ELECTRICAL APPLIANCE NUMBER

POPULAR ELECTRICITY MAGAZINE

IN PLAIN ENGLISH

(NON TECHNICAL)

GRAND COMMANDERY ARCH AT KNIGHTS TEMPLAR CONCLAVE

Vol. III OCTOBER, 1910 No. 6

A MAGAZINE FOR EVERYBODY 10 C

KNIGHTS TEMPLAR CONCLAVE STORY IN THI

Have you ever been in the beautiful islands of Hawaii? To think of these islands in the far Pacific, causes a restful minute of speculative thought as to what would happen if you were suddenly ushered upon the scene of bustle and enterprise, evident in the larger towns of this land.

Nine chances to one, you would stand open mouthed, wondering if your eyes were truthful in seeing such commercial spirit coming from residents of a country so torrid.

There is a reason for this tremendous increase in business transacted; it cannot alone be credited to the American residents, for other countries are largely represented. But a greater amount of business enterprise can be laid at the door of America, through its efforts to educate the people of the island in American methods. This is illustrated by the following letter which we received from a Hawaiian resident.—

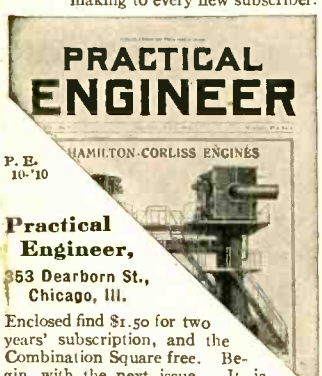
PAPAIKOU, July 20, 1910.

Practical Engineer, CHICAGO.

Gentlemen:—I picked the enclosure up on the street. Am I too late, if not I enclose a draft for $1.50. Please send me Practical Engineer and the special offer. Some one used the coupon before I found the circular.

Yours truly,
NORMAN G. CAMPUI.

Mr. Campui, while walking along the streets of Papuikou, happened to see our circular flying just ahead of him. The large bold letters describing this special offer caught his eye. Hurrying, he leaned over to read the offer we are now making to every new subscriber.



P. E.
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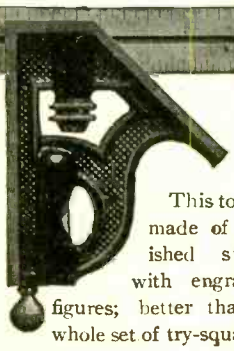
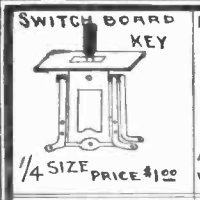
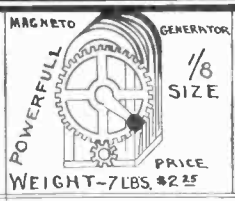
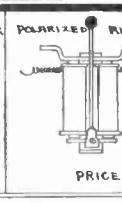
Mr. Campui asked if the special offer was still good. We told him as we now tell you, this offer is still open but **for a short time only. You can't lose. Money back if you are not satisfied. Send us your subscription today.**

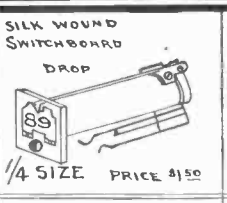


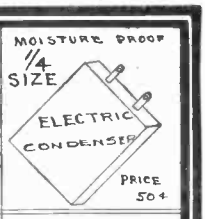
This tool is made of polished steel with engraved figures; better than a whole set of try-squares. Square, miter, depth gauge, level, scratch-awl, combined in this tool. Adjustable.

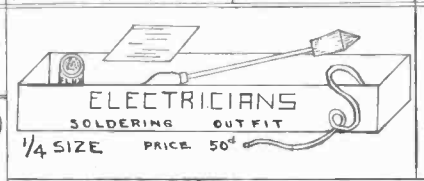


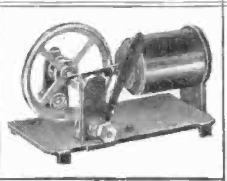


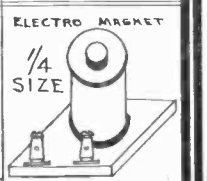


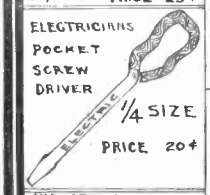












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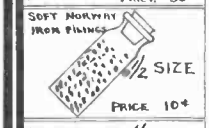

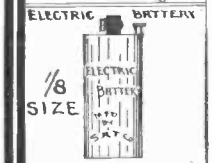

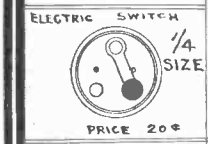

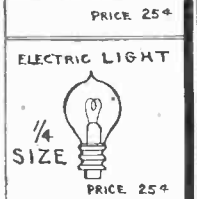

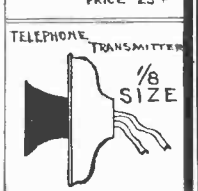

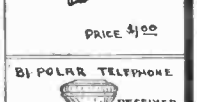

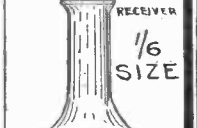

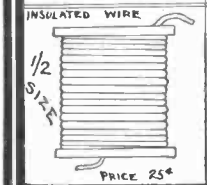

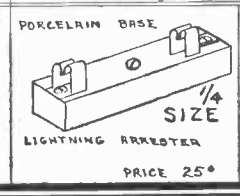

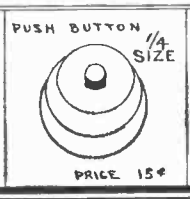

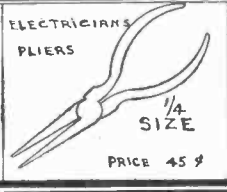

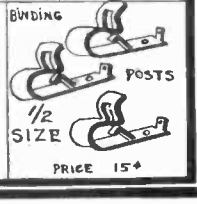

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CHICAGO, ILL.

Electrical Talks—Flash No. 4

WE have in mind a manufacturer who has exhibited at Electrical Shows for the past five years, telling us at the close of a show where 250,000 admissions were counted, that he thought an Electrical Show was a great thing from an educational standpoint and was of considerable benefit.

He put particular stress on the fact that he made sales to people whom he had never heard of before and never knew they were in the market for electrical goods.

A trade paper is an excellent medium, and without doubt performs its duty—but it develops nothing, it doesn't get outside of its sphere and develop the great multitude of people who are not only interested and possible purchasers, but the people who are constantly organizing and furnishing money to enter into a particular business.

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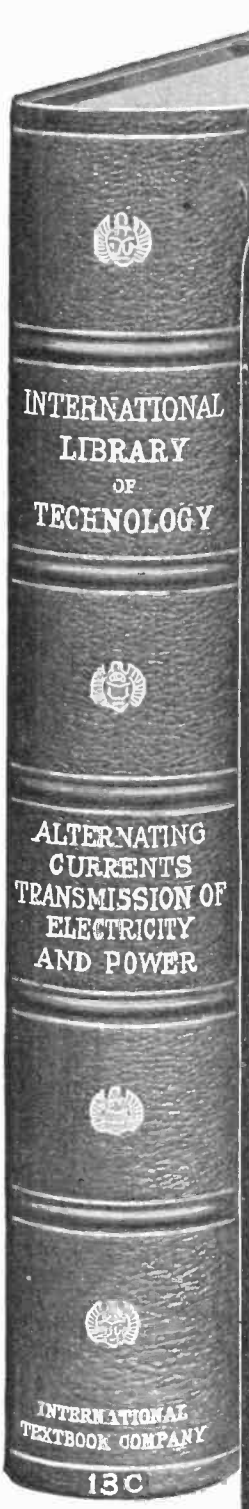
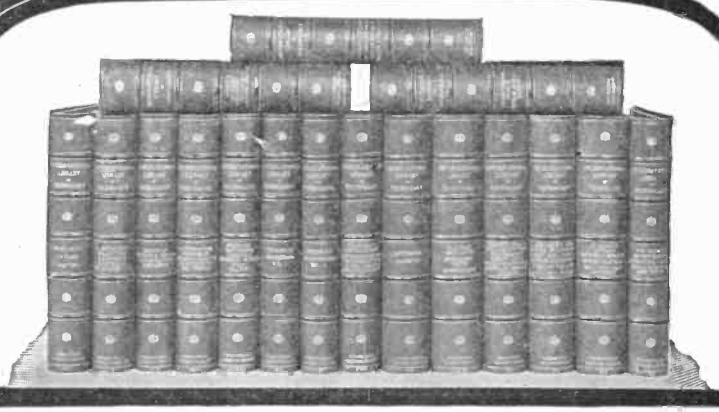
POPULAR ELECTRICITY.





