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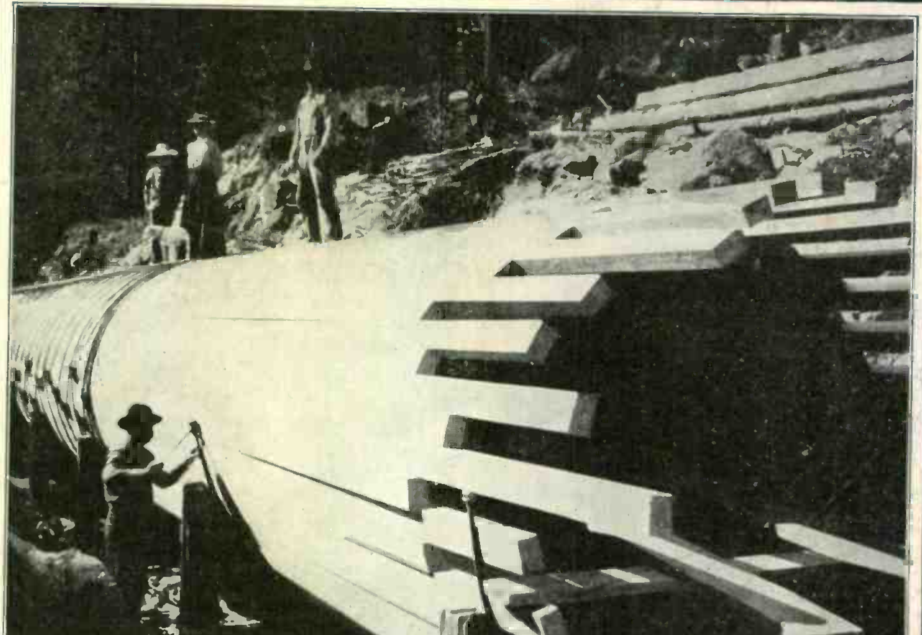

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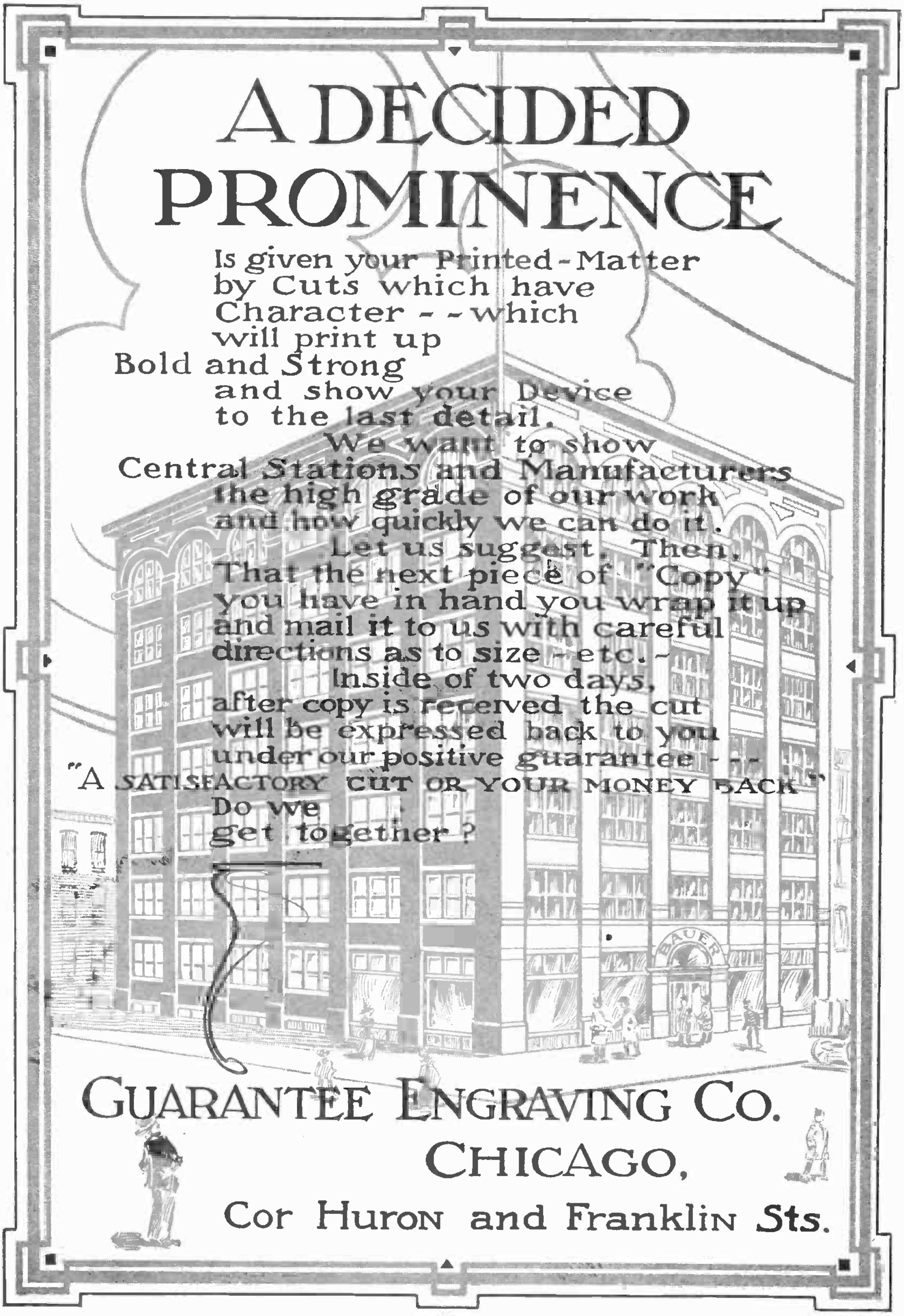
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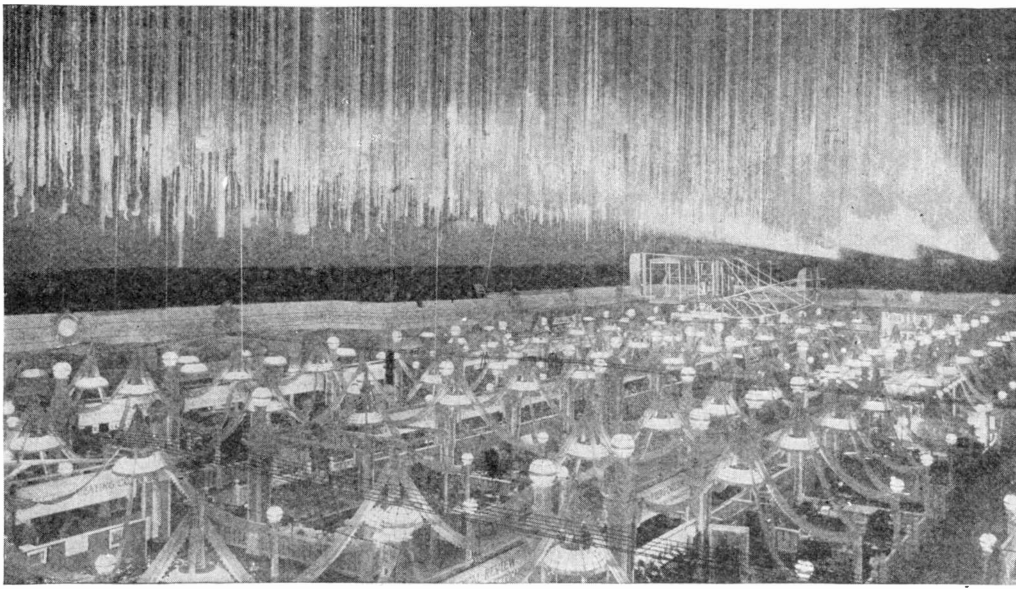

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IN PLAIN ENGLISH

HENRY WALTER YOUNG, Editor

Vol. III — May, 1910 — No. 1

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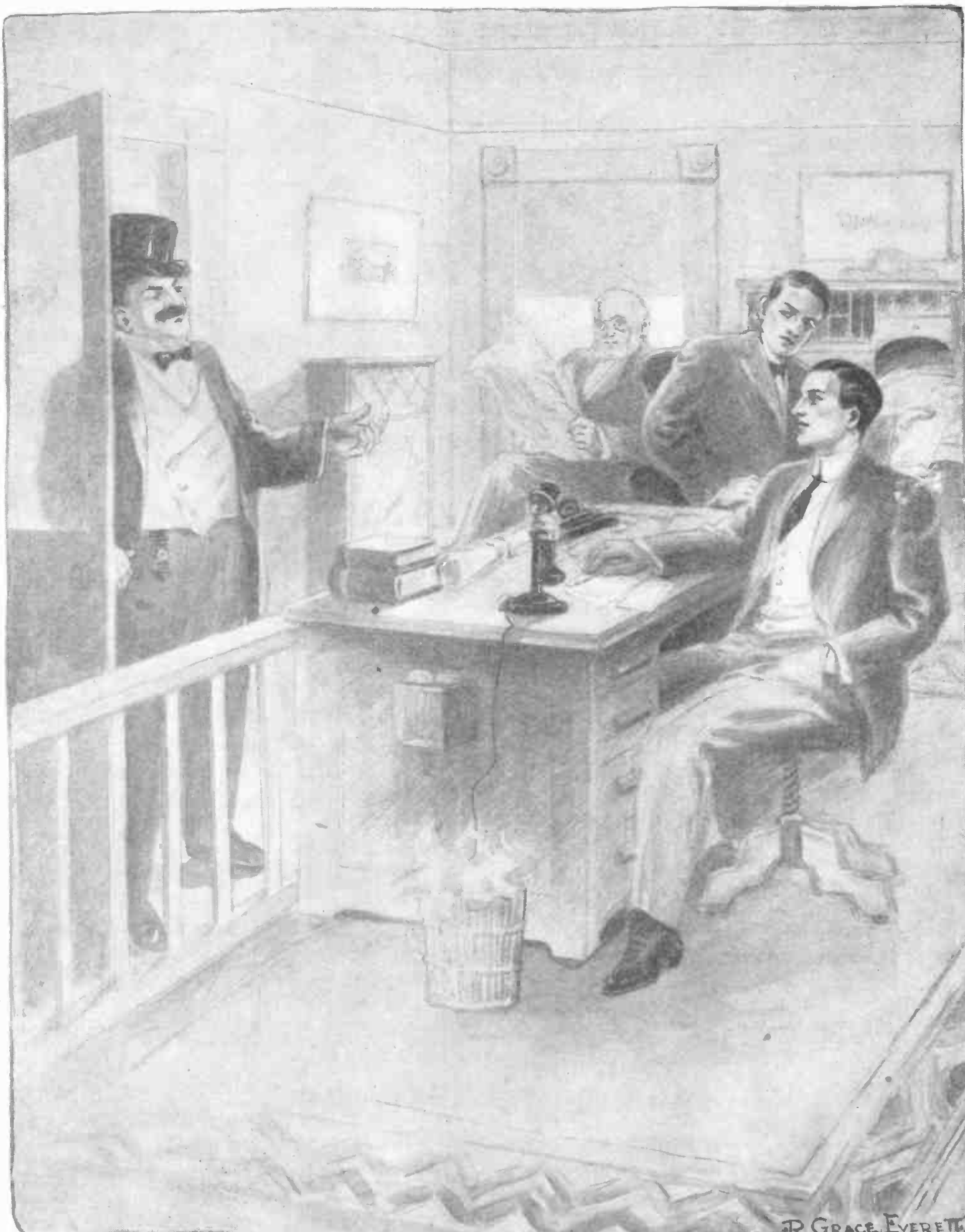


BOWERS FAVORED THEM WITH AN EXPANSIVE, REDDISH-MOTTLED SMILE

See page 3

POPULAR ELECTRICITY
IN PLAIN ENGLISH

VOL. III MAY 1910 No. 1

Current From—Where?

BY EDGAR FRANKLIN

CHAPTER I.

AN OBSTACLE OR TWO

The powerful little second-hand runabout grazed the curb and stopped; and Race, having delivered a last torrent of under-breath profanity at the world in general, turned toward the one-story brick office.

And his evil humor departed suddenly, as his eye caught the chaste brass tablet beside the door—Race actually grinned!

It was a pleasant thing to look upon, that tablet. "Bronton Electric Light & Power Company" stood forth in the unostentatious dignity of small, square black letters. It was a conservative, impressive sign—and very, very new and shiny.

"Bronton Electric Light & Power Company!" Bustling little Bronton had attained her place as a city; her first mayor was in his second year of office; and now she was to put away the gasoline and oil lamps of her earlier days. and shimmer with electric light!

Somehow the notion struck Race more forcefully than usual this morning. He stopped on the upper step and looked around, and he thought of the Bronton of eleven years back, when Dunbar's people had first located there and he had come to visit studious Bill Dunbar.

Where Main Street had been little better than a dirt road then, she boasted asphalt now; across the way, where the big granite bank stood now, had been a little ramshackle home, with two huge maples; on the other corner, Jenkins' store, with its wonderful maze of shovels and forks and wheel-barrows strung outside, had been replaced by Berg's three stories of department store and—incidentally, there was Berg, staring over at the Bronton Electric office, as if to ask just when the arc lights would be put on his fixtures and the current turned on!

Race came out of the dreamy past with something of a bump and turned abruptly to the office door. The smile had vanished in a flash, and his face was angry as he entered.

At one of the desks sat Dunbar, big, keen-eyed, sharp-faced—a man, like Race, in the early thirties—with a mass of blue-prints spread before him. At the other, Mr. Carey, Dunbar's wealthy uncle, was dozing comfortably over his paper.

Together, they looked up as Mr. Race landed in his own chair with a thud.

He glanced at his mail and left it untouched; he whirled his chair around and shot at them:

"Gentlemen!"

"Er——what?" Dunbar had almost lost himself in the plans again.

"As president, business manager and private detective of this company," rasped Race, "I have to report a fire at our eternally uncompleted central station!"

"*What?*" Dunbar came out of the land of blue-prints with a rush. "Another one?"

"Maybe it's the same one!" the president snapped. "It's only two days since the last!"

"But, my dear Robert," protested Carey, "how on earth——"

"I don't know how—I don't pretend to know how!" said Race, rather violently. "I know just this: if we're ever going to build that generating plant, we'll have to abandon that wooden shack, build a solid concrete power-house—and then hire a fire-engine to go around and around it at a slow trot, day and night!"

Race snorted. Carey folded his paper and frowned a little.

"What was the trouble this time, Robert?"

"Bunch of shavings—incidentally, soaked with kerosene—caught fire outside the north wall. Ryan found it just as the clapboards were getting a good start, early this morning. If we hadn't had him there for night-watchman the whole place would have been gone! And that's the third fire in a month!"

"But who——" Dunbar began.

"Some relic of the War of 1812, who doesn't approve of modern methods, I guess!" Race grunted.

He sat back, gnawing his lip. Mr. Carey cleared his throat.

"I don't know, boys," he said thoughtfully. "Somehow, it seems to me that this whole concern has been mismanaged from the start! The——"

"Why? In not building the plant first?" Race asked, rapidly. "I don't see it! Look here! When Bill, here, suggested that there would be a lot of money in an electric plant in this place, I threw up the job in Chicago, drew the savings of ten fat years out of the bank, cashed in my lonely five-thousand-dollar mortgage, and came here with the roll. Therefore I didn't come purely for love. See? I came for business—came here to do the *business* end of it myself, for Bill hasn't enough business head to buy cigars without being trimmed!"

Dunbar smiled a little at his life-long chum; that last statement was near to the truth.

"I may not be able to connect up a telephone without calling out the police and the fire department to help," pursued Mr. Race, whose capable tongue was well under way, "but I was able to walk in and get the charter for this company with two men already on the ground—and it didn't cost me two hundred dollars, all told, either!" he chuckled. "Why that blamed charter's so broad that literally all we're bound to do is to leave the town where it stands and be ready to sell it electricity before midnight, June thirtieth!"

"And just that June thir——" Mr. Carey interposed.

"We're getting well along into May now—I know it," the president admitted. "But that brings us to the point! Have I done good or bad business in letting the actual plant-building slide for the sake of hustling the distribution end of the thing? We've got our poles up and our lines and transformers and everything else on them before anyone could raise a rumpus! Not that anyone wants to—the whole town's too crazy for its light—but there are soreheads lingering around from the crowd that *didn't* get the franchise. If they'd managed to stir up a few property owners and get injunctions about planting poles, and so on—well, you know what an injunction is, Mr. Carey."

"You and William have done wonderfully quick work with the few good men you were able to get," conceded Mr. Carey.

"And now—good Lord!" laughed Race. "The interior wiring—fixtures—everything's ready, in the houses and stores and streets. Gentlemen, we have stirred this Western town into something about ten points livelier than New York! Now, with the building owned by you, Mr. Carey, and on your own land—we'll simply build our plant and——"

Dunbar had been silent. Now he looked up rather moodily.

"When we have something to build it with!" he said.

"You've got your boilers, Bill!" said Race cheerily.

"We're not calculating on furnishing Bronton with steam heat," said the engineer. "How much damage did the fire do?"

"Not much—not as much as the one day before yesterday—not nearly so much as the first one, a month ago. It's all easily fixed. We'll be ready on time!"

"And Ryan had no idea how it started?"

"Not the least. He said there was no one around."

"One fire inside, when there was no watchman about. Two fires outside, since we've kept Ryan there at night!" Mr. Carey mused.

"And no fires henceforth!" Race directed his optimistic smile at the elder man. "Because I told Murton to stop waiting around the station for the arrival of the fragmentary engine-room equipment he's going to put together some day, do his sleeping in the day-time and patrol the outside of the station at night!"

Silence came, the sort of heavy silence that had taken to invading the office recently. Race turned to his mail and opened an envelope.

"Coal people," he observed. "Guess it's our contract at——"

"Did you stop at the freight office?" Dunbar asked, irrelevantly.

"Yes." The president turned from his mail.

"Any signs of our generators coming?"

"Yes! They're actually on the way and almost here!" Race cried, enthusiastically.

"They've been that for some time!" Carey observed dryly.

"Well, this time——" Race began—and stopped short. "Lord! Here comes Bowers for a social call!" he said, softly.

The trio turned toward the glass door. A figure was visible outside; indeed the figure would almost have been visible through a wooden door, for it was clad in a wide-striped suit and its burly owner wore one of the few silk hats in Bronton, cocked at a jaunty angle over one ear.

Such was the exterior of Mr. Bowers, the newest important arrival in Bronton. Where he came from, what he had been, nobody seemed anxious to determine. He was merely a rather crude citizen who had made some money somewhere in lumber and, settling in Bronton, had interested himself in local politics—to what end the future alone could reveal.

"Everybody's friend is going to honor us again!" said Dunbar, rather wearily, as he shoved back the plans with a sigh.

Mr. Bowers closed the door and favored them with an expansive, reddish-mottled smile.

"Howdy!" said Mr. Bowers, as he waved one hand at them in a general sweep of greeting and plumped comfortably into the big chair in the shaded corner. "Have a cigar, anybody?"

They declined. Bowers smiled as he crossed his legs and puffed for a minute or so; then his lips opened with a characteristic smack and:

"Y'know, I never saw this town in spring before! Them trees on Ridge Street are like a picture, aint they?"

"They're fine trees," Race agreed, without enthusiasm.

"Say, when the leaves are out full, they're goin' to hide them wires of yours fine!"

"That's good," agreed Dunbar, apathetically.

Mr. Bowers smoked on contentedly for a little.

"Well, how's the juice factory comin' on?" he inquired. "Pretty near ready to light us up?"

"We're doing nicely!" replied Race.

"All ready, hey?"

"Oh,—there are always a lot of finishing touches to be put on at the last moment, you know," smiled Dunbar.

"Great town, this here!" mused the visitor. "Biggest kind of future for us fellers that come in about now. This place is going to grow so fast when the new road runs through, over at the other side o' town that—say! they ain't ten miles away with their track-laying now! Why the dickens didn't you people build over there, instead o' down across the old tracks? That old Kane Junction-Bronton branch'll be so dead when the new road comes that the pyramids'll look like a moving picture show beside it!"

"Well, the land belonged to us, you see," Dunbar explained. "Then, there was a building on the spot which——"

Race, with a rather caustic glance at his partner, broke in abruptly on that gentleman's charming frankness.

"I say, Bowers!" he said, with a grin. "That mysterious factory you've been building over in the new part—pretty nearly done, isn't it?"

"Eh?" Bowers turned suddenly dubious.

"We haven't seen any crates carted through here for a month," Race pursued. "Got your machinery set up ready for business?"

"That's what I came over to see *you* about," said Mr. Bowers, gravely. "Sure! I'm ready for business, all right, when——"

"What are you going to make over there, anyway?" Race urged, jovially, for he had little desire to dwell on anything connected with their own particular affairs. "Come on! Let's have the secret now, Bowers!"

The other looked at him grimly.

"It'll be no secret, by the time I'm turning out goods," he said, angrily. "Process patent I bought—compound for combs, poker chips, and that sort o' thing. Keep it quiet, if you will, boys."

Mr. Bowers sat up and looked at them, earnestly and very sourly.

"And that's the main thing I came t' find out!" he announced. "How'm I going to run a factory—how are you—*now?*"

"*Now?*" echoed Dunbar.

Bowers stared at him.

"Aint you trying to contract for coal with the Stelton people?" he asked.

"Of course. We can't buy from anyone else out here."

"Well, aint you heard from 'em, this morning's mail?"

Race regarded him for a moment; then he turned swiftly and snatched the letter from the envelope he had opened. Possibly twenty seconds were consumed in running over the two or three lines; then:

"*Holy Moses!*" gasped the president of the company.

"They won't sign *no* contract now, and if you want coal, you gotter pay *seven dollars a ton* for it—huh? Did they hand *you* that, too?"

Race licked his lips. He stared again at the typewritten note; then he faced Bowers.

"Yes!" he said, rather weakly. "They handed us that, too!"

CHAPTER II.

NAILED DOWN!

Half a minute, the trio sat almost agape, their gaze on Bowers. The visitor returned the stare, smiling ironically.

"What d'you know about that?" he inquired at last.

"Why, it's—it's idiocy!" Race gasped.

"It's worse'n that!"

"But—*seven dollars!* You can buy hard coal here cheaper than that from the little dealers!" Dunbar cried.

"Guess so—if you wanted it and could get enough," acquiesced the visitor.

"But—good Lord Almighty!" Race burst out. "This is nothing but a plain, old-fashioned hold-up! Here they'll sign no contract of any kind before the middle of August—they hint at some unholy figure then—and we can have what steam coal we want now for seven—bah!"

"Have you any idea of the cause?" Mr. Carey inquired mildly.

"I aint slept twenty-four hours every day," grunted Bowers. "I smelled this coming, and I've done what little investigating I could."

"And——"

"Well, it looks to me as if they thought this was a mushroom village, with a gold mine in the middle and a bunch of imbeciles around it! They've got us good; there's nobody else but Stelton to buy from; we're here to be milked good and proper—that's all."

"But they give reasons," Carey suggested.

"They'll give them in dozen lots! Have you tried to figger out what they mean, Race?"

"Well, they're not very definite, certainly."

"Why, they talk about—high-priced labor—increased difficulty in mining—coal moving slower and harder on the rails—impending strike almost certain—conditions are such that——and all that damned rot!" snorted Bowers. "I aint struck one yet that could be translated into English t' *mean* something!"

"Neither have I," admitted the president of the electric company. "I've had a hard job getting any kind of price from them, but—this!"

"Well, there are people enough in this town using soft coal and not paying seven dollars for it!" Carey announced flatly.

"Of course there are! They've got their contracts—anywhere from a year to five years!" said Bowers. "They're in soft, I suppose. That's all it amounts to. There's only four real factories here, and the whole four don't use half what you people and my plant can burn!"

For the moment, Race's chronic optimism seemed almost to have deserted him. His brow was wrinkled in a frown as he looked at Bowers again.

"It doesn't make so much difference to you," he began.

"It doesn't, hey?" The visitor snorted. "That little factory isn't all the money I've planted in this town! I've bought more acres of rough land, over by the new road, than you folks know anything about! That's going to be the factory center of Bronton, that is—and I expected to have a lot o' smoke whirling around there and be doing a regular land office business in factory sites by the end o' the year!"

"But you haven't anything you've got to deliver on the first minute of the first day of July!"

Painfully, as Race had been realizing more forcefully every day lately, the time limit on their charter was no secret. The infernal *Bronton Herald*, with its slogan of

"Light For The Fourth!" had, under Race's careful tutoring, absorbed more than his own enthusiasm over the impending reign of electricity; the date was anchored now in every brain in Bronton; postals and letters were coming in every mail from prospective consumers, begging that their actual lamps be put in place at once, to catch the first flare of the novelty.

A slow, rather compassionate smile came over Bowers' face, as he sat back and thrust his hands in his pockets.

"There's a whole lot in that, Race," he murmured. "All I have to do is to pay taxes and wait for sane coal. This dollar-a-pound rate aint going to last, no matter what anybody says. But I guess it'll last till August, anyway, and— you people have t' make good on the first o' July or quit altogether, hey?"

"Essentially!" said Race, between his teeth.

"Say! I'm sorry for you!" said Bowers. "A couple o' young fellers, with all their money sunk in a game like this. It don't matter to me. *I* got money. I aint tied down to any date! I——"

"Mr. Bowers!" said the president, and the words came with the effect of a machine gun. "This company is not insolvent. Neither will it fail to furnish the full five hundred kilowatt service it has planned; nor yet will that service be delayed ten seconds after midnight on the thirtieth of June!"

An instant, Mr. Bowers stared; then he burst into a boisterous laugh and slapped the silk hat back at its usual angle.

"Say, I wasn't rubbin' it in!" he cried. "I'm sorry for you—dead sorry! That's all. And—hey! Thunder! Is that clock right? Good bye!"

The door closed behind him, and a suppressed sigh of relief went up.

Carey, rather uncertainly, found his paper again. Dunbar stared at his desk and whistled softly. Race brought his chair round with a jerk and picked up an envelope; there was nothing in it that interested him particularly. He tried the next and the next and the next; nothing of importance was revealed.

Indeed, nothing under the sun could push aside that coal question! He stared savagely at his cherished bunch of clippings from the *Herald*—the little "Bronton Electric Company Incorporated"—the big, full-page article on "The Lighters of our City!" with its photographs of Dunbar and himself and a wood-cut of a glowing incandescent between them! His hands all but twitched to the point of tearing the whole bundle in two and hurling it into the waste-basket. And he was interrupted by:

"Were'n't you a bit hasty, Bob, in guaranteeing things in that wholesale fashion?"

Race grunted.

"Self-confidence is a mighty good thing," pursued Dunbar, "but——"

"Well, I couldn't make matters any *worse*, could I?" Race demanded wrathfully. "We might as well make a bluff at the thing and brass it out to the end, now!"

"But as a matter of fact, what *are* we going to do?"

Mr. Race bounded from his chair and took to walking the floor.

"We're going to have that plant running on time!" he cried. "I'm frank to say I don't know how, but—it'll be running."

Dunbar looked up from the figures he had been scratching on the back of an envelope.

"Bob," he said, very quietly, "we are practically bound to suppose that, for some unfathomable reason, we can't buy coal under seven dollars. When our plant is fully paid for, we haven't a surplus of more than four thousand dollars. Uncle Dick, here, is going to buy in enough stock to finance our first year's operating expenses, if necessary. We were reckoning approximately on thirty-five hundred tons of coal, bought under three dollars. This crazy increase in price adds just about *fourteen thousand dollars* to our expenses!"

"And I don't know that I'm quite prepared to finance that," murmured Mr. Carey.

The president stopped short before his chair.

"You're—you're a genius at figures, Bill!" he observed, wildly.

"They show the facts. Is there any use in your going down to see the Stelton people personally?"

"I've been twice and got nothing definite. Now they've declared themselves and—we're stuck!"

"You might see Keller, our attorney?" Dunbar hazarded.

"And drag the Stelton bunch into court to find out why they're trying to murder us?" Race laughed bitterly. "Did you ever hear of anyone starting one of those 'restraint of trade' actions without dying of old age before anything happened. *We've* got just about six weeks!"

"I suppose there is more truth than poetry in that," Dunbar sighed.

Mr. Carey cleared his throat.

"See here!" he said. "You both know well enough that I am no man to carry around a supply of wet blankets; but, facing it frankly and squarely, *isn't* the whole thing hopeless?"

"*No*," said Race, flatly. "We're hard up against it, but——"

"You've no power plant, Robert. You haven't more than a photograph of a generator or an engine!"

"The generators will be here all right enough!"

"And the boiler-room's all in shape, you know," added Dunbar. "It won't take long to mount the engine-room part of it; we've got the men on hand."

"Very well." There was a faint smile behind the gray beard. "Assume that the engine room is ready. Is your boiler room really valuable without coal?"

"If we were ready otherwise, we could buy in coal enough to start on time——"

Carey leaned back and lighted a cigar.

"William," he said, "you're many years from being children, but you both seem young enough still to neglect the future."

"Eh?"

"Your charter is good for nearly all eternity, isn't it?" asked the elder man, "provided that the service is satisfactory?"

"Yes."

"Have you any idea that, having signified your willingness to pay seven dollars for coal, you're going to buy it any cheaper in future—at least, until Stelton loses control of this part of the west?"

"Well, I—suppose not."

"So that the plant you build for profit is practically certain to run at a pretty heavy loss?"

"Well——"

"Then why have any plant at all?" exclaimed Mr. Carey.

Race looked at him in some bewilderment for a minute or so. He moistened his lips as he said thickly:

"Cold, conclusive business logic like that is a great thing! But if I had stopped to reason out everything that way, sir, in ten years on the road, I'd never have brought the thousands here that I did!"

Mr. Carey studied him earnestly.

"It may be young wits clashing with old ones," he said. "I'm hanged if I know!"

"Well, you'll admit that, up to twelve o'clock on the last night in June, we still have a show?" Race asked.

"Certainly."

"Good!" said Mr. Race, as he turned to his desk again. "Those generators'll be whirling around if I have to get a herd of wild horses and send 'em up a treadmill!"

Carey was forced to chuckle quietly. He liked Bob Race; he had liked him since little Robby had been paddling about in kilts. And if, more than once, that supreme self-confidence had rather staggered Carey, he could not recall one instance when—whether by energy, keen methods or sheer luck—Race had not made good!

"Bob! How about those engines?" Dunbar asked suddenly.

Mr. Race jumped an inch, as he whirled around.

"Say, what in blazes is this—an office or a place to tear the last nerve out of a man's body?" he yelled. "We've had shocks enough for one morning! You know as much about those engines as I do, don't you? You went east to Chicago with me and looked 'em over and said they were a bargain and would fit our plant better than anything else we could get without having 'em made to specifications! Didn't you?"

"Of course. But——"

"And you saw 'em begin to dismount the things before we left, didn't you? Is it my fault that they're somewhere on the railroad and not here? Am I running the freight business of three or four railroads?"

"I only meant," said Dunbar mildly, "is there any news of them in the morning's mail?"

"No!" said Race, as he turned and shuffled over the unopened envelopes. "Yes there is, too!"

He ripped open one of the envelopes and jerked forth the sheet. He stared hard at the thing—his eyes bulged crazily—and, with a wild whoop, Mr. Race's legs straightened out before him and his arms hung limp over the arms of the chair!

"Somebody bent on burning us out!" he chanted. "No coal—no generators—nothing but a boiler-room! None of 'em worth two cents without the engines!"

"Well, what about them?" Dunbar asked sharply.

"Nothing much, only *they've* caught it too!" shouted the president of the company! "They're sick of the job and they're taking a vacation! They've tracked 'em down at last and——"

Mr. Race calmed himself with a mighty effort.

"And now they're rusticating out in Los Angeles, California!" croaked the president!

(To be continued.)

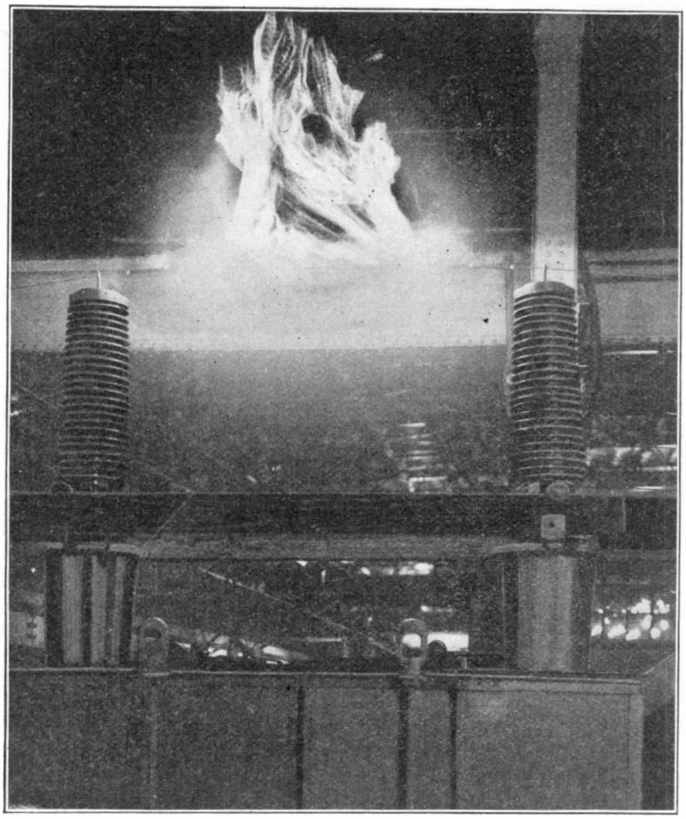
Testing With Half a Million Volts

As electrical transmission lines are built for higher and higher voltages, having now reached 125,000 volts, the problem of building insulators becomes more complex. There must be absolutely no defects in these insulators, otherwise the transmission line would in all probability be put out of service.

It would never do, therefore, to put up the insulators without knowing that they will stand the strain, so they are tested out in the factory under very much higher electrical pressure or voltage than they will be called upon to stand on the line.

To make the test, it is necessary to use a special transformer which develops a voltage across its terminals of hundreds of thousands of volts.

One terminal of this transformer is then connected to the part of the insulator which is to carry the wire when it is in service, and the other terminal is connected to that part of the insulator which is to be connected to the transmission tower.



TRANSFORMER DISCHARGING AT HALF A MILLION VOLTS

Then the "juice" is turned onto the testing transformer, water is sprayed on the insulator to imitate a rain-storm, and all sorts of things are done to allow the electrical pressure on the two sides of the insulator to puncture the porcelain or to flash over its surface. If the insulator "stands up" under the test it is considered sound and ready for shipment.

The illustration shows a testing transformer built by the Allegemeine Elektricitäts Gesellschaft of Berlin, Germany. It develops the enormous pressure of 500,000 volts across its terminals.

In the picture two small wires are connected to the terminals and their ends pointed toward each other, whereupon an electric discharge leaps from one to the other with a brilliant flash three and a half feet long, and with a sound that is almost deafening.

Elementary Electricity

By PROF. EDWIN J. HOUSTON, PH. D. (Princeton)

CHAPTER XXV.—SOME OTHER APPLICATIONS OF ELECTRICALLY GENERATED HEAT.

An important application of electrically generated heat is found in various forms of flat iron heaters, not only suitable for use in the house, but also, on a much larger scale, in laundries, tailoring or dressmaking establishments, etc. The advantages of the electrically-heated flat iron are many. Among these may be noted:

(1) They are smooth, free from smoke, soot or dirt, and always ready for use.

(2) The temperature of the room in which the ironing is done is free from the excessive heat and disagreeable odor so common where a number of gas burners or coal-burning ranges are employed.

(3) The temperature of the flat iron is easily regulated, so that it can be made just hot enough for the work to be done.

(4) Much time is saved in passing between the ironing table and stoves or other source of ordinary heat.

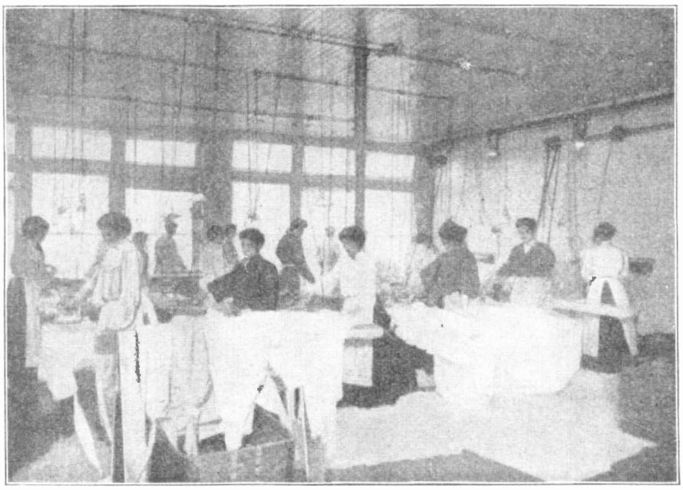


FIG. 160. USING ELECTRIC IRONS IN A COMMERCIAL LAUNDRY

Since the electric current can be supplied by wires that come down from the ceiling of the room, a free motion of the iron is possible. This is plainly illustrated in Fig. 160 which shows the ironing room in a commercial laundry.

Electrically heated flat irons do not differ in general appearance from ordinary flat irons. They are made in various sizes and weights. Fig. 161 represents a six-pound flat iron. These irons are generally made with the heating coil or unit arranged so as to be readily removed from or inserted in the iron.

A heavy twelve-pound iron, provided with a stand so arranged that the placing of the iron on the stand automatically cuts off nearly all the heating current, only permitting enough to pass to maintain the iron at the temperature required for use, is represented in Fig. 162. The device is so arranged that the act of removing the iron from the stand again automatically turns on the stronger current.

The following data will be interesting. A six-pound flat iron requires for its proper operation an expenditure of 500 watts of electric energy. Twelve-, fifteen-, eighteen- and twenty-four-pound irons require from 700 to 800 watts.

