信討論.

『推迸』二字,係作者試譯,肯賜指教或欲詢問取其『推』字有衝動之義,『迸』字有噴射之義,兩者均可附會於汽輪發動之原理.一如前人之譯蒸汽機爲『引擎』.究竟是否妥當,作者不敢武斷,甚望高明指教.

中國國內蒸汽旋輪(透平)發電機之調查 (補遺)

去年本刋四卷三號第509頁登有張延祥袁丕烈二君所著『中國國內蒸汽旋輪(透平)發電機之調查』一篇,該篇彙集各公司各洋行之記錄,排成表格,旣可利企業者參考觀察之用,又足供工程家研究比較之需,其有益焉,殊非淺鮮.故自發行後,不逾數月,該號工程,卽告售罄,可知社會人士,對於此種有價值之調查,均極注意.現由萬泰洋行(B.T.H.)交到補充表一紙,亟爲登入,以補闕焉.

THE BRITISH THOMSON-HOUSTON CO., LTD. ENGLAND

Name of Plant	Location	No. of units	Capacity each Unit	R.P.M.	Volts	Cycles	Year Installed	Notes
The Hongkong Electric Co.	Hongkong	2	1,500 K.W.	3000	6600	50	1919	High Pressure
,, ,, ,, ,,	,,	1	5,000 ,,	3000	6600	50	1924	,,
,, ,, ,, ,,	,,	1	10,000 ,,	3000	6600	50	1929	,,
The Taikoo Sugar Refining Co.	,,	3	750 ,,	3000	440	50	1920 to 1925	Extraction
,, ,, ,, ,, ,,	,,	2	750 ,,	3000	440	50		Back Pressure
The China Light & Power Co. (1918) Ltd. Kowloon	,,	2	750 ,,	3600	2200	60	1922	High Pressure
,, ,, ,,	,,	1	3,000 ,,	3600	2200	60	1924	,,
,, ,, ,,	,,	2	5,000 ,,	3000	6600	50	1930	,,
Nanchang Electric Light Co.	Nanchang	1	750 ,,	3600	2300	60	1929	,,
Nanking Electric Light Co.	Nanking	1	750 ,,	3600	2300	60	1929	,,
Sino British Coal Mining Co. (Mentoukou Mines)	Nr. Peiping	2	750 ,,	3000	5250	50	1928	,,
Wuchang Electric Co.	Wuchang	2	800 ,,	2400	2300	40	——	,,
Kiao Ao Electric Co.	Tsingtao	1	5,000 ,,	3000	3300	50	1930	,,
Chekiang Provincial Govt. (Hangchow Power Plant)	Hangchow	2	7,500 ,,	3000	14000	50	1930-1	,,
Total		23	60,850 K.W.					

DIRECT GENERATION OF ALTERNATING CURRENT AT HIGH VOLTAGES*

By the Hon. Sir Charles A. Parsons, O.M., K.C.B., F.R.S., Honorary Member, and J. Rosen, Member

(1) Preliminary Considerations of the Function of the Transformer.

Engineering history contains several examples of a complete change of procedure brought about by developments in a given field of work.

An example in the field of mechanical engineering is the use of step-up gearing in the early days of marine propulsion by screw propellers—a practice which is to-day reversed, for modern marine steam turbines and some of the latest marine Diesel engines are now connected to their propeller shafts through speed-reduction gears. Since an intermediate period in the development of the triple-expansion engine no gearing has been used.

Just as the mechanical gear forms a link between the prime mover and the driven machine, so in the field of electric power generation and utilization by high-tension alternating currents the transformer has for many years been a necessary link between generator and network, and between network and driven apparatus.

About 1890 the transmission voltage, using underground cables, and been raised to 10,000 by Ferranti and Partridge, by whom much pioneer work was done; and alternators of the same voltage were installed in the Deptford power station. These alternators were of lowspeed design and had revolving armatures, in spite of the high generating voltage. They were probably unique in this respect.

The transmission voltage was transformed down in two steps—10,000/2,500, and then 2,500/100. Here we have the complete antithesis of present practice, where generation at 6,600 volts or 11,000 volts is usual, these voltages being stepped up to 22 k V or 33 k V for the distribution network immediately surrounding the power station, and possibly again stepped up to 66 k V or 132 k V for the grid system of intercommunication of power networks.

---

*Reprinted with the permission of the Institution of Electrical Engineers, England.

In view of these considerations, there is ample precedent for a reversal or change of procedure, if such change is in the interests of modern development. The use of high-voltage alternators is, in fact, proposed by the authors, and with it the abolition of step-up transformers for some part of the power to be distributed.

(2) The Growth of Conditions Favourable to the Introduction of the High-Voltage Alternator

Apart from the work of Ferranti, pioneer development in England and America at voltages above 6,000 was not encouraged by the engineers responsible for design and operation of power plants.

In America, in 1899, the 5,000-h.p. water turboalternators at Niagara were built to generate 2-phase current at 5,000 volts. The transmission voltage was 11 000 volts. The alternators had an outer revolving field with a central stationary armature, and were widely known as the "umbrella" type.

In England, the early steam-turbine-driven alternators were designed with a revolving armature, which usually consisted of a smooth core having the windings laid over it and secured by binding wire. This type with a smooth core was used up to 2,000 volts, and up to 4,000 volts with a tunnel winding. They were single-phase machines.

It was found that at the higher voltages, especially where there was more than one phase, the difficulties in manufacture and insulation were great, and the revolving armature was discarded in favour of the revolving field.

Turbo-type revolving-field alternators of 1,500 kW at 1,500 r.p.m., generating at 11,000 volts, were built in 1905, and are still in operation.

While mica insulation was fitted to the end-windings, no mica was used in the conductor-insulating tubes, which were made of varnished fibrous materials.

Many alternators were built subsequently with improved constructional deails, at voltages up to 13,000 volts. It was not until 1921 that the authors' attention was again drawn to the possibilities of highvoltage generators, at a discussion in Newcastle-on-Tyne with an engineer who was responsible for a power supply system where the greater part of the energy was transmitted in bulk at 22 kV to a point some distance from the power station,

TABLE I.

Comparison of Stator Conductors for 1 500-*r.p.m.*, 50-*cycle Alternators*

Voltage	6 600	11 000	13 400	18 000	22 000	33 000
50,000 kW at 0.8 power factor — Current, in amperes	5,470	3,280	2,700	2,010	1,640	1,095
50,000 kW at 0.8 power factor — Total number of conductors	48	84	96	126	162	240
50,000 kW at 0.8 power factor — Conductors per pole per phase	4	7	8	10½	13½	20
50,000 kW at 0.8 power factor — Number of parallel circuits	4 (2 slots in parallel)	2	2	1	1	1
75,000 kW at 0.8 power factor — Current, in amperes	8,200	4,920	4,040	3,010	2,460	1,640
75,000 kW at 0.8 power factor — Total number of conductors	30	48	60	84	96	144
75,000 kW at 0.8 power factor — Conductors per pole per phase	2½	4	5	7	8	12
75,000 kW at 0.8 power factor — Number of parallel circuits	8 (4 slots in parallel)	4 (2 slots in parallel)	2 (2 slots in parallel)	2	2	1
10,0000 kW at 0.8 power factor — Current, in amperes	10,950	6,560	5,400	4,020	3,280	2,190
10,0000 kW at 0.8 power factor — Total number of conductors	24	42	48	60	84	120
10,0000 kW at 0.8 power factor — Conductors per pole per phase	2	3½	4	5	7	10
10,0000 kW at 0.8 power factor — Number of parallel circuits	8 (4 slots in parallel)	4 (2 slots in parallel)	4 (2 slots in parallel)	2 (2 slots in parallel)	2	1

the generating pressure being 11,000 volts. He expressed a wish that a reliable generator might be designed capable of generating direct at the higher voltage. This change of attitude on the part of a supply engineer led the authors to believe that the problem might be a general one; it came at a time when the authors' thoughts were turning to the design of the largest units, which have now materialized—that is, 50,000- and 100,000-kW units.

With the increase in size of generating unit, the greater were the advantages to be gained in the design of alternators by direct generation at 22 kV or 33 kV, and as there were also advantages to be gained in the power station it was felt desirable to make investigations.