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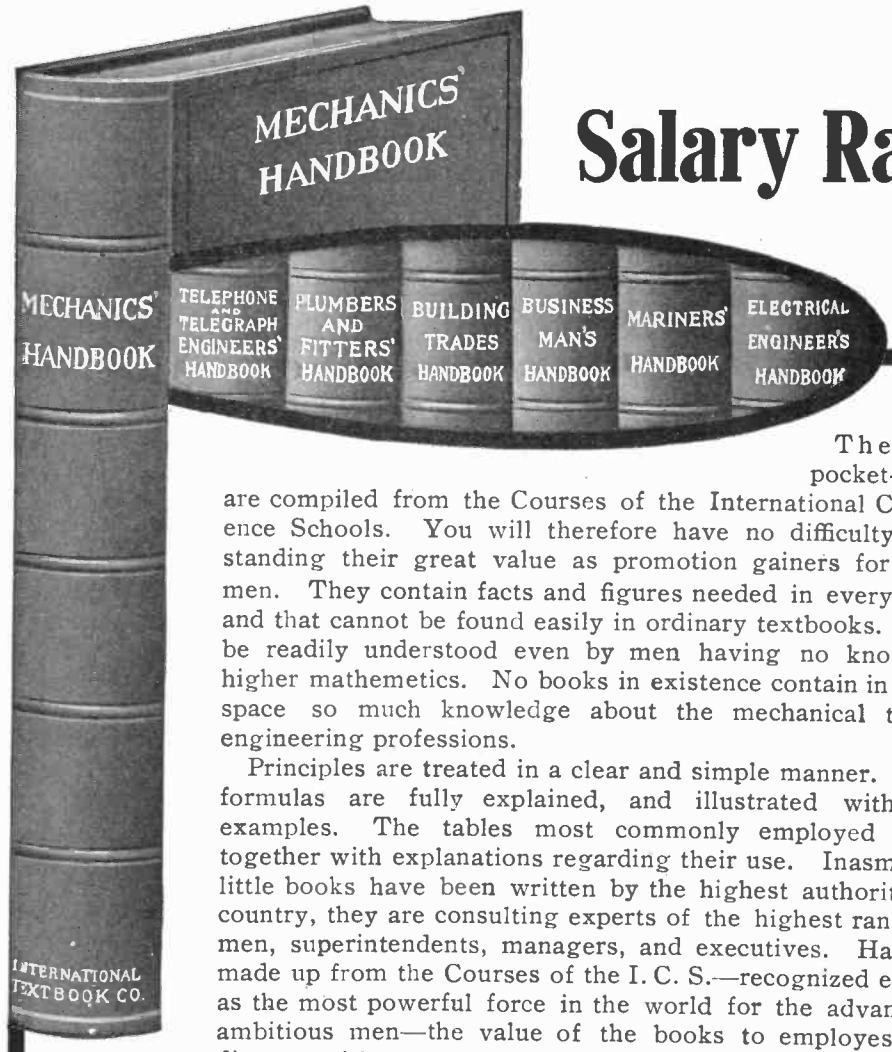

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POPULAR ELECTRICITY
IN PLAIN ENGLISH

HENRY WALTER YOUNG, Editor

Vol. III | October, 1910 | No. 6

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See page 463

THE ELECTRIC TRUCK IS PROVING OF ECONOMIC ADVANTAGE TO THE FARMER

Popular Electricity
In Plain English

VOL. III OCTOBER 1910 No. 6

"First Wireless from Mars!"

By WARREN H. MILLER

The city editor stared at the above title, written in a bold, round hand at the top of a yellow sheet of copy pad. He glanced up, first quizzically, and then with growing excitement, at the weather-beaten, blue-eyed young reporter who stood grinning at him across the desk.

"If that is *so*, Brownie," he growled, almost harshly, tapping the copy, "I say, if that is even in the remotest *degree* so, young fellah—why, then we'd better send over at once and borrow a set of headlines a foot high from the yellows."

"Read it!"

"No, I don't *want* to read it. I want to *know*. If this thing's the truth, *I* want to go and see it, right now—before a line of copy goes in——"

"They're talking—*now*—in this very city, this darned old town that's always getting out from under us, and the inventor is——"

"Not Prof. Charenton!" cried the city editor, rising and reaching hastily for his hat.

"No, you'd never guess it in a thousand years," the reporter gurgled, laughing with excitement, "he's a *she*, a young girl not yet twenty."

"No!" cried the other, incredulously, "come on! What are you standing talking there all day for? It's the most extraordinary scoop this old sheet ever got wind of. Some fair co-ed, I suppose——"

"Not on your life! No use conjuring up visions of some bony creature in specs, with a mathematical intellect. I tell you she's a raving, tearing beauty. Brown eyes, chestnut hair, a Venus of a figure——"

The city editor shot a keen glance at his enthusiastic young friend. "Ye-e-es?" he vouchsafed.

"Man, she's glorious!"

"Say, look here, are you taking me to see a scientific experiment," remonstrated the city editor, as they went out into the corridor, "or am I about to be introduced to the girl who has caught you at last?"

"And she's deaf as a post, if you'll be good enough to let *me* do some of the talking——"

"Aw, here! And has claws like a dragon, I suppose," added the city editor, ironically, as they turned down the subway steps, "there is a statue in the Luxemburg with the same idea—nothing new under the sun, no matter how hard you try."

"No. I know the one you mean—that's a cold snake, but this one's real—and warm—and brown-eyed—and with a wit like Rosalind's——"

"Got it bad," muttered the city editor, shaking his head, "don't go on and add that she's replete with fabulous riches—your picture won't hang if you do."

"The very thing that *makes* it 'hang,' as you put it. How could anyone else but a rich faddist do what she's done—but wait till I tell you all about it."

"Brownie, ever since you covered the Raisuli capture for us, and had all those hair-breadth escapes; ever since you wrote up the Jolo campaign where you ate those monkey chops and snake soups; and ever since you worked up the Belgian atrocities and the cannibal slave-trade, nothing but the extra-extraordinary suits your palate—

and still you manage to dig up something wonderful around these humdrum United States, when the rest of us can find nothing but fires or funerals. But this last combination beats them all. Supposing your lady love has *got* Mars on the 'phone, how does she manage to tell them the color of your tow topknot?"

"Numbers," replied Brown, succinctly, vouchsafing no retort to his chief's chaffing.

"Really!" replied the city editor, interestedly, dropping his bantering tone, "What have *they* got to do with it?"

"Only thing we have in common with the Martians is our numeral system. All human beings and most animals can count—take away one of your own setter's pups and see if she can't——"

"Granted——say, look here, where are you taking me? This is the Mott Haven station we're coming to, now."