It might be supposed that the amount of electric current required for the operation of flat irons from a central station would never be considerable. In point of fact, however, the station load required for this purpose is rapidly increasing. A single large company, the General Electric Company, furnishes the map, Fig. 163, showing the distributing centres for the operation of electric flat irons in the United States. As will be seen, there is scarcely a state or territory that does not contain one or more such stations.

Load curves of typical lighting stations are shown in Figs. 164 and 165. The shaded portions show the increase in the output required for the maintenance of electric flat irons. Fig. 164 is from the records of a lighting company in a city having a population of 25,000. Here, 100 flat irons are in use all day in factories, and 500 are distributed throughout the residential section. Fig. 165 shows a load curve in a city of about 30,000 with the effect of 500 flat irons on the lines.

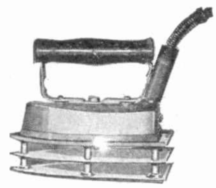


FIG. 161. SIX-POUND DOMESTIC IRON

The rapidity with which heat can be generated electrically and the ease with which any desired temperature can be maintained by regulating the quantity of electricity passing, have enabled heat of electric origin to compete favorably in many useful processes with heat obtained by the burning

FIG. 102. TWELVE-POUND IRON WITH CURRENT CUT-OFF STAND

of coal, oil, or other combustibles. Indeed, this is so true that certain processes can be carried on by electric heat that would be practically impossible by heat obtained in any other manner. This is the case with electric welding, electric forging, electric annealing, electric casting of metals, etc.

When a sufficient pressure is brought to bear against the ends of two pieces of metal that have been brought into contact, provided they have previously been raised to a temperature at which they begin to soften, they will cohere so firmly that if an effort is made to tear them apart the break or rupture will occur as frequently at some other place as at the welded joint.

In order to obtain a good weld it is necessary that the contact surfaces be kept clean and free from oxide. Since an incandescent temperature is required for the welding of most metals, the oxygen of the air tends to unite with the heated masses, so that it would be difficult to keep the surfaces clean were it not for the fact that by the use of a suitable flux the oxide is dissolved by the fluxing material and thus removed as soon as it is formed.

Probably one of the most important requirements for a good welded joint is that the proper temperature be obtained. The best welding temperature varies with different metals, and it is because the skilled workman has learned by long experience

FIG. 163. SHOWING DISTRIBUTING CENTERS FOR ELECTRIC IRONS

to ensure the temperature that the success of his work is due. But the means he adopts in order to determine at what point to stop the heating and press the heated surfaces together is by the very unsatisfactory indications of the colors and other appearances assumed by the heated metals.

In the case of electric welding, however, having determined the temperature that has produced the best results and noted the current strength required, and arranged the rheostat so that this current only shall pass, it is possible when pieces of the same character of metal, and the same dimensions are to be welded the passage of the same current will produce the same temperature.

Electric welding was invented by Professor Elihu Thomson, who has so perfected his system as to render it possible to employ it extensively in actual practice. Before, however, describing the Thomson system, it may be well briefly to describe a system invented by Bernardos, known as the arc-welding system.

The Bernardos system is not properly speaking a true welding system. In order to cause two plates of metal to be firmly united the following steps are taken. The edges of the plates to be joined are placed together and an electric blowpipe flame, consisting of a carbon voltaic arc deflected by the action of magnetic flux, is so directed at the edges as to fuse them. As soon as this is done the blowpipe flame is removed, and when the fused metal cools, the two plates form a practically uniform mass. It is evident that such a process cannot properly be called electric welding; it is rather electric soldering.

In the Thomson system of electric welding the surfaces to be welded are electrically heated by the passage of an electric current between them. Suppose, for example, that two pieces of wire are to be soldered end to end. These ends are brought into contact and an electric current passed between them across the contact surfaces. Now, as is well known, the temperature produced by the passage of a given electric current through any part of a circuit will depend on the electric resistance of this part. In the case of a circuit consisting of fairly heavy conductors, in which only a portion has a high resistance, the temperature of all the circuit except that having an especially high resistance, may be so low as scarcely to be perceptible to the touch, while the parts of high resistance may be raised to incandescence.

The above is the case in a circuit consisting of two fairly stout pieces of wire pressed together end to end. The contact surfaces are the points of highest resistance. The passage of the current at once raises these surfaces to incandescence, when, by pressing them firmly together, the welding is effected. Generally the entire operation requires but a fraction of a minute, or a few minutes at the most.

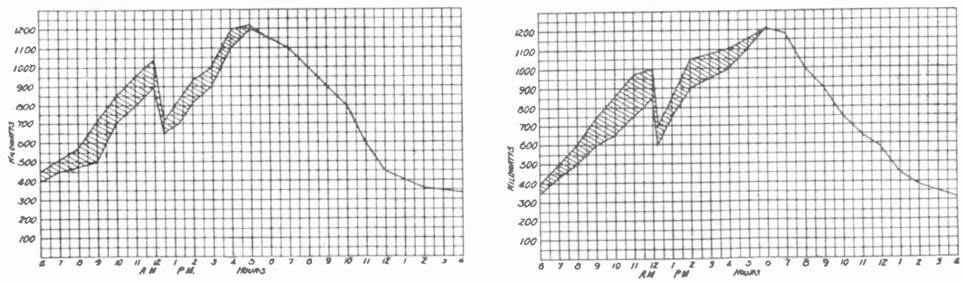
The fact that in electric welding the welding temperature is produced only at the surfaces to be welded gives to this process an immense advantage over ordinary welding. Indeed, so readily can the temperature necessary for a good weld be obtained and maintained that it has been found possible to electrically weld together metals that either cannot be welded at all by the ordinary processes or can only be welded with considerable difficulty. Some idea may be had of the advantages ensured by electric welding from the following quotation from a lecture delivered in 1877, at the Franklin Institute, by Professor Thomson. He says:

"The results obtained in the application of electric welding to the various metals, promise to be of great practical importance. While ordinarily it has been the exception that metals weld readily, with the electric method no metal or alloy yet tried has failed to unite with pieces of the same metal, and the trials have included most of the metals commonly known—such as wrought-iron, mild steel, tool steel, special steels, such as Mushet steel, and even cast-iron joints have been made between these different varieties of iron. Copper and its alloys, brass, bronze, German silver, etc.; silver, pure and unalloyed, gold, likewise platinum, zinc, tin, lead, aluminium.

The list is being extended as time and facilities permit."

There are two kinds of apparatus employed in Thomson's system of electric welding; i. e., direct welders and indirect welders.

In the direct welding apparatus an alternating current dynamo or alternator is employed for producing the electric currents



FIGS. 164 AND 165. LOAD CURVES OF LIGHTING STATIONS, SHADED PORTIONS SHOWING LOAD DUE TO ELECTRIC IRONS

and these currents are passed directly between the articles to be welded. Direct welders are employed for small work only, such as for the welding together of iron hoops, wire, etc. In this case the strength of the current passing through the welding joints or surfaces is regulated by means of a suitable rheostat.

In indirect welding the current produced by the alternators is not passed directly to the joints to be welded but through a suitable form of step-down transformer; that is, a transformer in which a comparatively small current of high pressure or E. M. F. is converted into a large current of comparatively small E. M. F., and this current only is used. Indirect welding is suitable for large work.

In order to ensure the exact amount of pressure that is required to produce the best results, ingenious devices have been provided by means of which, as soon as the desired temperature has been reached at the joints to be welded, the current is automatically thrown off and the pressure applied. Apparatus of this kind is called automatic welding apparatus in order to distinguish it from that in which the pressure is applied by hand.

Some of the advantages possessed by electric welding over ordinary welding have been thus described by Lemp:

"The heat is sharply localized to the joint and metal near it.

"The temperature obtained and required can be exactly regulated.

"The rapidity of heating and its distribution can be controlled by simple means. Irregular forms can be welded in the desired relation of its various parts.

"By this process all metals, as well as the alloys of all metals, are weldable.

"The welding operation is carried on under the direct inspection of the operator.

"The operation can be and often is made automatic, and the result is absolute uniformity; oxidized surfaces are excluded from the joint, and only clean metal unions made.

"Pieces can be welded to exact size, and finished pieces may retain their finish during welding.

"The process may be applied to pieces in place, as in track-welding. Water-power may be employed for the work, or the cheapest fuels of lowest grade.

"The greatest convenience and cleanliness likewise attend the practice of the process.

"The cost of fuel is not greater and generally less than in forge-welding, while the labor is reduced one half."

Another application of electrically generated heat is to be found in what is known as electric forging. In electric forging, the piece of metal to be forged is heated by the passage of an electric current through it, and when the required temperature has been obtained the metal is subjected to the forge or hammer in the usual manner.

In a modified form of electric forging known as electric swageing, the pieces of metal are first brought to the desired temperature when they are brought into the desired shapes by placing them on swages or anvils having the shapes it is desired the plates shall acquire. The electric current employed for heating the metal is obtained from a suitable, step-down transformer.

Still another application of electrically-generated heat is seen in the process of electric annealing. In what is known as Harveyized armor plate the percentage of carbon present in the steel plate is so great that when the plate is highly heated and then suddenly chilled it becomes so hard that it is able to resist the impact of heavy balls from large calibre guns. But this hardness renders it practically impossible to bore holes in places where they are required for the attachment of ladders, etc.

To anneal or soften any hardened steel plate it is only necessary to heat it to incandescence and then permit it slowly to cool. In electrically annealing Harveyized steel plates the portions of the plate that are to be softened or annealed are electrically heated by placing on them heavy blocks of copper so as to cover those parts only. A powerful electric current is then sent through the copper sufficient to raise it to incandescence, and this temperature maintained long enough to thoroughly heat the steel underneath it. As soon as this is effected the current strength passing through the copper block is gradually decreased until its temperature is the same as that of the rest of the steel, when the annealing is complete. Of course after the holes have been bored or other work done it is necessary to see that the annealed portions of the plate are again hardened by electrically heating them with the blocks of copper as before and then suddenly chilling.

(To be Continued.)

Electrical Securities

By "CONTANGO"

FINANCIAL TERMS—WAYS OF FINANCING A PLANT—SAFE AND UNSAFE INVESTMENTS

Having drawn direct attention last month to the great opportunity at this time present, in almost every kind of electrical enterprise, a more intimate discussion of the actual financial terms and financial questions usually involved in such undertakings is now in order.

One hears a good deal of stock or shares, common stock, preferred stock, bonds of various denominations paying certain rates of interest, income notes and other like terms.

What do they constitute?

For the most part *common stock* or *shares* (with the rate of dividend not fixed) and *bonds* bearing a fixed rate of interest are the form in which most electrical investments are offered to the public. It may be explained that "dividends" are defined as the division of profits made on shares of stock, representing the interest on them after certain fixed and other charges have been made. Dividends are therefore not fixed but are elastic. Payment on bonds is called "interest" and is at a fixed rate.

Stock is the manner in which the capital of a company is divided; the stock is made up of shares of specified denominations. Thus a company may have a capital stock of twenty-five thousand dollars, composed of 2,500 ten dollar shares, or twelve hundred and fifty 20 dollar shares, or two hundred and fifty one hundred dollar shares—the terms stocks and shares are the same. But though stock in a company is a form of investment offered to the public, it is mainly so in the case of large companies where there are a great many shares. In a small concern the capital stock or shares are usually owned by a few individuals and held by them, representing of course the ownership of the company, and the title to its property. The individuals who start the enterprise and form the company then take the common shares at its first inception, later for the object of improvements, additions and so on, they may vote to increase the capital stock and offer shares to the general public for investment, or they may decide on a bond issue.

Sometimes, too, in forming a company, those promoting it issue the common shares indicating ownership entirely to themselves, and offer to the public a limited partnership in the form of preferred stock or shares bearing a specified rate of dividend, but not conveying any voting rights or direct ownership rights, unless expressly stated. Stock of this kind draws dividends at a specified rate which must be paid before any dividend is paid on the common stock, and if this dividend on the preferred stock is described as *cumulative*, it means that all arrears of dividend must be paid up on it before the common stock gets anything. So if a company is earning a clear twelve per cent on its issue of five per cent preferred stock, that five per cent is paid on the preferred stock first, and the remaining seven per cent goes to the common. If only five per cent has been earned, it all goes to the preferred shares. If not enough has been made to pay the full amount of dividend due on the preferred stock and it is cumulative, then the deficit must be made up the next year and so on until the amount specified is fully paid before the common shares receive anything.

Assuming, however, that the company has been formed without any preferred stock and that a group of men have joined together taking so many shares apiece, then in all likelihood the usual course by which the public will be asked to participate in the undertaking as an investment is by the offering or issuance of what are termed *bonds*, bearing a fixed rate of interest.

Bonds in such companies are indeed the normal form of investment offered to the general public. They represent a first charge or lien on all the property and earnings of the company. A bond issue is in point of fact a blanket mortgage. It may not merely represent a mortgage on the company's plant, but on all its assets. The interest on bonds must be paid before anything else. If default is made bondholders can, after a certain period, take action to enter into possession of the company and its properties. But as long as the interest is paid, the bondholders, as those who own these securities are called, have no right to interfere in the management or affairs of the company. They have no more to do with it than a man with a mortgage on your property has, so long as his interest is paid to him. They must, though, be paid, and paid regularly.

It is therefore on the correct method of financing a plant that its success depends as shall be presently explained.

Securities of this type—bonds—at the present time must in the main, bear five per cent interest. It is true, there are some bearing as low a rate as four or four and a half per cent, but in most cases the market now demands a five per cent security. On the other hand when the interest offered is too high it is the danger flag.

SAFE AND UNSAFE INVESTMENTS

Will it pay, that is the question at issue?

Now it is probable that there is no safer or more attractive security at this time before the public than the bonds of an electric light plant where conditions are more or less settled, and where there is right along a normal and steady growth and where the company is run on a *cash basis*, and has been properly financed. The cash basis represents two things—actual investment of cash at the outset by the men who form the company and subsequent ability to meet obligations promptly out of earnings. The earnings of such a company, as before suggested, must be at least twice its interest charges, and even that figure of net earnings must be reached after a fair charge has been made for maintenance, and after an adequate reserve has been set aside for renewals and a depreciation fund. This depreciation fund should take the form of cash or some equivalent of cash. While the equipment of electrical plants is year by year becoming more settled, yet improvements are constantly coming to the front, and it is most important that the item of depreciation should be adequately recognized, in order that money may be available to add new and improved types of machinery where such additions will reduce operating costs.

Managers of plants are often under a great temptation to charge to renewals, expenditures that should go under operating expenses, and the careful bond buyer will therefore look carefully into the statements furnished by brokers and bond holders to see that this habit has been avoided, or at any rate get their assurance on this point.

To take up the manner of financing a plant: There are, it must be remembered, legal restrictions that prevail in different states. A lighting plant, or a trolley company is what is known as a public service or public utility corporation. It serves the public, is dependent on the public, and is therefore subject to special safeguards on behalf of the public, which, however, are not necessarily restrictions. New York state has a commission governing these corporations in certain directions; the state of Wisconsin has a state board governing them in other directions, and so on.

But assuming all regulations have been complied with, then it is usually a question of whether or not the original owners and promoters have put up part or most of the cash necessary for the enterprise, or whether the public shall furnish it as bond holders, subscribing the amount asked for in an issuance of bonds—the money realized from the sale of which will be used in building the plant and furnishing the equipment.

The group of men who get together to build and install a plant issue say 5,000 ten-dollar shares of stock among themselves, having acquired franchises and land; they then issue bonds with which to build and equip the plant and system. These bonds bearing interest say at five per cent payable in gold are offered in denominations of $100 each at the actual figure of $100. That is to say they are issued at what is called par. Or again improvements and additions are needed and bonds for that purpose are issued. Sometimes such bonds specify the purpose for which they are issued, but in all cases practically they are a first lien on the entire plant and system. If the company is well established and has no excessive bonded indebtedness, then the public may be asked to pay rather more than $100 for each one hundred dollar bond. This means that the bonds are thought so highly of as to be at a *premium*. Naturally if more than par has to be paid it reduces the return on the money invested. For instance, if $110 is paid for a $100 bond bearing 5 per cent interest, the interest on the investment will be a little over 4½ per cent. But it means also that the security is more than a gilt edged one.

It may be mentioned here that in some communities a limit is set to the amount of interest payable on the capital stock and there is also a limit to the amount of bonded indebtedness which is allowed to be created. In the United States, however, this matter is guided by the rule of the state in which the incorporation of the company is made and the regulations of the state or states where it operates.

The main points for consideration having now been considered, the practical character of the men identified with the undertaking as well as the character of the equipment installed must never be lost sight of.

Taking into account the future scope of almost all electrical enterprises it may be reiterated that there is no greater investment opportunity before the general public than the securities of electric light plants which are on a cash basis, are conservatively capitalized and competently managed.

There are naturally strong economic reasons on the side of combining the small companies into large ones and that is the tendency of the times. The economies of management, the economies of production on a large scale, the better results that come from comparison of operations in numerous plants—these are the obvious advantages of, and reasons for, the constant linking up of small electrical undertakings.

The placing of securities so wonderfully carried out by companies in the large and conspicuous cities in the past is now being extended to the smaller cities and the aggregation of small villages and hamlets, and the consolidation of these small enterprises into larger and more effective concerns will unceasingly attract investors in every market in the world. Nevertheless, it is the taking hold of the securities of the small centers at the start that gives the ground floor opportunity for the small investor, and he will, under the conditions outlined, find his greatest chance in the small plant. He can obtain the bond issues usually at a cheaper rate and therefore obtains a security increasing in value year by year and on which he can always realize at an advantage.

Electrical enterprises are doubling their profits on an average of every five years, and in the case of some of the larger cities the business has for years past doubled every three years. They are good at the start and if taken into a consolidation are guaranteed further by the larger company.

Motor Power vs. Boy Power

The recent educational advances made by China have so far been very slight along the technical lines, for the reason that teachers who speak the Chinese fluently are not yet available and it will take some years to train them. At present the technical instruction is all given in English and is therefore only accessible to those who have learnt English or who can command the services of an interpreter. Even at that these schools are overcrowded, so that at the technical institute in Shanghai (which offers a five-year preparatory and four-year technical course to boys entering when about 14 years old) there are about seventy pupils to each instructor.

No wonder that the majority of Chinese boys, however ambitious they may be, cannot be accommodated as yet, though another five or ten years will undoubtedly see a decided change. Meanwhile this absence of available instruction makes boy-power so cheap that even in Shanghai, where electric motors are easily to be had, most of the machine shops use lathes driven by boys. Each lathe is belted to a countershaft and this to a flywheel (about six feet in diameter) having a crank which the boy turns. With such competition the low current rate offered by the local electric light company is not very enticing in itself. But the much greater steadiness and higher daily output which the electric motor offers, is gradually being appreciated and promises to relieve one after another of these boys from their present monotonous task.

Seasoning Wood By Electricity

Have you ever lived in a frame house built of unseasoned timber? If so, you will be interested in knowing that in France by what is called the Nodon-Brottonneau process seasoning can be accomplished in a few hours. The timber is placed on a lead plate in a tank of water containing ten per cent of borax and five per cent of resin with a little soda added. The lead plate is connected to the positive side of a dynamo. Another lead plate is placed on the upper side of the timber which is not quite covered by the water. When current is turned on the sap in the wood seems to pass out and borax and resin take its place. Drying completes the process.

Where Electricity Stands in the Practice of Medicine

By NOBLE M. EBERHART, A. M., M. S., M. D.

CHAPTER VI.—ARTERIO-SCLEROSIS

"A man is as old as his arteries."

This saying is itself old enough to have arterio-sclerosis, but, if possible, it is more pertinent now, than when it originated.

This is because our present mode of life with its strenuous effort to gratify lofty ambitions; its excesses or indiscertions in eating, drinking, etc., has produced many men, young in years, whose arteries are those of the octogenarian, and forecast the probability of a sudden termination of their usefulness.

In other words it is the old story of "burning the candle at both ends."

Arterio-sclerosis means hardening of the arteries and it is a natural concomitant of old age. It may be looked upon as essentially a thickening of the muscular portion of the arteries, with an increase in the cells lining them and consequently diminished caliber in the blood-vessels. The muscular elements tend to be displaced by a hard form of tissue designated as fibrous, therefore one author defines it as a "fibrous infiltration of the muscular coat with degeneration of contractile tissue," and it is ordinarily accompanied by an increase over the normal blood-pressure.

The arteries are vessels carrying the blood from the heart; those returning it being known as veins.

The arteries divide and re-divide, much as the branches of a tree. The small arteries are called arterioles, and finally the smallest sub-division are known as capillaries or "hair-like" vessels. These capillaries seem to be merely extensions of the lining of the arterioles. They connect the arterioles with the smallest veins (venules) and mark the point where the return flow to the heart is inaugurated.

In order to understand the development of arterio-sclerosis and the phenomena of blood-pressure it is necessary to remember that the arteries are made up of three layers, an internal lining layer, a middle muscular wall, and an external cellular coat.

The internal coat is thin and elastic. The middle layer contains muscular fibres which by contracting or relaxing control the size of the artery. This layer except in the arterioles, also contains elastic fibres. The outer layer is composed of connective tissue, (a term that is self-explanatory), some elastic fibers and the tiny blood vessels which nourish the walls of the arteries.

The heart may be looked upon as the central station, the dynamo or pump and the pressure in the heart is therefore necessarily greater than in the arteries. This pressure, in fact, decreases as the size of the arteries decreases. The large arteries have a greater pressure than their smaller branches, and these in turn have more than the "hair-like" capillaries.

To continue this a little farther, the capillaries have a greater pressure than the tiny veins, and the smaller veins more than the larger, decreasing the nearer the veins are to the heart.

In this way we have the complete round of the circulation, and the blood follows the rule of water and of electricity and flows from a higher to a lower pressure, and thus circulates from the heart through the arteries, capillaries and veins, back to the starting point.

The pressure of the blood is an important factor in arterio-sclerosis, and it is measured by its power to lift a column of mercury and it is found to have normally a pressure capable of sustaining a perpendicular column of from 110 to 130 millimeters of mercury, the average being 120. In arterio-sclerosis it sometimes increases to over 300. The method of ascertaining it will be considered later, but before doing this let us look into the causes which produce arterio-sclerosis.

We might divide the disease into the functional and the organic stage. The functional stage would be that previous to actual hardening of the arteries and the organic would be that in which actual structural changes had taken place.

In the first stage there comes to be present a contracted condition of the artery, producing increased tension and raising blood-pressure, but this is essentially the result of irritation and spasm on the part of the muscular fibres and an actual degeneration and permanent change in their structure has not yet appeared.

Thus this disease develops gradually and usually without any particularly noticeable or alarming early symptoms.

The theory is that poisons (toxins) in the blood first cause irritation, and then contraction or spasm of the arteries, which may be intermittent, but later becomes a more or less steady contraction, thus establishing increased pressure by narrowing the caliber of the vessels. Later the permanent changes of the second stage occur.

It is but fair to say that although the great majority of physicians believe that high blood-pressure produces arterio-sclerosis, there are some who hold the reverse to be the case.

Be that as it may, increased blood-pressure is the most common and constant symptom of the disease.

The causes of the primary irritation are gout, uric acid, lead poisoning, excesses or abuses in eating, drinking, tobacco, etc. There is faulty conversion of food products into living cells; with failure to properly eliminate poisons from the system; and the absorption of the products of imperfect intestinal digestion. Other causes of arterio-sclerosis are worry, prolonged mental or muscular strain and the after-effects of infectious diseases.

The disease most frequently occurs after forty years of age; but no age is exempt, cases occurring in individuals of eight, fifteen and twenty-eight years, respectively, being on record. In men and women of middle age, say forty to fifty-five, it is found that three men are affected to one woman. The reason is apparent when the causes are considered.

We have given the impression, probably, that arterio-sclerosis is always a disease involving all of the arteries and therefore readily detected by feeling of those which are accessible to the touch. This is not true. The arteries supplying any organ, as the kidney, or the stomach, may be involved in this process and there may not be present any evidence in other blood-vessels, hence the value and necessity of testing the blood pressure.

"An ounce of prevention is worth a pound of cure," and today we are paying just as much attention to preventing disease as we are to curing it when present, and therefore I should consider myself subject to criticism if I failed to speak of methods of warding off or indefinitely delaying the development of arterio-sclerosis.

From the nature of the causes, it at once appears that habits must be regular, all excesses avoided, and worry and strain eliminated, if possible.

The diet should be simple, all alcoholic beverages tabooed and frequently even tea and coffee, although in suitable cases they may be allowed in moderation. Tobacco should be prohibited or used sparingly. Milk and buttermilk are allowed; especially the buttermilk made by adding lactic acid bacilli cultures to sweet milk. Red meats are to be eaten sparingly; but plenty of vegetables are advised.

There is a growing opinion on the part of many physicians favoring the partial or complete elimination of salt from the diet.

The individual should take his time and avoid all worry, haste and excitement. In addition strict attention should be paid to personal hygiene, and regular but moderate exercise, baths, etc.

It has been shown experimentally that in a normal subject the blood pressure may be raised five to ten millimeters by taking beef broth, hence the necessity for curtailing the amount of red meat.

Among the symptoms of arterio-sclerosis are drowsiness; morning fatigue; dizziness or vertigo; irritability; insomnia; tingling or numbness in arms or legs,; nose-bleed; slow healing of any injury; coldness of extremities; neuralgia; headaches; and loss of memory. Later there may be symptoms of apoplexy, etc. Above all the high blood pressure is to be looked for.

As I read over the foregoing symptoms, I am reminded somewhat of the old "patent medicine" almanacs and I do not wish to give the impression that having one or two of these symptoms implies necessarily that the individual has, or is tending toward arterio-sclerosis; but if several of them are present I would certainly advise consulting a competent physician for the purpose of ascertaining the blood pressure and thereby confirming or refuting the possibilities suggested by the symptoms enumerated.

Since the most important symptom of this disease is high blood pressure, it is desirable to know how this is estimated. The instrument used is called a sphygmomanometer and one form is shown in the illustration. Its action depends on opposing the pressure of a column of mercury with the pressure of the blood in an artery. For this purpose the brachial artery (a large vessel in the arm above the elbow), is selected.

MEASURING THE PRESSURE OF THE BLOOD

A cuff or band containing a rubber sack is fastened around the arm above the elbow, with that part from which the rubber tube emerges, lying in front, over the artery. Ordinarily the sleeve is rolled up before the band is applied, but if the clothing is thin this is unnecessary. A rubber tube runs from the cuff to the machine, which has a U-shaped glass tube containing mercury, with a gauge between. The zero mark on the scale is placed on a level with top of the mercury.

A rubber bulb is attached by a small tube to the machine, and the physician holds this bulb in one hand, while with the other he keeps a finger on the pulse in the patient's wrist. The bulb is now compressed and immediately air fills the cuff and the column of mercury begins to rise. The operator continues to slowly inflate the cuff until the pressure about the arm overcomes the pressure of the brachial artery and the pulse can no longer be felt at the wrist.

When this occurs the pressure of the column of mercury has balanced the pressure of the blood in the artery, and the reading on the scale opposite the top of the column is the patient's blood pressure.

One observer reports a study of the blood pressure in seventy men. At forty years of age the average pressure was 115; at sixty, it was 135; and at eighty it was 150.

Another physician found the average in 100 men to be a little over 118.

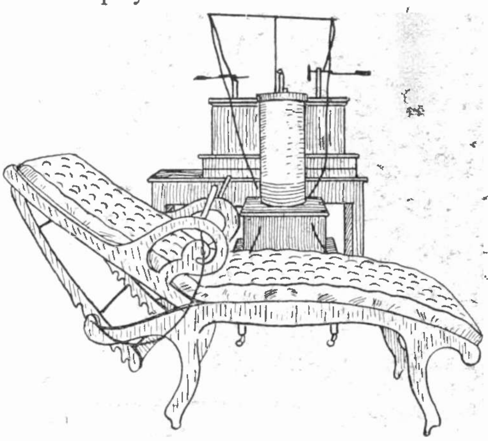
An increased determination of blood to the surface of the body, lowers the pressure, and, conversely, driving the blood from the surface, raises the blood pressure.

It is important that the sphygmomanometer be used, as in one series of 1000 tests it was observed that abnormal pressure existed in many cases that a competent and experienced observer failed to detect without.

In treating the disease all of the suggestions given under the paragraphs on prevention apply equally well. Methods of increasing the peripheral (surface) circulation are indicated, such as judicious massage; warm baths; electric light baths, etc. The bowels should be carefully attended to, and elimination through the skin and through the kidneys.

I have reserved for the last the method which, in my opinion, is the best we have for arterio-sclerosis. This is auto-condensation.

Many of my readers will recall reading in the daily press of that distinguished writer Bjornsen going to Paris that he might be treated by Prof. D'Arsonval for arterio-sclerosis. This is the form of treatment the latter employs.



THE AUTO-CONDENSATION COUCH

Auto-condensation is a method originated by D'Arsonval for the application of high frequency currents.

As the term implies the individual, "auto" or self forms part of a condenser, and is charged and discharged with the high frequency current.

In order to get the D'Arsonval current it is necessary to attach to the generating apparatus (induction coil, static machine, Tesla transformer), an apparatus in which two sets of condensers are connected so that the circuit on one side is made through a spark-gap and on the other passes through a solenoid or coil of coarse wire. The patient is connected to the solenoid side of the condenser circuit, and is placed on a couch, pad, or table devised for the purpose, and having a layer of condenser covered by some form of di-electric, as glass, mica, or rubber cushions stuffed with silk waste. The sketch illustrates the general appearance of the device.

The condenser layer is connected to one pole and the patient to the other, thus a charge of positive electricity is held in the patient while the plate below is negatively charged. These charges alternate very rapidly from positive to negative and the result is a high frequency wave, passing back and forth through the patient's body, thus influencing the individual cells composing the tissues. It is essentially a "cellular massage."

The primary effect of auto-condensation is to increase nutrition, and nutritive processes. It also increases the elimination of waste products; and raises bodily heat.

Furthermore it does what is especially important in arterio-sclerosis; it lowers blood-pressure when above normal. There are scarcely any exceptions to this rule if proper apparatus is employed.

The proof is at the command of the physician and "seeing is believing." It will be found by testing with the sphygmomanometer before and after a ten-minute treatment that even a single seance will reduce it five to ten millimeters. This will not be a permanent reduction but continued treatment will so result, and it may then be maintained by occasional applications.

The dosage of auto-condensation is from 150 to 900 milliamperes as measured by a hot-wire meter in the patient's circuit.

The average dose is 350 to 500 milliamperes. Daily treatments of ten minutes each are advised at first, gradually decreasing as the patient improves.

Auto-condensation is not only good for the treatment of existing arterio-sclerosis but it is strongly urged as a means of preventing its development.

One gentleman aptly put it as "anticipating old age." He observed that we put aside money in the bank for old age, and how equally important it was to save the vitality of our arteries for the same occasion. It might be called Life's Savings Bank.

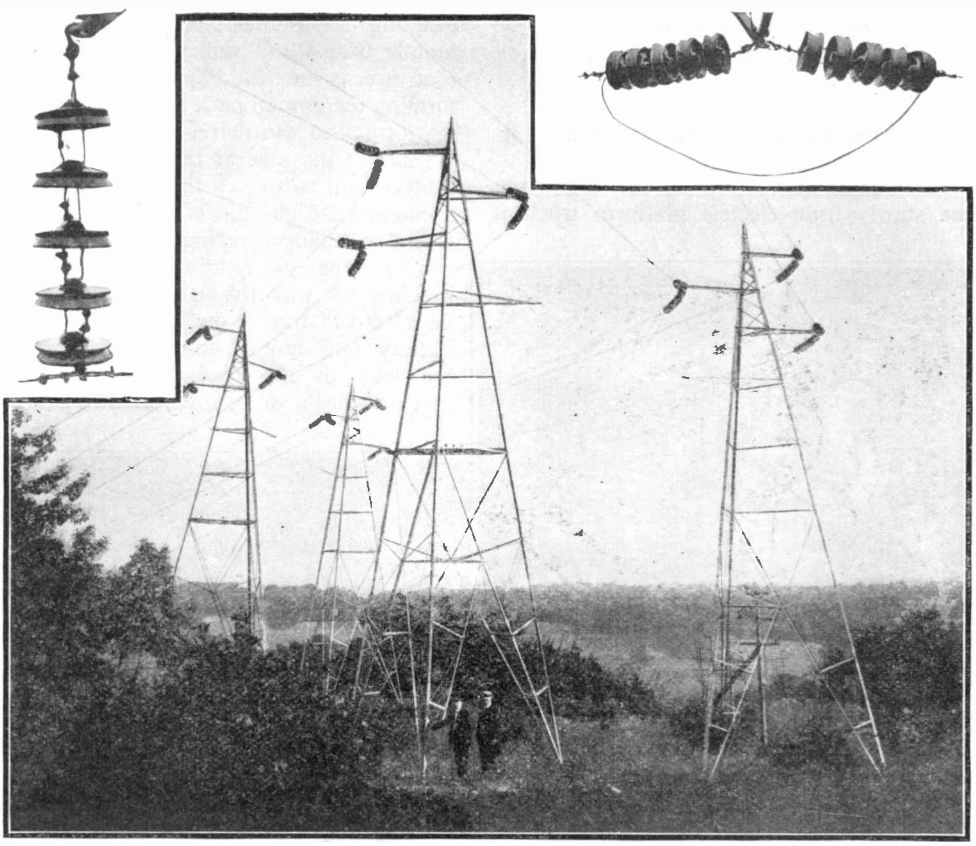
(To be continued.)

Current Overland at 110,000 Volts

It is no simple matter to insulate an electrical transmission line carrying current under the enormous tension of 110,000 volts, and the current is ever on the alert to escape to earth by any hook or crook. The transmission line of the Grand Rapids Muskegon Power Co., between Croton Dam, Michigan, and Grand Rapids, carries current at this pressure. The line is 50 miles long and is carried on 52-foot triangular steel towers, 10 towers to the mile on the straight-away portions.

As will be seen in the picture the line is in duplicate, there being two rows of towers side by side. If anything happens to one line the other is ready for instant use. There are three wires carried by each tower, following what is known as the three phase system.

The illustration also shows the General Electric link type insulators which carry the wires and prevent the current from leaking to earth through the steel towers. In going around curves the insulators stretch out nearly horizontally. Where the line wires are straight the insulators hang vertically, carrying the wires at the lower end. The insulators are each made up of five disks of specially mixed and carefully glazed porcelain. They are 10 inches in diameter and are hung together by steel links. Any current to pass to earth must jump across or creep over the surface of the entire five insulators, which it cannot do.



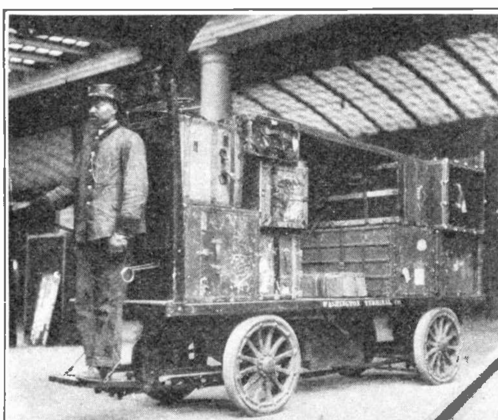
ONE-HUNDRED-AND-TEN THOUSAND VOLT LINE AND METHOD OF SUSPENSION

In the strain type (horizontal) insulator you will see that the wire carrying current is brought up to the ends of the two sets of insulators and anchors. It then drops in a long loop down beneath the insulators and far enough away from the steel cross-arm of the tower so that it cannot jump the space.

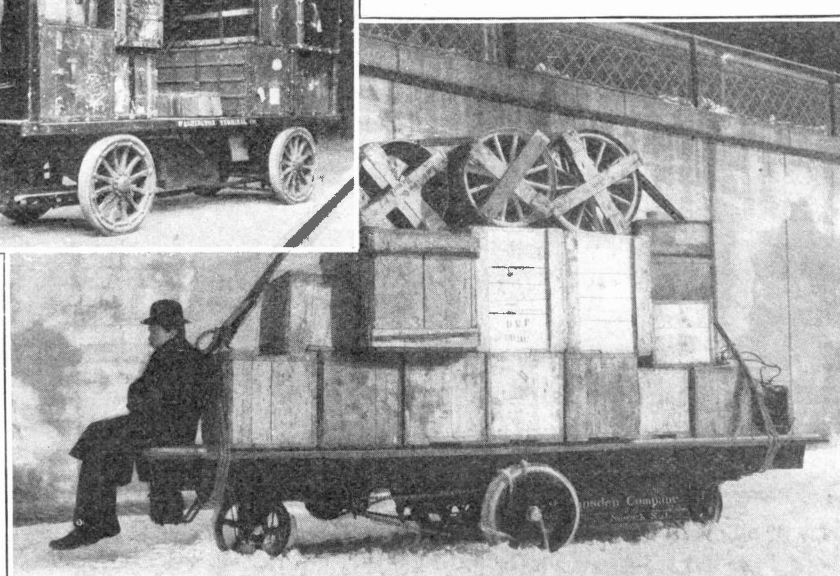
It is said that, at the working pressure of 110,000 volts, about the highest that has ever been used for transmission purposes, the brush or static discharge from the wires is plainly visible at night and a slight noise is distinctly heard. This discharge, however, does not represent a serious loss of power.

Electric Platform Trucks

In some of the stations in our large cities the sturdy little electric platform truck is becoming a common sight. The average passenger, alighting from an incoming train, would perhaps hardly detect the difference from the old hand-operated vehicle. The more observing person, as he walks down the platform from the train, may note that the long, low-bodied truck standing at the door of the baggage-car is being loaded with an extraordinarily large number of trunks and bags, and will perhaps pity the man, or set of men, who (he imagines) are going to have to push such a load, even on the level concrete surface.