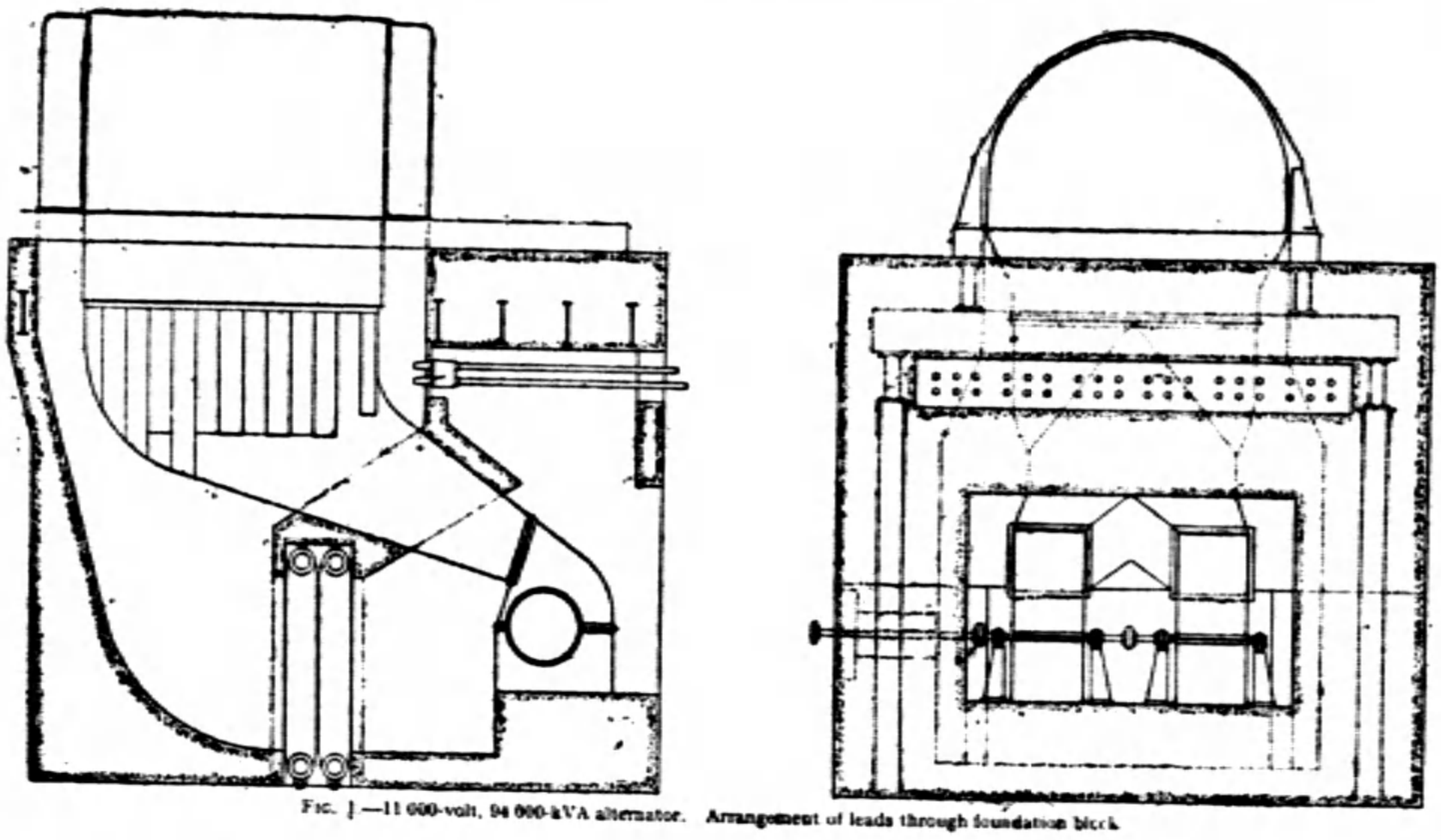


FIG. 1.—11 000-volt, 94 000-kVA alternator. Arrangement of leads through foundation block.

In order to illustrate the difficulties in the design of the largest units, and the lack of flexibility at lower voltages, a list (Table 1) of the current values and approximate number of conductors corresponding to various voltages is given for alternators of 50,000, 75,000 and 100,000 kW capacity.

It is clear that for large units at the lower voltages, to keep the current per conductor low, conductors in two or more adjacent slots would be connected in parallel, thus presenting difficulties in winding, in order that the resultant voltages of each parallel path should be equal in magnitude and also in phase.

The number of conductors in series per phase, upon which the designer can ring the changes, may be as low as 10 or 12. This restriction may impose such limits on the design that an alternator to meet the specified conditions may differ by as much as 20 per cent from the most favourable proportions, with consequent lowering of efficiency.

(3) The Advantages of High-Voltage Generation in the Design of the Large Alternator

On investigation, it was found that in many lay-outs the cost of the leads for a high-voltage machine would be much less and that the cost of the copper busbars and switchgear would also be lower. In fact, in the largest units, one switch only would be employed to carry and break the currents when, at lower voltages, two woul be employed to carry and break the currents when, at lower voltages, two would be necessary.

Considering the cable ducts for an alternator of 94,000 kVA, 11,000 volts, 4,920 amperes, and assuming a density of 820 amperes per sq. in. with lead-covered, paper-insulated, single cables, six cables, each 1 sq. in. area, would be required for each phase. Assuming that cables are run from the stator earth leads, then there would be a total of 36 cables to be led away from the machine. To suit the requirements or most electrical undertakings, the working density would be lower than that assumed, giving a still greater number of cables.

As it is impracticable to bring the leads through the end shields, the winding must be so arranged that the leads are led through the foundation block.

It is inadvisable to weaken the foundation block by bringing the leads through the sides, since the latter form the piers supporting the machine.

The leads cannot conveniently be taken down vertically on account of the ventilation system, and in practice it is found that the best arrangement is to form a cable tunnel in the concrete, running longitudinally from the machine terminals to the exciter end of the block. It will be appreciated that the tunnel has to be of sufficient size for accessibility in fitting the various parts in position.

For the 94,000-kVA, 11,000-volt alternator, much space is required to accommodate the cables and sealing ends mounted below the alternator terminals. Fig. 1 shows the arrangement for this machine. It is seen that the tunnel has to be made nearly the full width of the foundation block, and difficulty is experienced with the girders which reinforce the concrete.

With so many cables grouped together, the maximum output would not be obtained from them.

Most of these difficulties are overcome when an alternator of higher voltage is employed. Considering a pressure of 33 kV, the current is reduced from 4,920 amperes to 1,640 amperes; it will be seen at once that against 6 or 7 cables for the lower voltage machine there are only 2 cables per phase, and these can be loaded up to their full capacity.

A typical arrangement of the leads for the highvoltage machine is shown in Fig. 2. The leads and sealing ends are readily accommodated in

the foundation block, the width of the tunnel being reduced from 14 ft. to 8 ft. 6 in., and the machine placed on a firmer foundation. The sizes of 33-kV cable-sealing bells are only slightly larger than those for 11,000 volts, and little extra space is therefore required for them.

Regarding the cost of cables, those for the 33-kV machine cost £20 per yard run, and for the 11,000-volt machine £37 per yard run for the above output.

As an example of the necessity for reducing the current in large units, the General Electric Co. of Schenectady, in designing the 208,000-kW unit for the State Line station of the State Line Generating Co., near Hammond, Ind., found it necessary to increase the alternator voltage for this purpose. There are three main units running at 1,800 r.p.m., comprising a high-pressure turbine driving a 76,000-kW alternator (0.85 power factor), and two low-pressure turbines, each driving a 62,000-kw alternator.

The main alternators were first designed for a voltage of 18 kV instead of the standard voltage of 13,400 volts.

It was later found necessary to raise the voltage to 22 kV.*

The transmission voltages are 33, 66 and 132 kV; it is apparent that the generating voltage has been increased due to the difficulties which arise with the heavy currents.

The authors have been repeatedly reminded that if they can show sound reasons for generating at a higher voltage, then 66 kV, a voltage recognized as one of the standard transmission voltages, would be the most advantageous.

While 66 kV is a generator voltage which may be recalled that there are many conditions under which 22 kV and 33 kV would be considered economical, more especially where the power station is at the centre of, or at only a few miles' distance from, the main consumption of the power, and where underground cables may be employed for transmission. Several such plants may be quoted where the conditions for generating at 33 kV might be considered favourable, for example, Baton, Clye Valley, the proposed site at Carrington, and others. All have surrounding areas which can economically consume power at 33 kV, and enable a saving to be made by direct generation and switching at 33 kV.

---

*General Electric Review, 1928, vol. 31, p. 7, and 1927, vol. 30, p. 5.

(4) Financial Savings Effected by Direct Generation at High Voltages.

The authors have worked out the savings which may be obtained with the use of such high-voltage alternators.

Where the generator can be constructed to supply the transmission system directly, without the intervention of step-up transformers, the whole sum, representing the cost of the transformers and their housing, and the capitalized value of their losses, less the additional cost of the high-voltage generator, can be saved.

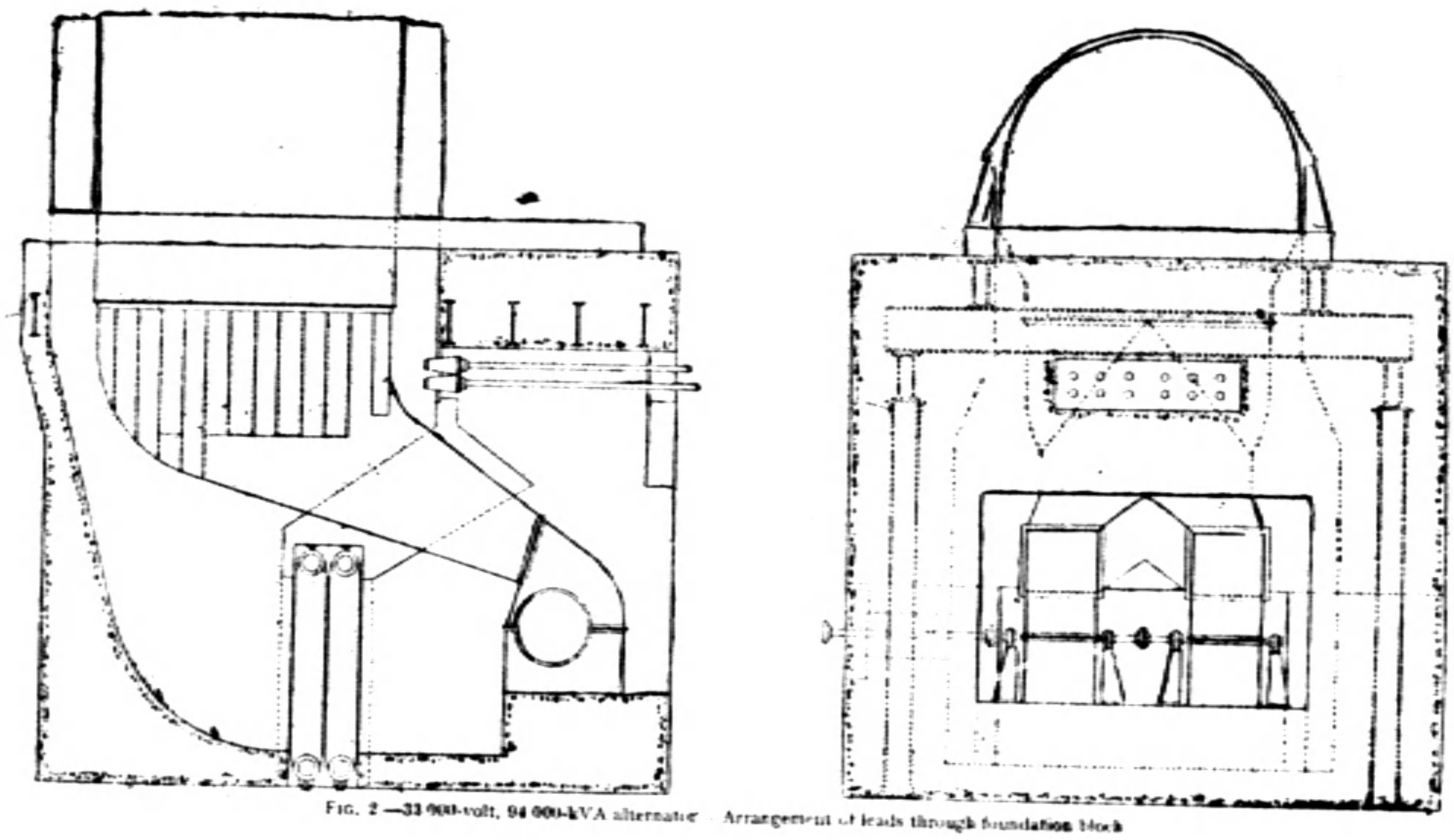


Fig. 2.—33 000-volt, 94 000-kVA alternator. Arrangement of leads through foundation block