"Don't worry. We get out at the Bronx and take a trolley."

"Beg pardon, for the interruption, old man. How did your fair young scientist get from numbers into speech?"

"Well, we haven't gotten that far yet. She counts and the Martian answers her, number for number; that's as far as we got—a real signal though, all right—when I begged her to let me rush out the news. 'First Wireless from Mars!'—oh, what a beat!"

"Oh!" ejaculated the city editor, with such disappointment in his tone that the reporter looked at him quickly.

"Skeptical? Well, we did a little better than that," he added hastily, "when I left, the Martian was spelling out some kind of a multiplication table—'two times two, four' or some such matter, and Marian—I mean the girl—was arranging the signals in orderly form."

"Oh, you solid ivory!" jeered the city editor, "Why there's your first word already! That word 'times'! That's what the Martian was driving at—I don't care what his signal was, it *means* 'times'!"

"Sure it does. If Marian gets the same signal all the way down the multiplication table, it surely means 'times'. We get off at the No. 19 trolley station."

The interurban whizzed along up hill and down dale over a countryside of wealthy places. Neat drives led from handsome private waiting lodges off across the autumn fields to where the windmill and clump of trees indicated the location of the manor house. No. 19 was such a station, and Brown led his friend along a path, crossing fields golden and yellow with the September sunset.

"Wireless!" ejaculated the city editor, excitedly, grasping the other's arm and pointing to a tall, white mast, strung with guy-wires and spreaders, that rose out of the green just over the hill.

"That's him!" corroborated the reporter, gaily, "Taking messages from Mars. Come to think of it, you know, we're apt to think of wireless waves as going out horizontally, whereas they really do go out spherically. And they keep on going, out and out, across space, passing in turn through every single planet and star, until spent, somewhere, we know not where."

"And of course the same thing happens with every single spark they may make on Mars. Why, man, that's the way we will reach them eventually, if your young lady hasn't, already!"

"Sure. Now, suppose you were rich enough to get some scientific instrument house to wind you a coil so big that it could reach Mars, and a receiver so sensitive——"

"——that every five-cent telephone coil on earth would affect it?—not on your life!" interrupted the city editor impatiently.

"Wait a bit, I'm coming to it. You've probably heard of electric resonance, in a general way of course, the same property that makes a certain sized room resound to one particular tone. It will give out that tone no matter how softly it is sounded, and be dead to all others. Well, that is the principle which is at the base of what they call the 'tuning' of wireless apparatus, so that it will take messages of only one frequency and be dead to all others. Now, Mari—the girl—has such a resonator, 'compound antennæ' they call it, and its 'capacity' is so great that no other coil on this earth can make it resound—do you believe now?"

The city editor shook his head slowly. "Not enough to borrow headlines a foot high. Tell me more about it."

"Well, the operators, mostly young German and French university men, had hardly gotten the apparatus up, with its newly perfected recording tape, before it began to count—one; one-one; one-one-one; and so on, up to ten. Then over and over again,

as though a clock mechanism were operating it. Then Marian opened the key——"

"Yes——go on, go on——"

"——And began to answer, number for number, and, pretty soon the counting stopped and—then it waited and seemed to listen—and then began to answer *her!*"

"Gosh!" murmured the city editor excitedly, "I seem to see—I *see* a big observatory over there in Mars. They've had that thing running, goodness knows how long, in the hope that *some* day we'll catch on—and then, at last, the answer comes!——"

"Do you believe, *now?*"

"No—I—I can't. It seems incredible, wonderful——"

"Well, here we are, and in a few minutes you can judge for yourself."

The path led directly towards a neat little stone power house, with the puffs of steam from some small engine issuing from an exhaust pipe, while, far overhead, towered the tall wireless mast.

The girl was absolutely unmindful of their entry, poring over a tape covered with dots and dashes. Then their shadows caught the tail of her eye, and she turned enquiringly, and instantly her eyes lit up as she recognized the young reporter.

They were wonderful eyes. All the lost sense of hearing had gone to intensify them, making the iris golden brown and glorious, and distending the pupils as if stimulated with belladonna, so that one seemed to see far into their dark unfathomable depths.

"A girl of tremendous passions, tremendous capabilities, if putting all the vital fires into only four senses really *does* intensify them," thought the city editor, noting the partly opened, coral cupid's bow of her lips as she gazed intently at his young friend.

Brown was introducing him, speaking very distinctly and using the full movement of lips, tongue and teeth to articulate his words, while she concentrated her whole attention on his every movement.

Then it was the city editor's turn, and he almost quailed under the battery of those glorious eyes. Their beauty bathed him like a flood of sunshine, seeming to search his uttermost heart, and, involuntarily he turned his own aside.

She held out the table of signals.

"He can't count," she smiled disdainfully, laughing in the peculiar inflexionless manner of the deaf. "This middle signal means 'times'," she went on in her unmodulated voice, "Sometimes he says 'two times two, four,' and sometimes, 'two times two, five,' and always a second signal after it, and I can't make head or tail of it."

"Let me see it, please!" requested the city editor with suppressed excitement. He snatched the paper from Brown's hand and ran his finger down the lines of dots and dashes. "Let's see—I used to know my Morse—no, it's not Morse, of course, but it's an arbitrary system of dots and dashes just the same."

Then, like a flash—"Here you are—'two times two, four—*right!*' 'Two times two, five, *wrong!*'—*that's* what he's trying to say! 'Two times three, six, *right;*' 'two times three, seven, *wrong.*' See, they alternate all the way down the table—I tell you those signals mean 'right' and 'wrong,' 'yes' and 'no!' " he cried.

The girl regarded him intently, but he spoke so fast that Brown had to translate. Then her face lit up, radiant, luminous with pleasure and understanding, and she shook his hands, almost hugging the philosophic city editor in her rapture.

"Eumm!" he muttered under his breath.

The girl strode over and opened a brass key in front of a huge mahogany mounted induction coil. She began sending, copying from the table of signals. Then the two large brass knobs in front of the coil began to glow with violet fringes, and long, thin, violet tongues stretched out, weaving uncertainly about in the air before striking at each other. They all stood watching the rapid violet discharges, fascinated, the girl with her intent luminous gaze, the city editor with brows damp with excitement, and Brown, stern, watchful and vigilant. Presently the weaving, snaky discharges ceased, and the girl studied the record of dots and dashes she had made.

"New word," she said, smiling wistfully at them both. "I feel just as I used to when they taught me how to talk. Here are some more numbers again, and here are 'right' and 'wrong'," she added, pointing them out with her pencil. "I'm getting so I can talk to my new teacher quite well," she laughed.

"Boy, your sweetheart must have a corking think-piece!" exclaimed the city editor under his breath as both men took the paper she held out to them. "Deaf, you say, from infancy?"

THEY ALL WENT OVER TO THE WINDOW TO GET THE LAST OF THE FADING TWILIGHT

"Look out!" warned Brown sharply. "She's looking at you and the fact that you are talking low don't do any good. Please dry up."

"Let's write out the table, leaving a dash for the new word," suggested the city editor, smiling re-assuringly at the girl as he returned the paper.

They all went over to a window to get the last of the fading twilight, and soon

had constructed the following table, the dash being the new word:

88—wrong.
225—wrong.
365—wrong.
687—right.

They looked at one another, enquiringly.

"Three-sixty-five," mused Brown, "why, that's familiar enough. That's the number of days in our—Quick! Get an astronomy," he commanded in his sharp, staccato accents. "As-trono-my!" he repeated, smiling into the girl's eager, upturned face. Her eyes dilated and returned again under his direct gaze. Just a little flash of emotion, as she turned away, but it did not escape the city editor. In an instant she had returned quickly, placing the open book in Brown's hands. There was another glistening swordplay of their eyes, and then he rapidly thumbed the astronomy, hot as a hound on the scent.