TRUCK USED AT THE WASHINGTON TERMINAL



TRUCK EQUIPPED WITH NEW EDISON BATTERY

The new Edison storage battery applied to the motors of the truck, however, makes no pushing necessary. This battery, which was first launched about six years ago, and which has now been developed to meet the exacting requirements of propelling automobile trucks and vehicles of all kinds for road use, is now the happy means of transforming the human pack animal on dock and platform into the driver of a power truck. He sits at his ease at the steering-wheel of a little giant of a truck that walks away with a mountain-high pile of baggage about as easily as a lady carrying a shopping-bag.

The type of four-wheel truck shown making its way through the snow has a flat, "flush" top or deck, with the storage-battery and motor slung beneath, out of the way of the load. The rubber-tired driving-wheels are in the middle and the two other wheels "fore and aft." The steering mechanism by which the driver controls the vehicle operates to twist the front wheel one way and the rear wheel the other way.

At the new $20,000,000 Union railroad station at Washington—the finest railway terminal in the world—somewhat similar trucks are now used. The concourse of this station being big enough to accommodate the entire standing army of the United States, made virtually imperative the use of some substitute for the old-time truck that would cover the great distances involved with less consumption of time. The new power truck does this admirably, and in addition to operating, under normal conditions, at from three to six times the average speed of the hand-power truck, it moves a load several times as great as is permissible with the old-style equipment. In short, as demonstrated at the Washington terminal, one power truck will do the work of at least five or six hand-power trucks, and inasmuch as both styles are operated by colored men at the same wage rate, the saving effected is the more tangible.

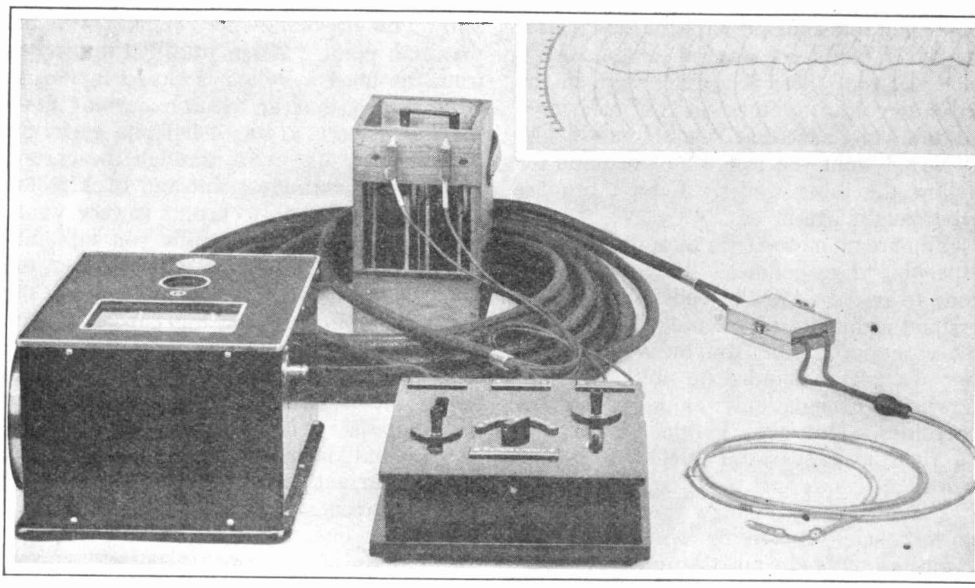
Two classes of the electric trucks have been introduced at the Washington station. They are identical in design and in almost all particulars save size and capacity. The larger size which will ultimately be used almost exclusively has a carrying capacity of 4800 pounds, and twenty-five of these trucks will be employed.

Record of Fever Temperatures

An apparatus for recording the variable temperature of feverish patients has been designed by Siemens & Halske of Berlin, Germany. Its principle is very simple, depending upon that quality of platinum by virtue of which its resistance to the flow of an electric current through it varies with its temperature.

In this unique German instrument a small coil of platinum wire forms part of the electrical circuit and is enclosed in a little tube which may be placed in the mouth or under the arm of the patient. Current from a battery passes through the coil of platinum wire and through the instrument which is similar to a millivoltmeter. As the temperature of the patient varies, the resistance of the platinum coil varies in direct proportion, and the needle of the instrument moves back and forth. This needle of the millivolt meter has a pen attachment which marks a record on a strip of paper carried by a drum which is revolved at a regular rate by clock work.

Thus the pen of the millivolt meter marks the record on the sheet of paper in the form of an irregular curve indicating just what the temperature of the patient was at any minute and hour during the days that the instrument is kept connected.



FEVER TEMPERATURE RECORDING APPARATUS AND ONE OF THE RECORDS

Talks with the Judge

HOW THE TELEPHONE "TALKS"

I entered the Judge's office one day just as he had finished speaking at the telephone, and as he swung around in his chair to greet me there was an interrogation point in his look and manner. In a half musing way he said, "I suppose I use that telephone a hundred times a day. It is a part of my business life—yes, and my home life as well; but do you know, when my little boy asked me the other day how it is that a telephone can talk I fell down entirely when I tried to tell him. Yes, sir! I found that when I got right down to it I was almost absolutely ignorant of the principle of the greatest time saver of this or any other age. All I knew was that there is a diaphragm in the transmitter and another in the receiver—and the kid knew that much himself.

"Now I want you to tell me once and for all how the thing works. I don't propose to be caught again."

"You are no more at sea than the majority of people," I responded. "Most of us are prone to rest easy in the belief that we understand a thing until we are called upon to give exact information on the subject, and then we are astounded to find that our knowledge extends only as far as a few generalties. However, I think I can put you right as far as the telephone is concerned."

"I shall not try to take you through all the intricacies of talking circuits, ringing circuits, switchboard apparatus, etc., for that would require a book. But what you want to know, I imagine, is the principle of the transmitter and receiver which convert sound waves into electrical waves and back into sound waves at the distant end.

"To begin with, sound, as you know, is only vibrations in the air. These vibrations strike upon our ear drums and set them to vibrating in unison, which vibrations are interpreted by the brain, through the auditory nerve, as sound.

"In the telephone transmitter, which you speak into, there is a diaphragm made of thin sheet metal. It is something like the drum in a person's ear, and as the air waves generated by your voice strike against it the diaphragm vibrates in unison with these waves.

"Back of the diaphragm is fastened a little platinum point which moves back and forth ever so little with the vibrations of the diaphragm. This point is adjusted so that it just touches a little carbon button mounted in the back of the transmitter. The pressure, therefore, of the point against the button is determined by the strength of the air fluctuations striking the diaphragm.

"That's about all there is to the principle of the transmitter most commonly used. One wire comes out from the telephone exchange and connects with the carbon button. The other line wire connects with the platinum point. When you lift the receiver from the hook a switch is closed in the instrument so that an electric current flows from a battery at the telephone exchange out over one line wire, through the carbon button and platinum point and back to the exchange. Now this current is very weak, but it flows constantly while you talk into the transmitter. As you talk against the diaphragm, the degree of pressure of the platinum point against the carbon button varies directly with the intensity of the voice vibrations, so that the area of contact between the point and the button increases and decreases with the pressure. This increases and decreases the resistance to the flow of current and, as a consequence, the talking current, as it is called, is a constantly fluctuating one, the rise and fall or the fluctuations of the electric current corresponding to the rise and fall of the air waves created by your voice.

"We will now consider that the proper connections have been made at the exchange and that the two wires from your instrument have been made to go straight through to the instrument of the party to whom you are talking. The next thing to consider is the receiver at the distant station.

"Inside the receiver is a long permanent magnet wound on the ends with little coils of very fine wire which are connected with the line wires. When the connection is made between you and your party, current flows as before described from the battery, through one wire to your transmitter, through the transmitter, back to the exchange through the other wire, then out through one of the wires of the called subscriber's line, around the little coils in his receiver and back through his other line wire to the exchange battery.

"By one of the principles of electricity, when current flows through a coil of wire wound around a magnet the magnet becomes stronger or weaker according to the strength of current flowing through the coil. Therefore the poles of the magnet in the receiver become stronger or weaker according to the fluctuations of the talking current set up by your voice, as before explained.

"Now right in front of the poles of the magnet of the receiver is a thin iron diaphragm similar to the diaphragm in the transmitter. The poles of the magnet draw the diaphragm toward themselves with a force corresponding to the strength of the poles, which, again, is dependent upon the strength of the current flowing around the coils.

"Therefore, it is plain to be seen that as you talk into your transmitter you cause the diaphragm to vibrate, which causes the current to fluctuate, which in turn causes like fluctuations in the strength of the poles of the distant receiver magnet, causing the receiver diaphragm to vibrate in unison with your transmitter diaphragm.

"The receiver diaphragm then sets up air vibrations which impinge on your friend's ear drums—and he hears."

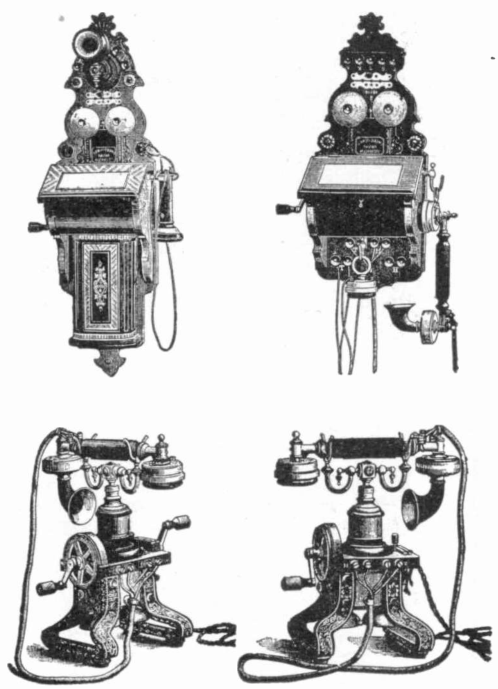
Are Upward Signs Coming?

Across the seas in Auvernier, Switzerland, an enterprising hotel keeper has decorated his inn with this sign:

Evidently he is catering to both the automobile enthusiasts and the aerial navigators, for his sign is the only one in the whole canton of Neuchatel that can be read from above. But he would have done still better by having the upper edge of his sign studded with electric lamps spelling the letters straight upwards for the enticement of the real "high fliers" who might patronize him.

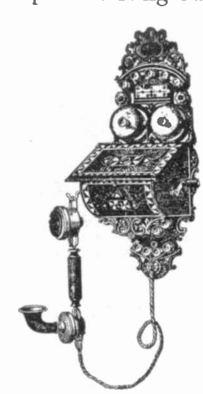
Subscribers' Unique Telephone Sets

The illustrations from *Telephone Systems of the Continent of Europe* will interest many because of the curious and elaborate design which was early displayed in the sub-



scribers' telephone sets used in Sweden.

The handsome wood carving and inlaid decorations are foreign to American instruments, while the connecting of receiver and transmitter is unusual except on testing outfits. A lightning arrester and connecting plug is shown on each wall instrument just above the bells.



The desk sets with the exposed gear wheel and central hook supports for receiver and transmitter remind one of a miniature fire engine. The cranks on opposite ends of the magneto-ringing shaft on one of the sets, are so placed to enable the bell to be rung from opposite sides of the table on which the instrument is placed.

ABOVE A BELOW GROUND AT THE BUSIEST CORNER IN PARIS

Underground Railways of Paris

Of all the corners in Paris which have been turned upside down, so to speak, by the works of the Metropolitan Railway, the Place de l'Opéra is the one that has suffered longest from the presence of the workmen. Three railways, each on a different level, are being built there, underground, and for each of these railways there must be a station requiring special means of access, and intercommunicating passages allowing the public to go from any one of these stations to another. These stations, being very near to each other, have been extremely hard to build because the whole of the earthwork and masonry has had to be done underground. The elevator shafts, only, have been opened up through the ground to the level of the pavement.

The three lines cross in the center of the place, one above another, one line, No. 3, crosses No. 7 upon a diagonal steel bridge, and line No. 7 crosses No. 8 the same way, so that the whole appearance of the work, outside of the masonry, is that of three metallic bridges placed one above another.

The preliminary work having been effected, there remained to construct a stairway of access common to the three lines by means of a general ticket-office; then to clear the way for the platforms and finally to provide the means of transfer between the platforms of the three lines. The three stations are disposed at the three points of an inclined triangle. Further, the second stairway leading down will be established on the enlarged refuge opposite to that of the first one, and within the axis of this latter and of the monument. It is the creation of these approaches which now makes of the Place de l'Opéra an immense basin, an exact idea of which is given by the plan on the opposite page.

The transfers between the six platforms will be effected by galleries, giving access to stairways. It may be imagined what difficulties were overcome by the engineers in establishing the plan of this labyrinth. Finally, in order to assist the passengers in knowing what direction to take, it was decided to build a vast hall of intercommunication through which the passengers can reach all the platforms. Furthermore, two elevators will deposit people conveniently at the level of their starting platforms after leaving the ticket offices.

This great hall of intercommunication, situated over 20 feet below the surface of the ground, measures 98 feet in length by 23 feet in width. It occupies a space excavated transversely before the Boulevard des Capucines. From there start the passages and the stairways leading to the two platforms of each station, to the two elevators and to the two distributing halls. The hall of intercommunication constitutes the central point of transfer.

Besides this network of communications, there have also been provided passages to connect platforms with the two elevator cages and with each other and with the ticket office.

The engineers took upon themselves the task of making all these passages, stairways and subterranean halls with the use of a single shaft, equipped with an electric crane and which is located at one of the extremities of the works not shown in the cut. It is through this shaft that all the waste and rubbish are carried up, and all the materials for construction are carried down. Nevertheless, when the tops of the two elevator cages reached the level of the pavement, they were obliged to open two shafts into which to place the elevators, but these served only for that purpose. All the masonry has been executed in concrete of slag cement or in crushed stone and cement mortar.

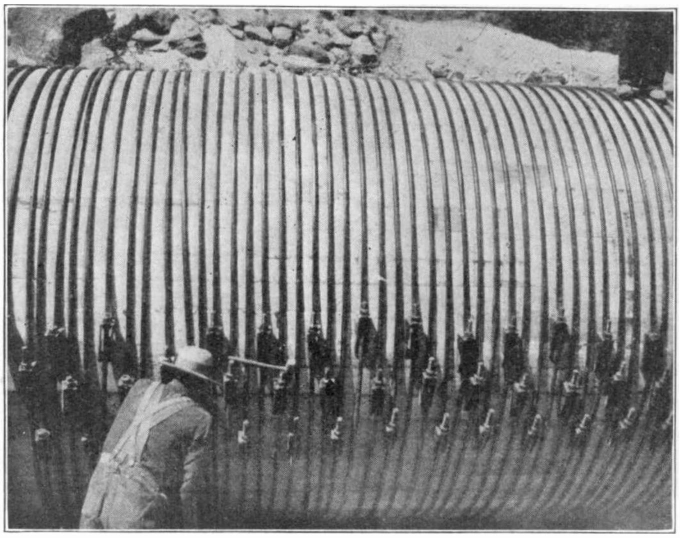
The total height of the elevator cages is 62 feet. Each one of these, measuring 16.4 feet on each side, contains two elevators running in opposite directions. The rails of the line No. 8 are 43.4 feet below the level of the street; those of the line No. 7 are 35.8 feet, and those of the line No. 3 are 20.4 feet below the same level. Finally, to give a concrete idea of the extent of the galleries built in this part of the Parisian sub-soil, we will say that they contain about 375 stairway steps. In short, the construction of these approaches was a veritable head-splitting Chinese puzzle, and gave rise to numerous projects with unceasing modifications, the execution of which was rendered more difficult by the necessity of doing this work under ground. *Condensed from a translation from La Nature, by Annette E. Crocker.*

Photograph by William H. Rau

THE ABOVE IS A VIEW OF THE PHILADELPHIA ELECTRICAL EXHIBITION HELD IN THE FIRST REGIMENT ARMORY, PHILADELPHIA, ON FEBRUARY 14 TO 26, 1910. THIS WAS PHILADELPHIA'S FIRST ELECTRICAL SHOW, AND IN SPITE OF THE LABOR TROUBLES WHICH THE CITY WAS EXPERIENCING AT THE TIME IT WAS WELL ATTENDED, VISITORS COMING ON FOOT, IN CABS, AUTOMOBILES, DELIVERY WAGONS AND BY OTHER MODES OF TRANSIT UNUSUAL TO THE CITY DWELLER

Pipe Lines of Wood

Continuous-stave, wood pipe is now very extensively used for conducting water to water power electric plants from reservoirs far back in the hills, and working under pressures of from 50 to 200 pounds. In fact the wood-stave pipe line of 40 inches diameter at a water power plant in southern California is operating under a 295-foot head. There is no electrolytic action on wood pipe, which is a non-conductor of electricity.



PIPE LINE OF WOOD STRENGTHENED WITH BANDS OF STEEL

The illustration on the front cover shows the construction of the continuous stave pipe line 8½ feet in diameter of the Great Northern Railway power plant, while the picture on this page illustrates the banding rod utilized on this remarkable conduit, which conveys the water to the hydraulic turbines.

Wood pipe being a non-conductor of heat and cold can be laid along the surface in cold climates to advantage. The wood-stave pipe is said to be as durable as cast iron and more durable than steel or wrought iron, while it is cheaper than either of the above and its capacity at all times is constant. The carrying capacity of iron and steel is said to decrease as time goes on, due to rust, greater friction, etc.

Setting Up Gravity Cells

A writer in the Signal Engineer gives the following directions for cleaning and setting up gravity batteries in order to reduce crystallizing:

(1) Have the jars, zincs, copper, and vitriol clean.

(2) Place the copper in the jar and fill, to the even top of the copper, with vitriol. Avoid using dust.

(3) Put the zinc in place. The top of the zinc should be one inch below the top of the jar.

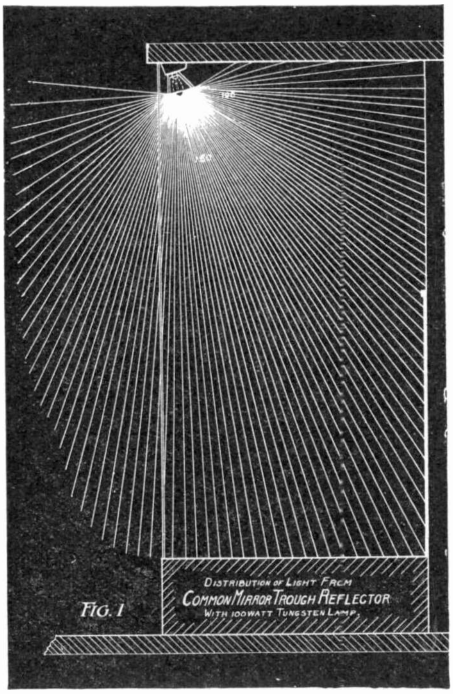
(4) Pour in clean water so that it fills the jar to a point just below the bottom of the zinc.

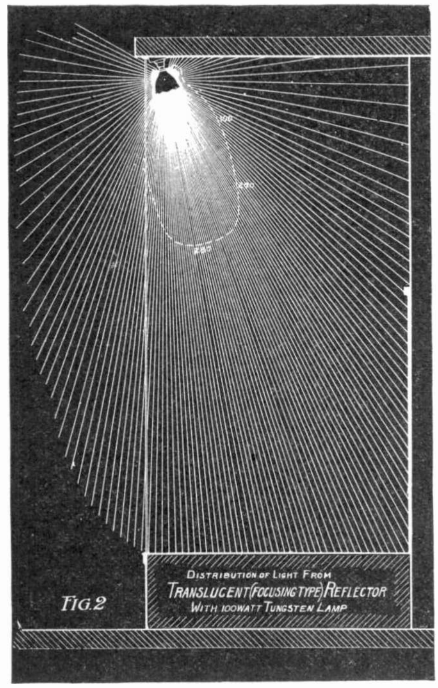
(5) Put a plug of wood in the center of the zinc.

(6) Carefully remove zinc from an old cell and pour the sulphate of zinc from this old cell into a pail having a cloth over the pail to strain it, so that it will be clean to fill the new jar.

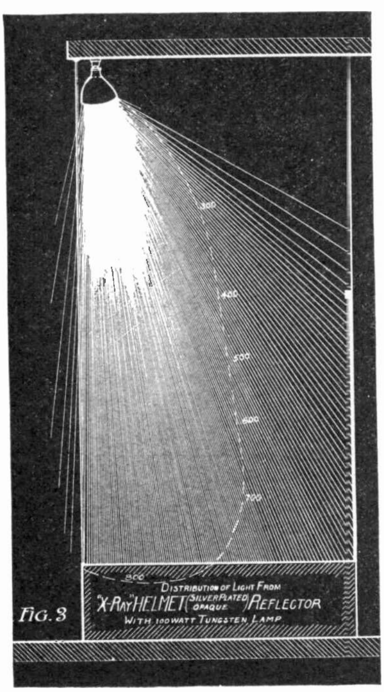
(7) Pour this sulphate slowly into the new cell letting it fall only upon the piece of wood in the center of the zinc. In this way the sulphate will run down slowly and will stay on top of the water.

Then, in a very short time, five minutes or so, the battery will be up in voltage and amperage and ready for business; the blue line will form in the center of the jar and the battery will respond in a satisfactory manner.





Correct and Incorrect Window Lighting



The principle of efficient show window lighting demands that lamps be placed high up in the front of the window and out of sight of the passer-by. Also the light must be strong in the window and minimum out on the sidewalk. The cuts illustrate the difference between efficient and inefficient lighting, being drawn on the plan employed by illuminating experts to illusintensity of light distribution.

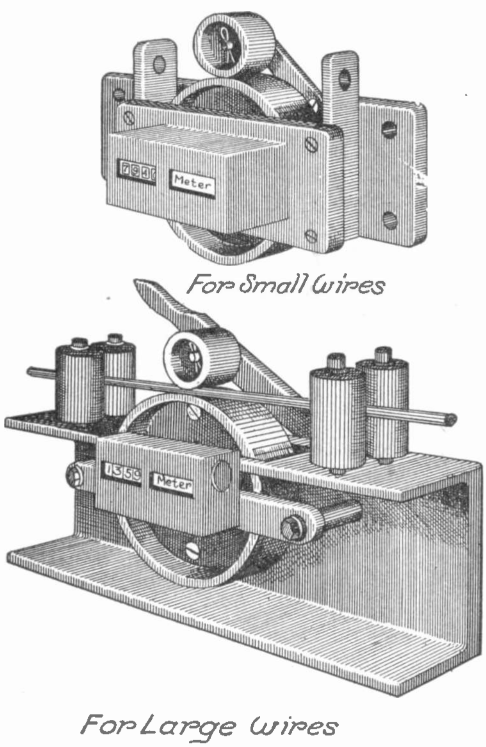
In Fig. 1 a form of trough reflector is used, sometimes these are home-made affairs. A large percentage of the light is not thrown into the occupied portion of the window at all but is directed into the street and over the top and ends of the window. It can only be made efficient by using a large number of lamps, which is expensive.

Fig. 2 shows the same window equipped with translucent, prismatic or opal reflectors. Considerable light passes through these reflectors and is wasted as far as results in the window are concerned. Such reflectors are all right in their place but not for show window lighting.

More nearly approaching the correct effect is that produced by what is called the X-ray reflector shown in Fig. 3. Here the distribution of light is strongest in the part of the window where it is needed.

Wire Measuring Devices

When wires or cables are bought by the foot, as is the case with all rubber covered wires used for indoor circuits, it pays to get exact measurements of the lengths of each



WIRE MEASURING DEVICES

size used on any given job. All that is needed for the purpose is a wheel of known circumference which will be rotated as the wire is drawn over it and which will record the number of times it revolves. If the circumference of the wheel is exactly one foot, the length of the wire we are measuring will be as many feet as the number of times the wheel has revolved.

Small sizes of wire may be guided through a pair of eyes in uprights on opposite sides of the measuring wheel. For large sizes the eyes can be replaced by vertical and horizontal rollers which may be adjustably spaced to suit varying diameters of wires. In either case an extra wheel resting on the wire makes it bear firmly on the measuring wheel so that it will not slip past the latter without turning it.

America Made Photography Practical

While the original photographic process was invented by a French artist, Daguerre to whom the French government gave a pension of 6000 francs in recognition of his work, it was an American who made this process practical. Just seventy years ago Prof. J. W. Draper took the first commercially successful photographs in the old building of New York University. London experts, perhaps a little vexed at having England left out of the early photographic honors, described Draper's success as "due to the brilliancy of the climate."

Perhaps there was some truth in this unsolicited comment, but America was not to stop with offering merely the brightness (and freedom from fogs) of its atmosphere for picture taking. When the incandescent lamp was perfected here, it was soon applied to photography but required too long an exposure to be extensively used. The arc lamp (also an American invention) proved much quicker for the purpose, but it took still another American to outstrip them all by developing a mercury vapor lamp which is cheaper to install and quicker in action than the arc lamp. For, while the greenish light of the Cooper-Hewitt mercury vapor lamp does not give the most pleasant appearance to what it lights, it abounds in highly "actinic" rays, that is, in rays which are quick in affecting chemicals such as are used on photographic films or plates.

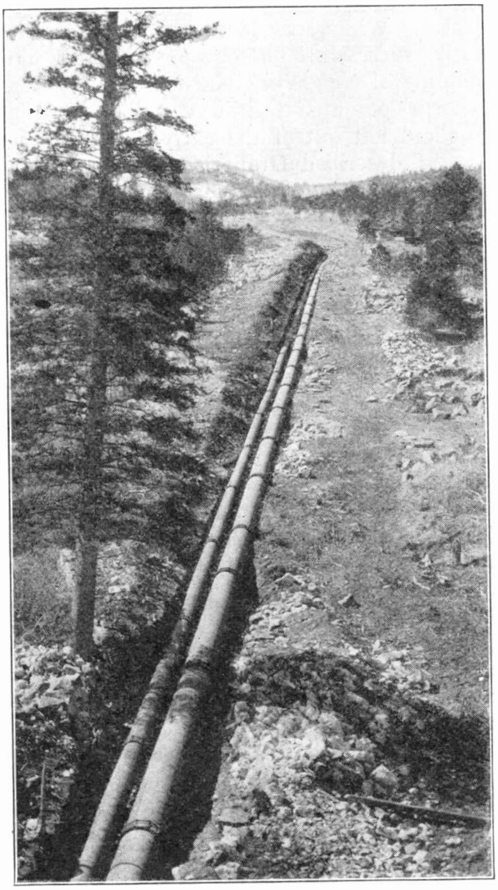
So our British cousins were quite right. It was the brilliancy of the light here that has led to American advances in photography, and when the natural brilliancy of daylight was too slow for American ways, we made it more and more brilliant artificially until now the brightness of the outer day (or night) need not be considered at all by the successful photographer.

Tungsten Ore

Most of the tungsten ore used in the United States is mined in the region of Boulder, Colo. A new field of deposits has been found near Round Mountain, Nevada, however and preparations are under way to mine the ore at these beds which are said to be more extensive than at Boulder.

Spiral Steel Pipe Lines

The accompanying picture illustrates the way water is brought from a source, some three miles distant, to the hydro-electric plant of the Homestake Mining Company at Englewood, South Dakota. The pipes, one of which is something over two feet in diameter, are made of spiral steel so well riveted as to withstand a pressure of 210 pounds per square inch. At the lower end where the power plant is located these pipes are equipped with nozzles which direct the stream of water into the buckets of the water-wheels driving the dynamos. These streams of water rush out of the nozzles under terrific pressure and are almost as solid as a bar of steel when they impinge on the buckets of the water wheels.



PIPE LINES OF SPIRAL STEEL

Electric Furnaces as Auxiliaries

At present the chief field for electric smelting furnaces seems to be in localities where both ore and waterpower are cheap and where the electric process can therefore compete with smelting by means of coal or other fuel. But even where coal is cheap and water power scarce, the electric furnace may still find its place as a supplement to the ordinary methods whenever high grade iron or steel is desired. The fuel-using furnaces all have their limitations because the flames themselves have an effect on the charge, which effect annuls the action that might otherwise be obtained from well known and cheap ingredients.

For instance, in making high grade steel by the Siemens-Martin process, the so-called protoxides of iron in the charge should be deprived of all of their oxygen so as to leave merely the iron. This is attempted by the use of silicon in the charge, but the flame of the fuel again oxidizes the hot mixture and undoes part of the good work. Now if the molten product is run into an electric furnace and silicon is again added there, its work can readily be completed as there is no oxidizing flame present in the electric furnace. By running the molten metal into this auxiliary, very little current will be required to keep it going and the absence of flame and smoke will make it comparatively easy to obtain standards of purity that have been impossible with the older methods.

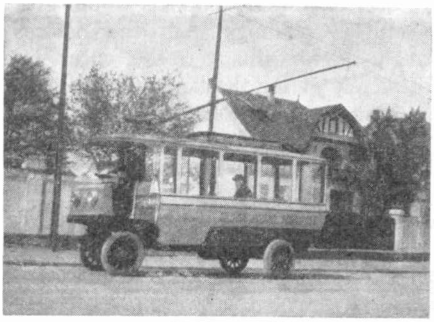
Fire Protection in Electric Plants

In the case of a fire in an electric power plant more care must be used than in an ordinary building because of the danger to firemen. The operator must decide whether any circuits may be "killed." Fine sand is commonly provided. However, in a recent fire starting from trouble in a compensator in which the cover of the latter was blown off, sand only raised the level of the oil without hindering the fire, which was finally put out by smothering with a heavy wet canvas tarpaulin. A Babcock fire extinguisher had no effect.

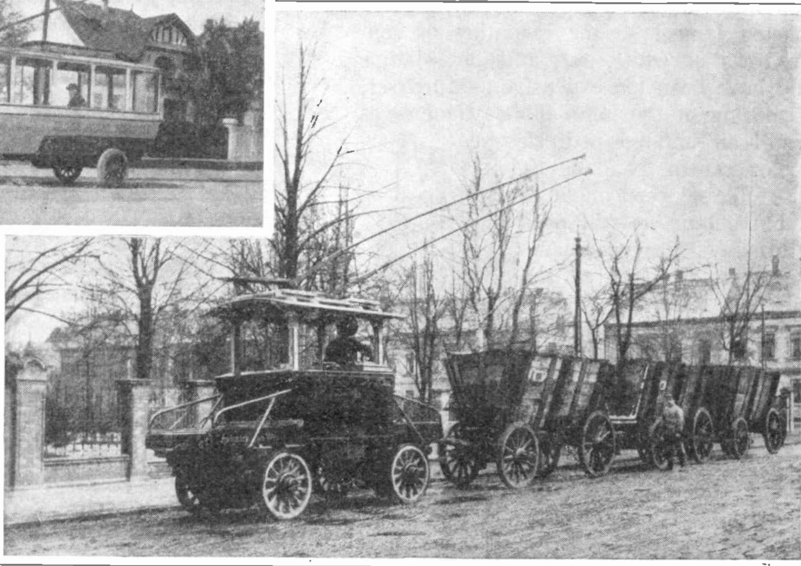
Care must also be used in playing a chemical extinguisher upon live apparatus, for it is said that the chemicals have the property of conducting electricity.

Trackless Trolley Lines

Trackless trolleys as they are called are in reality street car lines without metal rails. They are coming into quite extensive use abroad. One of the pictures shows a line running between Pirano Portorose and St. Lucia in Austria, a distance of about three miles. Four trolley wires are used two-thirds of the way and two the rest of the distance. Unlike the ordinary trolley pole with a single wheel, this car has a pair of sliding contacts, one to receive the current and pass it to the controller and twenty-two horse-power motor, the other to return it from the motor to the line. The car carries twenty passengers, runs at a speed of about fifteen miles an hour, and with rubber tires on stone, asphalt and macadam roads is a pleasant means of travel.



TRACKLESS TROLLEY IN ST. LUCIA



TRACKLESS TROLLEY LOCOMOTIVE AT WURZEN

The second illustration from Wurzen, Germany, shows a trackless trolley locomotive capable of hauling twenty-seven wagons of grain weighing five tons each, at a speed of three and three-quarters miles per hour. Like the Austrian road, two wires and sliding contacts are used, but two trolley poles instead of one. Current is supplied both systems at 500 volts pressure, which is the voltage ordinarily used for street cars in this country. Several short trackless trolley systems are used in Germany, some of which haul loads of fifteen or twenty tons up hills having a 45 per cent grade.

It is obvious, though, that before extensive use can be made of such systems in this country the roads must be improved to such an extent as to compare favorably with those in Europe.

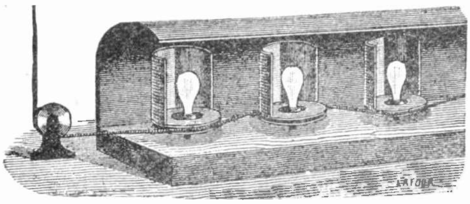
Electrical Bleaching Is Spotless

The damage done to clothes, paper or fabric by using chloride of lime for bleaching is due largely to two causes. First, there are impurities in the ordinary chloride of lime which discolor the articles treated. Then it is difficult to dissolve the chloride of lime and any undissolved parts will either stain the fabric or eat holes into it.

Both of these troubles are avoided by the electrolytic method which consists simply in passing a current through a solution of common salt. Everybody knows how easy it is to make a clear solution of ordinary salt, and when the electric current frees the chlorine from the dissolved salt, this also is readily soluble in water so that it remains well distributed. The result is a clear bleaching liquid with no half dissolved parts to damage the pulp or fabrics—the ideal bleaching mixture.

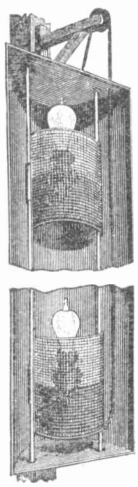
Color Changes in Early Stage Lighting

One of the interesting points about the early epoch of electric stage lighting was the way in which the changes in colors were brought about. At that time, more than



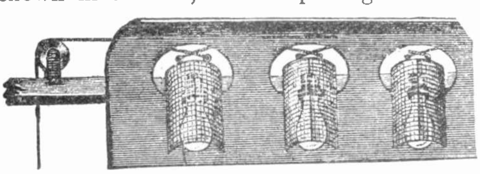
FOOTLIGHTS

25 years ago, incandescent (carbon filament) lamps were about as costly as the present Tungsten lamps, so the installing of separate rows of white, red and blue lamps would have been too expensive. Moreover, the coloring of the lamp globes themselves was still an undeveloped art, so color screens had to be used. These were made of the thin gelatin as still used in Christmas tree ornaments and either attached to the same base with the sockets or arranged as separately movable slides.



STRIP LIGHTS

For the footlights, each lamp was partly surrounded by a gelatin screen half of which was red and the other half blue. The screen reached only two-thirds of the way around the lamp so that the other third exposed the clear lamp which was mounted so that it could be rotated with its socket. Then a cord was run alternately in opposite directions around the bases of the lamps as shown in the cut, so that pulling the cord



BORDER LAMPS

would rotate the lamps and expose one or the other color of screen. A somewhat similar pull arrangement was used with the border lamps which were hung from their pivots, while in the strip lights the lamps were stationary and the screens were moved past them. These gelatin screens were too thin and flimsy to support themselves, so they were held up by the wire meshwork indicated in the cuts which show the arrangement originally used at a theatre in Munich.

A Surprise for Foundrymen

It was to be expected that electric pyrometers when used for measuring the high temperatures of foundry cupolas would give more accurate readings than the devices formerly used for this purpose. But instead of merely giving the temperatures with greater exactness, the electric devices have shown that some of the readings taken with the older types of thermometers were far out of the way.

Thus in the case of cast iron, our textbooks and cyclopedias commonly state (and on high authority, like that of Regnault or Rankine) that the melting point lies between 2600 and 3400 degrees Fahrenheit, varying with the percentage of combined carbon. Now careful measurements with electric pyrometers have shown that this melting point really lies between 2000 and 2250° F. and that cast iron is generally poured into the molds at a temperature of little over 2150° F.

So if discrepancies should be found between old and new textbooks on this subject, the greater accuracy of the electric thermometers may be thanked for correcting the figures.

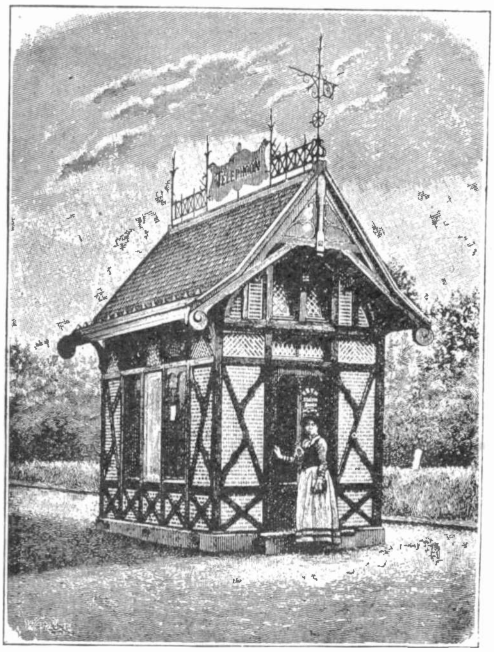
Electric Tableaux Here and Abroad

To us in America, the word tableau implies "living pictures" or similar representations by persons in costume. But not so to the electrical fraternity in Germany. There the term tableau means what we call an "annunciator," which, there as here, may be had in either the drop or in the dial type.

The idea evidently is that the dropping of a flap *shows* a number or name to the European, while with us it *announces* it. Hence what we call a drop annunciator sells abroad under the imposing name of (Tableaux-Klappen-Apparat) or, literally 'Tableau-shutter-apparatus."

Public Telephone Station in Holland

Without a telephone in the house, it is usually necessary in this country to go to the nearest drug store to find a public telephone. In Holland this is somewhat different, as is shown by the picture of a public telephone station in Baarn.