Where the generator voltage is stepped up at once to the transmission voltage, there is the advantage to power station designers of freedom of choice in placing the switchgar either on the l.t. or h.t. sides of the transformers.

The various items in which there is a direct financial saving by the use of high-voltage generators may be summarized under the following heading:—

(*a*) Cables.
(*b*) Transformers.
(*c*) Transformer losses.
(*d*) Transformer cooling equipment.
(*e*) Buildings.
(*f*) Switchgear.

(*a*) *Cables.*—As already stated, the cost of the cables between generators and switchgear or transformers increases rapidly with the current and size of unit. The expense of laying the heavy cables will also naturally be greater.

(*b*) *Transformers.*—These will usually be 3-phase units up to 20,000 or 30,000 kVA, and bands of three singlephase units for larger outputs. Artificial cooling, either by water or air, will be required above 15,000 kVA and is included in the prices given below. The figures apply to transformers stepping up the generator voltage to 33 kV.

(*c*) *Transformer losses.*—The capitalized value of transformer losses represents a considerable part of the total capital outlay, and is so much greater than the extra cost of the high-tension generator that the saving of this expenditure is alone sufficient to justify the use of higher generating voltages, when transformers can be eliminated. The correct basis on which to charge the transformer losses is not always easy to determine, and depends on the size and arrangement of the plant and system and the operating conditions, especially the load factor. It may be assumed that the load factor of a large generating unit in a modern power station supplying an extensive network is somewhere between 50 and 70 per cent.

The annual cost of the losses can be obtained by reckoning the actual generating cost of the losses thus obtained, to which must be added a fixed charge per kW of maximum demand, representing the proportion of the fixed charges of the installation which is chargeable at the point at which the transformers are situated; for step-up transformers at the generating station this charge should be lower than for distant distribution transformers, where the losses are supplied through the transmission system.

In order to capitalize the annual cost of the transformer losses, a rate of about 10 per cent per annum may be taken, to include interest on capital, depreciation, obsolescence and insurance.

(*d*) *Transformer cooling equipment.*—The cost of running the transformer cooling-plant motors (oil pump and fan) must be added to the cost of fixed losses of the transformer, as the cooler is usually in serivce all the time the transformer is alive. Where water-cooling is used the cost of water must be considered, although it is only in exceptional cases that this charge is appreciable.

(*e*) *Buildings.*—Transformer banks are now usually installed out-of-doors, but a certain expenditure is incurred for foundations and accessory structures. There may also be some saving in the construction of cable ducts and switchgear housing.

(*f*) *Switchgear.*—The cost of switchgear increases rapidly when the current exceeds certain values, and may become excessively high for very large units at low voltage. The cost of maintenance, also, will be higher for the very heavy gear required for large currents.

As a representative plant, a unit of 75,000 kW will be taken, giving its full output at a power factor of 0.8, the equivalent output thus being 94,000 kVA. It will be assumed that a generator of this output is wound for 11,000 or 33,000 volts, and has to supply a network at 33,000 volts, so that a transformer bank will be necessary in the first case. It is assumed that the switchgear is on the 33-kV side. The following comparison can then be made:—

	"A"	"B"
Generator output, kVA	94,000	94,000
Generator voltage	11,000	33,000
Approximate additional cost of generat	——	£10,000
Cost of cables (100 yards' run)	£3,675	£2,000
Cost of transformers	£19,000	——
Transformer losses.		
Fixed losses, kW	250	——
Variable loss at full load, kW	400	——
Variable loss at 60 per cent load factor, kW	144	——
Transformer cooling equipment.		
Input to motors, kW	50	——
Reduction in cost of buildings, etc., and transformer foundations	—	£500
Annual cost of fixed losses [at £1 per kW (0. 1d. per unit)]	£1,400	——
Annual cost of variable losses	£ 925	——
Capitalized cost of transformer losses at 10 per cent	£23,250	——

The 33-kV machine thus shows a capital saving of £44,425, from which the extra cost of the former must be deducted, leaving a net saving of of £34,400.

Where the generator voltage is stepped up to 66 kV it might be possible to take advantage of the low step--up ratio and effect a saving by the use of auto-transformers.

	"A"	"B"
Generator voltage	11,000	33,000
Cost of cables (100 yards' run)	£3,675	£2,000
Cost of auto-transformers	£16,000	£9,750
Capitalized value of losses	£20,000	£12,500
Reduction in building costs	——	£1,000
Cost of switchgear	£9,000	£6,200

The total capital saving on the 33,000-volt generator is then £19,225, less £10,000, or a net saving of about £9,000.

The above figures are approximate, but are submitted as representative of the conditions prevailing at the date when the paper was written.

(5) Historical Survey of Past Alternator Construction for Direct Generation at 30kV

The use of a generating pressure as high as 30 kV is not in itself new, since Porf. Mengarini installed two 5,200-kVA, 30-kV allernators, running at 450 r.p.m. and generating 3-phase current at 45 cycles per sec. in the hydro-electric power station of the Societa Anglo Romana at Subiaco, on the upper reaches of the River Aniene. The power was transmitted to Rome, a distance of 34 miles.

The engineers of the Ganz Co., Ltd., constructed these 30-kV alternators in 1905, in addition to others for service in Italy.

Credit must be given to the engineers for this early pioneer work, and the success of these plants shows a thorough understanding of the art of insulation.

The machines have not been repeated in recent times. The amount of power transmitted over long distances from hydro-electric stations has very much increased, and the transmission pressures now employed in Italy

have been increased to 100 kV and over. As it is unusual to have a large demand adjacent to a hydroelectric power station situated in the hills, the pressure of 30 kV has fallen into disuse, and the generating voltage was reduced to a lower figure suitable for the design of the moderately large electrical units employed.

The methods by which the engineers succeeded in constructing several successful 30-kV alternators as far back as 1905 are well worthly of study. The precautions which they recommended are now essential in electrically high-stressed materials such as are used in underground cables, etc.

From experience, it was found that the temperatures at which the alternators operated had to be kept at a moderate figure. Any difficuties that were experienced were traced to charring of the insulation. These difficulties emphasized the importance of using mica between turns, where the potentials were low, as well as between phases and to earth.

No attempt was made to grade the conductor insulation, but micanite was used throughout, and attempts were made thoroughly to impregnate the insulation and to expel the air.

The stator end-windings were not clamped, although the plants feeding the overhead transmission lines must have been subject to heavy short-circuits, surges, etc.

The necessary wide spacing of the end-windings, due to the high voltages, with large distances between phases and to earth, no doubt accounts for the remarkable freedom from mechanical failures or movement of the windings.

The authors take the opportunity of mentioning here this explanation of the lower mechanical stresses and forces in the end-windings, as a natural criticism has been levelled at a construction which removes the transformer, which, in the past, has acted as a buffer between the system and the alternator.

The forces on the end-windings are, in fact, much reduced, but this problem is dealt with later in the paper.

(6) The Design of the 33,000-Volt, 25,000-kW, 3,000-r.p.m. Alternator now Installed at Brimsdown Power Station, North London.

The authors' experience as far back as 1905 led them to believe that the voltage with ordinary design could be much increased, but not sufficiently to keep pace with modern developments in 1921. Some better and simpler solution had to be sought, and, in view of these considerations, the authors directed their attention to the design of a high-voltage winding for incorporation in the largest alternators. Several designs were prepared.

In all investigations their efforts were principally directed towards the use of recognized standard insulations, such as micanite, without subjecting the materials to greater electrical stresses or employing greater thicknesses than those which had already proved satisfactory over a period of years.