"Here it is, 'Diurnal revolutions of the planets'—Mercury, 88 days; Venus, 225 days; Earth, 365 days, *and* MARS, 687. What more do you want! Hooray! Marian, you're a peach!" He took both her hands in his own in his enthusiasm and wrung them again and again.

"E-e-umm!—Is this a scientific experiment, or—I say, there, old man," growled the city editor, trying to get in a chance to congratulate her.

"I will answer him," said the girl at length, disengaging her hands and blushing under Brown's ardent looks. She turned, her face a flaming rose of color, and opening the key, spelled out the dots and dashes of the signal "Right!"

They stepped back, waiting. Presently the snapping play of the violet serpents began again, now lighting up the dim laboratory with violet tones, and shining in iridescent lavender tints on the chestnut-brown filaments of the girl's hair.

"365 days——"
"687 days——"

it spelled.

"Oh, *I* can guess that," crowed the girl in her peculiar aimless modulations, "three sixty-five days, *you*, six eighty-seven days, *me*——"

"Sure! We're getting along famously!" cried the young reporter. "Why, you'll have their whole vocabulary, Marian, at this rate. I don't know much about scientific matters, you know, but, doesn't the spectroscope show the same metals in Mars as we have?"

"Yes, he can name them all to me, by giving their atomic weights—all the great physical facts common to all the universe, light, color, various well-known distances in diameters of the sun, density of the planets, water, heat—why a big vocabulary can be suggested by numbers alone. Let me answer him again."

"Well, what do you think of it—shall we go to print?" said Brown to the city editor, as she clicked at the key.

The latter shook his head doubtfully. "Brownie, old man—I—really—don't—— know. Sometimes I can't help thinking someone somewhere on this earth is faking——"

Oh, unfortunate word! The girl had turned at that instant and her quick eyes had caught it, unmistakably, as the letters are all formed at the front of the mouth.

"Faking!" she stamped, flushing angrily. "What are you talking about!" The great brown eyes flashed at him scornfully, and she turned away disdainfully, stepping up on a low stool beside the instrument and sweeping back the curtain of the laboratory window with a regal gesture.

"Beyond this little film of air," she said solemnly, pointing up at red Mars, who shone large and luminous, "across those forty million miles of void there is some being, who, sure as yon beams of light reach us, is striving to communicate with us. Once his electric rays pierce the few miles of air above him, there is nothing to stop them, nothing to hinder them, until they strike and pierce *our* little forty miles of air—Ah, how can you doubt!"

Suddenly they noticed a thin, almost invisible, wisp of violet passing out from her outstretched forefinger. It grew, and more wisps added themselves, while one of the large discharge balls of their own coil began to crackle and sizzle, enveloped with a halo of violet, as the Martian began sending again. Something was wrong. From somewhere out in space their aerial was collecting energy in such a deluge as to affect even their own transmitting coil!

"Oh!—What is the matter!" gasped the girl, turning white and terror-stricken, and, looking fearfully over her shoulder, she noticed for the first time that her clothing was in contact with the other knob. "Oh!"

she called, weakly, "save me! *I daren't move!*"

The two men stood paralyzed, fascinated, not knowing just what to do, while slowly a long, thin violet tongue weaved out towards her from the free discharge ball, like some deadly cobra.

"I don't know whether it's the right thing to do, but, here goes!" croaked Brown, hoarse and desperate. He sprang low at her, hoping to pass below the reach of the great discharge knobs, and his impact knocked her clear of danger. It was neatly and quickly done, but as well hope to be quicker than electricity as to wish for the moon, for with a vicious snap, both discharge knobs shot down violet tongues of flame into his neck and back. His body fell against the side of the coil, thus providing a path for the discharge directly into the coil itself, and the next instant there was a report like a pistol-shot, instantaneously followed by a roaring, rending crash, as the great coil short-circuited on itself. The laboratory seemed filled with one huge, blinding green copper flame, and the city editor staggered back against the wall, shielding his eyes with his arm. He seized the girl and stumbled out of the smoking room in a daze, dragging her with him. But she struggled out of his grasp like a wildcat and dashed back into the reeking laboratory, and between them they got the reporter out on the lawn under the stars.

"O-o-o-oh!—O-o-o-oh!" she moaned tremulously, entirely unmindful of her own burns. "O-o-o-oh, Go-od! He gave—his—life—for—me! I will not—I can not—*and I won't*—give him up! Get to work! !" she shouted at the bewildered city editor. "Here! Pull his hands above his head—so! Now, down to his sides again—so! Again! Again! Again! We *must* get him breathing!"

Together they labored over him as the minutes passed slowly, but no sign of life. The girl shook with convulsive sobs that quivered through her whole body, and still they kept at the monotonous task as the precious time crept on, minute by minute. Suddenly she gave a low cry, like a hunted, wounded animal, and ran sobbing to the laboratory, presently re-appearing with a small, hand magneto dynamo.

"Put these wires in his hands—*his hands*," she gasped in an entreating whisper.

Madly she spun the handle around and around, sparing her wrist no agony. The powerful little current set up a twitching that seemed but a mockery of real life, and after some minutes of it, the city editor dropped his friend's hands with a groan of despair.

"How dare you!" she snarled, springing at him with raging eyes. He slunk back to work again, reluctantly, hopelessly, compelled by her imperious will.

Then—suddenly—a cry, a pean of joy from the very soul of the woman——

"He lives!—*He lives!*"

And quietly the great brown eyes closed, and the full-fleshed palpitating body lay very still, with the strap of the magneto still across her bare outstretched arm, as Brown came to with tremendous writhing.

* * *

It will be fifteen years before Mars will again be in perihelion, and there was no time to re-wind the great coil that talked with that planet during the recent proximity. But, when he visits us again, Mr. and Mrs. George Brown will be "at home."

Electric Trucks on the Farm

The electric auto truck and tractor is invading the field of the horse even on the moderate size farm in harvesting wheat and in haying and other similar service.

An electric truck of 3.5 tons' capacity is seen in the frontispiece, as operated at a nursery located several miles from Rochester, New York. This truck when used during the harvesting season was able to handle 617 bundles of wheat, which yielded 45 bushels after being threshed, while the usual two-horse load consisted of 260 bundles.

The use of this electric power vehicle in the above service as well as the harvesting of the hay crop has been of great advantage on account of the time element being so important, due to uncertain weather conditions.

At this nursery the electric truck has been used to great advantage in delivering shrubs and trees to the railway station during the shipping season, returning with supplies and fertilizer to the farm. The electric storage battery truck was recommended to the farm owner for this work by the Rochester Railway and Light Company and wherever current can be supplied from power and lighting stations, to farms conveniently located, electric vehicles of this type can be employed with economy.