PUBLIC TELEPHONE STATION IN HOLLAND

Insulation—Electric and Otherwise

In its broader meaning, the term insulator means any substance which will not readily permit the passage of some form of energy. The latter may be a current of electricity, or it may be energy in the form of heat. Thus the layers of asbestos, magnesia, granulated cork or mineral wool which the steam fitters wrap around steam pipes in basements and around the "risers" or vertical pipes leading to the upper stories of tall buildings, are insulations. They are heat insulation just as truly as the wrappings around copper wire are current (or electrical) insulations. Hence the curious instance of a large Milwaukee and New York concern in which the electrical department is entirely distinct from the insulation department, the latter being devoted to the sale of heat-nsulating pipe coverings.

Can Trolleys Climb Mountains?

How steep a grade are trolley cars able to climb?

The answer depends not only on the speed at which the cars are run in proportion to the power of their motors, but also on the loads they have to carry. Steam railroads can readily limit the number of persons crowding into one of their cars; but the moment an electric line tries to do the same there is a general protest from the public, for apparently everything is thought possible when electricity is the moving power.

Thus on the electric railway running from the mining town of Cripple Creek to the city of Victor in Colorado, the rush hours often find the miners not only filling the cars but crowding the roofs as well, so that the load is far beyond that for which the cars were planned. Still the cars readily take the steep grades, climbing a thousand feet in a distance of three miles and making the total run of six miles in the remarkable quick time of forty minutes.

The grades on the Cripple Creek side average 6¼ per cent and the same cars could easily climb much steeper grades if they were to carry only the number of passengers which they could readily accommodate.

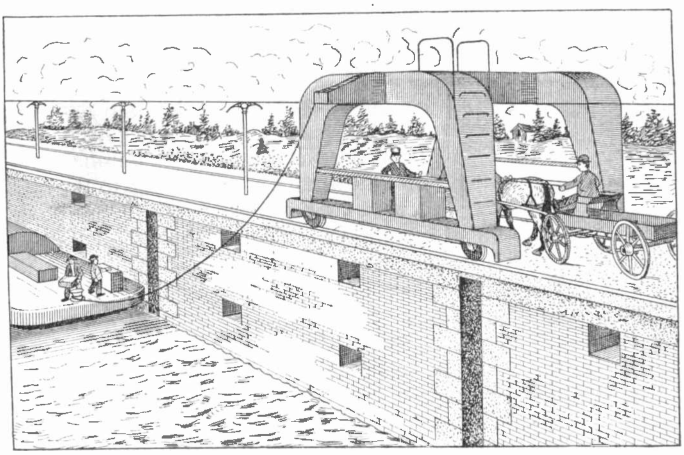
Why Electric Autos Wear Longest

"Whom the gods would destroy, they first make mad." Thus said the ancients tens of centuries before the days of our present machinery. Were those same Greeks or Romans alive today, they probably would apply the same saying to modern devices such as our automobiles. To them the auto having a mechanism that jerks, twists and thumps would seem possessed of some mad spirit that was working to destroy it; as indeed it is, for sudden strains do more to shorten the life of any machine than is done by long continued smooth running.

This absence of jarring and pounding is one of the great differences between the electric and the gasoline autos. With an equally strong framework and mechanism (or even with a somewhat lighter one for the electrically propelled vehicle) it takes no expert to see that the madly thumping one will be the one that will need the frequent repairs and that will give out much sooner than its smoothly purring competitor.

Freak Electric Locomotive

This picture is not part of the structure of a bridge as the reader may at first glance assume, but is a very oddly built electric locomotive for hauling canal boats. The masonry work upon which the locomotive rests is a roadway along a canal near Bremen,

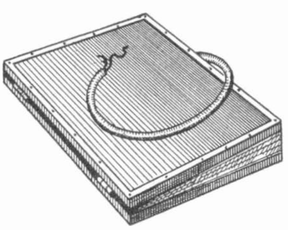


FREAK ELECTRIC LOCOMOTIVE

Germany, and has to be kept clear for the passage of teams. In order to do this, the two U-shaped steel structures were buil' and held together by the connecting girder. The trolley wires supply a motor located in the upper part of the peculiar locomotive and also furnish current for lamps which light the roadway as the locomotive passes along.

Electric Switch Mat

Operators of machines driven by small electric motors are apt to forget to turn off the current when they leave the machine. The motor keeps on running and wastes current. The Beynon switch mat is designed to prevent this waste. It is so constructed that the weight of the feet on the upper surface presses it down and closes the circuit. Upon lifting the feet the circuit is opened and the motor stops.



ELECTRIC SWITCH MAT

Growth of the Telephone Business

President Theodore N. Vail has sent to the 35,000 stockholders of the American Telephone and Telegraph Company the annual report of the directors, showing that 1909 was a year of remarkable progress.

The important activities include the purchase of a substantial interest in the Western Union Telegraph Company, the conversion of over a hundred million dollars of bonds into stock, the increase in the number of shareholders by over nine thousand during the year and the rearrangement of territories of some of the associated companies in accordance with state or geographical boundaries.

The number of subscribers' telephone stations in the Bell system was increased to over five millions, including one and a half millions operated by connecting companies; the wire mileage of the Bell companies has been increased to over ten million miles, the traffic has increased to nearly twenty million connections a day, amounting to six and a half billion connections a year; the plant additions were over $28,000,000, with nearly $45,000,000 applied out of revenue to maintenance and reconstruction purposes, with the result that the plant has steadily become more permanent.

All the telephone apparatus of the Bell Companies is manufactured by the Western Electric Company, being concentrated principally at its great plant in Hawthorne, Ill., a suburb of Chicago. The business of this latter company showed an improvement of $3,000,000 net during the year.

The relation between the telegraph and the telephone and the obligations of the company to the public consequent upon taking over a substantial interest in the Western Union Telegraph Company are explained at some length.

Briefly stated, it is maintained that the two services are supplemental or auxiliary to one another rather than competitive.

Telegraphy eliminates time of transit of correspondence, by the electrical transmission of the text from the office of origin to the office of destination, but it is incomplete in that the methods of collection and delivery are slow and primitive.

Telephony eliminates distance by placing parties at distant points in direct personal communication with each other, but the expense prohibits its use for the transmission of written messages over long distances.

Telegraph operation requires a separate, distinct and entirely different operating organization and equipment from that of a telephone company. Line construction and maintenance are common to both and can be combined or performed jointly with economy. The same wires may be used for both telephone and telegraph circuits at the same time, but the wires must be strung differently, and the differentiation continues from that point. Where there is density of message traffic sufficient to keep busy an expert telegraph operator, the telephone cannot compete with the telegraph in handling message traffic, but where the traffic is comparatively light, the telephone will gradually supersede the telegraph in handling message traffic. Each will have its well-defined field, the telegraph between centres of density and for long distances, the telephone for short distances and for collection and distribution between the customer and such centres.

English as It Is "Translated"

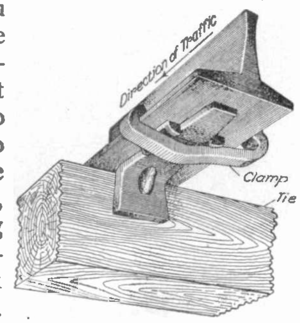
When foreign technical writers try their hands at the king's English, the resulting twists of words are sometimes rather curious. Part of them are easily understood, as for example the term "glow lamp," which the British persistently use instead of saying incandescent lamp, as we do. But other expressions are not so easily accounted for, as for instance the following five gleaned from a 1909 edition of a prominent technical dictionary:

Stretching Insulator (Strain Insulator).
Hook Screw (Screw Hook).
Cross Rod (Ground Anchor).
Indicator Disk Drop (Annunciator Drop).
Wall Lamp Holder (Wall Socket).

Perhaps those of us who are not interested in promoting Esperanto or some other prospective world-tongue, would do well to try and standardize the terms of our own international language.

Creeping of Rails

As you sat the other afternoon in a swiftly moving interurban car, being carried to your destination, you probably did not realize that the steel pathway which stretched out ahead of you is moving just a little in the direction you are going. The rails are "creeping," and that gang of men who stepped aside to let you pass are sawing off rails, readjusting joints, and replacing track bolts due to this. Roads having two or more tracks with traffic in one direction on each are subject to this trouble.

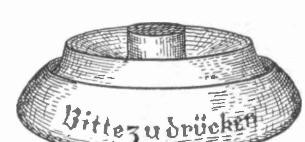


RAIL CLAMP

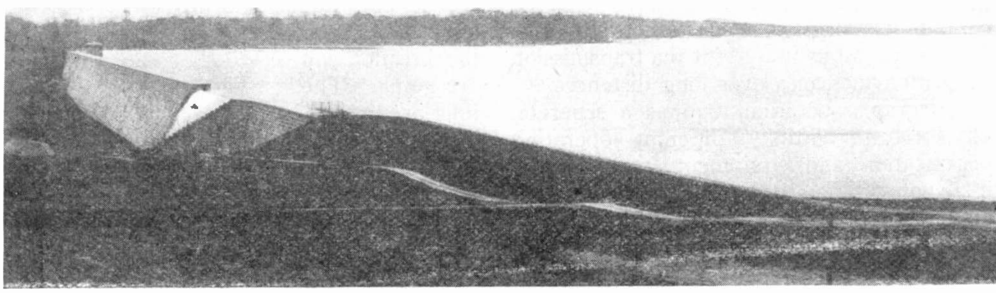
Engineers and trackmen are not quite sure as to the cause, but the blows given the end of a rail by the wheels, and the wave motion given to it are supposed to be responsible. The illustration shows a device to prevent creeping, any tendency to move in the direction of traffic only causing the clamp to grip the rail closer.

Please to Push the Button

If Rip Van Winkle were to awaken today, we can easily imagine him as looking in vain for the massive knocker at the front door of almost any house he might approach. Of



course among English speaking peoples we have no such out-of-time folks to deal with, but they are still to be found among the people of the smaller villages in other lands where even as simple an electric device as the doorbell has been slow to introduce and they need be told how to use it. That at least is what we would infer when we find pushbuttons still on the German and Austrian markets labeled "Bitte zu Drücken," which in our tongue reads "Please to Push."

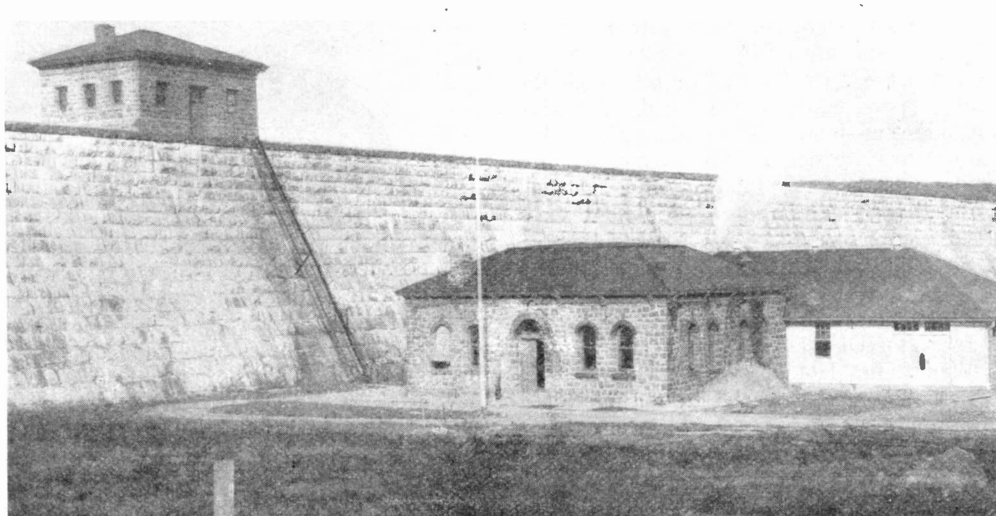


Purifying a City's Water Supply

The water supply of Jersey City, N. J., is derived from the Rockaway River and is impounded in the Boonton reservoir, having a capacity of 8,500 million gallons. A rather unusual feature of this great undertaking is that the water itself provides the power by which it is sterilized and made wholesone to drink.

A common method of sterilizing water is to use a substance known as hypochlorite of sodium. A very small quantity of this so-called "bleach" will purify a vast quantity of water, the objectionable bacteria in the water being destroyed by oxidation. At this plant the hypochlorite of sodium is made by passing an electric current through an electrolytic cell containing a solution of common salt (sodium chloride) and water. The electricity for this purpose is generated on the spot by a water turbine and dynamo driven by the water from the reservoir on its way into the pipes which supply the city. Thus the water not only serves the purpose of quenching the thirst of thousands but at the same time provides the means for its own purification.

After it is sterilized the water is carried to the city through a steel pipe conduit 23 miles long, the average flow being 40 million gallons a day.

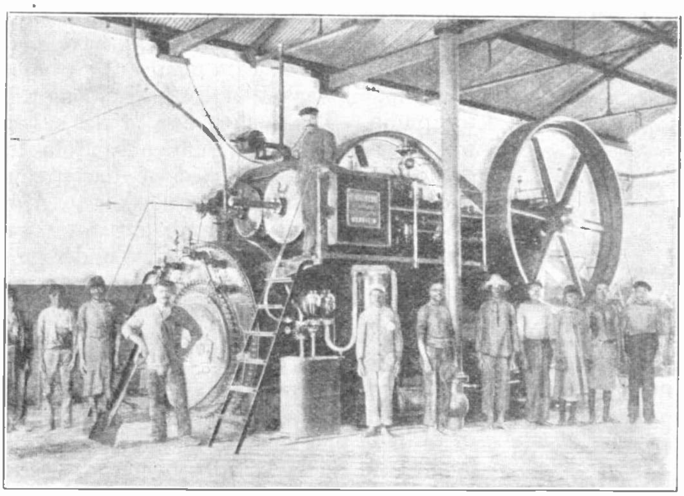


First Aerial Lighthouse

To make aerial navigation even reasonably safe at night, there will have to be strongly lighted points corresponding to the lighthouses on our coasts and rivers. The first of these has already been provided by the German government which has fitted up a tower at Spandau for this purpose. The equipment consists simply of 38 incandescent lamps of high candle power placed upright on a circular horizontal frame some twenty feet in diameter. By flashing the lamps at stipulated intervals, they will also be tried as a means of signaling at night to the military airships and dirigible balloons during the spring maneuvers at Spandau. Thus begins the new era when lighthouses will no longer be confined to points on our seacoasts and along navigable streams, but will dot our inland landscapes also.

Boiler-Top Electric Light Engine

In exporting apparatus of any kind, the transportation rate depends partly on the weight and partly on the space which the goods occupy in the hold of the vessel.



BOILER-TOP ELECTRIC LIGHT ENGINE

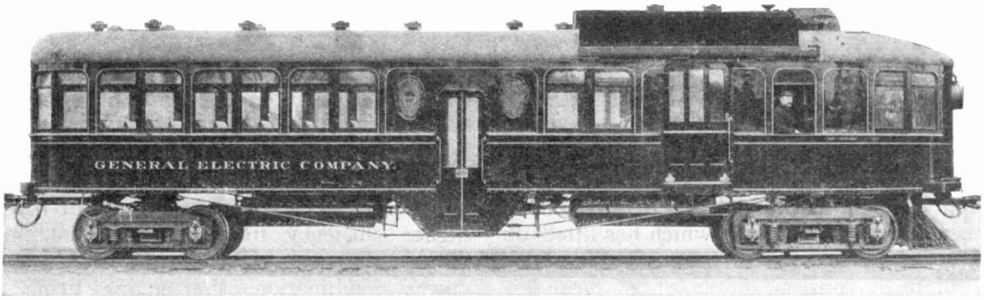
Knowing this the Germans who have been more keenly after the export trade than we of the United States, have designed some unusually compact types of machinery for this export trade. Thus instead of offering boilers and engines with separate bases, each of which adds to both the bulk and the weight, one firm is building them after the general plan of our farm thresher engines, with the engine mounted right on the boiler. The combination is considerably cheaper to transport to distant lands than the separate boiler and engine would be for the same capacity, and can easily be of much higher efficiency than our farm engines. The illustration shows such a 235 horsepower combination, the engine being a compound one, in the electric light plant at Lorenzo Marques in Portuguese South Africa. It also shows the native helpers of the electric light company who are being trained to understand the value of electrical devices.

No Longer an Infant

Among people of any education we now very rarely find any one so poorly informed as to repeat the old phrase that "electricity is still in its infancy." However it takes time for well balanced conceptions of any topic to become universal and occasionally our readers may still find some ready to repeat this long outworn quotation. If they do, just let them be ready with a few figures to show the healthy strength of the so-called infant. Not figures as to the extensive use of electrical devices (for a few decades more may make the present number of users seem quite paltry) but as to the rate of development attained in electrical devices as compared with any others.

For instance, the steam engine, in spite of so many years of development, rarely reaches an efficiency of 16 or 17 per cent, while dynamos and motors with an efficiency of 85 or 90 per cent are commonplace and even 96 per cent is frequently reached. In other words, these electric devices have already attained five or six times as much of their possible growth in efficiency as the steam motors which are many times as old in years.

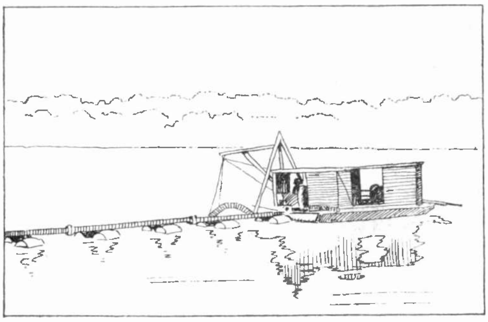
Which then is really the immature one?



A car, driven by electricity, which may be operated without a trolley wire or third rail, is realized in the type shown in the illustration and is somewhat different from the one described in the January issue. This car may be run over steam roads or city car tracks. A direct current, electric dynamo is coupled to a 100 horse-power, eight-cylinder gasoline engine and supplies current to two 60 horse-power motors. A water cooler for keeping the engine cylinders at a low temperature is shown on the roof of the car. A storage battery lights the car, and heat is provided by passing the exhaust of the engine through pipes in the car.

Electricity Solves a Dredging Problem

A land company was recently engaged in pumping sand out of the bed of the Des Moines river near Ottumwa, Ia., and loading it into cars on the river bank. The outfit consisted of a centrifugal pump on the bank driven by a steam engine. A long pipe extended out into the river from the pump, supported on floats, and sucked the sand and water up from the bed of the stream.



MOTOR PUMP ON A DREDGE

In high water the pump was submerged and they could not work. In low water the pipe line had to be extended half way across the river and it was almost impossible to retain an air tight suction system.

While in this predicament the Ottumwa Railway and Light Company suggested that it be allowed to try a motor driven outfit, which, after considerable argument and figuring was permitted.

It was then possible to put the pumping outfit out in the middle of the river on a barge; the cost of this would have been prohibitive with a steam plant. A 75 horse-power motor was put on the barge along with the pump. The suction end of the system was thus very short, being only from the pump down into the bed of the stream, and there was almost no leakage. After leaving the pump the sand and water was forced through the long pipe line under pressure instead of by suction. Here there was some leakage at the joints, but it was the water which leaked out instead of the sand, so no harm was done.

This system worked so well that they were able to fill a car with sand in 30 minutes instead of in one and one-half to three hours by the old method. Moreover the electric pump would work in all stages of water.

Letters By Telegraph

The Western Union Telegraph Company have inaugurated a night letter service between the hours of 6 p. m. and midnight. Between these hours fifty words may be sent at the same rate as ten during the day.

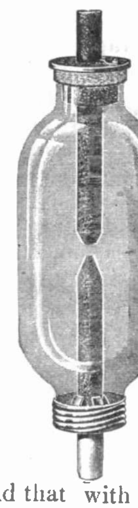
Lamp Adjuster

The sketch illustrates the "Noslip" lamp adjuster for regulating the height of an incandescent lamp when it is attached to the ordinary lamp cord. The device is made of hard fibre and the weight of the lamp and cord, when the latter is threaded through the two holes, causes the two cams which turn on centers to turn slightly and grip the cord so that it cannot slip. The cord is put in place by removing the center piece.

LAMP ADJUSTER

Arc Lengths Vary with the Gas

When Louis B. Marks, who is now one of the prominent illuminating engineers of New York City, developed the first successful enclosed arc lamp, he found that the length of the arc is much longer in a partial vacuum than in the open air.

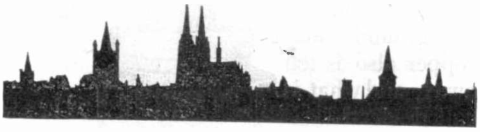


If instead of air we use some simple gas in the enclosing globe, the lengths will again change according to the gas used. And more than this: Villari (a French scientist) has found that the arcing length changes even in the same gas when the current is reversed. Thus in comparing hydrogen and oxygen as gases for use in the arc chamber, he found that with the positive carbon uppermost, the arc in oxygen was 25.7 times as long as in hydrogen; but when the negative carbon was uppermost, the arc in oxygen was only five times as long as in hydrogen.

The average experimenter might not have thought of reversing the current, so this shows how many factors must be watched by the true scientist and how important it is to have the test readings cover varying conditions

A Pioneer Telegrapher

Colonel Joseph Green, one of the oldest telegraphers in this country, while visiting the Philadelphia Electrical Show sent a wireless message from the station to ships on the Atlantic. He is 77 years old, and remembers the time when the telegraph instrument was as much of a curiosity as is wireless apparatus today. Colonel Green had the unusual honor in his younger days of hearing Professor Morse use the telegraph key, and of "working a wire" with Thomas A. Edison.



Street Lighting Once Thought Sacrilegious

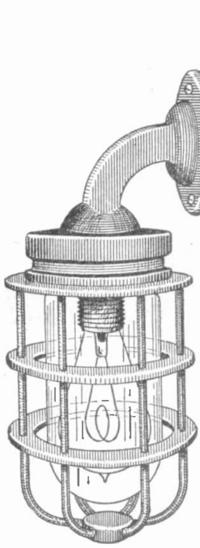
Those of our readers who have traveled in continental Europe will recognize this characteristic profile of the city on the Rhine that was over six centuries erecting the magnificent cathedral whose 500 foot spires are among the tallest in all lands. But few of them may know that one of the greatest battles in the early campaign for street lighting was fought here almost a hundred years ago, centering largely around the city hall whose magnificent tower shows at the left of the cathedral in the silhouette. The most influential local paper, the *Koelner Anzeiger* even combated the proposed street lighting on religious grounds, contending in strong editorials that "had the Almighty intended to have night turned into day, he would have created a second sun to shine after dusk."

To this the advocates of street lighting promptly replied: "Then since the Lord did not create a second sun, do you mean to imply that He intended us all to go to bed with the chickens?" For, devout as the people of Cologne were, they would go out after dark and were soon won over to the adoption of a general system of street lighting. This meant an extensive installation of gas lamps which in recent years have been supplemented and partly replaced by electric lights, for the great city on the Rhine continues to be among the progressive ones.

Electric Lighting on Shipboard

The electric wiring on board ships, especially those navigating in salt water, is difficult to keep in good condition unless well installed. It may interest some to know that this class of wiring has received particular attention from the Underwriters' National Electric Association in that the Code devotes several pages to "Rules for Marine Wiring."

Salt water on any current carrying device acts very readily as a carrier of current to ground, and copper also is led away, and what is called electrolysis or electrolytic action takes place soon, leaving the damp copper in a corroded condition.


PROTECTED LAMP USED ON SHIPBOARD

The lighting fixture shown is protected from mechanical injury by a substantial guard. Inside of this is a heavy glass globe, commonly called a "vapor-tight globe," screwed against a rubber gasket in the metal box containing the socket. The use of heavier metal in the conduit outlet than usual may also be noted, the whole device forming a water-tight fitting.

The Relief of Lucknow

Again the appeal for aid has come from the famous city in British East India where 1700 men held out for twelve weeks against a besieging force of 10,000 during the mutiny of 1857. But this time it will not be a thrilling theme for a Lowell to treat in poetry or a Bruch to set to music. For now it is relief from darkness and backwardness that this ancient city is seeking when it is asking foreign manufacturers to figure on lighting it electrically. And the relief will surely come, for a city of 250,000 people must offer a good field for electrical progress even in benighted India.

Galileo and the Telegraph

Had that keen observer, Galileo, been as fond of writing fiction as he was of stating exact facts, we might today be crediting him with being the first to predict the telegraph. Indeed, he just missed his opportunity, for in his "Dialogues" one of the speakers has this to say: "You remind me of a man who wished to tell me a secret for enabling one to speak, by means of a certain sympathy of magnetized bars, to some one at a distance of two or three thousand miles. I said to him that I would willingly purchase the secret, but that I would first like to see the experiment, and that it would satisfy me to perform it, I being in one of my rooms and he in another. He answered me that at so short a distance the operation could not well be seen. Thereupon I dismissed him, saying that I had no desire just then to go to Cairo or Moscow to see his experiment, but that if he, however, would go thither himself I would do the rest by remaining at Venice."

Evidently Galileo had some idea of the transmission of signals. A Jules Verne would not have ended the matter there, but would have sent one of the parties a thousand miles off to test the suggested magnetic telegraph. But Galileo, intent on his studies of pendulums, telescopes and the solar system, was too sober a scientist for this. Some years later the report spread in France and Germany that it was possible to correspond at a distance by means of magnets, but it took two more centuries to make this an accomplished fact.

High Efficiency Lamps in Ireland

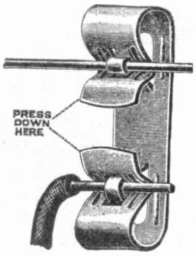
That the proverbially thrifty Scot should take advantage of the high efficiency tantalum and tungsten lamps to save current, was to be expected. But how about his colleagues of the Emerald Isle? If any one thinks they have been left behind, let him read the recent news from Dublin. There the people took so generally to the high priced, current-saving lamps that it cut the revenues of the electric light plant down to a losing point, whereupon the Dublin Electric Light Commission ordered a ten percent advance in the rate for current! Can this be another proof of the contention that centuries ago part of the Scotch emigrated to Ireland, taking their characteristic thrift with them?

ELECTRIC CURRENT AT WORK

NEW DEVICES FOR APPLYING ELECTRICITY

"Stay Connected" Connector

An hour spent in hunting for a broken wire or trouble on a bell or alarm system operated by batteries, frequently ends in finding one or more loose contacts where the wires are attached to the binding posts of the battery cells.

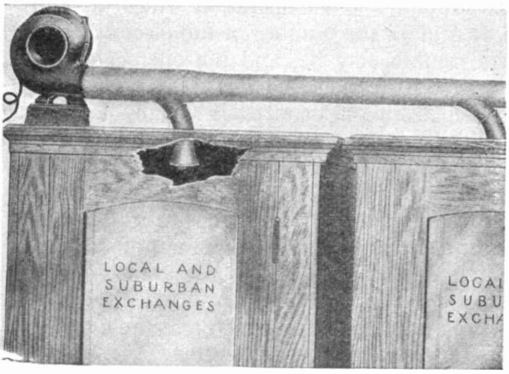


CONNECTOR

The Fahnestock connector is designed to hold the ends of two wires which are to be joined to close a circuit, the current flowing from one to the other through the metal of the connector. It is also made in a slightly different form to act as a battery binding post. Obviously no tools are necessary in making connections.

Telephone Booth Ventilation

"Gee! But that's a hot place." How often that remark is made by someone who has just emerged from a telephone booth on a moderately warm day. The ordinary telephone booth contains about 40 cubic feet of air, and in some states health departments require that this air be changed at the rate of 30 cubic feet per minute.

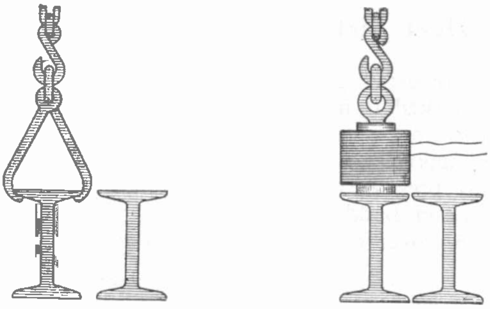


TELEPHONE BOOTH FAN

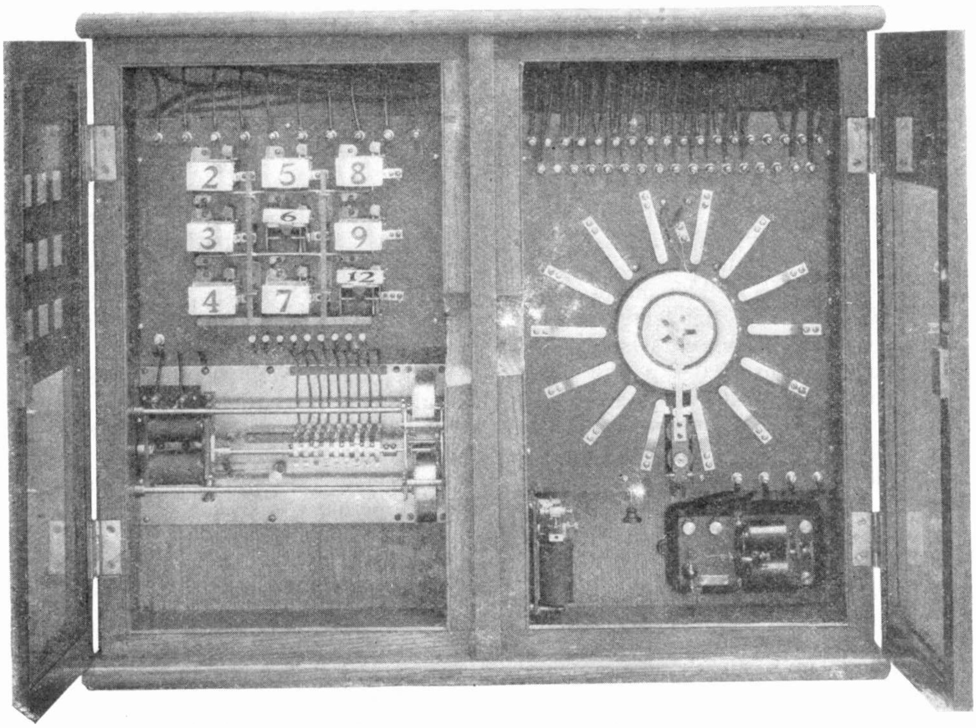
The picture illustrates a booth ventilating apparatus manufactured by the B. F. Sturtevant Company, Hyde Park, Mass. The equipment consists of a motor, fan, piping, and diffuser shown inside the booth. Fifty cubic feet of air can be blown into two or more booths every minute without noise, the air being released by a patent arrangement which does not affect the hearing at the receiver. Further, the dead air breathed by a previous user and containing germs of disease, perhaps, is driven away.

Lifting Magnets Save Space

One reason why electric magnets are preferred by modern steel mills to the old types of devices for gripping the articles to be lifted, is because they save space both in handling and in storing the articles. For instance, in handling steel I-beams by the old method, the tongs or grapple-hooks themselves spread out alongside the flange of the beam, so that these beams cannot be set close to each other. They may be slid over afterwards, but that requires manual labor and also means that they must either be slid back or tipped up when they are to be gripped again. Electromagnets, as now used more and more for such work, save this extra time and labor. With them each beam or rail can readily be set snug up against the previous one so as to use the storage space to the best advantage.



HOW LIFTING MAGNETS SAVE SPACE

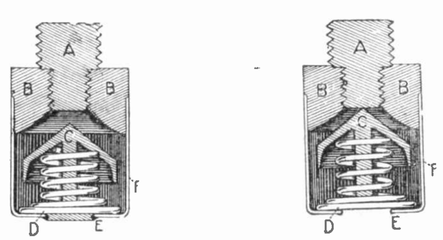


TESTING APPARATUS FOR AUTOMATIC JOURNAL ALARM

Heat Alarm in Grain Elevators

"Insuring grain elevators is a lottery," remarked an insurance man recently. Filled with floor openings and chutes, with always an unavoidable quantity of grain-dust and dirt present, a fire spreads rapidly in this class of buildings.

An overheated bearing covered with oil



THE JOURNAL THERMOSTAT, CIRCUIT OPEN AND CLOSED

and dust affords good conditions to start a fire. Automatic journal alarms used in 18 elevators in Chicago and in something like 42 in other cities, gives warning of hot bearings by ringing electric bells. The small illustrations show a journal thermostat, one being set in the cap of every bearing and connected to bells and batteries. (A) is metal surrounded by hard rubber (B), upon which fits a metal base (F). The coiled spring and T-shaped metal (C) are held down by solder which melts at 165° F., closing the circuit at (A) to ground. This operation rings a bell which gives the number of the circuit where the trouble may be, and the oiler can thus locate the bearing quickly.

The testing apparatus is usually located in the engine room. The right hand portion of the large illustration is a clock arrangement which may be revolved, making an electrical contact with the fingers shown, telling the engineer whether or not the circuits are clear. On the left are magnetic drops, one for each circuit. A fused thermostat operates the drop which tells the number of the circuit needing attention.

The Western Fire Appliance Works, Chicago, which installs and maintain this system, states that a record covering several years shows that the number of warnings of dangerously hot bearings in any elevator every three years equals the total number of bearings.

Electric Hoists as Time Savers

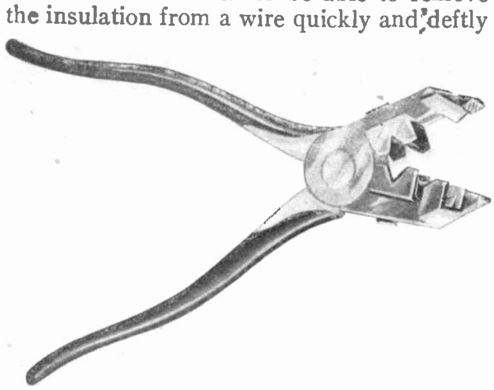
In moving machinery or materials by means of a crane, every minute saved in time increases the daily capacity of the man operating the machine; and where the parts moved are so heavy that it takes several men to guide them, every minute saved in the time of handling these materials counts for all of the men. For quite heavy loads a slow speed means severe enough strains on the crane and hoist, but when the loads are lighter it is logical that the same hoist should move them more quickly. This is actually done by modern electric hoists which are so designed that the speed changes automatically with the load. Thus in the case of a three-ton electric crane the rate of raising or lowering varies as follows, in feet per minute:

Load	6000 lbs.	Speed	6 ft.
"	4000 "	"	7¼ "
"	2500 "	"	8½ "
"	2000 "	"	10 "
"	1000 "	"	13 "
"	500 "	"	15 "
"	None	"	18 "

In other words, the empty hook returns to a new position in one-third of the time it took to move it with the three-ton load.

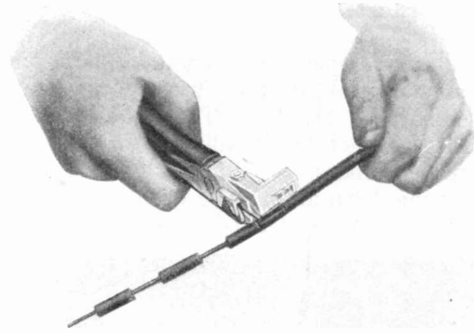
Combined Insulation Cutter and Pliers

It is no small trick to be able to remove the insulation from a wire quickly and deftly



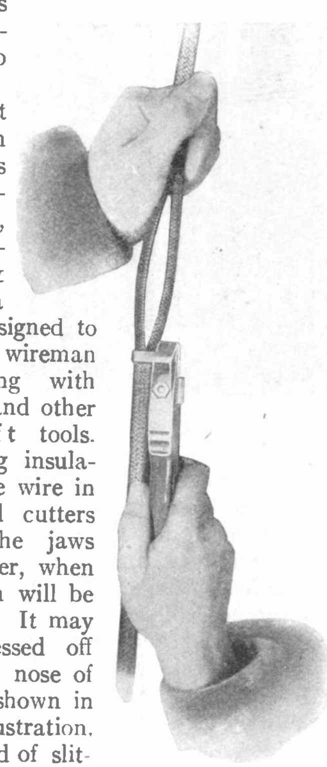
COMBINED INSULATION CUTTER AND PLIERS

in preparing it for a soldered joint. Wire, being "drawn," has a hard outer surface, which, if it be nicked with a knife when cutting through the insulation, loses much of



CUTTING INSULATION

its strength and the wire is liable to break at that point if there is any vibration or working back and forth. Also in "skinning" the wire it is quite difficult to do a neat job quickly as the insulation tends to fray out.



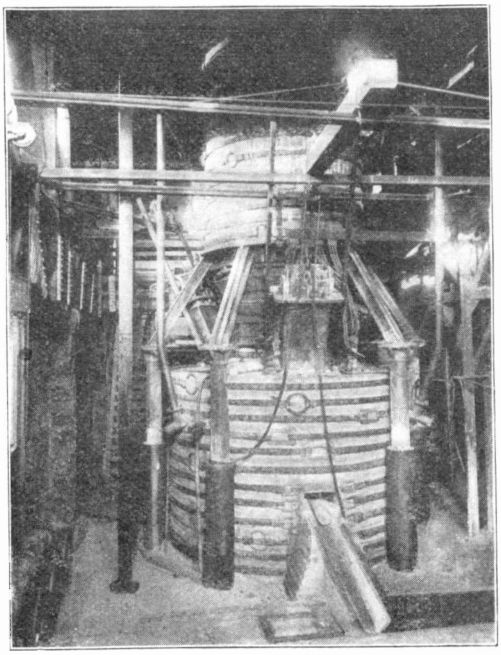
SLITTING INSULATION

The Goehst combination cutting pliers and insulation cutter, made by Mathias Klein & Sons, is a novel tool designed to relieve the wireman from working with jack-knives and other make-shift tools. When cutting insulation hold the wire in the V-shaped cutters and press the jaws firmly together, when the insulation will be cut through. It may then be pressed off with the flat nose of the pliers as shown in the second illustration.