After considering different schemes, including the grading of the quality and thickness of the insulation, it occurred to the authors that a concentric type of core conductor, of which knowledge was already available

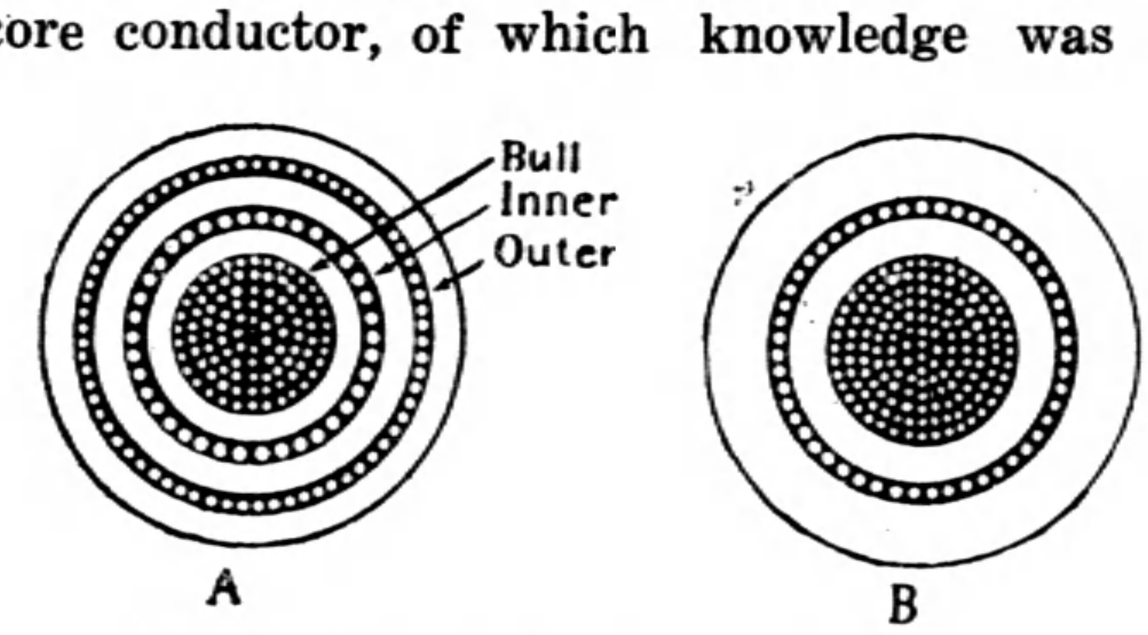


Fig. 3.—Sections through conductor bars.

through its application in other directions, might be adopted. By incorporating this type of conductor it became possible to prepare designs with greatly increased phase voltage without increasing the voltage gradient across the winding insulation.

The concentric conductor, which is the basis of the design and which is to be described, appears to afford a simple solution of the problem. By its use an alternator can be so wound as to distribute the dielectric stress and to lower its mean value at that part of the machine where there is limited area, and the maximum of heat generation at the regions adjacent to the

stator bore. In the designs of alternators for voltages of 33 kV and 44 kV between phases, there is sufficient margin to permit insulated conductor bars to be used with thicknesses of insulation not exceeding those of whcih experience has proved satisfactory.

A section through one conductor bar is illustrated at "A" in Fig. 3 and resembles an ordinary concentric cable, with the exception that the insulation between conductors is of micanite.

There are three conductors per slot, nested one within the other, the conductors being wound in such a manner that the voltage is gradually stepped down from the innermost conductor. This formation of conductor is also very strong mechanically—a distinct advantage where the conductor projects beyond the stator core for coupling to the end-connections. For ease in description, the respective conductors in each slot are referred to as the "bull," "inner" and "outer" (see Fig. 3).

The "bull" conductors of each phase are connected in series, and are then connected to the surrounding "inner" conductors which are again connected in series and finally connected to the "outer" conductors, which are

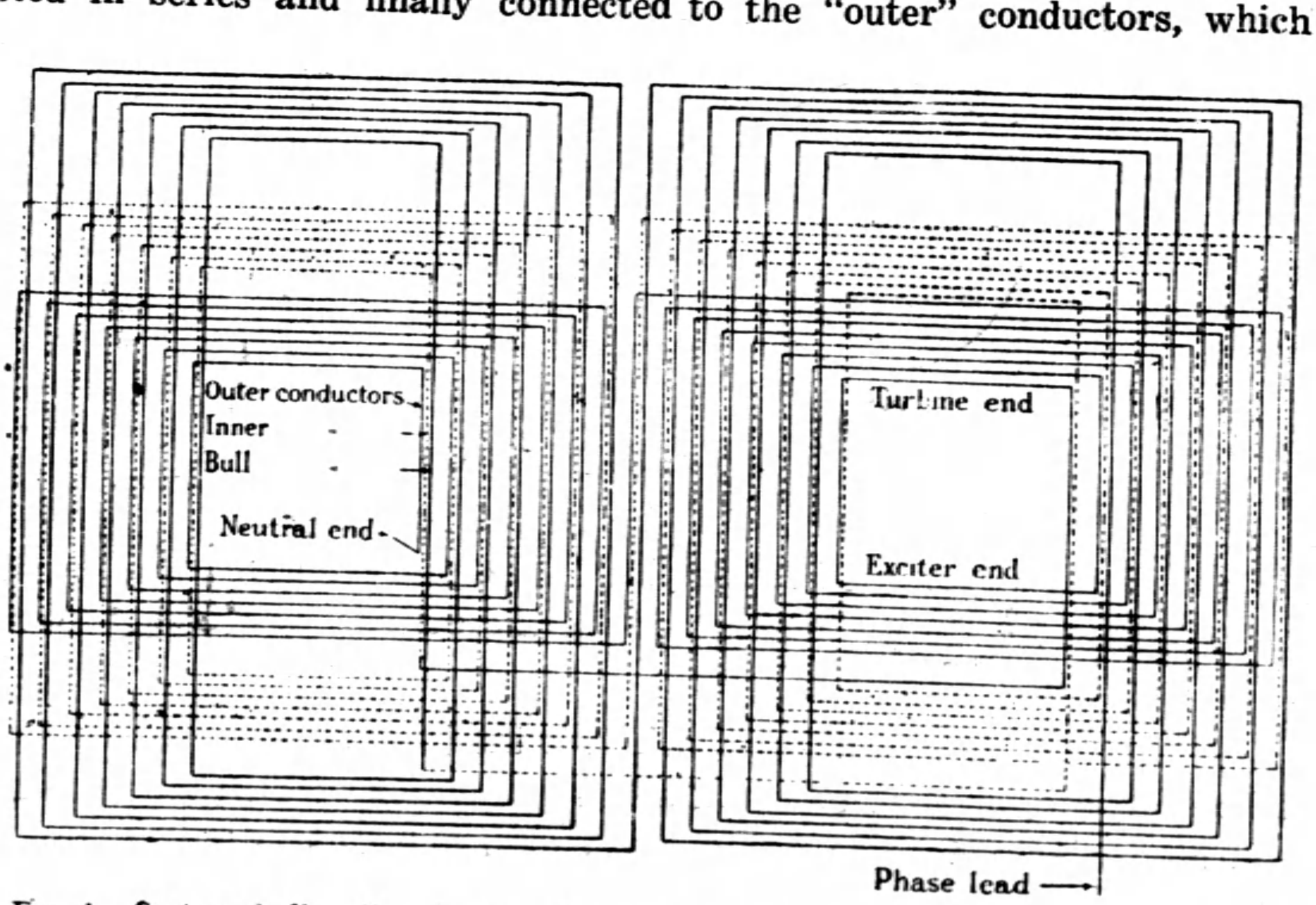


FIG. 4.—Stator winding diagram (one phase only) of a 3-phase, 2-pole winding with 90 slots and 264 conductors, 3-core concentric conductor

starred to the ends of corresponding cnductors of the remaining two phases, and then connected to earth. A diagram of connections is given in Fig. 4, in which the method of winding is clearly indicated.

Fig. 5 is a vector diagram from which, in the initial stages of design, the voltage difference between conductors in the same or different phases was readily obtained.

By numbering the conductors and using a straightedge on the diagram, it is possible to trace the potentials at the different points round the whole of the windings.

The diagram of connections shown in Fig. 4 is for a 3-phase, 2-pole alternator having 90 slots and three conductors per slot.

The winding of each phase has 88 conductors distributed between 30 slots, the voltage generated per conductor being 217. The phase voltage and the maximum voltage to earth is 19,080.

The "bull" conductor potentials range from 19,080 volts to 13,000 volts to 6 500 volts, and the "outers" from 6,500 volts to zero. It is clear that with such a design there is a substantially constant potential difference of 6,500 volts between the conductors in any one slot, and a maximum voltage from the conductor to eath of 6,500 volts. Such voltages are moderate and are readily dealt with.

The conductors are arranged in three rows as shown in Fig. 6, such an arrangement being found specially suitable for a high-tension machine. By staggering the conductor slots the flux density in the stator teeth is kept uniform, and it was found possible with this design, instead of providing an elongated conductor, as for a low-voltage machine, to use the round form above described and, at the same time, obtain increased internal reactance.

By adopting this arrangement it is not necessary to bend the core conductors where they project from the stator, in order to provide a reasonable leakage gap between the end-windings and the rotor end-caps.

The staggering of the slots gives a uniform distribution of winding, and in effect has the advantages of the smooth-core armature, without the disadvantages of an unduly increased air-gap. The excitation energy is therefore retained at very reasonable figure.

It will also be seen from Fig. 6 that the conductor ends are accessible, giving greater space for sweating and insulating the joints.

Several interesting problems were met in the manufacture of the conductors, but it is unnecessary in this paper to describe the mode of manufacture. It may be sufficient to mention that the "bull" conductor was made in the same manner as an ordinary cable, and varnish-impregnated *in vacuo*. The cable was cut into the requisite lengths, and alternate layers of mica and insulated copper strands were applied. After the application of each thickness of insulation the conductors were re-impregnated *in vacuo*. In no part of the manufacture were the conductors in any way bent.

From Fig. 7 it is seen that two slots per phase contain only two conductors instead of three; a detail of the conductor is shown at "B" in Fig. 3. The conductors of the highest potential are not carried to the slots adjacent to another phase. This increases the distance between regions of maximum potential, and so minimizes the electrical stresses. This reduces to 28 000 volts the voltage between adjacent conductors projecting from the core.

(To be Continued)

會 針 加 價 啟 事

本會會針,向售陸元,嗣因前定之數,近已告罄,亟宜添備,以應會員之需.惟廠方以金貴銀賤,懇請加價,而維血本.當經第五十八次董執聯席會議議決:每枚實售洋八元,郵費照舊.再本會會證業由薛董事次莘担任接洽印刷想不日可以告竣每位會員賡賜一紙,合併附誌於此!