Triennial Conclave of the Knights Templar

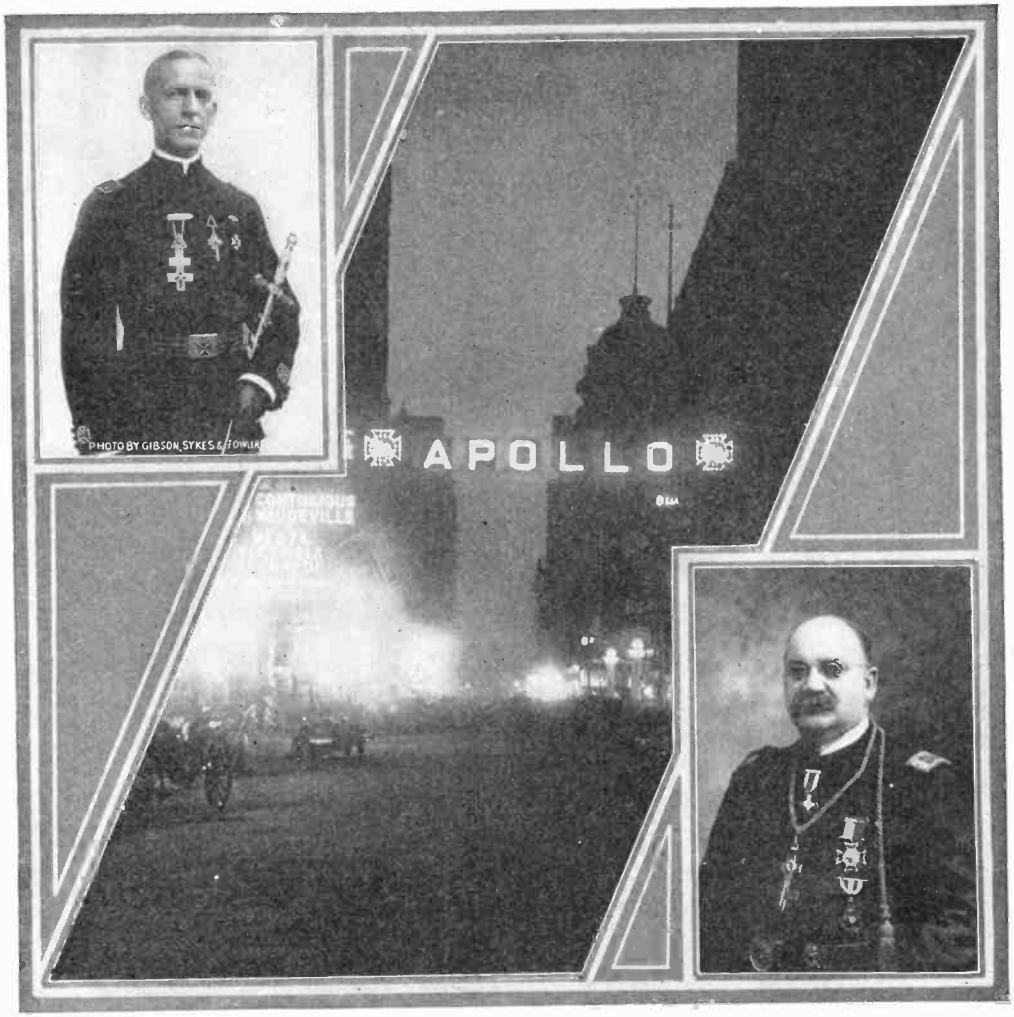
Every three years the Knights Templar hold a conclave. This triennial grand encampment is the rendevous of knights from the four corners of the globe. One of surpassing magnificence has just been held in Chicago, August 6 to 13, and it was in striking contrast to the encampment of 1880, the last one previously held in the western metropolis. Colonel La Fayette Lyttle, who was grand commander of the Chicago encampment of 1880, remarked on this later occasion: "I have seen every conclave except two since 1877. A 'City of Tents' on the lake front served us in 1880 and the affair was badly managed. This time Chicago is redeeming its good name."

Chicago had no electric lighting system then. Today this means of illumination figured more than anything else in presenting to its half-million visitors a spectacle of brilliant magnificence not equalled since the Hudson-Fulton Centennial.

Battlements and arches of medieval days were outlined by rows of electric lamps, while shields draped with black and white flags and each bearing in its centre an illuminated cross signified the ancient origin of the Order.

As the story is told, after the capture of Jerusalem by the Crusaders, infidels who had not yet been driven out of Palestine continued to annoy pilgrims who came to worship at the shrine of the Holy Sepulcher. Nine knights who had already aided in the taking of Jerusalem banded themselves together to protect these pilgrims, choosing Hugh de Payens as their leader. The Council of Troyers accepted their services, and rules relating to their duty and life were adopted. They wore a white robe, signifying a pure life, a red cross

GREAT WELCOME SIGN AT THE KNIGHTS TEMPLAR CONCLAVE
TALLEST ELECTRIC SIGN EVER CONSTRUCTED



TWO OF THE MOST PROMINENT KNIGHTS AND THE SIGN OF THE APOLLO COMMANDERY

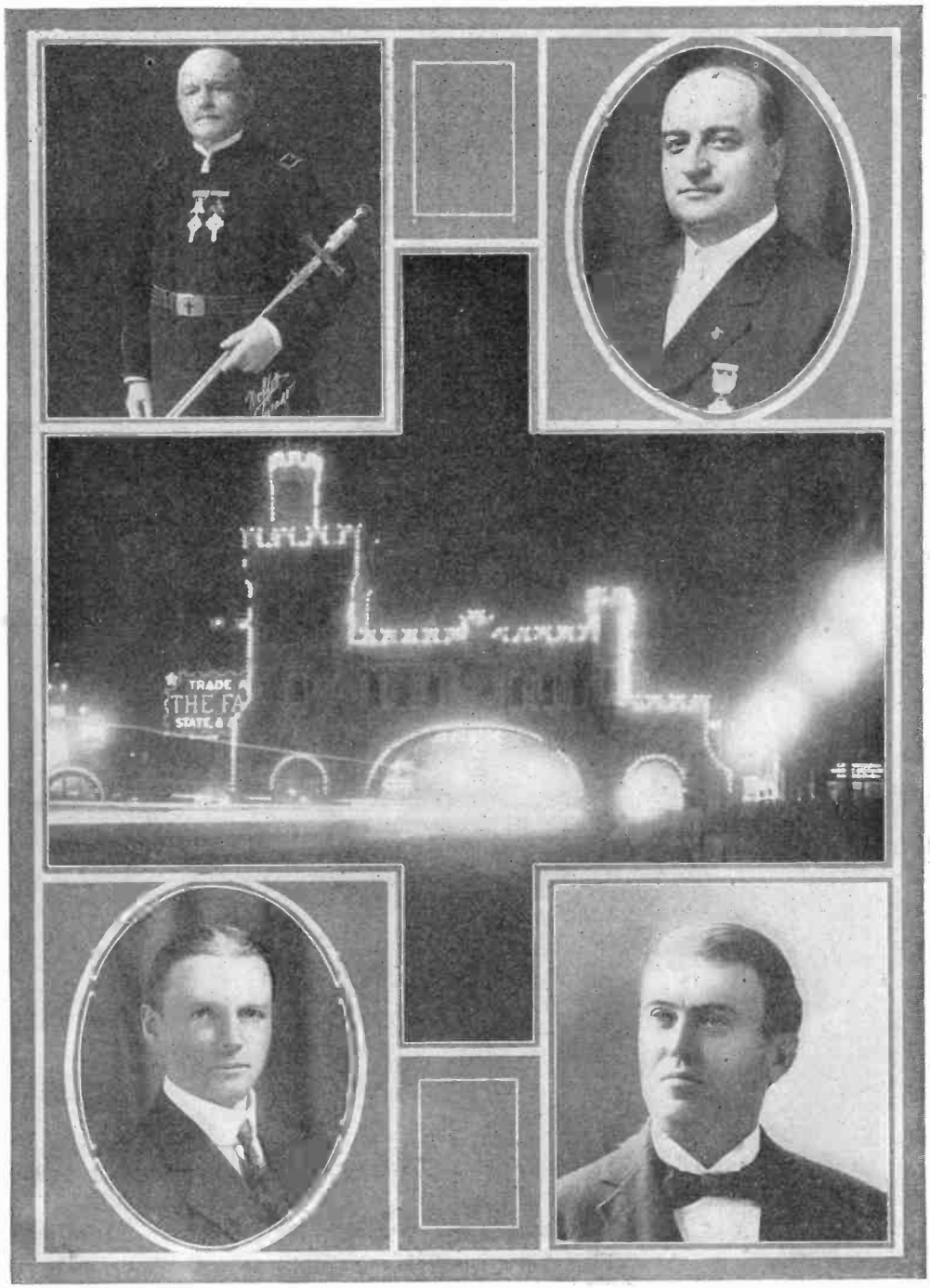
Rt. Em. Sir Knight John D. Cleveland, Grand Commander of the Grand Commandery of Illinois

Rt. Em. Deputy Grand Master William B. Melish

on their left breast symbolized their martyrdom, while the banner expressing their purpose was half black, meaning "terrible in battle," and half white, signifying "fair in peace."