The method of slitting the insulation on duplex wire is shown in the third illustration and is very simple, being done with the cutting jaws. These jaws are forced through the insulation and the pliers drawn toward the operator, the insulation being cut as rapidly and as clean as a piece of cloth with a sharp pair of scissors.

Electric Smelting Furnace

The accompanying illustration shows an iron and steel smelting furnace located in Domnarfvet, Sweden. Three-phase alternating current at 40 volts is turned onto three electrodes, two of which are shown plunging down at an angle in the top of the furnace. These electrodes are raised and



ELECTRIC SMELTING FURNACE

lowered by wires and pulleys. The lower ends come close together in the lower part of the furnace and the heavy current forms an arc across from one to the other so that intense heat is generated. No air is used in this furnace. The charge is made up of ore, lime, coke and charcoal.

When the charge is melted the plug shown in front is removed and the glowing liquid metal flows out through the spout.

New Rotary Snap Switch

The Tirrill snap switch upsets our idea that a rotary snap switch is usually placed on the side wall. This switch is designed to be placed on the ceiling. A strong fish cord, attached to the interior mechanism, extends through the switch cover to within reach. One pull turns the light on, and a second turns it off.

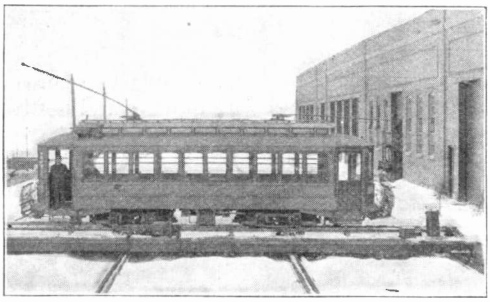
An Ironclad Bell

In the ordinary electric bell, the vibrating stem requires a long slot in the cover over the works, so that these cannot be completely housed in. If this vibrating clapper could be arranged to slide lengthwise through a closely fitting opening in the cover, then the mechanism could be better protected from the weather.

This can be done by connecting the usual vibrating armature of the magnet to a plunger mounted so that it will strike the gong at one end of its travel. It is easy to fit this plunger snugly into an opening in the casing which can be a heavy casting. The wires are brought out through a stuffing box which can easily be sealed watertight. For marine use the castings can be made of malleable iron and copper plated to withstand the action of the salty mists.

Electric Transfer Table

The Oneida Railway of New York has adopted transfer tables to use in handling their cars in switching at the barn instead of putting in a costly layout of switches and track that is not required with this arrangement. Not only does the arrangement



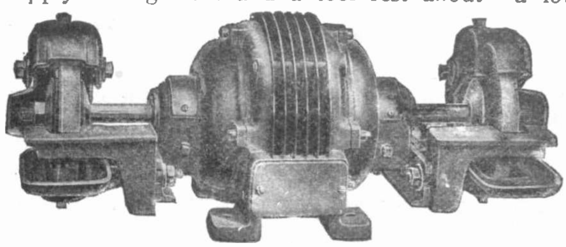
ELECTRIC TRANSFER TABLE

quickly and efficiently convey cars from one track to another, but it also does it silently and without the changing of trolleys necessary in switching. This device also saves a considerable amount of space in front of the barn for the laying of switch frogs in the old method.

The movable track is run by a regular car motor of fifty horsepower and controlled with an ordinary controller. The photograph shows one of the cars in the process of handling by this unusual method.

Motor Driven Grinder and Buffer

Along with the rapid increase in the use of labor saving devices in shops and factories comes a General Electric induction motor equipped with an emery wheel, a water supply arrangement and a tool rest about

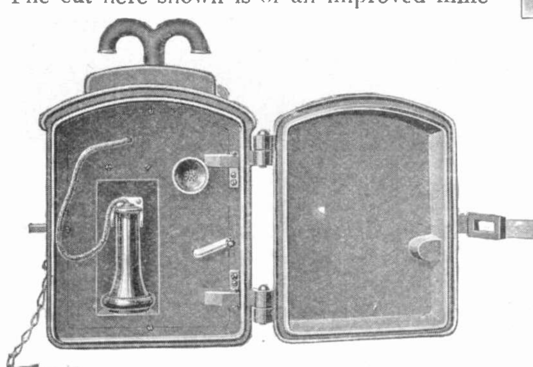


MOTOR DRIVEN GRINDER AND BUFFER

the shaft on each side of the motor. The entire device is shown in the illustration and is a valuable help in shops where sharp tools are necessary. The shaft being threaded at each end, buffers for smoothing up and finishing work may be attached when desired.

Mine Telephone

Prevention of loss of life from fires in mines has become imperative. The most practical safeguarding measure that has been advanced by authorities on the subject is a systematic use of the telephone. The cut here shown is of an improved mine



MINE TELEPHONE

telephone made by the Western Electric Company which has special features adapting it to damp underground places.

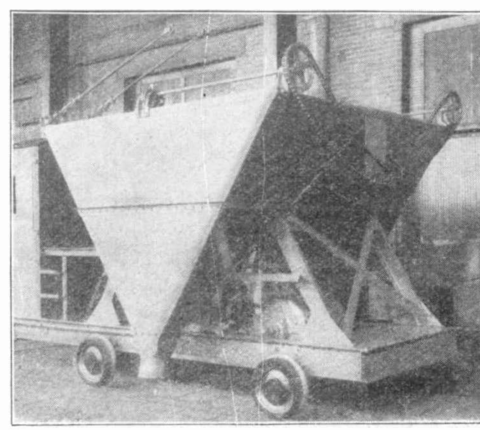
All the parts are enclosed in a compact metal case, and when the door is closed they are protected from the wet and from corrosion due to acid fumes and gases, all of which would quickly destroy the usefulness of an ordinary, unprotected telephone.

The parts may also be readily removed without the use of a soldering iron and so are easily accessible for quick inspection and repair.

The gongs are especially designed to give a loud, clear ring which can be heard a long distance in the mine. They are protected by a hood, making it impossible for large particles of foreign matter to fall on them or interfere with their action.

Charging Coke Ovens

The accompanying illustration shows an electrically driven coke oven charging car

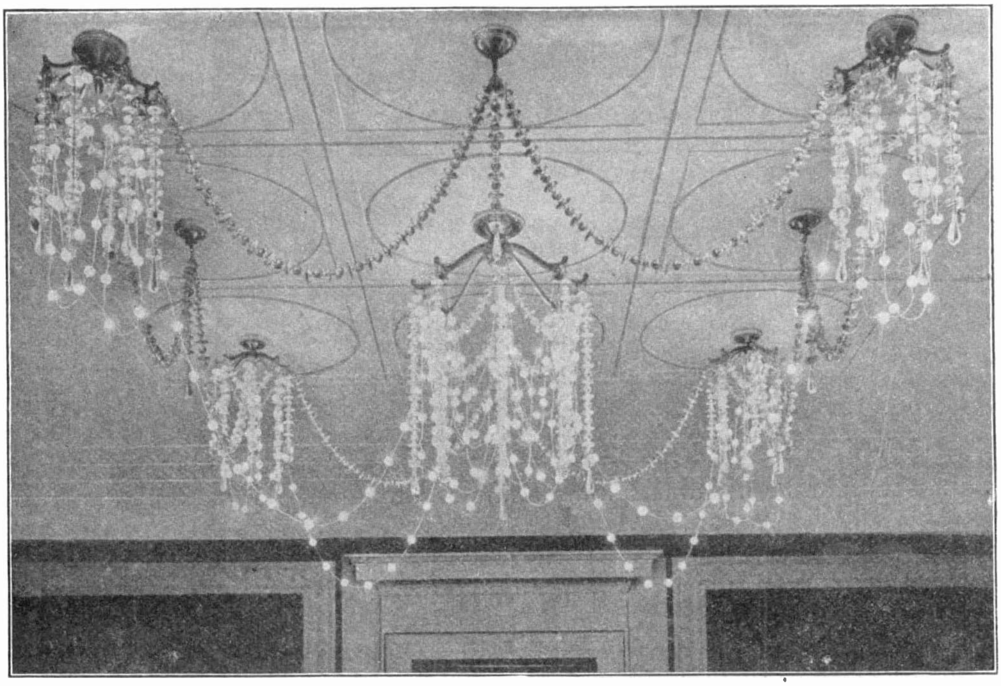


COKE OVEN CHARGER

designed and built at Columbus, Ohio. A large driving motor of the rolling mill type of construction is geared directly to the rear axle of the car, and is operated from the controller in the enclosed cab at the left. This motor is suspended from the truck frame by heavy springs to reduce jarring strain on the gears. A second motor operates two shafts at the top of the hopper, and from these, two "poking" rods prevent the coal from clogging the discharge spouts through which it must pass to the ovens. At the top of the hopper are two trolley poles instead of one as on the ordinary trolley car; one trolley wire bringing the current to the motors and the other conducting it back to the power plant, an arrangement frequently used in Europe on trolley cars operated without a track.

Room Illuminated by Miniature Lamps

The world-renowned art dealers Keller & Reiner of Berlin, Germany, have recently remodeled their old establishment on Potsdam Street. One of the rooms in this building is fitted up as a parlor containing the most elaborate decorations. This parlor, which was designed by Prof. Peter Behrens of Neubabelsburg-Erdmannshof, contains something new in the way of illumination.



MINIATURE LAMPS STRUNG IN FESTOONS

The visitor on entering the parlor is surprised by what appears to be a wealth of pearls spread in graceful festoons over the whole upper part of the room. The artist seems to have had the intention of proving that the chains of small globular lamps, destined originally by the General Electric Company of this country for use only for purposes of festive illumination, may well be employed as permanent lighting factors. And he arrived at his conclusion through the consideration that the lighting of a room can best be effected not by the strongly concentrated light from one source only, but by the diffusive one, dissolved into numberless small light centres. This method is made possible by the miniature lamps, while prisms of crystal glass heighten the light-breaking and decorative effects. A faint idea of the beauty of the arrangement is shown in the picture, reproduced from *Mitterlungen der Berliner Elektricitäts-Werke.*

Humming of an Induction Motor

Inquiry is often made as to the cause of the singing or humming of induction motors. This in part is due to the vibration produced along the air-gap by the teeth of the rotor and is lessened by building the slots nearly closed.

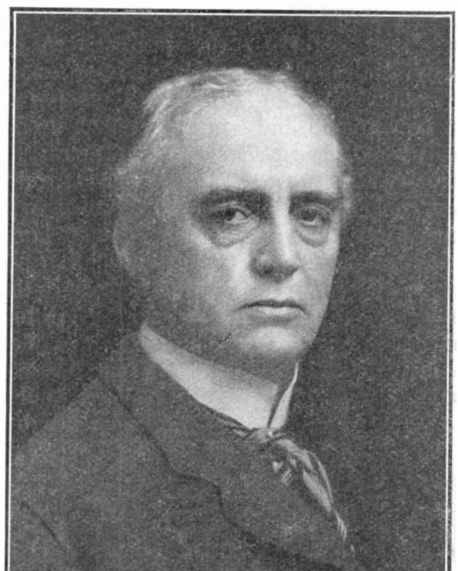
We know also that by striking a magnetized steel bar several sharp blows with a hammer that much, if not all of its magnetism will be lost. The theory of a magnet is that its molecules arrange themselves end to end along the path of the magnetic lines of force, which are not strong enough to hold these particles against the shock of the hammer.

The changing magnetic action about the laminated portions of an induction motor no doubt causes vibrations which add their notes to those of the air-gap's song.

Electrical Men of the Times

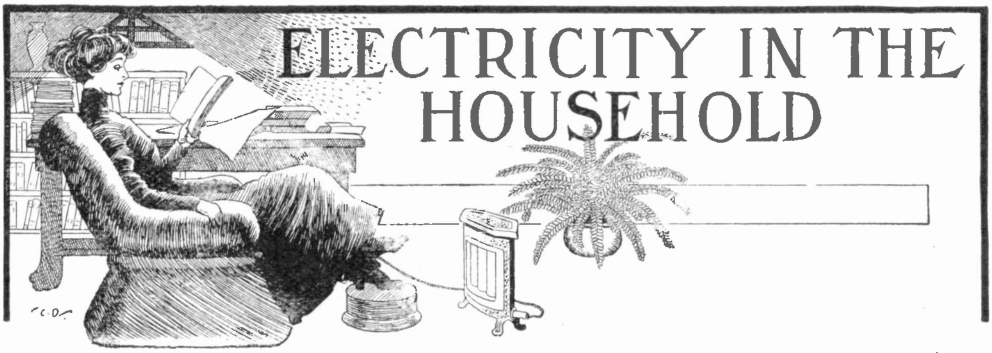
ENOS M. BARTON

The man whose strong face is pictured on this page has played an important part in the development of the electrical industry. For forty years Mr. Barton was actively engaged in the manufacture of electrical apparatus, and when, in 1908, he retired from the presidency of the Western Electric Company to become chairman of the board of directors, probably no man in the higher positions in the entire industry had exceeded him in length of service. Mr. Barton built up a great business, identified largely with the telephone—a business that numbered its employees by the tens of thousands and became known around the world. But he traveled no easy road to success.



Enos M. Barton was born on a farm in Lorraine Township, Jefferson County, N. Y., December 2, 1842. He now lives on a farm, at Hinsdale, near Chicago, but it is a different sort of a farm. He started in life with one great advantage; he was well born—well born in the American sense that he came from a long line of sturdy, upright native ancestors, with the inestimable advantage of the example and counsel of a good mother. The Barton farm contained but 17 acres; the household was one of plain living and high thinking. The father, a school-master and a scholarly man, died before Enos was 13, and even before that the boy had gone to work, first in a grocery store and later in the Watertown (N. Y.) telegraph office, where he learned the rudiments of telegraphy. Thereafter, for several years, he had many vicissitudes. At one time the ad was a clerk in the Watertown post-office. Here his fellow clerk was the late Roswell P. Flower, who became governor of the state In the intervals of various employments, Enos was studying and going to school when he could. At 16 we find him a night telegraph operator in Rochester, where he managed to attend a preparatory school and later the University of Rochester, where he remained a year. From 1861 to 1863 he was a Western Union operator in New York, handling press reports of war news. While there he entered the University of New York and completed his sophomore year. Returning to Rochester as chief day operator, Mr. Barton worked faithfully for several years. Then he managed, partially by the help of his mother, who mortgaged her home, to raise the money to enter into the business of manufacturing electrical supplies in Cleveland, in partnership with George W. Shawk. This was in 1869. The Cleveland enterprise prospered. Within a year Mr. Shawk sold out to Elisha Gray, later one of the inventors of the telephone. In 1870 Gray & Barton removed to Chicago, General Anson Stager having previously been admitted to the firm. The ultimate successor of this business was the Western Electric Company, formed in 1882, of which Mr. Barton became president in 1886.

Mr. Barton has been a man of deeds rather than words, but his work proves him to be an executive of the very first rank. His success has been conspicuous, and it has been an honestly earned, clean success.

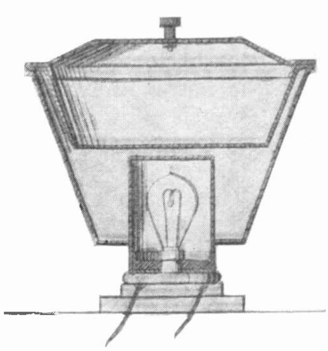


The Electric Fireless Cooker

We hear a lot of talk these days about fireless cookers. They all work on the principle that a comparatively small amount of heat is required for the ordinary cooking operations if that heat can be confined and not allowed to escape as wasted energy, which is the case in the ordinary cook stove. The simplest form of fireless cooker consists of a large receptacle of some kind which is lined with material which is non-conductive of heat. Into this is set the cooking utensil containing the food which is to be cooked, the latter having been partially cooked in an oven or on the stove and already at a high temperature. The fireless cooker is then covered over airtight and left to stand, the cooking process going on uninterruptedly for several hours due to the heat already in the materials, which heat cannot escape. Beans, which require a long time to bake, can be thoroughly cooked through in this manner after having been only partially baked in an oven.

As stated above this is the principle of the simplest form of fireless cooker. Obviously an improvement would be to generate the small amount of heat necessary inside of the cooker itself and do away with the stove altogether. This idea has been worked out in an electrical fireless cooker, the heat being generated by electric lamps of special design. These lamps are of low efficiency as far as lighting goes but throw off a great deal of heat as in the case of the lamps used in luminous electric radiators.

You say you do not see how an incandescent lamp could produce a temperature high enough to cook with. It could not if it were exposed and the heat were constantly being carried away into the atmosphere. But take that lamp and confine it in a place where the heat cannot escape and the temperature will immediately rise to an astonishing degree.


CEREAL COOKER

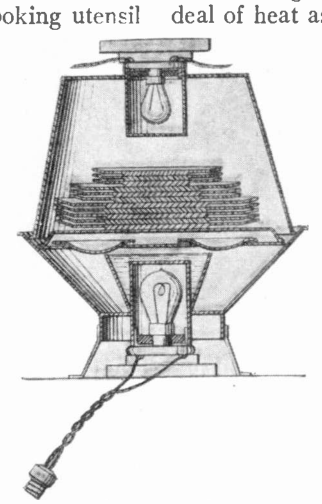
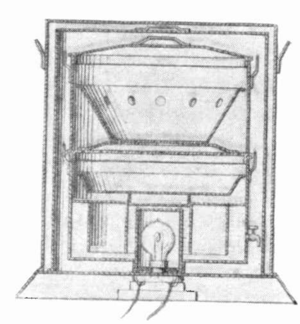
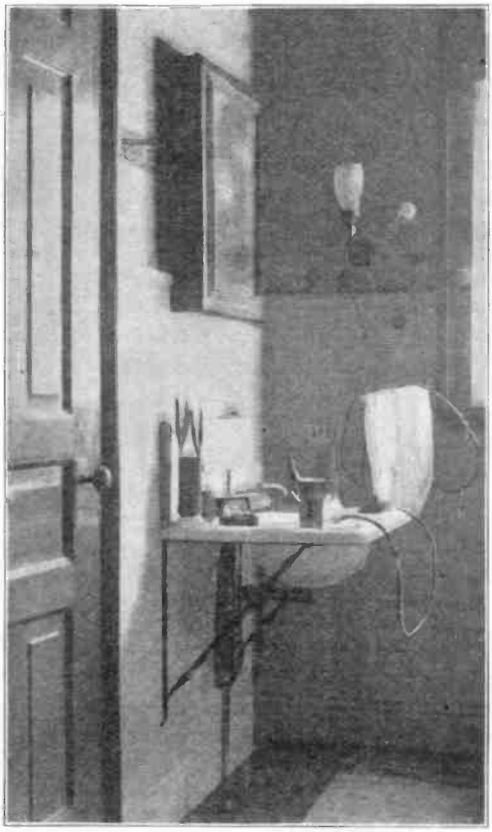


PLATE WARMER


COFFEE URN

In the line drawings showing the interior of the utensils will be seen the principle applied to an electric cereal cooker, plate warmer and egg poacher, and a coffee urn. As will be seen, the ordinary cooking utensils such as are sold by the thousands, and consequently of low price, are employed, with slight alterations. Take for instance the cereal cooker; an ordinary one is employed and a hole cut in the bottom over which a tomato can is soldered in an inverted position to receive the incandescent lamp. This is mounted on a suitable base to keep the heat from escaping. The same is true of the coffee urn and the egg poacher, an outer heat-holding casing being added where necessary as in the case of the urn. In every case the lamp imparts its heat directly to a small quantity of water which comes in contact with the vessel which contains the articles to be cooked.

It is held that in these electric steam and vapor cookers with incandescent lamps there is only necessary the heating of a small film or thin layer of water to the boiling point or thereabouts, the vapor or steam arising from this small amount of water doing the cooking in the steamer, while the remaining quantity of water is at a much lower temperature, and is utilized only as a source of supply or storage, while it is at the same time absorbing heat



APPLICATIONS OF THE FIRELESS COOKER

which is ordinarily wasted by radiation.

As it is well known that dead air space is one of the best heat insulators, this is taken advantage of in this electric fireless cooker, by providing air chambers and outer shells, with air spaces between the same, for retaining the heat, the water boiling in the center while the outer shell is comparatively cold. While with ordinary fireless cookers the heat is all first absorbed by the water heated by a flame, and then given off to the food during the night, the electric cooker applies only a small amount of heat electrically and continuously for a considerable length of time, the food being then hot and ready to be served.

With this system of fireless cooker units the ordinary gas range becomes merely a table as shown in one of the pictures; in the dining room the sideboard becomes an electric kitchen and in the bathroom the curling irons and shaving mug are heated upon the same novel principle of utilizing the heat of lamps.

THE SIDEBOARD BECOMES AN ELECTRIC KITCHEN

Why Should You Fear Electricity?

There is probably no other subject in the world with which really intelligent and cultured people are so unfamiliar as electricity. We all know, of course, that it gives us light and runs motors which do a variety of useful work, and that it will heat flat irons, warming pads and a few small utensils. But that is about as far as most people's knowledge goes.

This is not at all surprising—in fact, if people knew much more, *that* would be remarkable. For, in the first place, electricity is such uncanny stuff—*nobody* in the whole world knows what it is. All we know is that it will do certain things. And again, because of its very mystery, the newspapers have always "played up" all the strange and sensational electrical stories until many people are afraid of it.

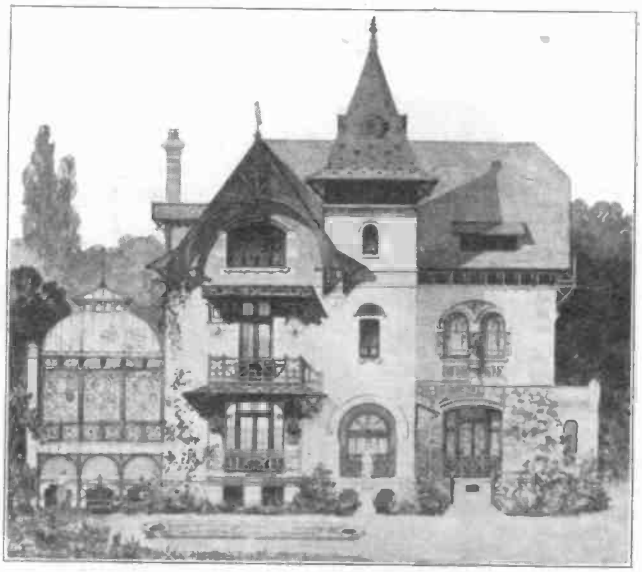
Too few have told us about the millions and millions spent to make electric service not only safe but practically "fool proof." Too few have bothered to show us that this strange force has been so harnessed and trained that a mere child can use it.

This lack of familiarity with electricity, coupled with just a touch of hereditary fear of the lightning flash, is back of that timidity on the part of some women to adopt electrical innovations. In this connection there are two things to be remembered: modern electrical construction will not permit you to come in contact with live wires if you try; wires of house circuits carry current at such low potential or pressure that if you were to contrive to touch them you would not be harmed.

Plan of a Parisian Mansion

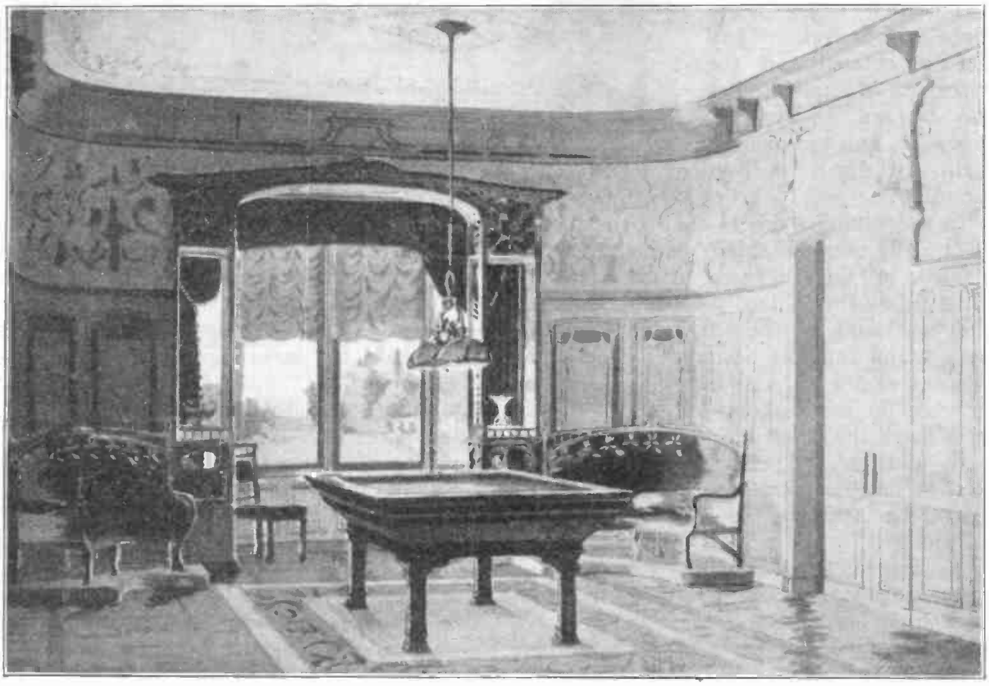
BY EMILE RUEGG

Those who read the description of the wonderful electrical mansion of Georgia Knap, which appeared in the January issue of Popular Electricity, may think that the application of electric current was there carried to extreme. But the curiosities of today are the realities of tomorrow and we cannot be justified in saying that houses built on such elaborate plans may not even become common as people use electricity more and more. In this article some views and plans are shown which give a better idea of how the strange things were accomplished in Mr. Knap's double-walled house



ELECTRIC MANSION OF GEORGIA KNAP

If electricity is to be fully applied it is evident that the exposure of wires, tubes, motors, switchboards, rails and machinery of all descriptions would make an awkward appearance, thus spoiling much



BILLIARD ROOM WITH DISAPPEARING TABLE

of the real value which such service would otherwise afford.

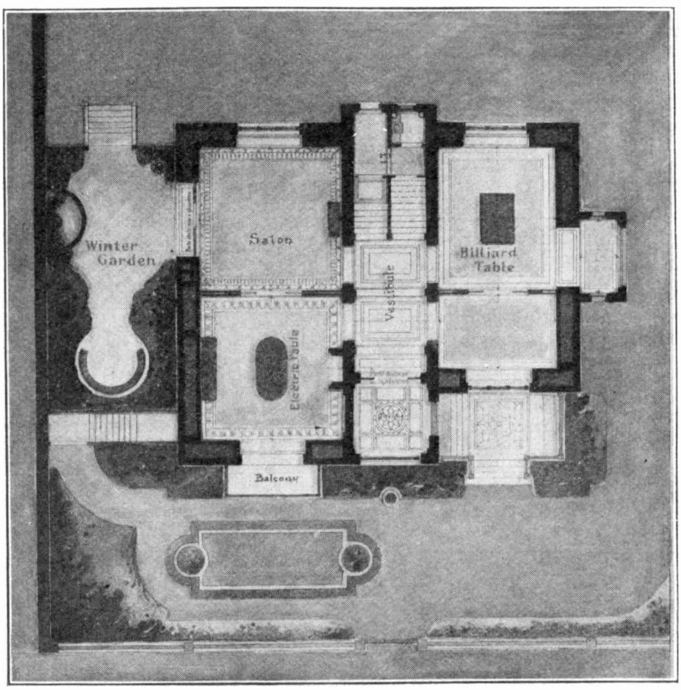
It is quite natural therefore to build such a mansion on the plan of double walls, which plan was carried out.

The construction of double walls gives to the house real value if we consider that they keep the building warm in winter and protect it against the heat of midsummer. The chill of the rainy weather with all its consequences may also be almost completely eliminated. Then, too, the water and other pipes are kept from freezing in winter, besides being hidden from view, and are easily reached and repaired without intruding into the costly rooms. All the wires, motors, conduits, etc., are easily accessible if necessary and remain unseen at the same time. The plan of the main floor as shown here indicates how the double walls are arranged, the space between the inner and outer walls being three or four feet. They can be entered and the wires, pipes and cables can be put in and arranged to suit the requirements of the various rooms.

In the dining room is shown the unique electrically served table which was described in the previous article. In the billiard hall the billiard table is so arranged that by closing a switch the table is lowered by a motor into the basement beneath, the opening closed up, and then the room may be used for a ball room.

With all the plans and illustrations shown here and in the previous article it is easy to imagine how an electric mansion might be arranged to the best possible advantage.

As said before, although this may all seem somewhat visionary, still such houses have been built, several of them, in Paris, according to Mr. Knap's plans, and there is no reason why they should not ultimately become popular.



PLAN OF THE DOUBLE-WALLED MANSION

From Whence Comes the Heat?

"Mama, where does the heat come from?" asked a 10-year-old boy as he pointed to a dish of water boiling on an electric heater, and at the same time felt of the cord that led from the plug to the device. "The electricity does it," replied the mother, and there is where we nearly always stop explaining.

When electric current travels along a wire it expects plenty of room, and when this is not provided, a protest is made in the form of heat, part of the energy of the current being used up in overcoming the obstruction to its flow, called "resistance." If a fine piece of platinum wire be inserted at some point in a copper wire carrying current, it will oppose the passage of this, more than does the copper wire, and the platinum will become white hot. This is just what takes place in any electric heating apparatus when you turn on the current, but here the resistance which may be fine wire or some thin flat metal between the two ends of the copper wire in the cord, is hidden under the heater plate, on in the "heating unit", as it is called.

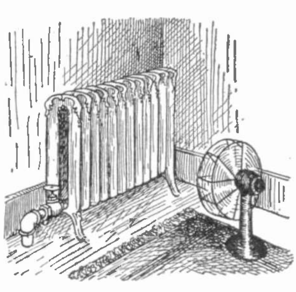
An Electrical Fan the Year Around

With the approach of warm summer days it is natural to think about buying an electric fan for the home. Last summer and the summer before you were on the point of doing it, but put it off until the worst days were over and then thought that the fan would be useless until the next hot season, so didn't get it.

Did you ever stop to think of the electric fan as an all-the-year-around proposition? Probably not. But just the same there is hardly a day in the year when it cannot be used to advantage.

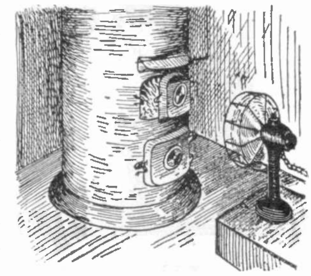
Very little need be said about its advantages in the summer time when its cool breeze is a blessing. But aside from its cooling properties it may be made to act as a ventilating device on those particularly muggy days when there "isn't a breath of air stirring" and it seems impossible to change the air in the house even with all the windows up.

At such times a little 12-inch fan when properly placed in front of a window will create a very noticeable circulation of air. By driving the air out of the house in this manner air from the outside must of course come in at other points to fill the vacuum and so the air circulation is obtained.


GIVES BETTER HEAT DISTRIBUTION

In the coldest days of winter it is a good plan to place a fan near the steam radiator so that the breeze from it will play upon the coils. This will be found a very efficient means of driving the heat from the radiator to the farthest corners of the room—heat which otherwise would rise to the ceiling. Also, if the house is heated by a furnace the same effect may be obtained by placing the fan near the register.

Some days it is almost impossible to get the furnace to "draw" properly, especially on those cold, still mornings in the winter. Then you may transfer the fan from the room above down into the basement and set it in front of the furnace draft. It is surprising how quickly the furnace will respond to tnis treatment and get down to business.

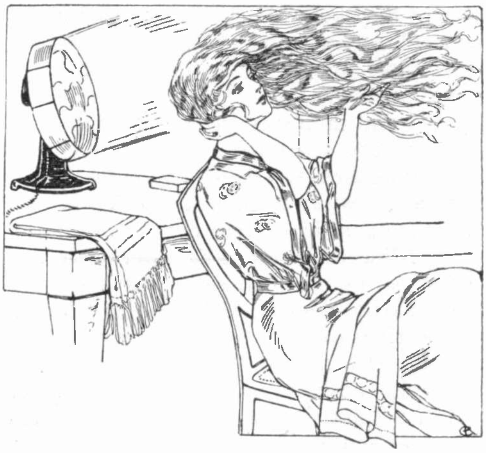

HELPS THE FURNACE "DRAW"

On cold mornings you have had trouble with frost on the windows. Do you know that a fan placed in front of a window so that the breeze will play upon the glass will very soon clear away every trace of frost? This principle is often utilized in show windows to good advantage.

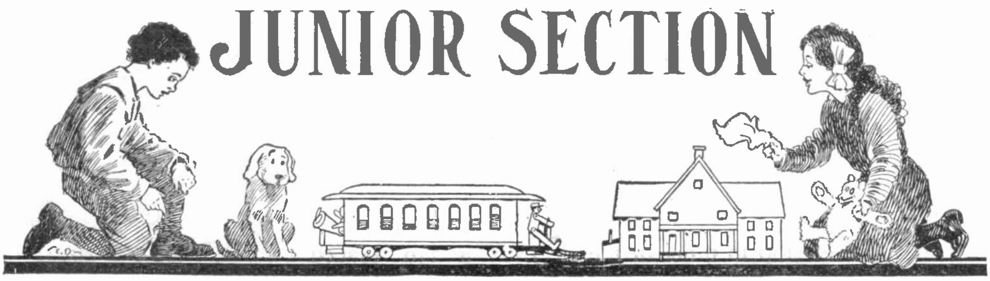

DRIES THE CLOTHES

There are days when the clothes cannot be hung out to dry; then is when a fan becomes the assistant of the laundress and you will be surprised how quickly the clothes will dry in the basement.

The breeze of the fan is also a ready and efficient aid in drying out one's hair after a shampoo.


DRIES THE HAIR TO PERFECTION

No matter what the season may be there is always a use for the fan.



An Electrical Laboratory for Twenty-Five Dollars

By DAVID P. MORRISON

PART V.

ALTERNATING CURRENT AMMETER AND VOLTMETER

the brass tube. Cut from some ⅛-inch brass two pieces one inch long and ⅝-inch wide.

The ammeter and voltmeter described in the previous chapter will work satisfactorily on a direct-current circuit, but it cannot be used in measuring alternating current and voltage. The instruments described in the following article will operate on both alternating and direct current circuits, but their indication is more accurate when used on the former.

"The repulsion" or "magnetic vane" type of ammeter or voltmeter depends in its action upon the fact that, if two pieces of soft iron be placed inside a coil carrying a current they both become magnetized in the same direction; and since like magnetic poles repel, the result is the two pieces of iron repel each other. If one of these pieces is fixed and the other free to move the two pieces will be separated. The force tending to separate them will depend upon the degree to which they are magnetized, which in turn depends upon the current flowing in the coil surrounding them. The movable piece can be balanced on a small shaft that is parallel to the axis of the coil, and mounted between two bearings so that it is free to move. This movable element can be caused to assume a definite position by attaching the inner end of a spiral spring to it and then fasten the outer end of the spring to the stationary part of the instrument. With this arrangement the movable element will take a definite position for a given current, since the spring acts against the magnetic force tending to move the two pieces of iron apart, and as a result the deflection will be a measure of the current flowing in the coil. This indication can be read by means of a pointer attached to the movable element and arranged to move over a marked scale.

In the following instructions dimensions are given for a moving system that may be used as an ammeter or a voltmeter by simply changing the winding; which will be explained later.

Secure a piece of brass tubing 1½ inches long, inside diameter 11-16 inch and a 1-16-

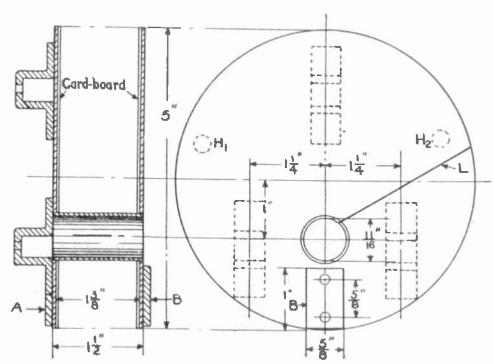


FIG. 38

inch wall. Cut from some 1-16-inch sheet brass two circular pieces five inches in diameter. Make an opening in each of these pieces one inch from their center and of such a size that they will slip on the ends of the brass tube. Cut from some ⅛-inch brass two pieces one inch long and ⅝-inch wide.

Drill two 3-32-inch holes in these pieces 5/8 of an inch apart and tap them to take a machine screw. Now solder them in place as shown in Fig. 38, making sure they are exactly in place when the solder cools. If you tin the surface of the disks and the back of the brass blocks you can join them by first clamping them in place with an iron clamp and then heating the joint until the solder melts. The solder on the surfaces no doubt will be sufficient to hold them; if not, a little more can be added, making sure that there is no solder in the holes before you cool the joint.

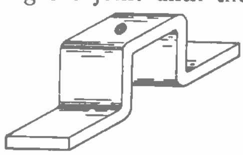


FIG. 39

Cut from some 1/8-inch brass three pieces 2 1/2 inches long and 1/2 inch wide. Drill a 1/8-inch hole in the center of each of these pieces and tap it for a machine screw. Now bend them into the form shown in Fig. 39. They should then be soldered to the outside of one of the disks, as shown by dotted lines and in cross-section in Fig. 38. The spool formed from the two brass disks and the tube is to be supported by these three pieces, which will rest on the wooden base of the instrument and be fastened to it by three screws passed through from the under side and countersunk.

The two brass disks can now be soldered to the brass tube forming a spool, but before doing this cut from some heavy pasteboard two pieces whose dimensions correspond to those of the brass disks. Slip these on the tube before the last disk is soldered in place. You must be very careful in forming this spool to see that the two disks are parallel and that their plane is perpendicular to the axis of the coil.

The pasteboard disks should now be fastened in place with some shellac. Wind on the cylinder several turns of heavy paper and shellac each layer in place.