開立方捷法

原因　下次之三方廉,如過多位,計算較繁,余於民元研究得一捷法,茲特錄出,乞教明達.

捷法

上次之 { 三長廉面 (A); 一隅面 (B); 三方廉面,三長廉面,一隅面和 (C); 一隅面 (B) } 之總,再乘以 100

即爲下次之三方廉,(D)

即(A+B+C+B)×100=D

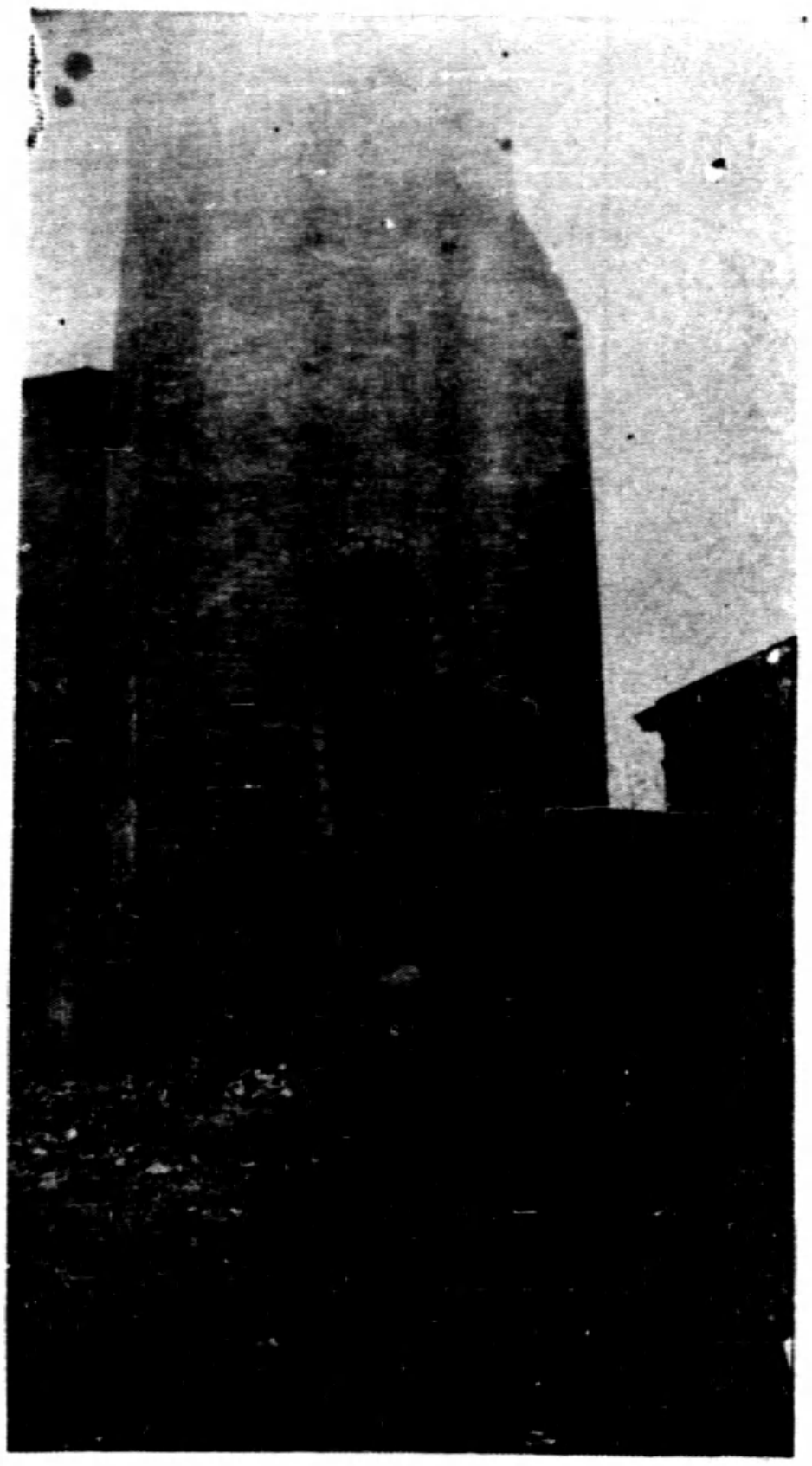
劉增冕識於山東建設廳

民19.6.3.

$$\sqrt[3]{40.000,000,000}\,(3.416\cdots\cdots$$

$3^3=$	27		
$30^2\times3=$	2700		13000
$30\times3\times4=$	360	(A)	
$4^2=$	16	(B)	
$4\times$	3076	(C)	
			12304
	16	(B)	696000
$340^2\times3=$	346800	(D)	
$340\times3\times1=$	1020	(A)	
$1^2=$	1	(B)	
$1\times$	347821	(C)	
			347821
	1	(B)	348179000
$3410^2\times3=$	34884300	(D)	
$3410\times3\times9=$	92070		
$9^2=$	81		
$9\times$	34976451		314788059
			23390941

(一)



(二)

美國沃海沃省漢明屯(Hamilton, Ohio, U. S. A.)市政局發電廠,近拆毀磚烟突二座,卽於其底下挖空,令其自倒.圖(一)爲第一座傾倒時現象.圖(二)爲挖鑿第二座時情形.挖時先於欲其向之傾倒之一方,開鑿一孔,然後向兩旁挖掘,兩人各用冷氣鑿一具,各在一方.挖空部分,豎立小木條數根,藉以表測烟突欹側程度.挖至越過中線數寸乃至一尺時,烟突卽自倒落.第一座高165呎倒時先傾側,次折斷如圖(二)所示.第二座高150呎,倒時則完全向下崩潰.

拆此二座烟突時,挖空處未用支柱,至傾倒時,工人始急速逃避.如挖掘時且掘且加支柱,至扡空强半後,將支柱用火焚毀,或在遠處用繩洩倒支柱,令烟突倒落,工人得以從容走避,則遠較安全也.

十八,十二,十二陳宗漢記.

美洲分會附刊

第一期

中國工程學會美洲分會編輯出版委員會編輯

委員會主席　顧毓琇

書記　黃輝

目錄

引言……顧毓琇……547

Modern Developments in Railway Signaling……張錫蕃……548

中華民國廣播無線電網之重要建設（附工程經濟計劃）……楊樹仁……554

本會發軔於美洲,後遂移植於本國.有此緣源,故現下該處雖屬分會,而一種蓬勃之氣,仍不衰弱,實爲各分會之冠.該會顧君,去年在滬時,曾以專闢一欄見商,本刊自極歡迎,惟以篇輻太多,祇可分期登出,不必限於某期.又凡事倡議易,持久難,深望該會能將佳稿,陸續見賜,則無任感荷矣.

周厚坤誌

引言

美洲分會編輯出版委員會,今年起決定出版刊物,實是了幾年來未償之宿願.分會方面早就感到需要一個『自己的園地』來耕種,國內方面也久已殷切的希望美洲方面——中國工程學會發祥地——能不時給點新的Information,刊物,到現在方應運而出,實在已經延遲了.

因爲分會方面經濟不大充裕,刊物只得暫時『借地造屋』.在總會『工程』上附一欄,由分會編輯稿件.這個『借地造屋』辦法,承蒙總會編輯委員會周厚坤先生答應,並給我們很多鼓勵,十分覺得感激.

其次委員會要感謝這次投稿諸君,並且希望會員指教.

MODERN DEVELOPMENTS IN RAILWAY SIGNALING

By S. V. Chang (張錫蕃)

Introduction

In technical sense railway signaling means the art of regulating and controlling railway traffic by means of signals. The first problem confronted by the railroad was not one involving train rights or train interference. It was mainly a problem of mechanical design, motive power, rolling stock and tracks. Train rights were introduced when there was more than one train on a division of road at the same time. As soon as the number of trains increased and also did the length of runs, the train schedule, which gave each train definite rights, became inadequate. Now the Morse telegraph which led the way to the telegraph train dispatching system gave the answer. Train orders were used, which were in reality telegrams copied on prescribed forms and delivered to the parties concerned. This enabled the centralized control of traffic by a dispatcher to a certain degree. By this method the dispatcher could nullify the train schedule, or he could establish new temporary schedules. Trains classified by right by class and right by direction has lessened the work of the dispatcher, by enabling the train crews to dispatch themselves to a great extent. Then the dispatching trains by signal indication as used in automatic block signal system and interlocking plants has given a new era in modern railway signaling. These systems have greatly the safety of operation in that it checks the dispatching and protects against other hazards which are not detected by any other expedient.

Signaling is primarily divided into two main classes, namely, interlocking and block signaling. Interlocking is of English origin, the first interlocking was made in England in 1859, it was applied to the stirrup frame. The first patents of interlocking plants for manually operated devices were granted between 1856 and 1867. The first installation in America was made

in 1874. The first electric interlocking plant embodying the dynamic indication was installed in 1901. The early history of block signaling runs about the same as interlocking as it was a development of the English practice and was first used in England in 1842. In 1863 it was first employed near Philadelphia in America. Wire circuit automatic block signals were installed in New England in 1871. Closed track circuit was invented by William Robinson in 1872 and was first introduced into actual practice in 1879. Not until 1882 the first successful use of directing train movements by signal indication was installed at Louisville, Kentucky. In 1907 this method of operation, following an installation made on a single-track line with track circuits for controlling the manually operated signals, fully gave the efficiency and reliability as a means for directing train movements without train orders. Now the field of signaling is not limited wholly to the use of signals for conveying informations to trains, for the signal scope has been enlarged in recent years to cover the protection with signals of roadway traffic at highway grade crossing, the interconnecting of signals with dispatching systems, the development and installation of automatic train stop and train control devices, and the application of car retarder system.