Chicago's first greeting to the modern Knights of the Cross was the "entrance" arch erected on Michigan avenue near Park Row. This was built to resemble the massive masonry of an ancient battlement. Over portions of this, English ivy had been so carefully placed that one might imagine it had grown there for centuries. The towers and turrets were outlined by 1,100 lights at night and its windows, back of which were electric bulbs, were made to resemble stained glass. Buglers were stationed at its top to announce the approach of the 35,000 plumed knights as on parade they "entered" the city. Tramping to the music of 145 bands, the procession of knights required nearly four hours to pass through the arch.

Near the La Salle Hotel was erected the Grand Commandery arch, this hotel being the headquarters of the Grand Commandery of Illinois, at whose head presides Rt. Em. Grand Commander John D. Cleveland, under whose auspices the conclave was held. This arch, illuminated by 1,000



ENTRANCE ARCH ON MICHIGAN AVENUE. THE MEN WHO PLANNED AND SUPERVISED THE GREAT ELECTRIC SPECTACLE

Em. Sir Knight Gorham B. Coffin
Chairman Decorative Committee

S. W. Van Nostrand

William Becker

Thomas Cusack

DAY VIEW OF STATE STREET DURING THE TRIUMPHAL PROCESSION

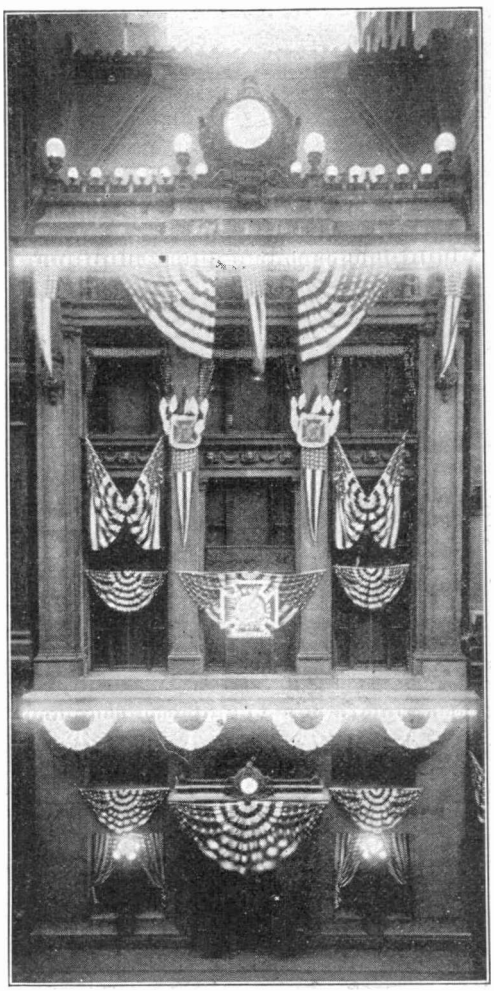
STATE STREET AT NIGHT WITH SPECIAL ILLUMINATIONS

incandescent lamps, had each pillar surmounted by a figure, fourteen feet high, representing a mounted knight helmeted and clad in armor.

State Street was transformed into "Templar Way" by 16,000 electric bulbs and 92 white Corinthian pillars along the curb. Upon the top of each pillar a globe was placed and studded with 21 stars, each star being a lamp. From pillar to pillar festoon lights were strung, upon which various emblems were suspended and lighted by numerous colored lamps.

The most prominent feature of all was the official emblem of the conclave erected in Grant Park at the foot of Jackson Boulevard. The tip of the helmet at the top was 133 feet from the concrete foundation, the width at the base being 66 feet. The letters in "CHICAGO 1910" were three feet in height. The sword hilts were eight feet in length by two feet wide, while from the letter "K" to the letter "T," inclusive, was 40 feet. From the knights' heads in the second part of the emblem to the horses' hoofs was 16 feet. The words "GRAND ENCAMPMENT OF THE U. S." were 32 feet wide by 22 feet high, while the letters "IN HOC SIGNO VINCES" ("In this sign you shall conquer") at the bottom were two feet in height. "WELCOME" was proclaimed in letters 10 feet high. This word burned steadily in letters of red. Three separate flashers controlled by a master flasher operated the three sections of the emblem. The upper part flashed first. Then the circle of lamps around the eagle and shield and around the letters "K" and "T" appeared to revolve. The ribbon in the eagle's mouth was made to present a constantly waving effect.

The second section flashed on quickly after the first and the horses of the knights appeared as if galloping towards the observer. In the third section, which quickly followed, the jewels of the crown were surrounded by waving lines of light in steady motion until all flashed off together, then on again for a moment, thus completing the cycle which was immediately repeated. In this sign were 5,120 tungsten lights. About 1,500 of these were of the natural color. Other shades and tints which were shown were produced by a special background of colors and method of application, with only clear white lamps. No colored caps or dipping solutions of any kind were used. Current to the various circuits was conveyed over 5,000 feet of steel cable and 20,000 feet of wire.



DECORATIONS OF THE COMMONWEALTH EDISON COMPANY'S BUILDING

For the encampment of 1880 records show that $653 was spent for entertainment by Illinois and Chicago knights, while $50,000 is estimated as being used for decorations alone at the last Conclave just held in Chicago.

William B. Melish, Acting Grand Master of the Encampment, said:

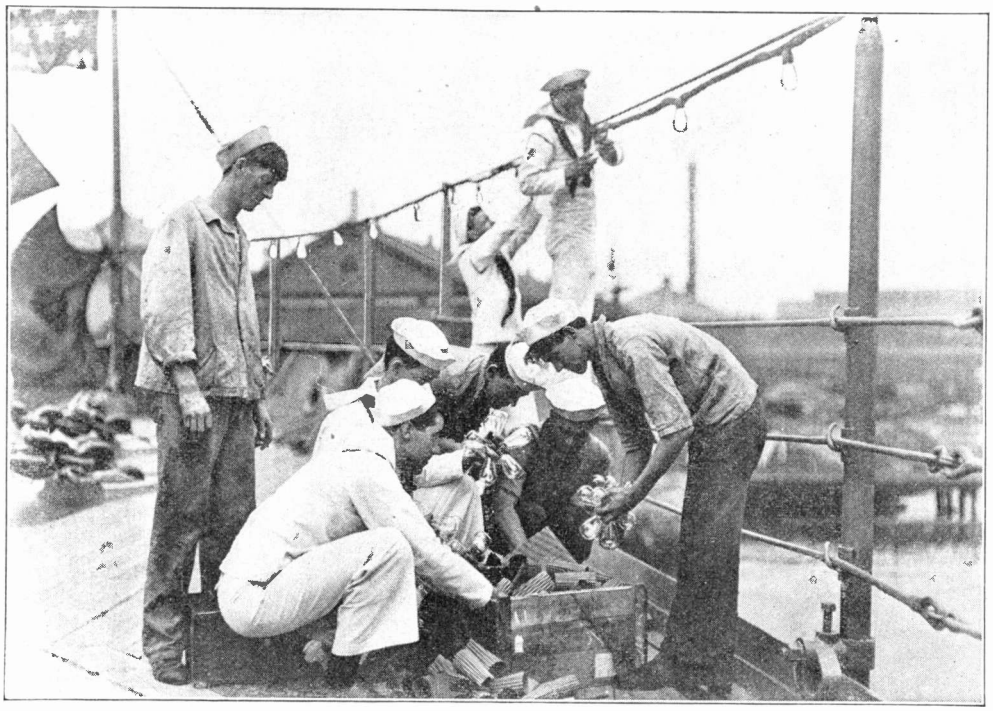
"Since my arrival in this city I have been so overwhelmed with the immensity of the welcome that I am at a loss to express my appreciation of the manner in which Chicago has risen to the occasion."