Drill two 3/8-inch holes in the lower disk as indicated in Fig. 38, (H1) (H2). The terminals of the winding that is to be placed on the spool are to be carried out through these holes, and they should be insulated. Small paper cylinders will serve this purpose or the conductor can be well taped where it passes through the metal.

The spool is now complete with one exception: you must saw a slot, with your hacksaw, through both disks and one side of the tube as indicated by the line (L) in Fig. 38. The purpose of this is to prevent the disk acting as a short circuited secondary on the field produced by the current in the coil.

Secure a piece of very thin soft iron, about two or three-hundredths of an inch thick, and cut from it a piece whose dimensions correspond to those given in Fig. 40. Bend this piece into the form shown in Fig. 41. The outside diameter of this piece after it is bent should be a little more than the inside diameter of the brass tube forming the center of the spool. Slip this piece into the core so that the projection is in the position shown in Fig. 42. This piece can be soldered in place before the insulation is put around the outside of the brass tube by filing a groove in the tube and applying the solder from the outside, first making sure you have the iron in the proper place.

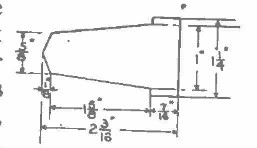


FIG. 40

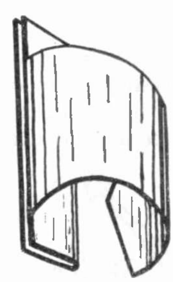


FIG. 41

Cut from this same piece of iron another piece whose dimensions correspond to those given in Fig. 43. This piece is to form the moving element when properly supported. Secure a piece of steel rod two inches long and 1-16 inch, or a little less, in diameter. Point both ends of this rod and temper them. Now bend the projecting lugs on the piece of iron around this steel rod and solder it in place as shown in Fig. 44.

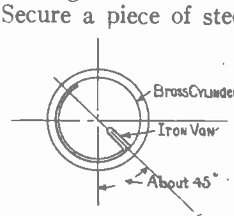


FIG. 42

Make a pointer or indicator, similar to that shown in Fig. 43, from some very thin sheet brass, and mount it on the steel rod as shown in the figure. The piece of iron and the needle should be on exactly opposite sides of the steel rod.

Form a small brass cylinder 1/8 inch long from some 1-16-inch brass by bending it around a piece of iron that has an outside diameter approximately the same as the steel rod. Solder this cylinder in place as shown in Fig. 44.

Now obtain from the jeweler a small spiral spring and solder its inside end to this cylinder. The plane of the spring when it is soldered in place, should be perpendicular to the axis of the steel rod, and so arranged that it coils up when the end of the pointer is moved toward the right, the outer end of the spring being soldered to a projecting lug as explained later. The moving system is now complete with the exception of balancing which can be done as follows:

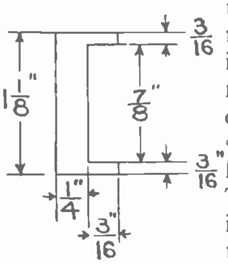


FIG. 43

Support the steel rod in a horizontal position by allowing its end to rest on two parallel pieces of thin metal, which are also horizontal. The lighter side can be easily detected in this way and the system balanced by adding solder or beeswax to the lighter side. Your instrument will be a great deal

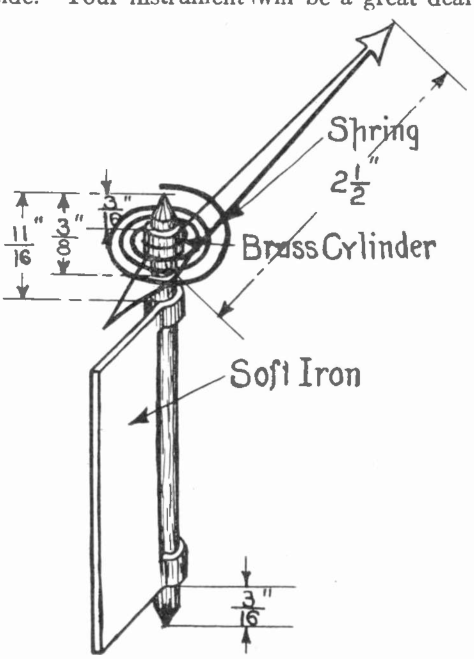


FIG. 44

more accurate if properly balanced and its indication will not depend upon it always being in the same position as it was when it was calibrated.

To mount the moving element inside the brass tube you will need two supports for the bearings in which the ends of the steel rod are to be placed. Cut from some $\frac{1}{8}$-inch brass two pieces whose dimensions correspond to those of (A) and (B), Fig. 45.

Drill two holes in (A) to match those drilled in the piece (A), Fig. 38. Now mount this piece in place with two machine

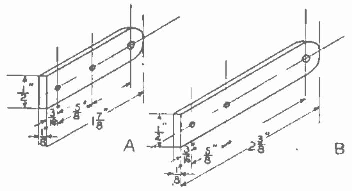


FIG. 45

screws, with one end projecting over the opening in the tube. Cut two pasteboard disks that will fit snugly inside of the tube and place one in each end having made a small hole in the exact center of them. Now pass a long needle through both of these holes until it strikes the projecting piece of brass you just mounted. Mark the point where the needle touches the brass, and drill a 3-16-inch hole in it with this point as a center.

Now drill two holes in (B) to match those in (B), Fig. 38. Bend this piece into the form shown in Fig. 46 and fasten it in place with two screws. Locate a point on its projecting end as you did in the previous case and drill a 3-16-inch hole with this point as a center.

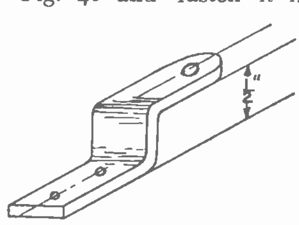


FIG. 46

Drill a 1-16-inch hole in the end of (B) after the end has been filed round as shown in Fig. 45, and solder the end of a piece of brass wire about $1\frac{1}{4}$ inches long into this hole.

Two glass bearings can now be made as described in the previous chapter and they can be fastened in place with some common sealing wax. The movable piece of iron should be the same distance from each end of the brass tube, when it is in place, which can be accomplished by the proper adjustment of the bearings in their supports.

Secure a piece of cherry or other close grain wood $6\frac{1}{2}$ inches long and $5\frac{1}{2}$ inches wide, and one inch thick that is to serve as a base for the instrument. Drill three holes in this base to match those in the three pieces shown in Fig. 39 that were soldered to the lower side of the brass spool. Drill two other holes to match those in the lower brass disk, (H1) and (H2) through which the terminals of the circuit are to be passed. The first three holes should be countersunk so that the heads of the screws used in fastening the instrument to the base will be entirely below the surface of the board.

Now mount two binding posts on the board one in each lower corner. These binding posts in the case of the voltmeter need not be very large as they will carry a small current, but should be considerably larger for an ammeter as they are to carry a greater current then, depending, of course, upon the current capacity of the instrument. It would be best for you to use binding posts of the back connected type. Cut two grooves in the under side of the base from the binding post to the two holes (H1) and (H2). The binding posts should now be removed, the edges of the board all rounded off and the base thoroughly finished.

A cover or case with a glass top may next be made to suit the fancy of the builder.

Your instrument is now ready for the scale. Cut from some good quality white cardboard a disk of the same size as the upper brass disk in the spool. Make openings in this disk so that it will drop down upon the brass disk and fasten it in place with shellac. Draw two arcs, with the bearing as a center on the upper portion of the cardboard disk. These arcs should be so drawn that the end of the pointer is midway between them and their length will depend entirely upon the angle the moving element is to move through. When the zero position on the scale has been located you can solder the outer end of the spring.

Bend the wire, projecting from the end of the upper bearing support, down at right angles so that it touches the outer coil of the spring and cut off the end so that it is just flush with the lower side of the spring. Now solder the spring to this wire when the needle is at zero.

It is impossible to give the proper number of turns that must be placed on the spool to give a full scale deflection, with a given current through the winding, as there will be slight differences in the construction of different instruments, due to different quality of iron, springs of different strength, etc. You can determine the proper number, however, as follows:

Wind on the spool a few turns and pass a known current through them, increasing the number if the deflection is not large enough and decrease them if it is too large. When the current with which you desire to produce a full scale deflection is flowing through the winding the needle should be at the extreme right of the scale. The wire you use must be of sufficient current carrying capacity to carry the current that will produce the maximum deflection without undue heating. After adjusting the number of turns to their proper value solder the ends to the binding posts. You are now ready to calibrate your instrument which can be done as follows:

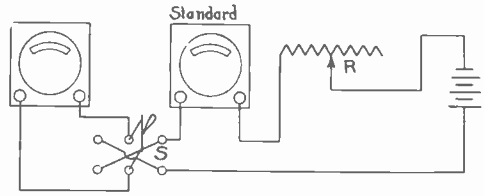


FIG. 47

Connect the instrument in series with a direct-current ammeter as shown in Fig. 47. The switch (S) is a double pole, double throw switch so connected that the current through the instrument you are calibrating can be reversed without changing it through the standard ammeter. You will find that there will be a difference in the indications when the same value of current is flowing through the instrument but in opposite directions. The average of these two indications for the same current is the one that an alternating current of the same value would produce. Make a mark on the scale to correspond to this average value. Now decrease the current by disconnecting batteries or changing the resistance (R) taking two readings again for the same current and making a mark on the scale to correspond to the average. The nearer these marks are together the more accurate the scale, you of course need not determine all of the small divisions in this way but can approximate them quite closely after locating those corresponding to greater ampere steps.

It will always require the same number of ampere turns to produce a full scale deflection, that is, the product of the number of turns in the coil and the current will be constant, so to double the current carrying capacity of the instrument you will need to reduce the number of turns to one-half of their original value, making sure, however, that your wire will safely carry the increased current.

To make this same kind of a moving system serve as a voltmeter you will need many more turns of wire than in the ammeter and the resistance of the winding should be as high as possible. The ammeter will always be connected in series and its resistance should be very small, while the voltmeter will be connected across the circuit and its resistance should be large to prevent a large current flowing through it; which would mean a loss. You will have to determine the required number of turns to produce the desired deflection experimentally as you did in the case of the ammeter. Start with No. 28 B. & S. gauge copper wire and change the number of turns until a full scale deflection is produced by the desired voltage. The connection for making this calibration

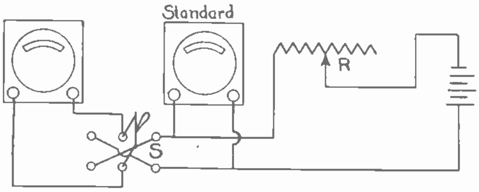


FIG. 48

is shown in Fig. 48. The new voltmeter is connected through a double throw switch, cross connected as shown in the figure, to the same leads that the standard is connected across. Two readings must be taken as in the case of the ammeter, with the current through the instrument reversed. If you make a full scale deflection correspond to fifteen volts the instrument can be made to indicate higher values by connecting non-inductive resistance in series with the coil. To make a non-inductive resistance take two wires and solder one pair of ends together and tape them, then wind them on a wooden spool as though they were one wire.

The outside ends of these two wires will form the terminals of the coil. The coil is non-inductive because the current flows around the core through one-half of the turns in one direction and through the remaining half in the opposite direction and as a result the magnetic effect of the current is practically zero. The wooden spool can be made such a size that it can be placed in the upper part of the brass spool. A common binding post can be used and connection made for various ranges as shown for the direct current voltmeter.

A HANDY SWITCHBOARD

When you have completed your instruments you can mount them on a switchboard with your transformer and various connecting switches. An inexpensive switchboard that will serve your purpose nicely may be constructed as follows: Secure three pieces of oak three feet long, 10 inches wide and ⅞ inch thick. True up the ends and edges and glue them together, making a piece 34 inches long and 28 inches wide. Fasten two cleats of wood, 28 inches long, two inches wide and ⅞ inch thick, across each end, with screws about one inch from the end. It might be well to glue these pieces in addition to using the screws. Now give the piece several coats of good shellac, paying particular attention to the finish of the front.

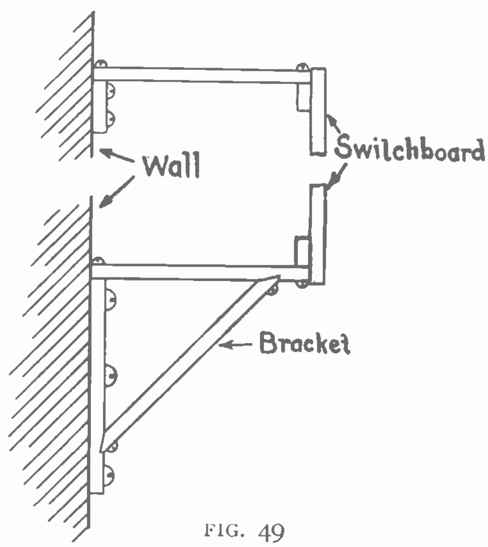


FIG. 49

Construct two brackets, from some oak pieces three inches wide, as shown in Fig. 49 that are to serve as supports for the switchboard. Two other pieces 18 inches long, three inches wide and ⅞ inch thick may be used at the top to steady the board. The figure shows a side view of a board supported as just described.

The transformer previously described can be mounted on the back of the switchboard and the switches for varying the voltage controlled by rods proiecting through the board with small handles or wheels on their outer ends, as shown by (R1) and (R2) in Fig. 50. Your voltmeter and ammeter may be mounted in the upper corners. It might be well to stand them in place rather than to mount them permanently and make the connections to the binding posts so that they can be easily disconnected when it is desired to use the instruments in some other part of the laboratory.

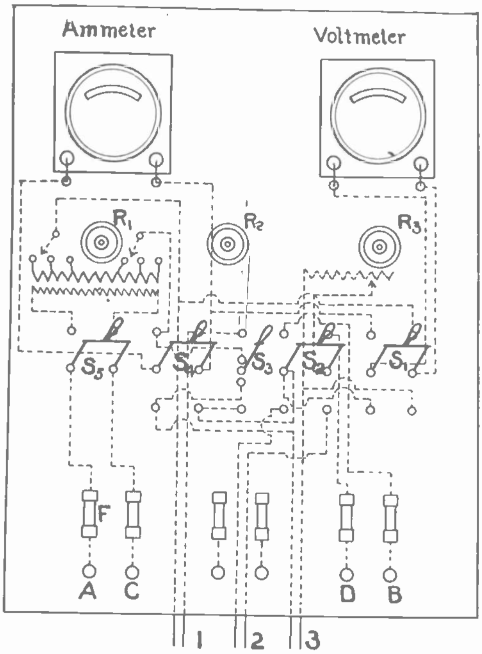


FIG. 50

Fig. 50 also shows the circuit for charging a storage battery (which will be described in the next chapter) with the electrolytic rectifier, transformer and rheostat. This circuit is of course subject to many changes and is given merely to serve as a guide. The voltmeter may be connected to either side of the rectifier by means of the switch (S1). To charge the battery close (S5) and throw switch (S2) down. If you want the ammeter to read the current in the alternating current leads to the rectifier throw switch (S4) up and switch (S3) down. If you want the current flowing through the battery throw (S4) down and (S3) up.

When you want to discharge the battery throw switch (S2) up. The rheostat is connected in this circuit and the ammeter may be if desired. The terminals (A C) are for the alternating current connection which may be made with a piece of lamp cord with a plug on one end to fit the socket in the lighting fixture and the terminals at the other end under the binding posts (A) and (C). The terminals (DB) are for taking current from your storage battery, or they may be connected direct to the direct current terminals of the electrolytic rectifier.

The additional handle (R3) on the right of the board is to control a rheostat (to be described later) that is placed in series with the battery on charge and discharge. This rheostat is to be mounted on the back of the board with the transformer so you must mount your tranfsormer on one side of the center. Other switches may be mounted on the board that will connect to the other batteries you have constructed.

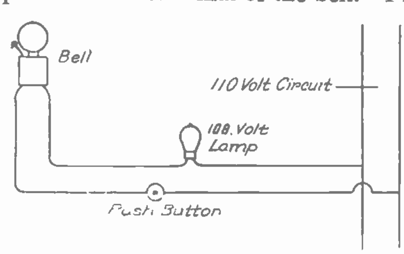
The rectifier and batteries should be placed away from the board on account of the gases they give off when in use.

Fuses are placed in the various circuits and are represented by (F). The leads lettered (1) are the alternating current leads to the rectifier. those marked (2) are the direct current leads from the rectifier and those marked (3) are the battery leads.

(To be continued.)

To Operate a Bell from a Light Circuit

A simple method which has been used to operate electric bells from the lighting circuit and do away with batteries is shown in the diagram. A wire is led from one side of the 110-volt circuit through a 108-volt lamp and to one terminal of the bell. From



BELL OPERATED FROM LIGHT CIRCUIT

the other terminal of the bell a wire is led through the push button switch back to the other side of the circuit. When the button is pressed the lamp lights up and the bell rings. This scheme will work as long as the voltage of the supply current is fairly constant around 110 volts. If it should fall, to around 108 for instance, the bell would not ring. Likewise if the circuit is alternating you will require a bell that will ring on alternating current.

POPULAR ELECTRICITY WIRELESS CLUB

Membership in Popular Electricity Wireless Club is made up of readers of this magazine who have constructed or are operating wireless apparatus or systems. Membership blanks will be sent upon request. This department of the magazine will be devoted to the interests of the Club, and members are invited to assist in making it as valuable and interesting as possible, by sending in descriptions and photographs of their equipments.

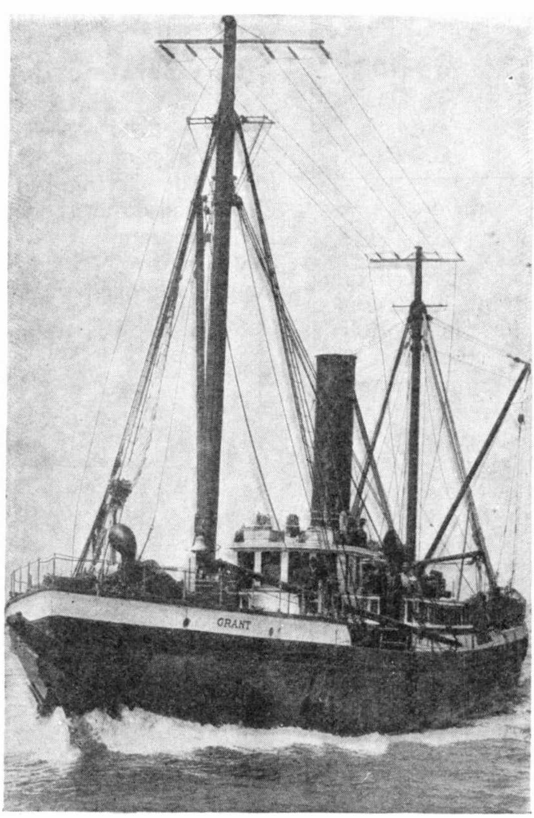
Wireless in the Puget Sound Fisheries

By FRANK C. DOIG

Sea-going steamers go forth from the ports of Puget Sound and Vancouver, B. C., to wrest from the waters of the Pacific the crop of great white halibut and bring the harvest back to be shipped to all parts of the United States in fast refrigerator cars.

Off the coast of Vancouver Island and in the vicinity of Cape Flattery on the Washington coast, these big fish swarm in sluggish schools. The little steamers launch their boats and spread their nets and after loading to capacity race with each other for port.

The rivalry between the companies operating the steamers has grown in the last few years. As a result every modern device for aiding in handling the cargoes and dispatching the vessels, is employed. The latest addition to the equipments of these steamers is the wireless telegraph.

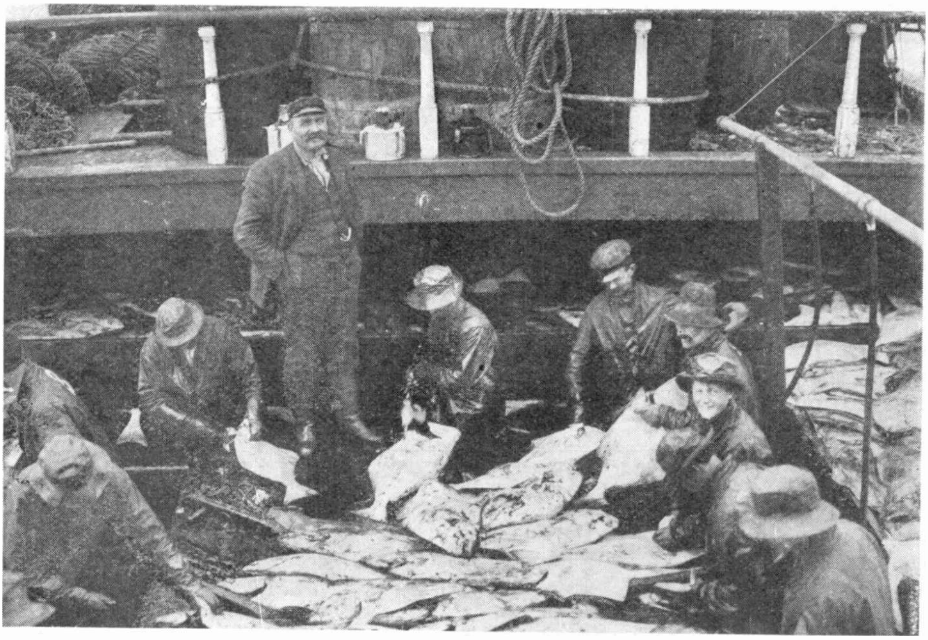


PUGET SOUND FISHING BOAT EQUIPPED WITH WIRELESS

Managers of the concerns that have fitted their vessels with wireless apparatus, say wireless has become one of the most important, if not the most important, addition to the equipments. By means of it, the owners are able to keep in constant communication with the skippers and know to a certainty what results are being accomplished with the nets.

As soon as a steamer lifts its tackle and starts for port, the captain notifies the home office that he is starting back. He tells the size of the catch, the condition of the fish, the probable time of arrival and any other information of value to his employers.

With all this information the managers of the



OVERHAULING THE CATCH

warehouses are able to make arrangements for receiving and shipping the fish. This method saves a large amount of money and avoids the annoyance and confusion that would result, if this information were not received until the boat docked.

In addition to the reports of the catch the captain may make requisitions for supplies and repairs, if any are needed. It is estimated by owners who have equipped their boats that thousands of dollars can be saved yearly.

Popular Electricity Wireless Club of the Central West

Popular Electricity Wireless Club of the Central West, which was organized in St. Louis last fall by Mr. David Marcus, has reached astonishing proportions. It now has 2500 members throughout Missouri and neighboring states to show for a little over six months' work, which figures do credit to the organizer and secretary. That Mr. Marcus stands high in the opinion of the members is shown by the fact that they bestowed upon him a diamond-gold medal, recently, as the most enthusiastic and popular non-professional. The medal was awarded in a voting contest and Mr. Marcus received a plurality of 1084 votes.

As we have more than once received inquiries as to how to carry on intelligently the work of a local or sectional wireless club or association, we believe readers of this department will be interested in how they went to work to put this St. Louis Club on its feet and doing so well in so short a time.

The main object of the club is to exchange views and propose experiments relative to the development of wireless. Most of this is done through the mails. The question is mailed to the home office of the club (1820 Washington street, St. Louis), and at its regular weekly meetings the various topics on file are discussed by the local members. The questions are given open debate and experiment, and the distant member who asked the question is informed of the result.

As a consequence of these debates and experiments carried on at the meetings the interest and enthusiasm of the members is kept up.

Hearing Grand Opera by Wireless

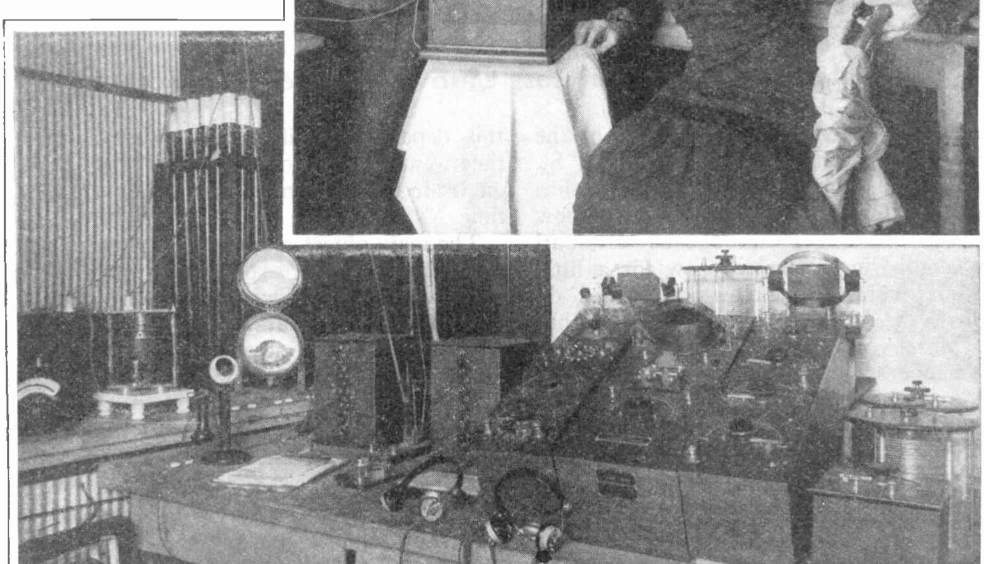
By PAUL M. CRAIG

Considerable speculation in regard to a new field for the application of wireless has been occasioned by a recent exhibition in New York of the transmission of vocal solos through several miles of space by Mme. Mazarin, the new star of the Manhattan Opera Company.

Of course the idea has not been unfamiliar for some time that wireless could some day be utilized for the distribution of music, lectures and even news, and one or two writers have dwelt at length upon the possibility of having the music of an orchestra or other entertainment reproduced in restaurants, on steamships and even in the home.

While it is true that in January the entire performance of "Cavalleria Rusticana" by the Metropolitan Opera Company was heard in such a manner as to give considerable promise for the future of that sort of wireless transmission as soon as the proper amplifying and sound-gathering apparatus could be perfected, the test of Mme. Mazarin was the first entirely satisfactory demonstration of opera by wireless to become an impressive factor in the field of entertainment.

The prima-donna sang selections from "Carmen" and "Elektra" which were heard



MADAM MAZARIN SINGING INTO THE WIRELESS TELEPHONE—LEE DE FOREST ADJUSTING INSTRUMENT at a wireless laboratory in Newark, N. J., by several notable technical writers, but the best results were obtained at the wireless room of the Metropolitan Life Tower, over a mile away from the singer who was stationed in the DeForest laboratory, just opposite the Grand Central Station. At the Metropolitan Tower a select company including Prof. Hudson Maxim, several city officials and members of the Manhattan Opera Company heard distinctly every note of the music.

The writer's impression of the entertainment was that of a voice coming from nowhere in particular and yet apparently emanating very softly from some one present in the audience.

The guests listened through head telephones, much the same as those used by the old-fashioned phonograph, and while close attention was necessary for proper appreciation of the music, the climax of the selection from "Elektra" which must have been almost deafening in the small transmitting room, could be heard several feet from the receiving apparatus in the Metropolitan Tower.

After the performance many of the guests repaired to the laboratory where Mme. Mazarin and Dr. Lee DeForest were heartily congratulated for the success of their achievement. Prof. Maxim especially was enthusiastic and showed a great knowledge of wireless by ably assisting the inventor in explaining the operation of the wireless transmitter, which consisted of a "multi-microphone" in connection with the new "radiotone oscillator" which sets up a rapidly vibrating radiation from the antenna, varying in accordance with the variations caused by the human voice modifying the microphone circuit. The receiving apparatus consisted of a regular long distance wireless telegraph receiving and tuning apparatus at the Metropolitan Life Station, using the audion in connection with half a dozen head telephones, and at Newark of the regulation Navy wireless telephone receiving set with both audion and perikon detectors as shown on the preceeding page.

A High-power Wireless Equipment

By ALFRED P. MORGAN

PART I.—AERIALS

The novice in search of information upon the construction of wireless instruments, has been forced to rely somewhat upon a variety of disconnected articles, which often lead the reader into the predicament of Mark Twain's famous steamboat which had such a large whistle and such a small boiler that the boat had to be stopped in order to whistle. For instance, a tuning helix and spark gap are often described and used in connection with a one or two-inch spark induction coil when in reality they are more suitable for a one-quarter kilowatt transformer.

In this series of papers it is proposed to give details pertaining to the construction and operation of a set of wireless instruments, both for transmitting and receiving, which are capable of the most exacting work. The apparatus is all entirely practical and is only offered after considerable study and experimental work.

The builder need not possess exceptional skill or ingenuity but rather patience and judgment. No departure from the design and dimensions here offered is advisable unless they only affect very immaterial factors.

The old proverb, "Haste makes waste," applies very well to the construction of electrical apparatus. It is apparent that straining an induction coil just to see how long a spark it will give, before it is properly completed and insulated, is exceedingly foolish unless the builder is blessed with time and a fat pocket book. There are always those who prefer not to spend any time in putting a finish on the wood or metal, but it may well be said that care with the little details always insures the successful completion and operation of the collective instruments.

The station in question has a positive transmitting range of 100 to 300 miles, depending upon whether the induction coil or the transformer is used. By "positive range" it is meant that the station will tranmit messages these distances without being seriously hampered by weather conditions or the state of the ether. Under very favorable circumstances it might be possible to communicate three times these distances, but such occasions would be somewhat exceptional.

The receiving apparatus is not only capable of giving good, clear signals in the telephones when used to receive from the transmitter in question over the distances named above, but if properly adjusted will detect signals over one thousand miles.

It should be understood that sending and receiving radii are only relative terms and depend upon many factors. The ability of the operator in many cases determines the distance over which the station can work sucessfully. The favorable location of one station sometimes makes it possible to send twice as far from that station as from one of the same rated power. It is impossible to base any statements of the transmitting or receiving range of a station on such data as the kind of tuning coil, spark gap, aerial, etc., but something about the conditions under which the station is operated must be known and even then the distance cannot be based on any data but rather upon knowledge gained by actual experience. In giving the probable range of the outfit which we are considering the author has not taken into consideration any exceptionally favorable factors but rather considered the question from a more fair standpoint and named figures that can be relied upon.

The antenna or aerial system consists of a number of wires elevated in the air and insulated from surrounding objects. Its purpose is to convert an electrical current into electromagnetic waves and to regenerate part of the energy of an intercepted wave back into an electric current.

All electrically charged bodies are surrounded by an electrostatic field, the nature of which in theory is a state of strain. The action of the transmitter is to charge the aerial, say with *negative* electricity, and establish a field of force in its vicinity varying in area from a few feet to several miles. The lines of electric strain stretch from the aerial to the earth on all sides as represented by the dotted lines in Fig. 1. They are spherical in form although of course on paper they must be represented in one plane.

When the charge reaches a certain value, the air gap between the spark knobs is broken down and the space becomes conductive so that the electricity in the aerial rushes down into the earth and the aerial is discharged. With the discharge the strain in the electrostatic field is released, but in so relaxing it produces a new current and charges the aerial with *positive* electricity. A new strain is immediately built up around the antenna but is *opposite* in direction to the first. This process repeats itself very rapidly and with every oscillation or reversal of current the direction of the dielectric strain is changed and the lines which originally stretched from the aerial to the earth are displaced and the ends terminating on the aerial run down it and form semi-loops or inverted "U's" standing with their ends on the earth in a circular ripple around the aerial and moving away from it with the speed of light. In Fig. 1 two complete oscillations are represented as having taken place and the aerial is about to discharge a third time. The small arrow heads indicate the reversals of direction in the lines of strain. Right here it may be stated that the distance between like points on any two consecutive waves is the wave length.

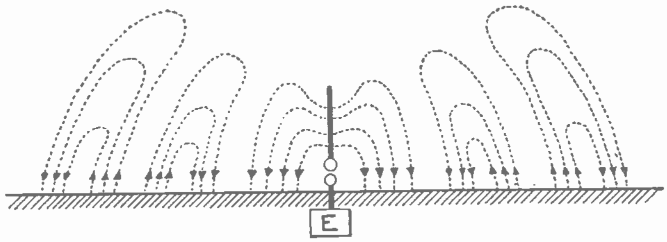


FIG. 1. THEORY OF THE ACTION OF WIRELESS WAVES

Modern practice demands greater efficiency in producing oscillations than the above method affords, but the systems, although they differ in the details of their operation are the same in principle. Instead of generating oscillations directly in the aerial itself, they are first produced by means of condenser and spark gap and then impressed upon the aerial through the medium of a transformer called a transmitting helix. The action of the condenser will be explained later.

A long wave length is generally desirable since the dissipation of energy due to trees and sunlight is not so pronounced. The length of the wave emitted by an aerial composed of a single vertical wire having a spark gap at its lower end near the earth is, generally speaking, between four and five

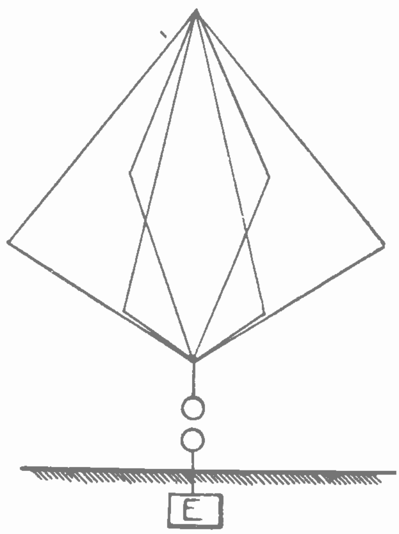


FIG. 2. THE UMBRELLA AERIAL

times the length of the wire. However, many undeterminable factors depending upon the location of the aerial influence its wave length and make it impossible to accurately predetermine it without the aid of

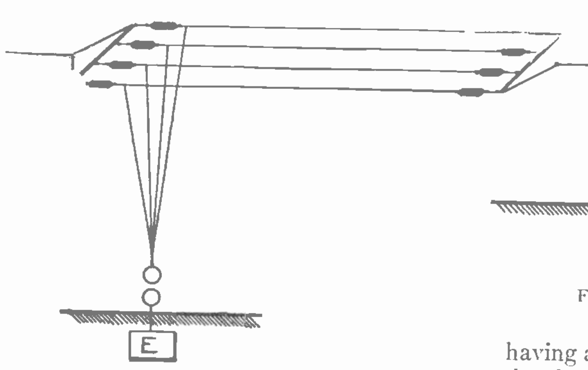


FIG. 3. INVERTED "L" AERIAL

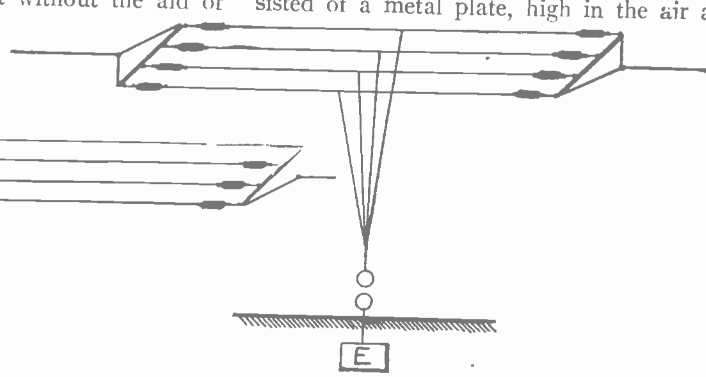


FIG. 4. THE "T" TYPE AERIAL

a special instrument termed a cymometer or wave meter.

The higher an aerial is placed above the surface of the earth, the wider will be its electrostatic field and consequently the more powerful will be the electrical waves developed. But after a height of from one hundred and eighty to two hundred feet is attained the engineering difficulties and the expense increase so rapidly that few but ultra-powerful stations exceed it.

After the limit in a vertical direction has been reached, the only remaining possibilities are to increase the surface and to spread out horizontally.

The desirable feature of an aerial is measured by the quantity of the charge required to raise its potential one unit, and is called its electrostatic capacity. An increase in capacity enables more energy to be accumulated in the antenna and consequently more powerful waves are emitted. The capacity may be increased by adding wires to the aerial, but the increase must not be carried too far or the transmitting apparatus will not be able to raise its potential sufficiently. Owing to an effect of mutual induction between the wires, the lines of strain are not distributed evenly and symmetrically. As a result, the capacity does not vary directly as the number of wires but rather approximately as the square root. In order to decrease this effect and use the surface more efficiently, the wires should not be placed nearer than one-fiftieth of their length and preferably farther apart.

A few years ago the wireless antenna consisted of a metal plate, high in the air and having a wire suspended from it. But today the form best capable of sending and receiving equally well in all directions is that illustrated in Fig. 2, called the umbrella aerial.

The wires spread out from the top of the mast similarly to the ribs of an umbrella.

The outside or lower ends lead into the station at the foot of the mast.

It often happens, as is the case on shipboard, that the horizontal space available is confined to two dimensions. The best form is then one of the flat top aerials shown in Figs. 3, 4 and 5.

Fig. 1 is the inverted "L" in which the vertical leads are taken off from one end of the horizontal. This form is advisable only in certain well defined cases, where, for instance, two stations are intended only for communication with each other and not with outside stations.

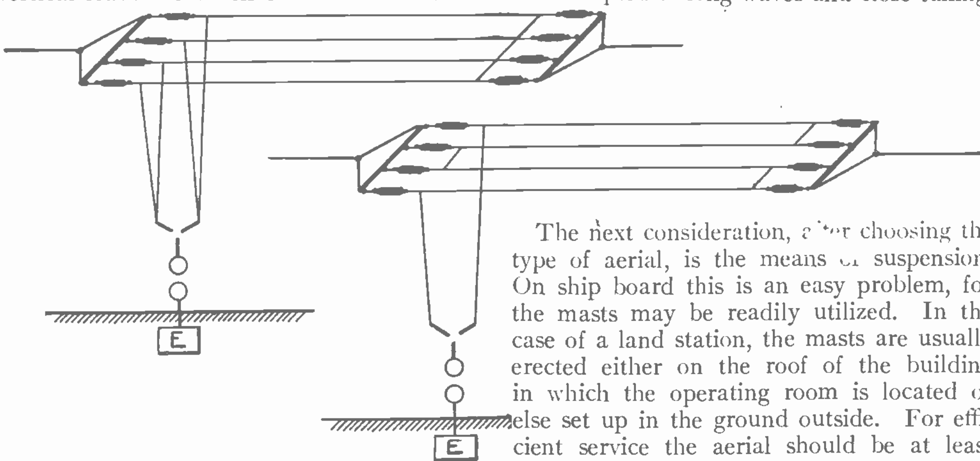


FIG. 5. THE LOOPED AERIAL

This aerial radiates its waves most strongly in a direction opposite to which its free end points and receives its signals best from a station lying in the direction of maximum radiation.