Modern Developments

As previously stated the most remarkable developments in recent years in railway signaling are remote control of power swithes and signals or centralized traffic control by the dispatching system, the automatic train stop and automatic train control, and the car retarder system or the power operation and control at classification yards.

The dispatching system provides an economical means whereby signals are made use of, not only to protect and space traffic, but also to dispatch traffic. Operating costs are greatly reduced by reducing delay, by dispensing with intermediary operators, by reducing the number of stops. De-

lays are so reduced by eliminating two out of three stops when trains take siding, by making closer meets and passes due to flexibility of system. In this new system, the signals and switches of a division are operated and controlled from a certral plant by a dispatcher solely by the use of electrically operated signaling devices and without the aid of operators. The dispatcher directs the movements of trains by operating the signals whose indications authorize the movement. By direct operation of the switches as well as signals, the train dispatcher also sets up the route as required.

The dispatcher seated at his desk which is in front of and attached to the control machine. He directs and arranges all meets and passes, and in fact all operations and movements of trains over his territory by merely operating small levers which control the switches and signals. On the control board locates the track model, light indicators, control levers and key switches. The track model serves for the purpose to visualize the road which the dispatcher controls. The dispatcher is kept in constant contact with trains by an ingenious automatic indicating and "OSing" system. A typical installation of which showed that 70 per cent of all meets in a 40-mile section are being made without either train stopping, and that equipment failures, such as broken draw bars and couplers, have been reduced 72 per cent. Furthermore the tonnage per train has been increased from 5,700 to 6,900 tons or 20 per cent.

One of the most important advantages of train control, as reported by the operating officers and enginemen, is the benefit of the cab signal which brings the way side indication into the locomotive cab. The first permanent automatic train control was placed in actual service in 1914. The object of

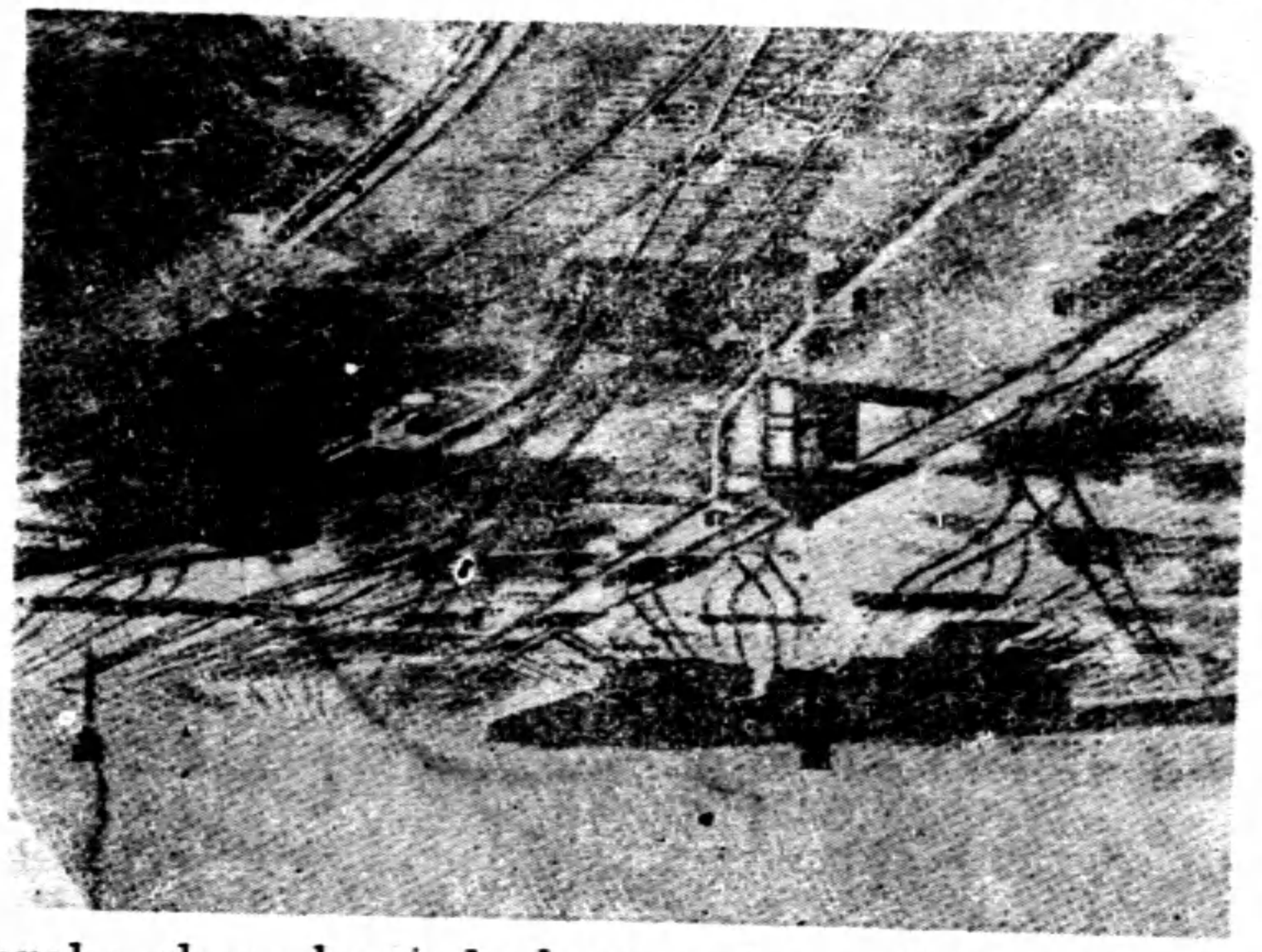
the system is to enforce safe train speeds by imposing maximum, tapered and low speed limits which are continuously responsive to traffic and track conditions. Under normal operating conditions in a clear block, a green light in the cab indicator is lighted. In case a signal is at stop indication, this cabsignal indication changes from green to red when the engine reaches the braking dstiance from the stop signal. In order to prevent an automatic application of the brakes, it is necessary for the engineman to operate the acknowledging lever and start a manual reduction of brake pipe pressure sufficient to apply the brakes and reduce speed below a low speed limit. If the engineman should be incapacitated, or for any other reason should fail to take action to acknowledge and apply the brakes after the change from green to red in cab indication, then the brakes are applied by an automatic train control device and the train being stopped.

In the continuous train control system receiving coils are mounted on the locomotive just ahead of the leading pair of wheels. Its function is to provide the means to receive alternating current energy from the rails for energizing the train stop equipment, thus controlling its performances. In transmitting the energy from the rails to the locomotive equipment the principle of induction is used. The action between the rails and the receiver acts as a transformer, in which the rails act as the primary and the coil windings as the secondary. The energy induced in the receiver is amplified and then passed through the master transformer to operate the master relay.

The total track mileage installed with train control in America as to Dec. 1928 amounts to 19,728 miles and the locomotives equipped to 7,297.

The invention and introduction of the car retarder have been made by George Hannaner and E.M. Wilcox in 1924. When railroading was in its infancy, freight was simply handled from one point to another by being picked up by one freight train and set off by the same or another freight train. Then the classification yard has become a very important link in this chain

of transportation. In this system hump and gravity yards were built where gravity did the work formerly done by the switch engine. In years past, the time gained in running cars faster over the road was often lost in the receiving yard due to slow and inadequate methods of classification. And now we have the power operated switch where one operator taking the place of a number of switchman and the car retarder where a few operators taking the place of a large number of car riders.



The car retarder itself is, in effect, a car brake, and at its location, performs the same function. It is an arrangement of brake shoes located along and parallel to the track rails, which shoes are forced against the inside and outside of the car wheels by electric energy or compressed air through levers. The retarder, as its name implies, reduces the speed of the car and the effect of which one the car is the same as if either the hand brake or the air brake had been applied.

The classification yard is made to use in parallel with receiving yard and departure yard. The hump engine pushes the train over the hump and is broken up and classified. This movement is controlled by signal indications. With the retarder system switching lists are prepared by the conductor when his train pulls into the receiving yard. With the switching list in front of the operator it is easy for him to direct each car into its proper track, and by means of retarders, to control its speed so that it couples to the cars already on that track as just the proper speed—that is, a speed to insure the coupling being made, but a speed not great enough to cause damage to either car or lading. The chief advantage for adopting the retarder system in classification yard is no doubt the decreasing the cost of yard operation by eliminating car riders and switchmen. Other inherent advantages for this system are reduced delays in the yard and more even spacing

of departing trains. More than 17 yards had been equipped with retarders prior to 1929, and several further installations are just under way.

Economics of Modern Signaling

The economic advantages of modern signaling by directing the train movements by signal indication can be summarized as follows:—

(1) Delays are reduced.—By signal indication instead of train orders in directing the train movements, slow-downs or stops for orders are eliminated and trains are kept moving.

(2) Track capacity is increased.—The track capacity is increased when delays are reduced and trains are kept moving. When track capacity of single track line is increased, double-tracking (often prohibitive in cost) can be postponed.

(3) Safety is increased.—Train operation by signal indication provides many facilities that reduce the operating hazards to a great extent.

(4) The costs for operating freight trains are reduced. Operating costs are reduced when delays are reduced. It has been shown that the time lost in making meets under time-tables, train orders and manual block system is 20.3 minutes, while the time lost in making meets under train operation by signal indication is 11.15 minutes. So the saving in time is 9.15 for each meet, that is, about 45% saved of lost time. In a particular installation the freight train speed before the directing trains under signal indication is 13.35 M.P.H., and after that it has been increased to 16.52 M.P.H. For this same case the total cost of installation includes engine and wayside equipment for train control and revision of interlocking is $2,329,227. The total annual saving made possible by this installation is $367,943. Now we subtract an amount of 139,753 dollars for interest on cost of installation at 6% from the total annual saving we get the net annual saving of $228,190.