Much credit is due the Thos. Cusack Company and particularly Mr. S. W. Van Nostrand and Mr. William Becker who in conjunction with Chairman Gorham B. Coffin, of the Decoration Committee for the Templars, formulated and carried out the plans for the magnificent electrical spectacle.

Illuminating Our Warships

The general public which, on the evening of a national holiday or other festal occasion, views a United States warship silhouetted against the darkness by lines of light, gives never a thought to the amount of work and preparation necessary to produce such unique illumination and yet to thus "dress ship" is one of the most arduous tasks that falls to the lot of the electricians on one of Uncle Sam's big fighting craft. The serious phase of the matter from the standpoint of these naval electrical workers is that all the preliminaries for such a burst of glory represent what might be termed "extra work." Now, be it known, the electricians on a naval craft are, under normal conditions, just about the busiest men in the universally active warship community. Their regular work ordinarily taxes their time and energy and when on top of this routine comes the necessity for outlining the entire ship with strings of incandescent lamps it is imperative that every member of the electrical squad shall step lively from dawn to dusk.

On an average there are perhaps a dozen different occasions in each calendar year when a warship puts on gala attire. There are, of course, the different national holidays such as Washington's birthday anniversary, Memorial Day, the Fourth of July, etc., and then there are an indefinite number of other occasions, as, for instance, when a warship is detailed to take part in some marine parade, attend some celebration, or lend interest to an exposition with the implied obligation to put forth her best attire in honor of the event. Under such circumstances both day and night decorative



DRESSING A WARSHIP WITH ELECTRIC LIGHTS

schemes are carried out, but the latter entails much more preparation. The adornment for the daylight hours consists in a lavish display of flags—especially half a hundred gaudy signal flags that are strung as closely as may be on a rope that extends from the bow over the two mastheads to the stern of the vessel.

For the hours of darkness an elaborate system of electrical illumination is standard among all the ships of Uncle Sam's sea patrol. This involves the use of practically every illuminant above decks from the powerful searchlights to the electric torch used for "wig wag" signalling at night, but the main responsibility for the spectacle rests upon great numbers of extra incandescent bulbs brought into use specially for such an occasion and which are utilized to outline the contour of the warship in what appear from a distance like continuous lines of fire. Colored globes are used to some extent, but for the most part lamps of 16 or 32 candlepower with clear glass globes are used.

In the illumination of a first-class battleship anywhere from 2,500 to 5,000 extra incandescents are placed on the exterior of the vessel. The lamps are placed at intervals of from six inches to a foot on wires which are strung on all the distinctive outlines of the armorclad. A line of lights replaces the string of flags which during the daylight hours connected the two masts and slants to bow and stern respectively. The masts likewise support perpendicular lines of lights and other glowing bulbs indicate the form of the huge smokestacks. In some instances a string of lights is placed just above the water-line of the ship and in calm weather the electricians of some warships are wont to depend strings of lamps from the overhang of the stern. However, this latter decorative touch presents the problem that if the wind be at all high the string will sway back and forth and some of the lamps be inevitably dashed to destruction.

The electricians aboard ship begin work on their special scheme of wiring soon after daylight on the day set for an illumination. If the vessel is anchored in the harbor of an "exposition city" or other environment where the illumination is a nightly affair, the task for the electricians after the first day consists merely of testing the lamps and replacing those that have burned out, but under the more ordinary circumstances, as on a national holiday, when the illumination is to be merely a one-night affair, the major portion of the morning will be spent in the wiring work. This completed the wooden cases of incandescent lamps are brought up from the hold and a squad of men set to

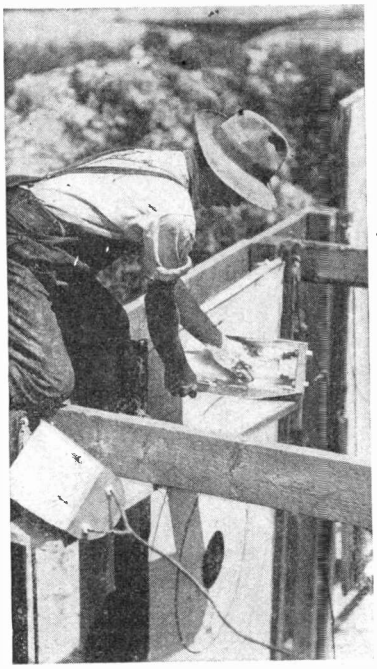
OUTLINING A SMOKE STACK WITH LAMPS

work putting them in place. Several of the seagoing electricians busy themselves unpacking the lamps and removing them from the protective cones of corrugated board; others carry the lamps to the wires and a third squad attaches the lamps to the sockets.

When all the lamps are in place the current is turned on for a test and an inspection made of every lamp. Some of the lamps must be removed as defective or worn-out, whereas others only require an adjustment of the connection to glow properly. The visitor watching these testing operations is apt to be struck by the matter-of-fact manner in which the average bluejacket pokes his forefinger into the socket of a lamp to probe for the current when a lamp has failed to illuminate. Occasionally, however, on a rainy day, when the deck and all the steel upperworks of the ship are wet, a venturesome tar has a twinge as the penalty of this practice. The searchlights are also tested, for a searchlight drill lasting for thirty minutes or an hour is a feature of a battleship illumination. Finally the red and white incandescent lamps of the semaphore and other forms of night signalling are brought into requisition to add to the splendor of the illumination.

Electricity at a Modern Rifle Range

By WALDON FAWCETT



Modern rifle ranges are distinctly a development of latter-day military science, and it is particularly fitting that such products of Twentieth Century progress should be largely dependent for their successful operation upon electricity—the Twentieth Century power. Indeed, electrical communication, as exemplified in the telephone and the telegraph, supplies a nerve system without which it would be utterly impossible to conduct target practice at long range with that systematic precision and rapidity of operation which now characterizes it on the great ranges maintained by the national government and the several States of the Union.

Target shooting has, of course, been a pastime for civilians and a duty for soldiery almost ever since firearms were invented. However it is indeed a far cry from the old-time conditions of "shooting at a mark" to the present-day procedure at a field specially fitted for long-range markmanship. Many private citizens are yet content to fire at targets placed at 20, 30 or 50 feet, such as are familiar in the shooting galleries yet to be found in every town and city and at every popular summer resort. Not so, however, the soldier, the sailor, the big game hunter and others who make more or less

of a business of shooting with small arms. The perfection of the modern rifle and its high power, the added force of the newer kinds of powder and changes in the form of bullets are only a portion of the improvements which have revolutionized conditions and decreed that effective combat henceforth must be at long range.