This directive action may be considerably lessened by taking the leads off at the centre and forming a "T" aerial as in Fig. 4. This type is slightly directional and emits or receives signals best in its own plane, but the effect is not pronounced unless the horizontal is much greater than the vertical height.

The leads should preferably be taken off at right angles to the horizontal but sometimes an oblique direction is necessary. There is a difference of opinion whether or not the ends of the horizontal wires should be connected together and it is impossible to say with good reason which method is the best.

Fig. 5 illustrates the type of aerial used by the United Wireless Telegraph Company, and known as a looped aerial. Either the "T" or inverted "L" may be converted to this form by bringing the vertical leads in pairs down to the receiving instruments. A station equipped with a looped aerial system does not suffer the annoyance of a hum in the telephone receivers caused by induction from neighboring light and power lines. It has the further advantage of being well adapted to long waves and close tuning.

The next consideration, after choosing the type of aerial, is the means of suspension. On ship board this is an easy problem, for the masts may be readily utilized. In the case of a land station, the masts are usually erected either on the roof of the building in which the operating room is located or else set up in the ground outside. For efficient service the aerial should be at least 125 feet above the ground. The erection of a pole of any considerable height is a matter best left to the dealer who furnishes the pole and so nothing will be said here regarding the operation.

It is very important that the material used for the insulation and suspension shall be of the best grade so that in event of bad weather, the station will not be losing energy or be put out of operation because the aerial blew down. Every effort must be made to guard against faults in the insulation which would cause leakage. Hard rubber is undesirable since it is affected by the atmosphere and becomes coated with a conducting layer. The most widely used form of aerial insulator is that shown in Fig. 6, called the Electrose insulator.

It is made of a dense, hard material known under the trade name of Electrose. The iron rings are moulded into the ends so that it is impossible for them to pull out. The insulator is corrugated so that it presents a large surface and there is less likelihood of a conducting film forming on the surface.

The wires are held apart by two wooden spars and one spreader, preferably of spruce, and made to conform with the dimensions indicated in Fig. 7. The spars are nine feet long and $2\frac{1}{2}$ inches in diameter at the centre. They taper to 1½ inches in diameter at the ends. If the aerial is short the middle spreader is unnecessary unless the vertical wires are taken off at the centre, when it

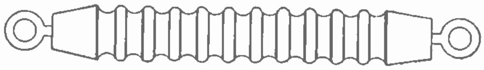


FIG. 6. ELECTROSE INSULATOR

must be used to prevent the horizontal wires from being pulled together.

The necessary hardware may be purchased from a dealer in ship chandlery. Two mast withes 2½ inches in diameter and having one eye, four two inches in diameter also having one eye and four 1½ inches in diameter having three eyes are required, as shown in Fig. 8. Eight lap links are

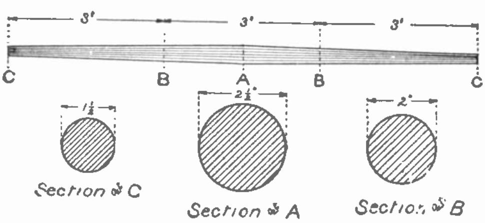


FIG. 7. SPAR

used to fasten the insulators to the spars. Forty feet of steel stranded cable, 3-16 inch in diameter and two wire rope thimbles and two screw shackel bolts shown in Fig. 9 are necessary to form the bridle.

One of the largest mast withes is forced on the centre of each spar, and the next smaller ones, 1½ feet to either side. The smallest withes should just fit on the ends

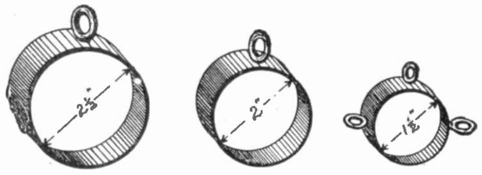


FIG. 8. MAST WITHES

of the spars and be placed so that one of the three eyes points down and the other two respectively to the front and rear.

An Electrose insulator is secured to each of the eight withes other than the two centre ones by means of the lap links.

The bridle is arranged as shown in Fig 10. The ends of the wire rope are spliced through the rear eyes in the end withes. A wire rope thimble is included in the centre of the bridle and a short length of cable leads from the thimble to the eye on the centre withe. A rope thimble is fastened to the end of the hoisting rope and connected to the thimble in the bridle by means of the screw shackle. A short piece of hemp rope fastened through the lower eyes in the end withes and tied to the supporting

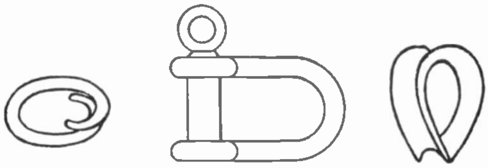


FIG. 9. WIRE ROPE THIMBLES AND SHACKEL BOLT

mast some distance below the pulley will prevent the aerial from turning over and becoming twisted in windy weather.

The wire used for the aerial itself is soft drawn phosphor bronze cable, made up of seven strands of No. 20 B. & S. gauge. Phosphor bronze is tougher, has better wearing qualities than copper and does not sag or stretch as easily. Four pieces are cut, each about one foot longer than the length of the aerial and all of exactly the same length.

The spars are laid on the ground, at a distance apart equal to the desired length

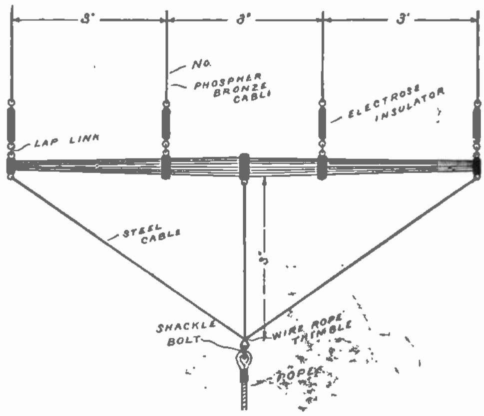


FIG. 10. BRIDLE

of the aerial, and the ends of the wires passed through the eyes in the corresponding insulators. The ends are then doubled back, bound with a No. 16 phosphor bronze wire and soldered. In case the aerial is a looped system of the second type, the wire may be one continuous length laced around through the eyes in the insulators. If a "T" aerial is used, the leading-in wires which are also phosphor bronze cable are soldered as nearly as possible to the centre. In this latter case the horizontal wires pass through short lengths of hard rubber tubing set in the spreader, shown in Fig. 11, so that the strain of the vertical wires cannot pull them together.

The rope used to sustain the aerial is one inch manilla hemp. It passes through a

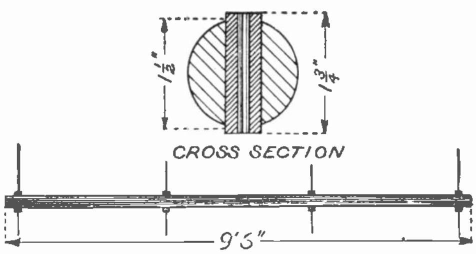


FIG. 11. SPREADER

tackle block fastened to the top of the supporting mast so that when the aerial has been assembled as directed above it may be hoisted aloft. It should not be pulled up taut but rather allowed to hang slightly slack.

The leading in wires must all be of exactly the same length and gradually converge until they terminate in one wire just outside of the point of entrance to the building where the operating room is located. Where the wire enters the building itself it must be very highly insulated and the best method is to lead it through a hard rubber bushing, Fig. 12, in the window-pane.

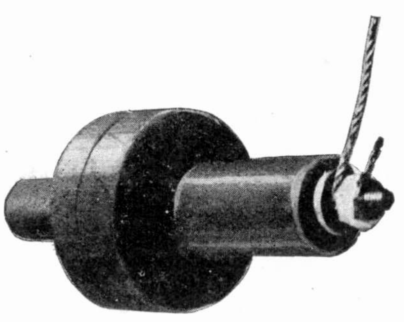


FIG. 12. WINDOW PANE BUSHING

The construction of this bushing is illustrated in Fig. 13. A $\frac{3}{8}$-inch hole is bored through the axis of a hard rubber rod six inches long and $1\frac{1}{4}$ inches in diameter. One end of the rod is turned down to one inch in diameter for a distance of two inches. The centre portion is threaded for a distance of $1\frac{1}{2}$ inches. Two hard rubber flanges or washers $\frac{1}{2}$ inch thick and three inches in diameter are bored through their centres and threaded to fit the middle portion of the rod. A piece of $\frac{3}{8}$-inch brass rod, $7\frac{1}{2}$ inches long, is threaded at both ends for $\frac{3}{4}$ of an inch and passed through the axis of the hard rubber rod.

A hole $1\frac{1}{4}$ inches in diameter is bored through the centre of the window pane in the operating room and the insulator placed therein with one of the hard rubber washers on either side of the glass. A soft rubber gasket must be placed between each of the hard rubber flanges and the glass to reduce the liability of its cracking.

The leading-in wire is clamped to the outer end of the brass rod which passes

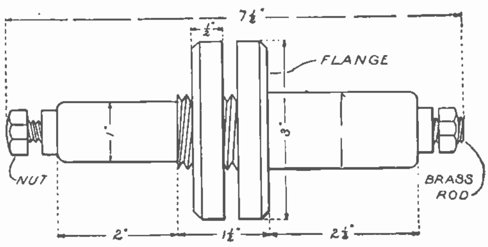


FIG. 13. DETAILS OF BUSHING

through the insulator, by means of two brass nuts. A wire connects to the inner end in the same manner and leads to the aerial switch. The high tension cable used for the secondary wiring on automobiles, is very suitable for the interior wiring.

The leading-in wire must be anchored outside of the building with an Electrose insulator, so that the glass pane is relieved from all strain.

(To be continued.)

The Kentucky and Alamo

Motors connected to fire pumps are now built so as to be entirely enclosed or "splash proof." Need of this protection was recently shown in another line, when the steamship Alamo rescued the Kentucky after receiving a wireless call. It is said that the dynamo for operating the wireless on the latter had to be wrapped in tarpaulin blankets to keep out the water until the rescue.

First Wireless Union

Record of the first movement to organize wireless workers was made on Feb. 18, 1910, when formal application was presented to E. McEachren, president of the Cleveland Federation of Labor, for admission to the American Federation of Labor.

This new organization, according to the application, names B. D. Smith as president. The name of the "Order" is to be the "Order of Wireless Operators and Constructionists," and is the first of its kind in the world.

WIRELESS QUERIES

Answered by A. B. Cole

Questions sent in to this department must comply with the same requirements that are specified in the case of the questions and answers on general electrical subjects. See "Questions and Answers" department.

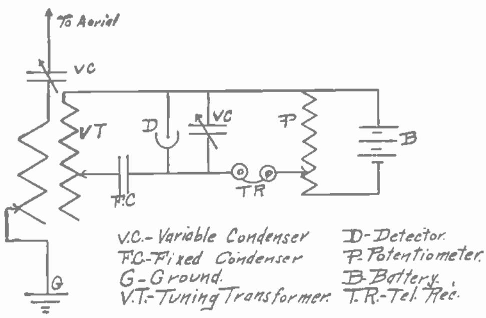
Wave Length; Sliding and Stationary Condensers

Questions.—(A) How many meters' wave length will a tuning coil like that described in the January, 1910, issue respond to? (B) What would be the wave length of this tuner using enameled wire, and what size enameled wire should be used for the primary and the secondary, and how many ounces of each? (C) Please explain how to make a sliding condenser and a stationary condenser. (D) Give diagram for connecting two sliding and one stationary condenser, a variable coupling tuning coil, electrolytic detector, potentiometer, and 2000 ohm telephone receivers.—E. J., Chicago, Ill.

Answers.—(A) About 500 meters, if used in connection with an aerial 60 feet long.

(B) About 600 meters, with the above aerial. The primary will take about nine ounces of No. 18 enameled wire, and the secondary will require about six ounces of No. 24.

(C) By a sliding condenser you probably mean a variable one. This may consist of two brass tubes of slightly different diameters, separated by paraffined paper. The larger tube may have an inside diameter of two inches, and both may be eight inches long. Connect a binding post to each tube. By sliding the smaller into the larger, the capacity of the condenser is increased. By a stationary condenser you probably mean a fixed condenser. This consists of sheets of metal or foil separated by paraffined paper about one-fourth inch larger all around than the metal sheets. Alternate sheets of metal are connected together. A total metal surface of 400 square inches is sufficient for most wireless



CONNECTIONS OF VARIABLE AND FIXED CONDENSER

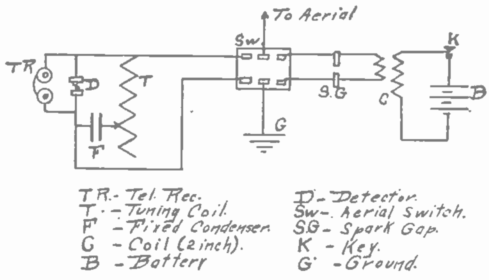
purposes, if a moderate pressure is applied to keep the sheets close together.

(D) See diagram.

Portable Five-Mile Outfit

Question.—What instruments would be necessary to assemble a portable wireless outfit to send 3 to 5 miles? Please name instruments for as cheap and compact an outfit as will do the work; also show diagram of connections for such a set. I already have a one-inch spark coil.—H. H., Monmouth, Ill.

Answer.—The following instruments will be needed: Two inch coil; D. P. D. T. porcelain base switch; spark gap; telegraph key; eight dry batteries; single slide tuner; small fixed condenser; silicon detector; double headband with two 500-ohm receivers. The aerial should be at least 60



CONNECTIONS OF PORTABLE EQUIPMENT

feet high, and consist of at least four parallel wires. A one-inch coil might send five miles, but could not always be depended upon to do the work. See diagram above for connections.

QUESTIONS AND ANSWERS

Use of this department is free to readers of Popular Electricity, but attention will not be given to questions which do not comply with the following rules: All questions must be written in the form of a letter addressed to the Questions and Answers Department and containing nothing for the other departments of the magazine; two-cent stamp must be enclosed for answer by mail, for space will not permit of printing all answers; the full name and address of the writer must be given.

Action of Induction Coil; High Tension Coil; Plunge Battery

Questions.—(A) Please explain the action of a medical induction coil. (B) How can I make a high tension jump spark coil? (C) Explain the plunge battery as to construction, voltage, current, use and internal resistance.—F. B., Great Kills, N. Y.

Answers.—(A) If two wires be placed side by side and parallel yet insulated from each other, and a current be sent through one wire, this current by induction produces a current for an instant in the second wire. Then if the current in the first wire be interrupted or the circuit broken, a galvanometer in the second wire will show another rush of current in a direction opposite to that caused by the closing of the circuit in the first wire. Thus we know that opening and closing circuit No. 1 induces a fluctuating current in circuit No. 2. Circuit No. 1 is termed the primary circuit and circuit No. 2 the secondary circuit. By winding wire No. 1 on an iron core, and over and insulated from it wire No. 2 be wound, a strong inductive effect is produced between the two coils by concentrating the lines of force. Providing a contact breaker described in several issues of Popular Electricity gives the means for making and breaking the primary circuit. What is called extra current must be taken care of. On the "make," induced current in the secondary flows in the opposite direction to that in the primary. The primary wire acting on itself weakens its own current so that at the "make" the effect on the secondary is weak. However, at the break a current is induced similar in direction to the inducing current. In the primary wire the same effect is found and the two currents, initial and induced, travel in the same direction in the same wire, which produces a strong effect on the secondary and shows itself in the extra current in the primary by giving a bright spark at the contact breaker when it opens the primary circuit. To reduce this sparking and assist the effect on the secondary coil, a condenser is bridged across the make and break contact.

(B) On page 724 of the March, 1909, issue of Popular Electricity are given complete "Specifications for a Thirty-inch Spark X-ray Coil." Also see article "Spark Coil Construction and Operation," May to August, 1909, issues, for coils for wireless work.

(C) In a plunge battery, the plates are of zinc and carbon, usually three of the former and four of the latter in each cell. The electrolyte which is best contained in glass jars is made of three parts of potassium or sodium bichromate dissolved in eighteen parts of water, to which four parts of sulphuric acid is added. This cell gives a voltage of about two volts, and has an internal resistance of about one ohm. The American Bell Telephone Co. uses the Fuller bichromate cell, which is capable of giving .6 of an ampere at two volts.

The Leclanche Cell

Question.—Will you please tell me how to make a sal ammoniac cell?—J. P. H., Macon, Mo.

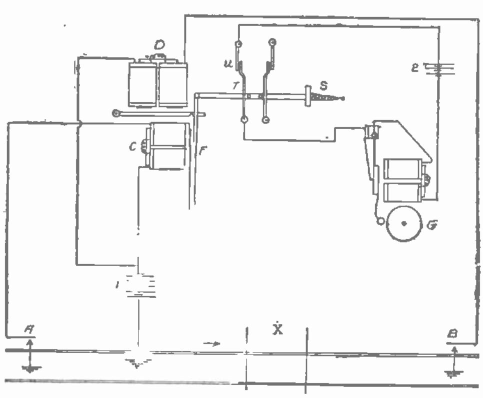
Answer.—Provide a glass jar 4½ inches in diameter and 6 or 7 inches high; a 7-inch zinc, ⅜ inch in diameter; a porous cup, 3 inches in diameter and 5½ inches high; carbon, 6 inches by 1½ inches by 5-16 inch. In the porous cup place the carbon stick and pack around it coarsely powdered manganese dioxide mixed with small pieces of crushed coke. Drill a hole in the carbon stick and run in a little lead. Drill this lead for a binding post. A binding post contact should also be arranged on the zinc rod. Over the top of the packed carbon stick and manganese pour paraffin to prevent creeping of the salts from the porous cup.

Sealing wax also may be used for this latter purpose. Place the porous cup and zinc in the glass jar and fill with water two-thirds up, putting in about five ounces of sal ammoniac.

Railway Crossing Signal

Question.—Please explain how to connect an electric bell in such a way as to have it ring when a car passes over a certain place in the track about one-eighth of a mile from the bell.—H. B. W., Bennington, Vt.

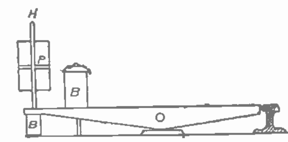
Answer.—The diagrams show the general arrangement of Hall's electric railway signal for crossings. The essential parts are: two track instruments (A, B), two interlocking magnets (C, D), a gong (G), and



HALL'S ELECTRIC RAILWAY SIGNAL

two sets of batteries. Suppose a train to be approaching the crossing (X) from the direction indicated by the arrow. When the engine reaches the point (A), the track instrument is operated by the weight of the wheels and closes the circuit through battery (1) and magnets (C), the armature (F) of the latter being attracted. Armature (H) passing through a slot in (F) and being notched, as shown, holds (F) locked. (F) in being attracted pulls against the tension of spring (S), and a projection on the horizontal bar presses spring (T), making contact at (U), closing the gong circuit through its battery (2). The gong now continues to ring until the engine reaches (B) where the second track instrument closes the circuit of magnet (B) which attracts its armature, releasing (F) which is drawn back by (S), the gong circuit being then broken at (U). The points (A) and (B) are chosen in accordance with the length of the train and the length of time it is desired that the gong shall ring before the train reaches the crossing.

The second illustration shows a little more in detail the track instrument which is a lever with one end at the track and the other resting between hard rubber buffers (B, B), so that the instrument can be operated only by a heavy weight. The vertical rod (H) has at its upper end an opening and closing device which operates as the rod, to which is attached a piston (P), rises and falls. All delicate working parts are enclosed in metal.



DETAILS OF TRACK INSTRUMENT

High Voltage Transmission; Copper and Aluminum Wire

Questions.—(A) Compare the carrying capacity of copper and aluminum wire on a 110,000-volt line. (B) What is the advantage of small wires over large ones on a transmission line? (C) Can a copper wire $\frac{5}{8}$ inch in diameter carry an unlimited voltage if the insulation is sufficient? (D) Suppose a wire on a 110,000-volt line were to break and fall on dry grass. Would it set the grass on fire? (E) Suppose the wire in (D) fell on a wire fence supported by cedar posts, would it kill a cow leaning against the fence some distance from the line? (F) When giving the voltage of a system what is meant?—H. R. H., Burlington, Ont., Canada.

Answers.—(A) Aluminum has a conductivity of about one-half that of copper, and its density is 2.7. Aluminum wire weighs $\frac{2.7}{8.89} \times \frac{1}{.5} = .607$, or a little more than one-half as much as a copper wire of the same length and resistance. Although aluminum wire is light, it must have about twice the cross-section of an equivalent copper wire, and hence would require more insulating covering where used inside.

(B) Your question is not clear. Do you refer to small wires in a cable or do you have in mind the small wires used in three phase transmission lines.

(C) Yes, if properly insulated. It is the *current to be carried* which determines the size of the wire.

(D) If the soil were damp or contained mineral deposit, current into the soil through these conductors offering resistance would generate heat. Absolutely dry soil without mineral conductor would act as an insulation.

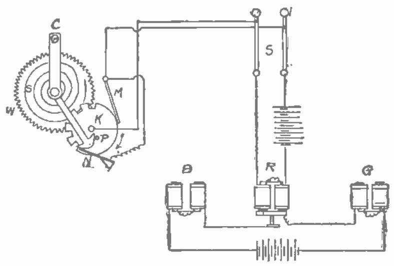
(E) In rainy weather enough grounds between wire contact and cow might be established to provide for escape of current to the earth, sufficient to kill the animal.

(F) The highest reading obtainable by connecting each wire of a system through a voltmeter to earth is the potential of the system, or the highest voltage obtainable by a voltmeter reading between various wires. If a series arc system, the voltage reading to earth at the positive terminal of the dynamo is the potential of the system.

Messenger Call Box

Question.—What is the circuit of a messenger call-box?—J. W. M., Boston, Mass.

Answer.—The diagram shows a single stroke bell (B) operated by an electromagnet wound to about four ohms. (G) is a four-ohm magnet operating a pen Morse register. (B) and (G) on the same circuit work as this circuit is opened and closed by relay (R) of 100 ohms on the back stop. This portion of the equipment is in the central office.



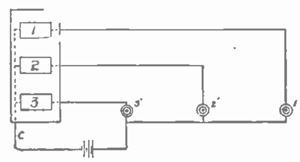
MESSENGER CALL BOX CIRCUIT

The call-box contains the toothed wheel (W) and a recoil spring (S). (W) is mounted loose on the shaft of crank (C), but is geared to wheel (P) so that the tendency is to turn the latter in the direction of the arrow. When a call is sent in, crank (C) is pulled to the right, and the cam is moved out of the path of pin (P). The wheel (K) is then free to move. A ratchet and pawl prevent (W) from turning with (C), and (S) is put under tension. When the crank is released the spring unwinds, turning (W) with it, operating wheel (K). (K) makes one complete revolution when the cam again resumes its position in the path of pin (P). Spring (M) falls into the notches in wheel (K) making and breaking the circuit to the central office in accordance with the box number which in this sketch is five. To guard against the opening of the circuit when the call-box is in its normal position an additional spring (N), resting against the cam, is provided with connections to the same point as spring (M). In case (M) fails in normal contact, a closed circuit is still maintained.

Wiring a Three Push-Button Annunciator; Uses of Brushes on Dynamo; A Ground Circuit

Questions.—(A) Please give diagram for wiring a three push-button annunciator. (B) Of what use are the brushes on a dynamo? (C) What is meant by a ground circuit?—R. S., West Springfield, Mass.

Answers.—(A) In the diagram a common wire (C) is run from the battery to one side of each magnet coil. From the other side of the battery taps are taken off running



WIRING OF ANNUNCIATOR

through each push-button and to the magnet coil this button is designed to operate.

(B) The brushes on a motor or dynamo are for collecting current from, or passing current to the moving commutator or slip rings.

(C) The dynamo at the railway power house has its positive terminal connected to the trolley wire and the negative wire grounded. The current passing from the trolley wire down the pole to the motor and off to the tracks makes its way back to the power station along the rails, by way of pipes, earth, etc. This return path is a ground circuit. Single wire telephones are operated by using the earth as one side of the line. The March, 1909, issue, page 725, shows a diagram of this latter circuit.

Flaming Arc Lamps

Question.—Can flaming arcs be used on either direct or alternating current?—H. H. S., Cleveland, Ohio.

Answer.—Both alternating and direct current lamps are on the market and are made up for the standard voltages.

Notes on the Law of Patent Titles

By OBED C. BILLMAN, LL. B., M. P. L.

1. **In General.**—Patents and interests therein may be owned, transferred, and made the subject of contracts like any other property, subject to such restrictions or conditions as may arise out of the nature of patent rights as property, or as are imposed by law.

2. **Legal or Equitable Title.**—As in the case of other property, the legal title to a patent may be in one person and the equitable title in another. And in such case a court of equity will ordinarily treat the holder of the legal title as trustee for the equitable owner. But the legal title will prevail over the equitable title unless the former was acquired with notice of the latter.

3. **Co-ownership.**—Where a patent is issued or assigned to two or more persons they become cotenants. There is no limitation in the United States of the number of persons who may be joint owners of a patent right. The exact mutual rights and liabilities of co-owners of patents are perhaps not fully settled in all respects, the peculiar nature of patent rights as property making it difficult in some cases to apply the ordinary rules of the law of cotenancy.

Assignment by Co-tenant.—One part owner may assign his undivided interest without the consent of his co-owner and the latter cannot sue the assignee for infringement.

Use of Patent.—Each co-owner may use the patented invention with or without the consent of his co-owner, and without being liable to account to him for profits.

License by One Co-owner.—A license granted by one co-owner of a patent is valid as against the licensor and his co-owners, and the licensee is liable to the licensor for the agreed price, but he is not liable to the other co-owners. There are intimations in some of the cases that the licensor is liable to account to his co-owner for what he receives from the licensee, but in a recent case it has been held that he is not so liable.

Co-owners May Become Partners by Agreement, but in the absence of such agreement they are not partners.

Power to Bind Co-owner.—One part owner cannot bind his co-owner by any special contract with an assignee of the patent, not connected with the enjoyment and exercise of the common privilege under the patent. Nor can one part owner prejudice the rights of his co-owners, as by a release of the right to recover damages for an infringement, or otherwise.

4. **Partnership.**—Patent rights may be held in partnership like other property, the mutual rights and liabilities of the partner being determined by the agreement of the parties and the general law of partnership.

5. **Invention by Employee.**—An invention made by one employee independently of his employment and without any assistance from the employer belongs to the inventor.

6. **Transfer of Patent Rights.—Assignments.**

1. *In General.*—A patent right being created by the federal laws may be transferred only when and in the manner authorized by such laws.

The statute provides that "every patent or any interest therein shall be assignable in law, by an instrument in writing; and the patentee or his assignee or legal representatives may, in like manner, grant and convey an exclusive right under his patent to the whole or any specified part of the United States.

2. *Who May Assign.*—By the terms of the statute, a patent or interest therein may be assigned by the patentee or his assignee or legal representatives.

3. *Who May Be Assignee.*—No restrictions whatever are imposed by the statutes as to who may be an assignee of a patent right or interest therein.

4. *What Constitutes Assignment.*—(a) Execution—aa. In General—Necessity for Writing.—The assignment must be by an instrument in writing, executed by the assignor, or by some one acting for him and in his name under legal authority. As between the parties, however, a verbal assignment is valid and passes an equitable right.

Seal.—The assignment need not be under seal, though executed by a corporation.

Acknowledgment, is not required by the statute, but an acknowledgment in due form obviates the necessity for other proof of execution.

Recording.—The statute provides that an assignment, grant, or conveyance of a patent or interest therein shall be void as against any subsequent purchaser or mortgagee for a valuable consideration, without notice, unless it is recorded in the patent office within three months from the date thereof. The only object of this provision is to protect bona fide purchasers for value without notice. As to them the assignment is void unless recorded as prescribed. But as between the parties, or as against infringers, or subsequent purchasers with notice or not for a valuable consideration or within three months from the date of the assignment, the assignment is valid though not recorded.

Time of Recording.—It is immaterial whether an assignment offered in evidence was recorded before or after the suit was brought.

Effect of Record.—Where an assignment has been duly recorded the assignee will be protected as against a subsequent assignee of the assignor. The record of an assignment is constructive notice to all the world, and a purchaser has the right to rely upon the record title.

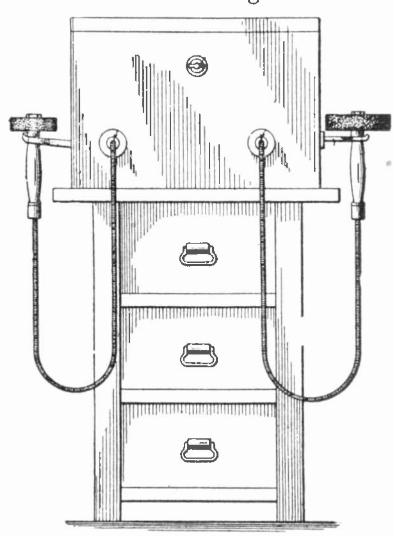
Form and Contents.—No particular form of assignment is required, but there must, of course, be some operative words expressing at least an intention to assign. A mere certificate in writing that a certain person has a joint interest in a patent right with the subscriber will not operate as an assignment. But an irrevocable power of attorney to hold and control a patent may operate as an assignment.

THE ELECTRICAL ENGINEER'S POCKETBOOK. By the International Correspondence Schools. Scranton: International Textbook Company. 1908. 414 pages with 225 illustrations. Price $2.00.

There is such a vast amount of available material which might be profitably embodied in an engineering handbook, that the problem becomes one of selection and condensation of information which is likely to come up the most times in every-day engineering work; and at the same time keep the book from becoming an encyclopedia instead of a handbook. The publishers appear to have made the selection and condensation of the material in a logical manner and the book is everything that it is designed to be—a pocketbook in reality as well as in name. It is 3½ by 5½ inches and easily carried in the coat pocket. But in these small dimensions there has been collected a great quantity of useful information; and it is presented in very readable form, for the printing is good and the illustrations nicely done, leaving nothing to guesswork. The most important subjects have been treated in considerable detail, such for instance as the description of dynamos and motors, the faults to which they are liable and the methods of locating and remedying these faults.

Shoe Shining Machine

This device for shining shoes is automatically operated by an electric motor inside the neat appearing cabinet. At the left is a dauber wheel, for polish, and at the right is the polishing brush. These are carried on flexible rotating shafts. In the middle of the front panel is a snap switch for turning on and off the current.



SHOE SHINING MACHINE

To shine your shoes you step on a platform, turn on the current, remove the dauber from the hook and apply the polish. Next take down the polishing wheel and complete the operation. Then turn off the current. The inventor is George E. Russell of Longbeach, Cal.

ON POLYPHASE SUBJECTS

EDISON WRITES FOR POPULAR ELECTRICITY

Let everyone be glad! Thomas A. Edison has contributed an article to Popular Electricity, and it will appear in the June issue. Long and anxiously has the public waited for a message direct from Mr. Edison and it is with just pride that we announce his selection of Popular Electricity as the medium through which he will make known his views on subjects near to his own heart and to the hearts of his readers.

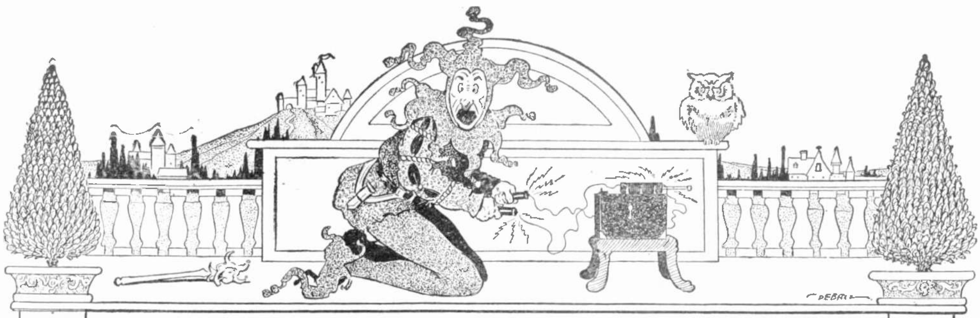
"The Tomorrows of Electricity and Invention" is the title of Mr. Edison's article. The keen insight of the great inventor into the needs of humanity is manifest in every paragraph, every sentence, and the promise of future strides to be taken toward the conservation of human energies, the triumph of brain over brawn and the general betterment of conditions of living are bright, indeed, for those who are to live on, in the great Electrical Age which we are barely entering.

Great as have been the accomplishments of Edison; world-wide though his fame may be, as the greatest inventor of any age; ideal that he is of every aspiring boy in the land, still, with characteristic modesty he believes his work to be only preliminary to that of an age of electrical development along practical and economic lines which will completely overshadow the things which have thus far been done. He says:

"It is those that will work at the art in the next fifty years that are to be envied. We poor gropers of the last fifty are like the struggling farmers among the bare New England rocks before the wide grain fields of the West were reached. The crops have been thin, without reapers or threshers to harvest them. We haven't got very far beyond Franklin or Faraday."

For the man who has taken out nearly a thousand patents in his time, contributing to almost every field of electrical development and other fields far removed from electricity; inventions so original in their conception and far-reaching in their benefit to mankind as those of the incandescent lamp, the phonograph, and the moving picture machine—for him to say that these are only gropings in the realm of scientific discovery is truly significant. Yet in the mind of an Edison there are visions of future things which do not come to the minds of other men.

Read, then, his own words in the June issue and live with him for a time in the Great Age that is to come.



SHORT CIRCUITS

The Fernie (B. C.) Free Press, has recently had an electrical equipment installed and has consequently suddenly become electrically enthusiastic to the extent of printing the following definitions: A transformer is an apparatus that hangs on a pole on the street and grinds the volts into domestic sizes for adjacent consumption. A meter is an automatic casekeeper that is designed to keep the conscience of the consumer pure and untainted. A motor is a Christian Science medicine box that is influenced from the powerhouse by absent treatment. The method of operation is as follows: The armature amperes the rheostat at the switchboard by kilowatting the voltage, thereby transforming the resistance into two-phase electromotive ohms, with which the motor absorbs the peak load on the cut off. The dynamo reduces the insulation of the series wound exciter, producing multipolar generators on the direct current, and you pay at the city clerk's office.

* * *

A sailor had just shown a lady over the ship. In thanking him she said, "I am sorry to see by the rules that tips are forbidden on your ship."

"Lor' bless you, ma'am," replied the sailor, "so were apples in the Garden of Eden."

* * *

The First Phonograph.—A reporter was interviewing Thomas A. Edison.

"And you, sir," he said to the inventor, "made the first talking machine!"

"No," Mr. Edison replied. "The first one was made—long before my time—out of a rib."

* * *

'There was a young lady named Banker
Who slept while the ship lay at anchor;
She woke in dismay
When she heard the mate say,
'Now hoist up the top sheet and spanker.' "

* * *

"Oi'll work no more for Dolan."

"An' why?"

"Sure, an' 'tis on account of a remark he made."

"An' phwat was that?"

"Says he, 'Casey,' says he, 'ye're discharged.' "

* * *

Bystander: Come, cheer up, old man. You may not be so badly hurt after all.

Victim: How can I tell how badly hurt I am until after I have seen my lawyer?

* * *

It takes a lot of nerve to enable a young married man to enter a store and purchase a dozen safety pins from a former sweetheart.

* * *

A Scotchman and a commercial traveler occupied neighboring seats. The Scotchman was not inclined to talk. Finally the commercial man said: "Could you lend me a match?" The Scotchman took one out of his pocket, and gingerly placed it on the window-ledge.

"Oh! by-the-way, I've forgotten my tobacco, too!" said the traveling man.

"Um! Then ye'll nae need the match," replied the Scotchman.

On a recent declamation day in a New Jersey school a promising young idea shot off the subjoined.

"Our yaller hen has broke her leg,
Oh, never more she'll lay an egg;
The brindle cow has gone plumb dry,
And sister Sal has eat a pie;
This earth is full of sin and sorrow—
We're born today and die tomorrow."

* * *

A good story is told of a doctor, who, while making out a patient's receipt, forgot his visitor's name. Not wishing to appear forgetful, and thinking to get a cue, he asked her whether she spelled her name with an "e" or an "i". The lady, smilingly replied, "Why doctor, my name is Hill."

* * *

Hipe—Do you keep your mug at the barber's?

ipe—No. Only take it there to get it shaved.

* *

Sunday School Teacher (to the quiet looking boy at the foot of the class)—In what condition was the patriarch Job at the end of his life?

"Dead," calmly replied the boy.

* * *

"They say that when a mountain climber has a fall all the sins he ever committed flash through his mind. Was this the case with you?"

"Oh, no. You see, I fell from a ledge only a hundred yards high."

* * *

The Speaker—Marriage, my dear sisters, is a huge mistake! Believe me, I would not marry the best man in the world—

Sweet Voice (from audience)—You couldn't. for I've got him.

* * *

Little Girl—Papa would like to borrow your lawn mower.

Subhubs—Tell your father I'm sorry, but I've made a rule never to let it go off my premises. But if he'd like to use it on our own lawn, it's at his disposal at any time.

* * *

"Father, what is meant by bankruptcy?"