In conclusion, it has been best known that in addition to the increased safety of train operating, the modern railway signaling makes it possible to reduce or eliminate the written train orders, lengthen the maintainer's sections, reduce the capital investment charges and provide a more efficient and reliable train control system.

中華民國全國廣播無線電網之重要建設

(附工程及經濟計劃)

著者: 楊樹仁

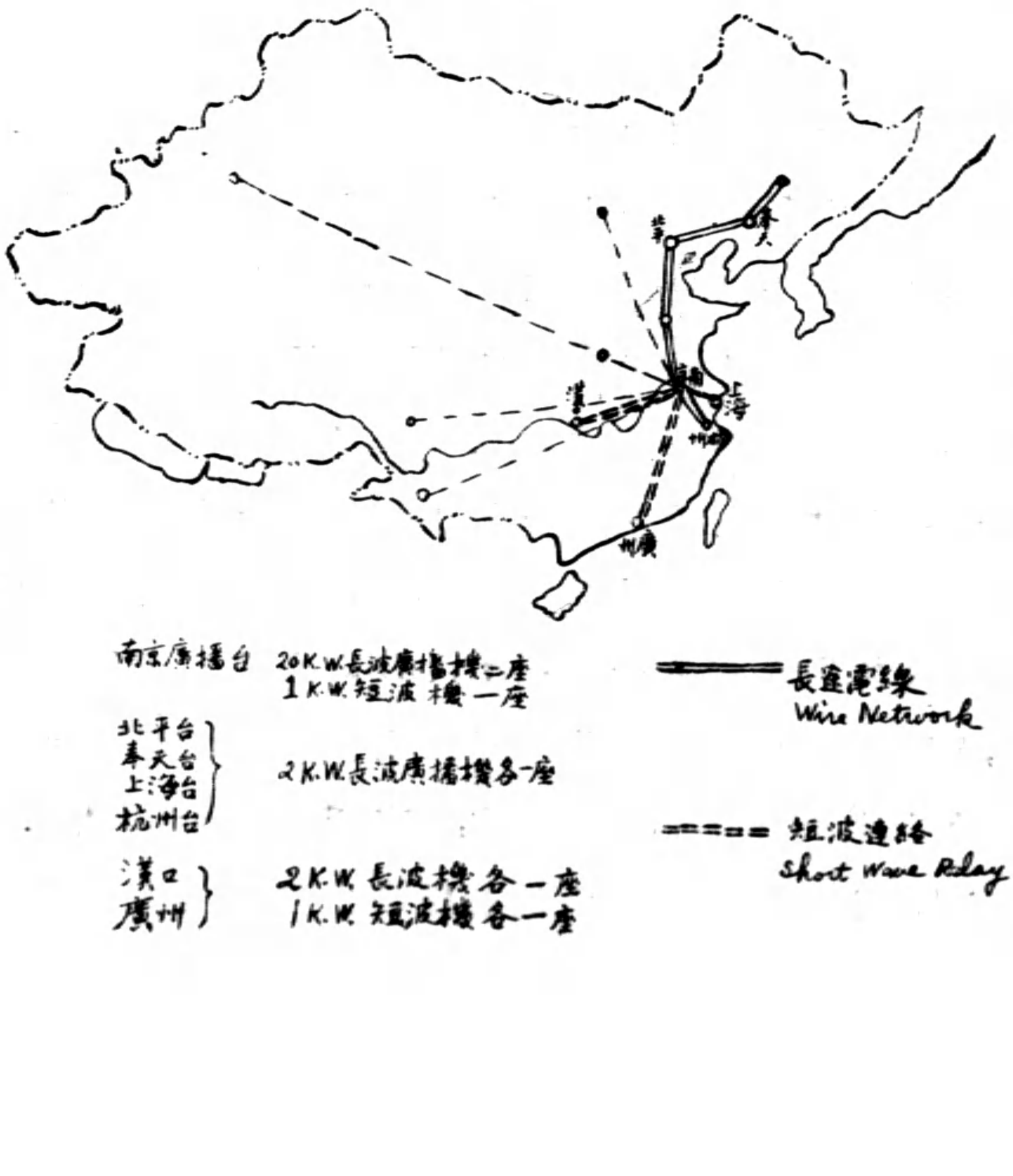
無線電爲二十世紀之運幸兒.歐戰時,無線電訊,初次大出風頭.歐戰停止後,國際商業競爭,無線電訊更有成効.一九一九年,巴黎和會開議之際,美國大總統威爾遜氏,深慮遠謀,目睹英倫早執世界海線電訊之牛耳,乃移目光注重無線電之發展.專商美國奇異公司,威司丁電機公司,及波士頓合衆鮮菓公司,互相籌資合作,促成美國合組無線電公司簡稱(RCA)之成立.十年苦心經營,發展國內無線電各種事業,並與歐洲各國,南美,中美,日本,及南洋羣島互通國際電訊,使紐約造成爲國際無線電網之中心點.又日本政府,重視無線電已久,在一九二二年底,日本政府交通部向美國購辦長波收報機全副,訂約與RCA公司互通商報.不幸半年後,即有東京及橫濱之大地震,繼以火災,有線電訊,毀殘殆盡,幸賴無線電台,得國內之急救,並即電告美國,轉知各處,引起各國之同情.無線電,對於吾國去年北伐軍事進行,亦極有成績.龍潭戰事及去年五三濟南慘案,其効用之最著者也.

無線電事業,就其應用之不同,可分爲四類:(一)國際無線電訊,(二)國內無線電訊,(三)海岸船舶無線電訊,及(四)國內廣播無線電網.吾國國際無線電訊,倡議甚早,迄未實現.北京腐敗政府,利用電訊借欵,爲發財之機會,引起英日美列强之越俎代謀.日本三井公司,在雙橋代造大電台,毫無成績可言,野心有餘,而力不足.當一九二二年間,美國加省電報公司與合組無線電公司協作,向中國建議,在上海設立國際大電台,同時上海,北平,廣州,及哈爾濱,各設較小電台一座,由美商包辦出資代造,並享長期代管之利.美國之獨專計劃,爲英國日本政府所反對,外交之抗議,使美商之進行,毫無結果.國民政府成立以來,注重無線電之建設,爲保障主權起見,出資向合組公司訂購

大電台二座,可與歐美二洲,直接通報.並向德國購小電台四座,分佈於上海漢口,廣州及天津,專作國內通報.將於上海北郊,興造電台,大無線電機,由美運滬,靜待裝置.明夏倘能成立通報,正當一九三〇年,大東,大北海線電訊合同,重行簽訂之時,吾國恃大無線電台作爲後盾,有恃無恐,必使不平等之條件,無存在之餘地也.遼甯省政府,因軍事上之關係,向德購大電台,早與柏林通報矣.但國內西南諸省,重山峻嶺,有線電網,設備不全,電報通訊,十分困難,又轉電手續欠佳,時有延遲之弊.上海往四川之電報,因各種關係,或較郵寄快信爲遲,此係過去之事.自國府交通部及建委會之努力建設,造成國內短波電訊網,成績極佳.上海往四川之商電,數時內卽有回音.又上海拍往雲南之電報,在昔每字須洋一元.(經法國水線轉)現每字降至一角,亦足稱快也.海岸船舶無線電訊,交通部提倡甚力.如招商局等航海商輪,均有長短波無線電機之裝設,使海上生命之安全,多一保障也.

吾國自辦之廣播無線電台,成立於大城市者,已有年,而廣播無線電網之重大建設,無人注意,尙須鼓吹,以促其實現.所謂廣播無線電者,乃一地發出電波,而四隣收受也.在理論方面,其周圍之收音者,並無限數.但事實上,有天時地形之種種關係.中等電力之廣播台,在距離千里以外,卽難得可靠及滿意之收音也.當暑期以內,北平廣播電台,播送京劇,(例如梅蘭芳之六月雪)住在上海之熱心收音者,不易收得良好之結果也.全國廣播無線電網建設之目的,乃使優美之節目,由南京,上海,杭州,北平,天津,漢口,廣州,等電台,同時一致廣播,凡重要之新聞,科學之演講,及北平京調,廣州粵曲,上海之崑腔等節目,一瞬間,駕臨國內數十萬之家庭,及萬百之聽衆,亦非難事也.廣播無線電,爲美國所發明.威司丁公司所首創.第一廣播台,(KDKA)設在美國之東畢城,於一九二一年夏,作廣播之試驗.半年後,從事正式之廣播,大受各界之歡迎,爭起興造廣播台於各地.未滿二年,全美境內,設有四百五十電台.現有五百八十八台,(一九二九年)從事廣播也.至於吾國境內,最先美人某氏,在

上海永安公司屋頂,設立廣播電台,電力極小,嗣受當局之干涉即停止.但一九二三年後,美商開洛公司上海分店,除電話機外,兼售無線電料,爲推廣生意起見,在徐家匯附近,築造一百瓦特電力之廣播台,(現已增大五倍)每日廣播滬市商情,蘇灘,及唱片等.滬上人士,好奇心生,爭買收音機,作家庭之娛樂品,滬蘇甬商家,亦惠顧甚衆.在一九二五年春,收音機之生意爲最盛.嗣後無線電熱,向北流行於華北區域.北平及天津早辦廣播台.北平電台並得京戲院主之合作,廣播好戲之節目,頗博聽衆之歡迎.東北方面,哈爾濱已向美商購機,設立一千瓦特之廣播台.因其地勢優異,頗少天電阻擾,且隣近日本之大阪,名古屋等廣播台,故無線電之風行東北,理所當然也.民國十七年,南京中央廣播電台,及杭州廣播電台,相繼成立.去年夏季,中央派人在北平,開封,漢口,長沙,南昌,等處,作收音之試驗.但南京電力不大,數千里以外,即難獲滿意之結果.廣州,南昌,及西安,聞亦有設立廣播台之議,不久亦可實用也.



吾國各地廣播電台,相繼設立,有如雨後春筍之怒發,乃極好現象.惟各台經費,未能十分充裕.以供給良好之節目.北地電台,時有拿手之節目,頗難接近長江流域之聽衆.南方亦有優美之節目,只限於百里以內之收音者.各廣播台不相協助互勵,僅恃唱片之廣

播,壽星唱曲,乏味之至,長此以往,聽衆易生厭惡之心理,而無線電營業,將有失敗之危機.欲救此弊,必連絡各方廣播台,互相合作,以完成全國之廣播無線電網?茲將其計劃略述於下:

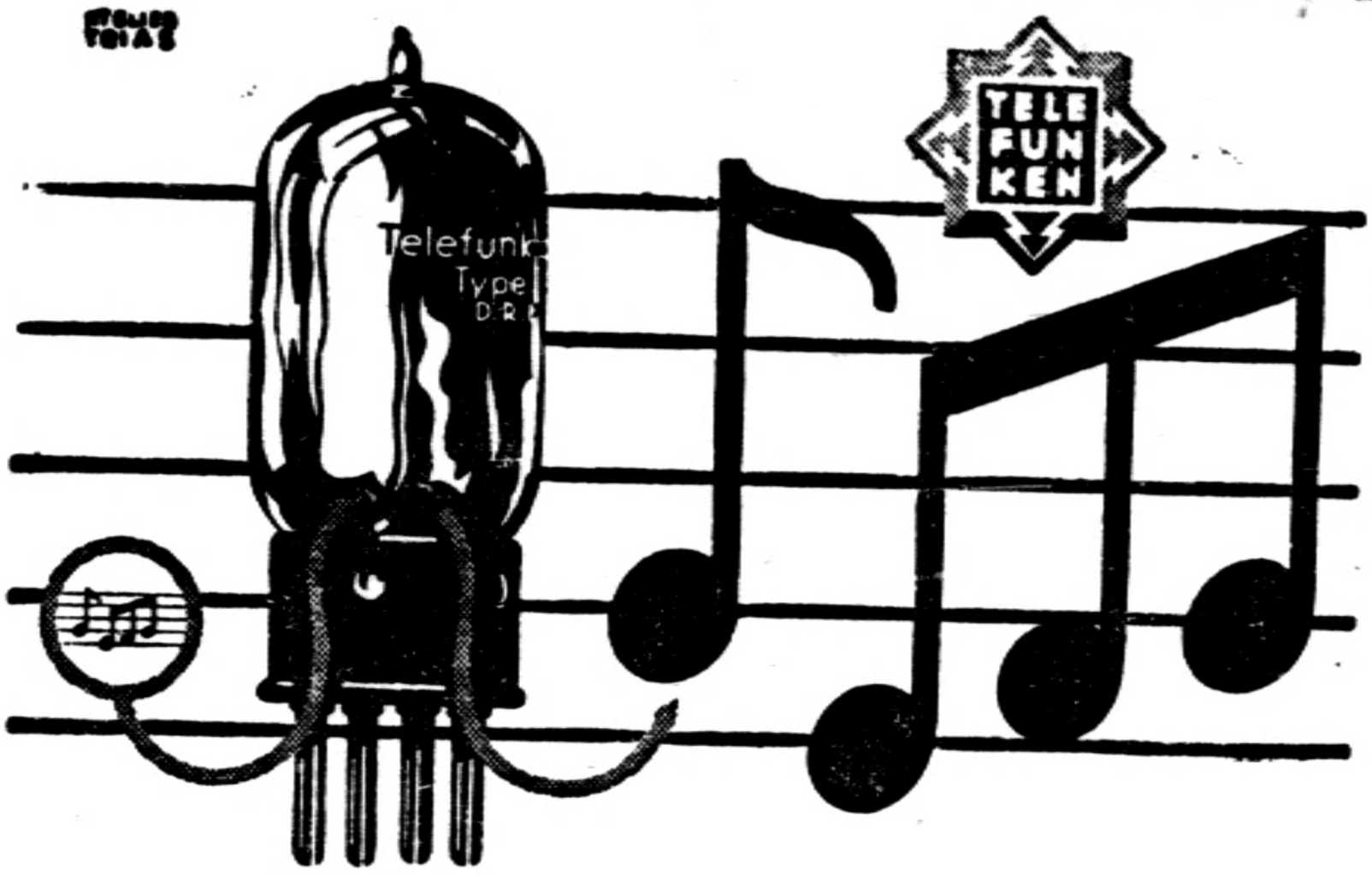
例以南京電台,爲廣播網之中心點,其電力可增大二十倍.擇適當地段,建立中心電台,計有 20 K.W. 長波廣播機二座,(其一爲備用權)及 1 K.W. 短波廣播機一座,播音室仍在舊址,利用電話線,與電台相通連,同時以長途電線,接通上海之播音室,及杭州之播音室.滬甯間,早通長途電話,倘得電話局之合作,增添電線一對,每晚四小時間,專作滬甯互通廣播節目之用,餘時仍開放商用.甯杭長途電線,亦仿此辦理.(參觀附圖)南京,北平之間,亦可沿津浦線,增設長途電線.北平往奉天,早有平奉電話線之建設.漢口與廣州二地,擬造 2 K.W. 廣播台,及 1 K.W. 短波廣播台各一座,其發電台及播音台亦由電話線相接連.第一步計劃,南京台賴長途電線之連絡,使北平,上海及杭州台之好節目,可傳送至南京播音室,並由短波無線電之收受,漢口台及廣州台之廣播節目,亦可採爲南京電台之播音資料.南京之節目,利用二種不同之波長.(假定爲 380-Meter 及 33-Meter) 同時廣播於四方.北平播音台之京劇,既賴長途線,與南京台同時廣播,廣州方面,恐不能直接收受北平台之電波,但可收得南京大電台之 380-Meter 電波,或 33-Meter 之短波.廣州台收到北平節目,即由其電台轉播,則羊城之居民,僅用鑛石收音機,亦可享受京劇之權利也.反之,廣州既有長短波電台各一座,(假定爲 350-Meter 及 45-Meter 二種)亦可同時播送極好之節目.南京台收得之後,再由其大電台轉播送,而福州或南昌等處之收音者,可於四種不同之波長,擇選其一而收受之.或當地有小播音台,(100 Watt)亦再轉播,使近郊之居民,雖用簡易之收音機,可聽受千里外之音樂.南京台除轉播外,並將收得之廣州節目,由長途電線傳達至北平,或奉天電台轉播,使塞外客商,東北農民,亦可聆嶺南飛來之歌曲也.

第二步,增 1 K.W. 廣播電台於各大城,如安慶,南昌,長沙,福州,汕頭,梧州,

南甯,雲南,貴陽,常德,重慶,成都,襄陽,宜昌,迪化,蘭州,甯夏,西安,鄭州,太原,綏遠,熱河,德州,濟南,青島及徐州等處,並附有上等之短波收音機以便收受南京及廣州等節目,作廣播之材料.倘若中央有重要之宣傳,或政府之緊急佈告,由此種廣播網之利器,以傳達於各地之民衆,對於意志之統一,及文化之宣傳,無線電有極大供獻也.或謂各地人民,生活十分艱難,無力購備收音機者甚多,此困難亦可設法解決,卽增添公共收音機,於茶館,浴室,飯店,旅社,及學校醫院等處,使無線電成爲民衆之娛樂.各地廣播台之電力漸漸增大,使普通之收音機,亦可應用滿意,而國內無線電製造事業,同時進行大量生產制,(Mass-Production) 使價廉物美之收音機,易於銷售也.吾國內地,因數千年內之交通不便,造成各省不同之方語,言語之異歧,易生漠視之心理.例如今歲陝西省旱災之重大,遠地各省頗難引起同情之救助.倘有廣播網之設立,政府卽採用標準之方言,作爲統一國語之宣傳,並促進中華民族之團結,務使『秦人視越人之肥瘠』之地方主義,根本剷除也.又吾國未實行强迫教育,以致不識字之人民,占大多數,廣播電台,兼作普及教育之演講,及時事之報告,所以補助平民教育之不足也.

廣播網之建設,最初須政府之資助,有欵十萬元,從事進行.至於廣播台之經常費,其籌謀,有間接法及直接法之不同.由政府抽收無線電收音機之特稅,作爲電台之經常費,英國政府廣播電台,及菲列濱羣島之廣播台等,均採用此種間接法.又美國商辦廣播台,在節目內,雜和廣告之宣傳,以得相當報酬費.若日本及德國政府,則直接向聽衆,抽取收音之照會捐,以供給政府所辦之廣播台,此種辦法,似大麻煩,與吾國情形不相宜.可仿英國之方法,由政府設立廣播局,(Broadcasting Bureau)得財政部之許可,由海關增收無線電收音機進口稅一成,或無線電材料進口稅半成.此種特稅,專用於廣播網之建設,及維持,卽可從事工作,使南京,北平,廣州等七大電台,利用長途電線及短波轉電制,(Relay System) 以完全國廣播網之初步,供給優美音樂之節目,及報告確實之新聞.爲廣播之持久政策,易得民衆之歡迎,逐漸推廣,使第二步計劃,亦有實現之希望.又音樂對於國民之生活,頗有重大關係.國樂之廣播,亦宜提倡,務使民衆賞聆音樂,成爲普及之嗜好也.

TELEFUNKEN



全世界的無線電波皆可用

得力風根眞空管

收音或放音

對於每一種用途總有一只最適宜的

得力風根眞空管

總經理——中國西門子電機廠

上海 天津 北平 奉天 哈爾濱 漢口 廣州 香港 重慶

上海顧客請向下列各電料行接洽

明遠亮記電料行	湖北路
鴻康電料行	南京路拋球場
大中華電器行	南京路日升樓
永安公司電器部	南京路
新新公司無線電部	南京路
大華科學儀器公司	博物院路
中華三極銳電公司	霞飛路福開森路

請聲明由中國工程學會「工程」介紹