"Bankruptcy is when you put your money in your hip pocket, and let your creditors take your coat."

* * *

Ethel, aged six had gone down the village street with her new doll It could be plainly seen that she was in dire distress. She stood still, and after a close scrutiny of several men who passed, she accosted one.

"Say are you an honest man?" she demanded.

"Why, yes, I think so," was the astonished reply.

"Well, then, if you're sure you re an honest man," said the little maid, "please hold my dolly while I tie my shoe."


ENCYCLOPEDIA
WHY DO SNAKES HAVE TAILS
A MACHINE FOR CHILDREN WHO ASK 1000,000 QUESTIONS PER DAY
1
ELECTRICAL PRIZE FIGHTERS
2
ME HAT'S CROWIN FOR EIGHT O'CLOCK - I'LL BE LATE TO WORK
AN ELECTRICAL HAT THAT WILL CROW EVERY HOUR
3
I ADORE YOU MADLY YOU ARE THE ONLY GIRL I EVER TRULY LOVED. WILL YOU BE MINE? ETC
FOR BASHFUL YOUNG MEN
5
6
DE BALL

COMMON ELECTRICAL TERMS DEFINED

In this age of electricity everyone should be versed in its phraseology. By studying this page from month to month a working knowledge of the most commonly employed electrical terms may be obtained.

ACCUMULATOR.—A term commonly applied to a storage battery. Also used to designate a Leyden jar; a condenser.

ACOUSTIC TELEGRAPHY.—The method of reading messages by means of a sounder, the dots and dashes being distinguished by the periods of time between the forward and back stroke of the armature of the magnet.

ADAPTER.—A threaded coupling used to provide a screw shell for an Edison base lamp on old type sockets having a center screw contact. A device for connecting incandescent lamps to gas fixtures.

ADJUSTER FOR LAMP.—A device for regulating the height of an incandescent lamp suspended by a flexible cord.

A. I. E. E.—An abbreviation for "American Institute of Electrical Engineers," the foremost electrical engineering society in the United States.

AERIAL.—A term used to designate electrical conductors suspended in air as distinguished from those in the water or underground. Applied also to the antennae in wireless telegraphy.

AGEING OF TRANSFORMER.—A condition brought about in the iron core of a transformer by running it at a temperature exceeding 80° C, which increases the core loss and decreases the efficiency. The mechanical and chemical character of the core iron has much to do with this change, which may also be produced by heating in any other way. Known as transformer fatigue.

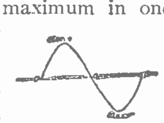
AIR-GAP.—The space between the armature and pole pieces of a motor or dynamo. It tends to cause magnetic scattering or leakage of the lines of force. Also designates the space between the poles of a magnet.

ALARM, ELECTRIC.—Any system operated by electricity to give a warning or signal when certain conditions exist. Among those so designated are: water level, overflow, valve, sprinkler supervision, fire, journal and burglar alarms.

ALIVE.—A term commonly applied to electrical conductors, switchboards or other devices when subject to electric pressure or carrying current.

ALLOY.—A mixture of two metals which combine upon the application of heat or in an electrolytic cell.

ALTERNATING CURRENT.—Current which changes direction periodically, the voltage and current starting from zero rising to a maximum in one direction, dropping to zero, passing to a maximum in the opposite direction and returning to zero, in a constantly recurring cycle. Alternating current is represented by a curve of this general form known as a sinusoidal curve.



ALTERNATION.—A change in the direction of flow of current; one-half cycle.

ALTERNATOR.—A dynamo which generates alternating current.

AMALGAMATION.—Covering a metal with a film of mercury, usually done by dipping first in sulphuric acid and then in mercury. Amalgamation prevents eating away of the zinc by the chemical action of the acid.

AMMETER.—An instrument measuring the amperes of current flowing in a circuit. Sometimes called ampere-meter.

AMPERE.—The unit of current. It is the rate at which electricity will flow through a resistance of one ohm under a potential of one volt. As defined by the International Electrical Congress it is the current which, under specified conditions, will deposit .001118 gram of silver per second when passed through a solution of nitrate of silver in water.

AMPERE-HOUR.—The quantity of electricity passed by a current of one ampere flowing for one hour. A unit sometimes used by light and power companies to measure electric energy in which case the voltage must be constant. Used also in rating the capacity of a storage battery, which by agreement among manufacturers is referred to an eight ampere-hour rate as a standard. This rating is based on the constant current at which the battery will discharge without the voltage falling below 1.75 per cell. A battery giving fifteen amperes under this condition would be called a 120-ampere-hour battery.

AMPERE-TURNS.—A term applied to magnet coils and specifying the product of the number of turns of wire multiplied by the number of amperes flowing in the coil. Thus, a magnet wound with a coil of ten turns of wire carrying two amperes would be regarded as affected by twenty ampere-turns.

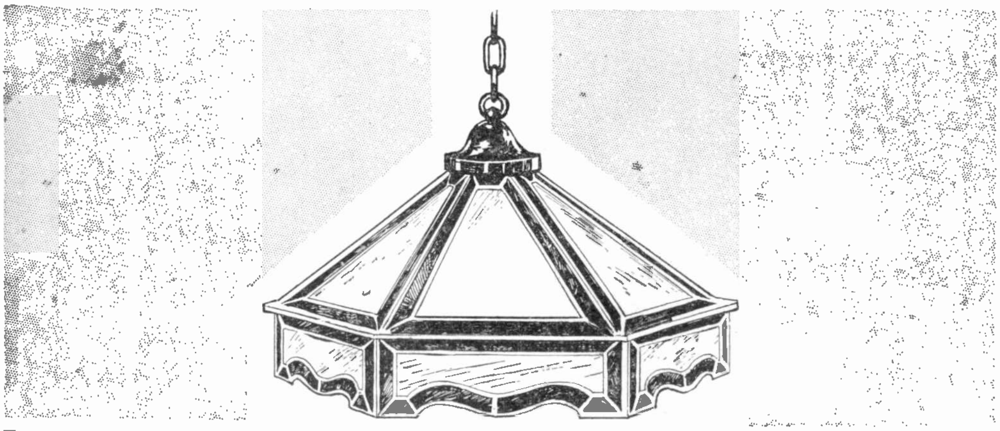
ANGLE OF DECLINATION.—The angle measuring the amount that a magnetic or compass needle deviates from the true north and south position. This deviation varies according to location, and is due to the fact that the real north pole and the north magnetic pole are not at the same place.

ANGLE OF INCLINATION.—The angle measuring the dip below the horizontal which a magnetic needle free to move makes, when placed in the magnetic meridian. Due to the path of the earth's magnetic lines.

ANGLE OF LAG.—Self-induction in a circuit carrying alternating current causes the current to lag behind the electromotive force or voltage which is forcing the current through; that is as the voltage rises and falls (see alternating current) the current will reach say its maximum value a little later than the electromotive force. Considering a cycle or double alternation as 360 degrees, the angle by which the current lags behind the electromotive force is called angle of lag. The term is also applied to the angle through which the brushes of a motor are moved backward against the direction of rotation (given a lag) to overcome sparking.

ANGLE OF LEAD.—When a circuit contains capacity, such as a condenser, the current leads the electromotive force; that is it reaches a maximum value during the cycle before the electromotive force. The amount (measured in degrees) is called the angle of lead. Also the angle through which the brushes of a dynamo are moved forward to secure sparkless commutation.

This Art Glass Electric Dome, $20



Dignified and Stately in Design And Agreeable in Colors

This is an exceptionally attractive and strongly constructed Electric Dome— one that fulfills every demand that can be made for usefulness and ornamentation in a lighting unit for the dining room.

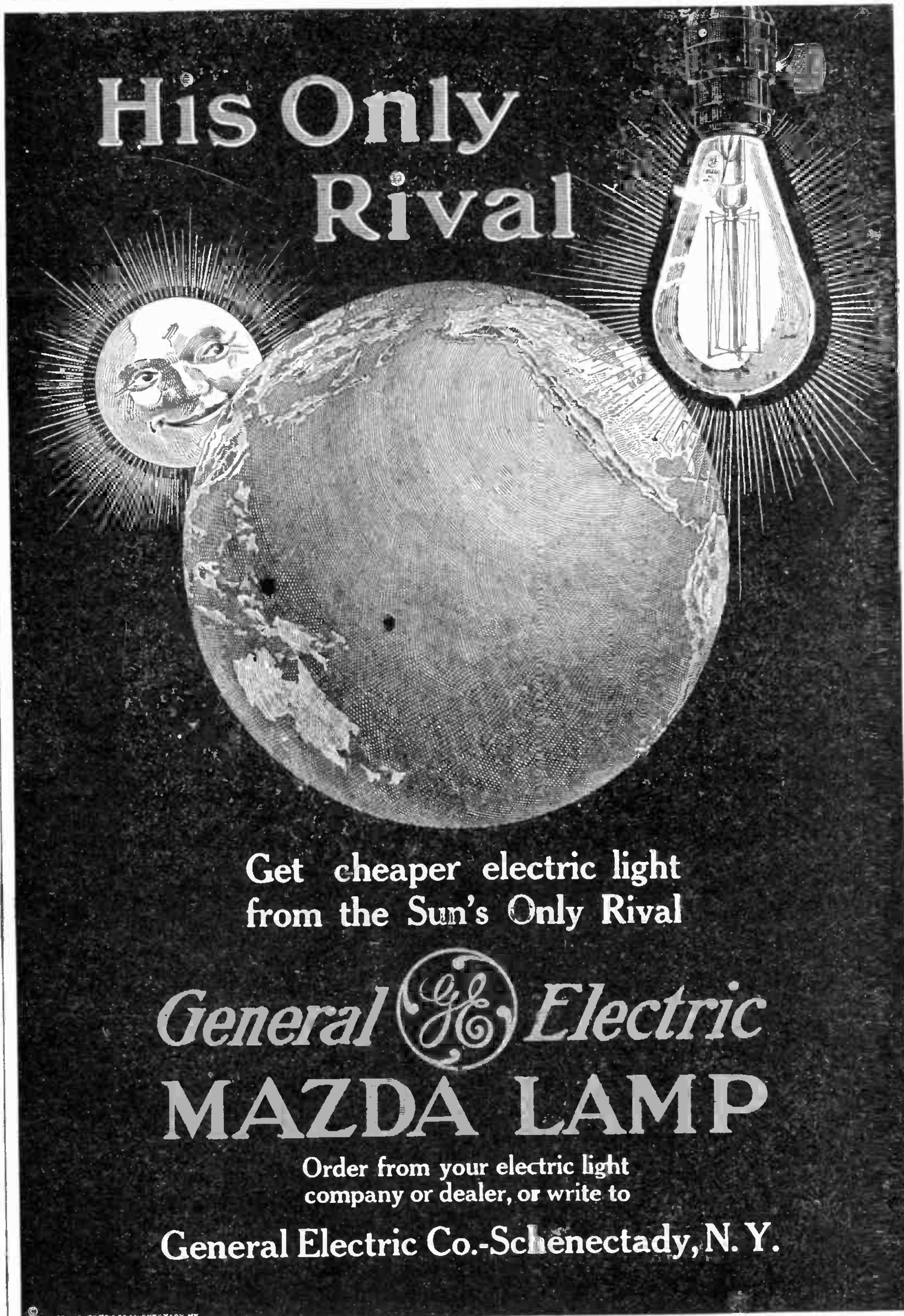
It may be had in either of two color combinations: (a) Amber, with a rich, brown border, or (b) Green, with an amber border.

The chain, ceiling canopy, and all metal parts on the dome itself, are brush brass finish. About three feet of chain is furnished, which permits hanging the Dome at any height above the table one desires.

The panes of Art Glass are strongly interlocked by the copper ribbon process. The Dome is of the three lamp cluster, pull chain socket type. Shipped complete, with electric lamps; price $20, express prepaid.

Inquiries are invited concerning anything electrical for the home. Complete descriptions and prices will be promptly supplied.

Electric Shop Cor. Michigan and Jackson Boulevards **Chicago**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General Electric
MAZDA LAMP
Order from your electric light
company or dealer, or write to
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¶ In order to secure the proper classification, advertisements must be in this office the first of each month preceding date of issue.

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CIVIL SERVICE EMPLOYEES ARE PAID well for easy work; examinations every month, expert advice, sample questions and Booklet 50 describing positions and telling easiest and quickest way to secure them free. Write now. Washington Civil Service School, Washington, D. C.

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The Warner Tungsten Arc Lamp

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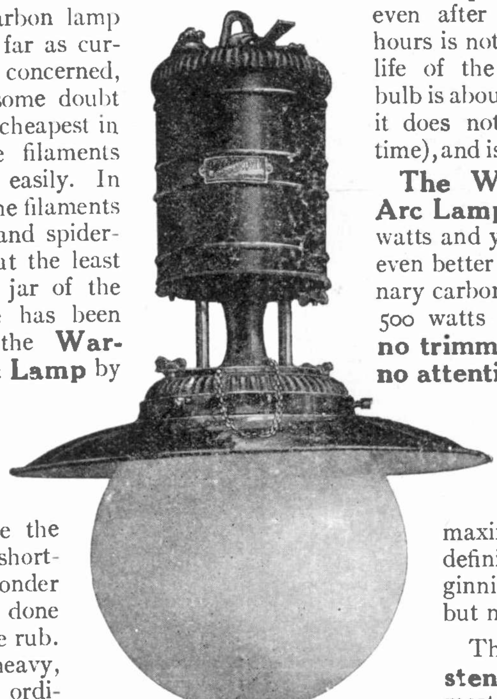
The Filament is the thing that places the **Warner Tungsten Arc Lamp** head and shoulders above every other artificial lighting device for your use. It makes **higher** efficiency at **lower** cost and doubles the period of its useful existence. It corrects the objection that has hitherto been raised against Tungsten Lamps.

There is no question among lighting experts but that the **Tungsten lamp** actually produces three times as much useful light as the carbon lamp and much cheaper as far as current consumption is concerned, but there has been some doubt that it was really the cheapest in the end because the filaments break so often and so easily. In all Tungsten lamps the filaments have been long, thin and spider-web like, and break at the least vibration or sudden jar of the lamp. This trouble has been entirely overcome in the **Warner Tungsten Arc Lamp** by making the filament —the vital—fragil—breakable part— **short, thick, and** durable. It seems a simple thing to make the filaments heavier and shorter and perhaps you wonder why it has not been done before. There is the rub. You cannot use a heavy, short filament on the ordinary 110 to 220 volt lighting current without some reducing and regulating apparatus. The **Warner Tungsten Arc Lamp** provides the necessary transformer and regulating apparatus to adapt the lamp to all lighting circuits, whether direct or alternating, series or multiple.



1500 burning hours guaranteed for the bulbs used in the **Warner Tungsten Arc Lamp** and they will be good even after that—3000 burning hours is not at all unusual. The life of the ordinary Tungsten bulb is about 600 hours (provided it does not break in the meantime), and is not guaranteed at all.

The Warner Tungsten Arc Lamp only consumes 250 watts and yet it gives as good or even better results than the ordinary carbon arc lamp that takes 500 watts or more. It requires **no trimming, no repairing, no attention.** Gives absolutely steady, pure white light, and the up-keep expense is reduced to one item alone—the bulb renewals—the maximum for this cost is definitely known at the beginning. It may be less but no more.

The **Warner Tungsten Arc Lamp** is almost a universal lighting unit when operated in series; whether on series or multiple circuits, it works equally as well on A. C. as D. C., and on A. C., any cycle. In fact it is about the only practical lamp for 25 cycles A. C. work that has ever been offered for sale.

ABSOLUTELY NOTHING LIKE IT ON THE MARKET

Better find out the superiority of this lamp without delay. We also furnish **low voltage** Tungsten Lamps for residence lighting, that reduce lighting bills to one-fourth what they formerly were. In writing us give your business, and to save time let us know for what purpose you are interested in using lamps, as well as the probable number that you could use. Write us **today.**

DO IT NOW

WARNER ARC LAMP COMPANY — **Wilton Junction, Iowa**

DEAFNESS CURED

By New Discovery

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The secret of how to use the mysterious and invisible nature forces for the cure of Deafness and Head Noises has at last been discovered by the famous Physician-Scientist, Dr. Guy Clifford Powell. Deafness and Head Noises disappear as if by magic under the use of this new and wonderful discovery. He will send all who suffer from Deafness and Head Noises full information how they can be cured, absolutely free, no matter how long they have been deaf, or what caused their deafness. This marvelous treatment is so simple, natural and certain that you will wonder why it was not discovered before. Investigators are astonished and cured patients themselves marvel at the quick results. Any deaf person can have full information how to be cured quickly and cured to stay cured at home without investing a cent. Write today to Dr. Guy Clifford Powell, 6305 Bank Building, Peoria, Ill., and get full information of this new and wonderful discovery, absolutely free.

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Can you realize what it means? And do you know that you can **avoid** the **terrible consequences** of **neglected** Weak, Smarting, Sore, Aching Irritated Inflamed, Watery, Diseased Eyes? If **your eyes** are **diseased**—or **failing** you, for **any reason**—begin treatment **NOW**, before it is forever too late.

Perfect Eye Health

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The **majority** of such cases can be **restored to perfect eye health** under **proper treatment**—for, if not **hereditary**, or caused at birth, the imperfect eyesight can be remedied by **gentle, scientific, medicated massage**. My **FREE BOOK** tells about my **simple and inexpensive home treatment**. **Write for it**, and you will receive details of a **Special Offer** of **Three Months Trial Treatment FREE** to every purchaser of the **Natural Sight Restorer**. Address

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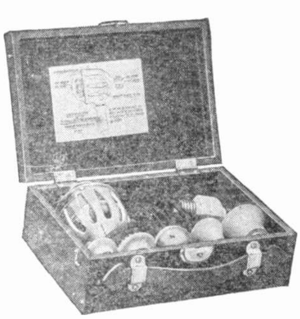
VITAL POWER

100% Added to your Mental and Physical Capacity

The Swedish Electric Vibrator



Operates on either Alternating or Direct Electric Light Current or its own Powerful Batteries.

Prices, $12.50 to $30.00

will cultivate your system up to the top notch standard; it will CURE nearly every ailment; it will give you VITAL POWER; it will throb and thrill you into a tireless human engine with POWER to think TWICE AS CLEARLY and DO twice as MUCH. When you come in from a hard day's work, it will SOOTHE, REST and REVITALIZE you from head to foot; it will cause your blood to go LEAPING and BOUNDING through your veins and arteries; cause the flow of nerve fluids to saturate the innermost nerve. You can actually feel disease and weakness being driven from you and NEW LIFE and power being generated.

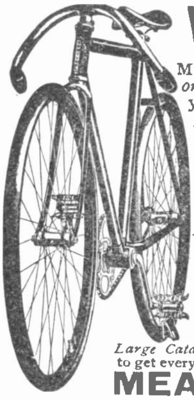
IT SETS LOOSE in the blood and lymphatic vessels all stray and impure matter that CLOG UP the capillaries. These impurities are poisoning and weakening your system and need only to be RATTLED LOOSE, combined with blood so that it can and will be TAKEN OUT OF THE BODY through the excretory organs

It takes a big, illustrated book, with charts and diagrams and instructions in PLAIN ENGLISH to SHOW and TELL HOW OUR VIBRATOR will cure any ailment, correct any physical condition. We will send it to you FREE.

Write us today—and let us PROVE to YOU what we say—at our cost.

SWEDISH ELECTRIC VIBRATOR CO., 1740-1750 FARRAGUT AVENUE CHICAGO, ILL.

WHEN desirous of information inquire at the information Dept. of Popular Electricity Pub. Co.



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LOW FACTORY PRICES We furnish the highest grade bicycles it is possible to make at one small profit above the actual factory cost. You save $10 to $25 middlemen's profits by buying direct of us and have the manufacturer's guarantee behind your bicycle. **DO NOT BUY** a **bicycle** or a pair of **tires** from *anyone* at *any price* until you receive our catalogues and learn our unheard of *factory prices* and *remarkable special offer.*

YOU WILL BE ASTONISHED when you receive our beautiful catalogue and study our superb models at the *wonderful low prices* we can make you. We sell the highest grade bicycles at **lower prices** than any other factory. We are satisfied with $1.00 profit above factory cost. **BICYCLE DEALERS**, you can sell our bicycles under your own name plate at double our prices. Orders filled the day received.

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TIRES, COASTER BRAKE rear wheels, inner tubes, lamps, cyclometers, parts, repairs and everything in the bicycle line at **half usual prices. DO NOT WAIT**—but write today for our *Large Catalogue* beautifully illustrated and containing a great fund of interesting matter and useful information. It only costs a postal to get everything. **Write it now.**

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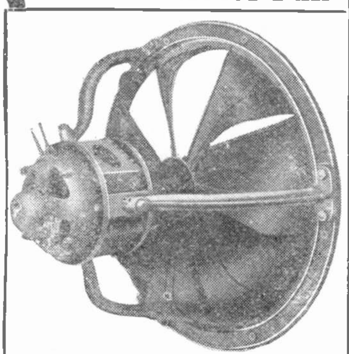
Watson Motor Driven Ventilating Fans are so aligned and made that they run smoothly and noislessly The outfits are furnished complete with automatic release speed controller. They range in size from 18 in. to 42 in., and in voltage from 110 to 500. Equipped with our special curved blades or with straight Blackman or Davidson blades.



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Highest efficiency, economy and durability were the results striven for in these fans and motors. We got the quality we were after and we can prove it. Yet the cost is no greater than for the ordinary fan or motor. Write to-day for prices and full information.

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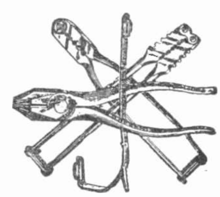

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Your name and address on a post card is sufficient.

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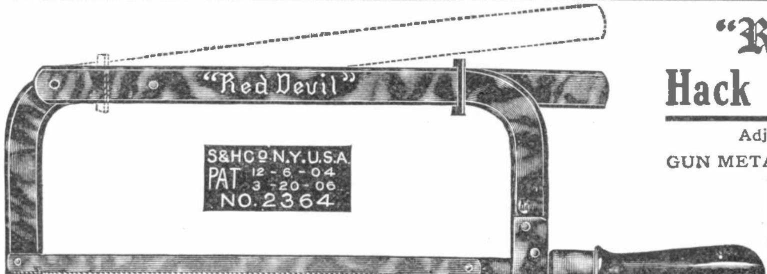

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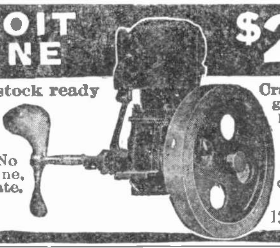
2 H. P. DETROIT ENGINE

$29.50

Engine only, without Electrical or Boat Equipment



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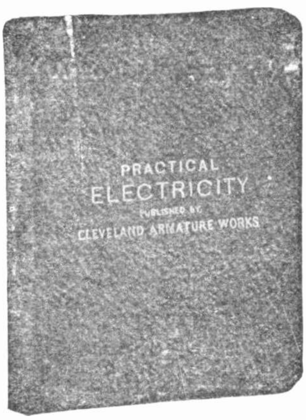

There are XX chapters in all, XIX carrying you from the fundamental principles of electricity on through the various branches to a point where the careful student comprehends the complete designing, care and operation of a dynamo or motor, and I chapter on electric automobiles, outlining their construction, care and operation, and all about storage batteries and how to handle them. Each subject is carefully written and to the point. After a student studies a subject, he is questioned on that subject in such a manner as to bring clearly to his mind the points he needs to know regarding same. A DICTIONARY in back of book will enable him to learn the meaning of any electrical word, term or phrase used in this book, as well as hundreds of others in common use. All required tables necessary in the study are in it.

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XIV—Winding of Dynamos and Motors.
XV—Proper Method of Connecting Dynamos and Motors—Self Excitation.
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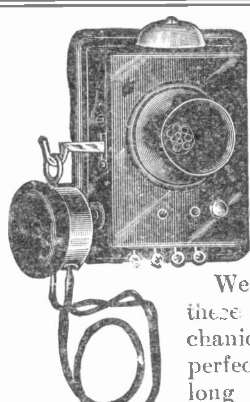

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Instruments are equipped with push button and bell for signaling.

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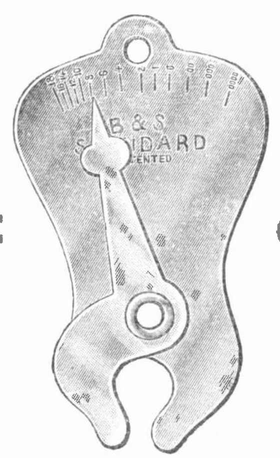
WIRE  **GAUGE**

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¶ Anything that reduces your unit cost of production means additional profit and here is where

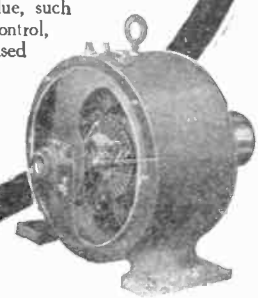
Fort Wayne Motors Prove Their Superiority

¶ We will be glad to furnish you with guarantee performance curves for any of our motors and if you will send us your specifications our engineers will solve your individual problems and recommend sizes, etc.

¶ With this information you can easily figure out how much you will gain by installing electric drive in YOUR plant.

¶ There are a great many advantages also on which it is hard to place a MONEY value, such as cleanliness, convenience of locating machines regardless of power supply, ease of control, automatic operation, economy of floor space, elimination of belts and pulleys, increased safety and freedom from accidents to employees, more light and less noise.

¶ These points apply in general to almost all motors but there are particular features about Fort Wayne Motors that make them the *best purchase on the market.* Anyway it will pay you to send for our Bulletin "Motor Drives." It's free.



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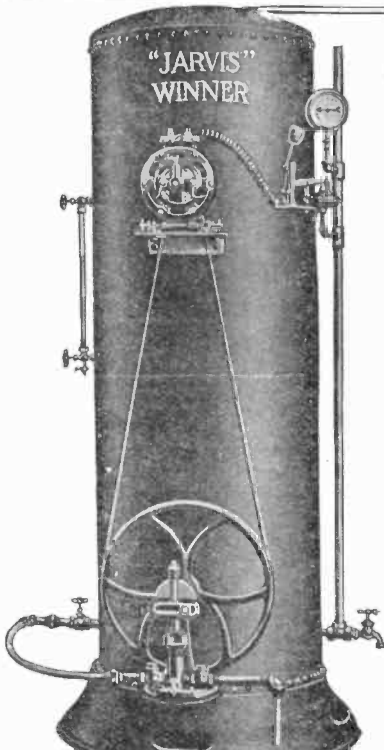

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NOR GO WITHOUT IT. THE

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ELECTRIC PUMPING OUTFIT

Will give you all the advantages of

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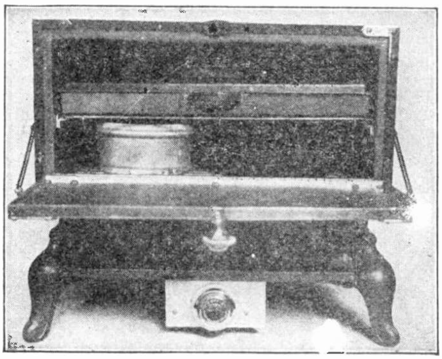
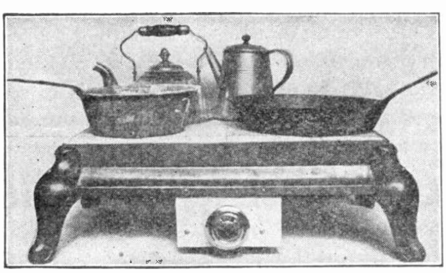


Stove size No. 2, showing an open oven in place

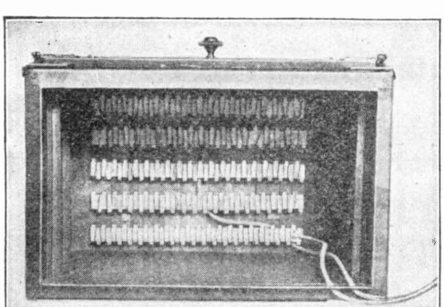
This is a perfect stove for ordinary family use, of 30 amperes on 110 volts, will do any kind of work that can be done on any stove, with the oven off it is a perfect hot plate for any purpose, and as the top is of soapstone it makes an excellent Pancake Griddle.



Stove size No 2. used as a hot plate or range

It toasts perfectly, boils, fries and stews: The oven does excellent Baking or Roasting. The broiler does excellently as a broiler and with the oven off and tipped up it makes a beautiful open grate heater for cool r w mornings and evenings when it isn't worth while to build a heavy fire.

Pronounced by all as the most perfect Electrica l Stove.



Stove size No. 2, used as an electric radiator or fire place

Size of Hot Plate 20 1-2 x 12 1-2 inches
Size of Oven, 20 1-2x13 1-2 inches
Price Complete with Broiler, $35 00
Price Complete without Broiler, $25 00
Write today for particulars and circular
Electric Dealers Wants. Write for Prices

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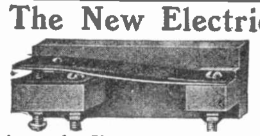

can be used in connection with any 16 c. p. electric lamp, a. c. or d. c. and flashes the lamp as well as a motor driven flasher will. Innumerable Electrical Effects may be produced by its use. Most fascinating novelty ever invented. Size 1 x 3 x 1 inches, weighs 2 1-2 oz. Price by mail 80 cts. Write today.

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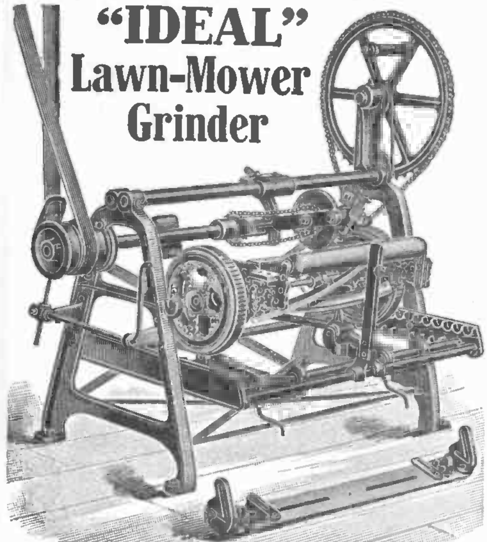
The NEW 1910 MODEL "IDEAL" Lawn-Mower Grinder



Grinds the reel knife to fit either a crooked or straight lower blade — something never done before. Nothing like it on the market. Sharpens a mower perfectly in 15 minutes. The biggest money-maker you can have in your shop. Write for circular and price TODAY.

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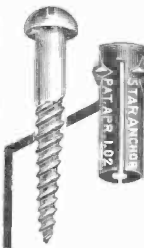
Where an Ordinary Screw Wouldn't Hold

You formerly drilled a hole and "leaded in" your bolt.



Note beginning of positive "inner end" expansion

Painfully slow, tiresome, and costly. Avoid all this. There's a better, cheaper, cleaner and more economical way. Try this way.

Star Screw Anchors

Are especially adapted for all light work in concrete, brick, stone, cement, marble, tile and slate. They hold where wood plugs decay. Rain and dampness does not affect them. Insure YOUR fastenings by using the Star.

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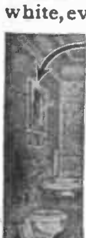

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We refer to any Mineralogist. Established 1876

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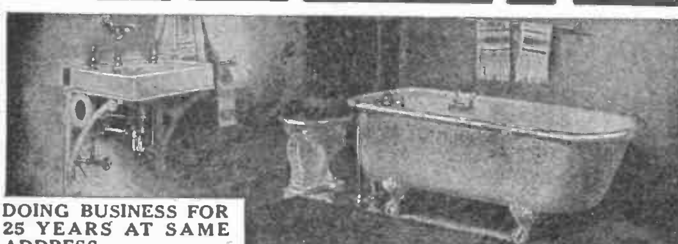

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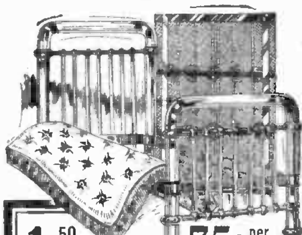

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Bed just as illustrated above—in gold bronze, or enameled in any color, any width, posts $1\frac{1}{16}$ inch diameter, also fine cotton top mattress, durable ticking, best woven wire springs with spiral steel spring supports. *Terms $1.50 cash, 75c per month.*

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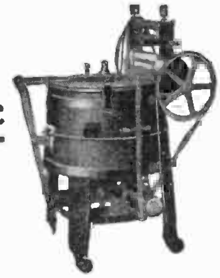

is driven by a rawhide gear; an exclusive feature of this machine.

¶ The reversible wringer enables the operator to release clothing caught in the rolls. No other machine on the market offers these advantages with so little gearing and levers to confuse. Built for women to operate.

¶ Write for terms and prices.

Automatic Electric Washer Co.

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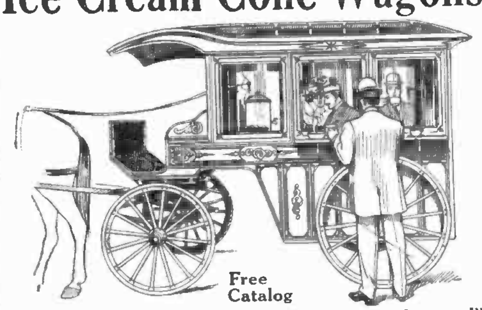
$50 to $150 a Week

WITH OUR COMBINATION

Hot Lunch Cars and Ice Cream Cone Wagons



"I made the cost of my wagon in one day."—Ben Berry, Streator, Ill.

Our Combination Lunch Cars and Ice Cream Cone Wagons offer an exceptional opportunity for men with small capital. Our **Free Catalog** describes fully how to start a big money-making business, and tells of the wonderful success others are having. Explains our Easy Payment Plan. Write for it today.

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Ice Cream Cone Wagons, $225 and upward.
Small Cash Payment, Balance Monthly.

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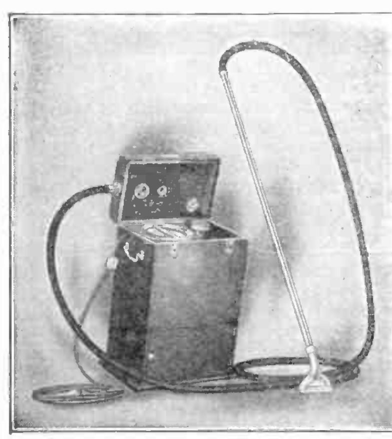
The "IMPERIAL"

A Portable Vacuum Cleaning Machine

Combining Efficiency, practicability and economy.
Can be attached to any electric light socket.



"The Only High-Grade, Efficient Machine on the Market." Guaranteed.

A Dividend Payer for Central Stations

Growing Concerns and responsible parties wanted as agents. Exclusive territory given. Send for catalogue and particulars.

Price $100 Complete

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AMERICAN

Black Enameled Wire

You Can't Beat It For

Coil Windings

Because It's

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More Value for Your Money

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ORDINARY MAGNET WIRE
Ask for Samples and Prices

American Electric Fuse Co.

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Muskegon, Michigan

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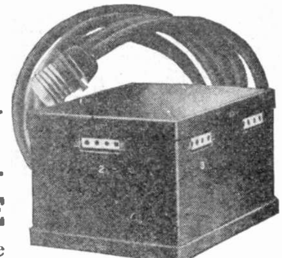

No. 2

designed to operate any class of electrical toys, such as small fans, motors, miniature electric railway trains, ring bells, buzzers, light small lamps, operate Ruhmkorff or any other type of induction coils; in fact the different uses it may be put to are unlimited, depending only on ingenuity of experimenter.

Transformers are so arranged that they can be connected to any alternating current lamp socket.

Made in two sizes.

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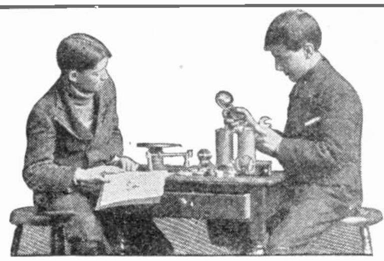

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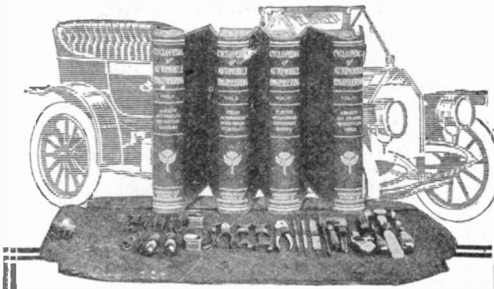

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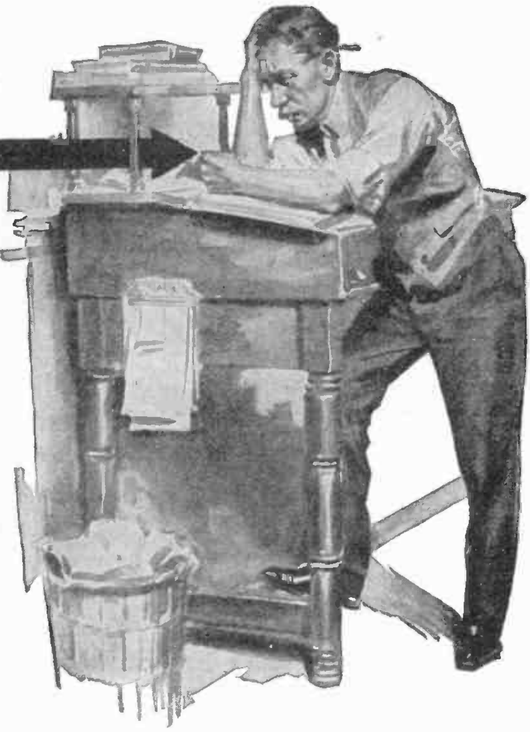

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