With the advent of a new era of longer ranges for prospective battles came, of course, the necessity for target practice at longer range, and this has presented many problems, the last of which has only recently been solved. With the aid of telescopic sights and other inventions it was found that marksmen could hit the targets at 500 or 600 yards just about as accurately as they did in the old days when the distance was much less between firing line and target. However, the scoring of shots, the manipulation of the targets and other features of the practical operation of a long-range shooting arena presented problems not so readily solved.

In the old days of short ranges it was usually possible for a marksman to ascertain from the firing line in just what part of the target he had placed his bullet. Likewise was there little danger of accident during the placing of targets and other necessary manipulation because marksmen and target tenders were always within earshot of one another and a first-hand mutual understanding was possible as to just when the shooting should be done. However when the ranges were increased to 200 yards, to 600 yards, to 1,000 yards and finally to 1,200 yards

no such intimate relations were longer possible. However, recourse was had to electrical communication and with the modern rifle range now wholly enmeshed with a network of telephone and telegraph wires the system of operation is, in effect, just as simple as in the old days. The new conditions have also enabled a notable advance in yet another direction—namely in the number of marksmen who may be shooting simultaneously without in any way interfering with one another.

The great rifle range at Camp Perry, Ohio, which is one of the finest in the country and may be cited as representative, covers nearly 500 acres and has a total of 236 rifle and revolver targets, all arranged to the north so that they can be shot upon from a common firing line. There are revolver targets at 15, 25, 50 and 75 yards and rifle targets at 200, 600, 1,000 and 1,200 yards, and, with a far-flung firing line, smokeless powder in use and an individual target tender for each target, there is no reason why, should circumstances dictate, it would not be practicable to have firing in progress simultaneously at every one of this long line of targets.

With the perfection of the modern rifle range and the introduction of the telephone as the universal artery of communication has come a change from the old-time primitive conditions under which the target was tacked to heavy boards and set up against a convenient tree. Nowadays, the targets, pasted upon burlap stretched on frames of wood, are exposed (to receive the marksman's bullets) above the crest of what appear from the firing line like earthwork entrenchments such as soldiers throw up for shelter in time of war. In reality these target pits, as they are termed, consist of stone-walled alleys, heavily banked with earth. Here are stationed the boys—one for each target—who act as target tenders or "markers" and here, out of sight of the riflemen, they perform all the tasks of chronicling the position of each shot; pasting a piece of paper over the bullet hole following each shot; and putting in place a wholly new target when one in use has become so riddled with bullets as to prove useless. The targets, it may be explained, are all arranged in duplicate and placed on elevators so perfectly balanced that as one target is elevated into the line of vision of the marksmen its mate is simultaneously drawn down into the shelter of the pit. It is predicted that ultimately the approved type of target elevators of this class will be electrically operated.

The communication from the target pit to the firing line of the "score" made by each marksman may be accomplished by colored flags or disks, but the approved and dependable method is by means of the telephone. Telephone wires connect the firing line at each range with the target pits for that particular range. At the firing line the "station," occupying a shelter house or a roofed box affixed to a convenient pole, is placed in a central location so that the operator can readily communicate with any of the scorers who sit, with blackboards mounted on easels before them, keeping tab in detail on the marksmanship of the various participants in the shoot.

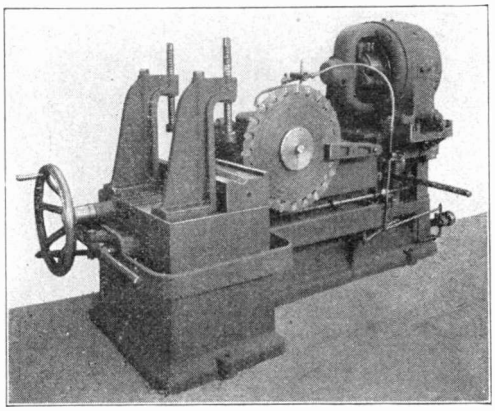
Whereas the main volume of communication is, of course, between a firing line and the targets of that range, an exchange located on the camp grounds, makes it possible to communicate between any two stations of the system. For instance, if desired, the range officer in charge at the 200-yard range might communicate with the target tenders on the 1,000-yard range in order, we'll say, to admonish them to prepare the targets for marksmen who might desire to proceed from the one range to the other. The telegraph is used on some target ranges but is not generally considered as effective as the telephone. Overhead wires are used for most of the communicative systems at rifle ranges

Electric light is also coming to be used to a surprising extent at the modern rifle ranges. First of all the power plant which is an adjunct of the thoroughly up-to-date range supplies current for illuminating all the streets and all the tents and mess halls provided for the marksmen—there may perhaps be as many as 1,500 of these marksmen—who live at the range for several weeks during a practice period or a competitive national match. More interesting, however, is the recent innovation of utilizing electric lights to illuminate the targets so that shooting may be carried on at night. For this there are employed the most powerful incandescent lamps, partially enclosed in metal cases that serve at once as shield and reflector and these are placed just below the crest of the target pit; that is, protected from the bullets and yet at such an angle as to flood the target with light.

ELECTRIC POWER

How Metal Is Cold Sawed

The picture shows what is known as a cutting-off saw, which will eat its way through a steel I-beam as if the latter were a stick of tallow. The saw is 26 inches in

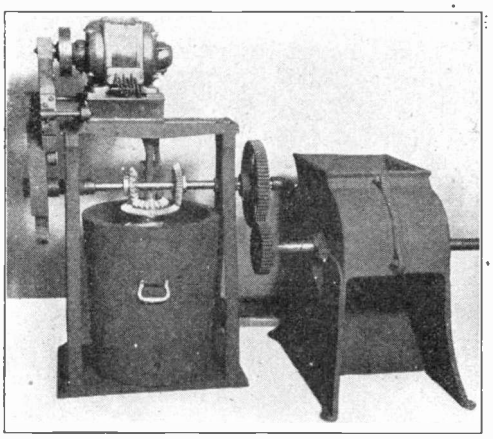


A SAW THAT CUTS THROUGH STEEL

diameter, driven by the electric motor at the right. The metal to be sawed is clamped in the moving carriage at the left and fed against the saw by the hand wheel. Each tooth of the saw is removable.

Combined Freezer and Ice Crusher

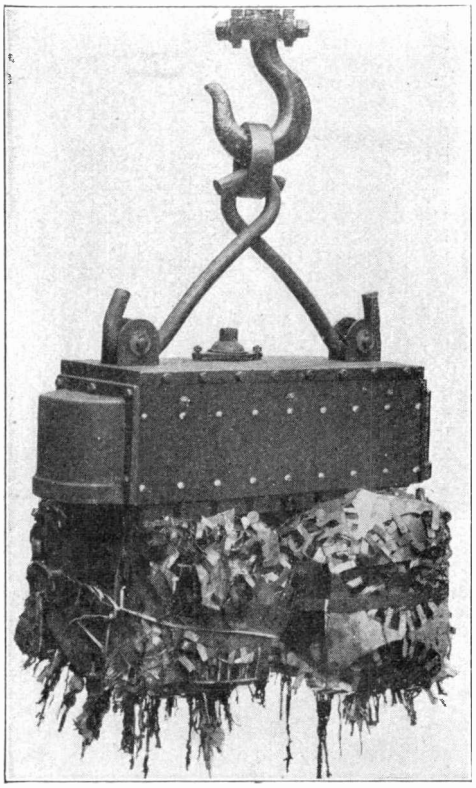
This machine is both an ice crusher and ice cream freezer. By a simple arrangement of gears the one horse-power General Electric motor drives the crusher which furnishes a constant supply of cracked ice, thereby doing away with one of the most disagreeable features of ice cream making. The freezer has a capacity of $4\frac{1}{2}$ gallons of ice cream.



ICE CREAM FREEZER AND ICE CRUSHER

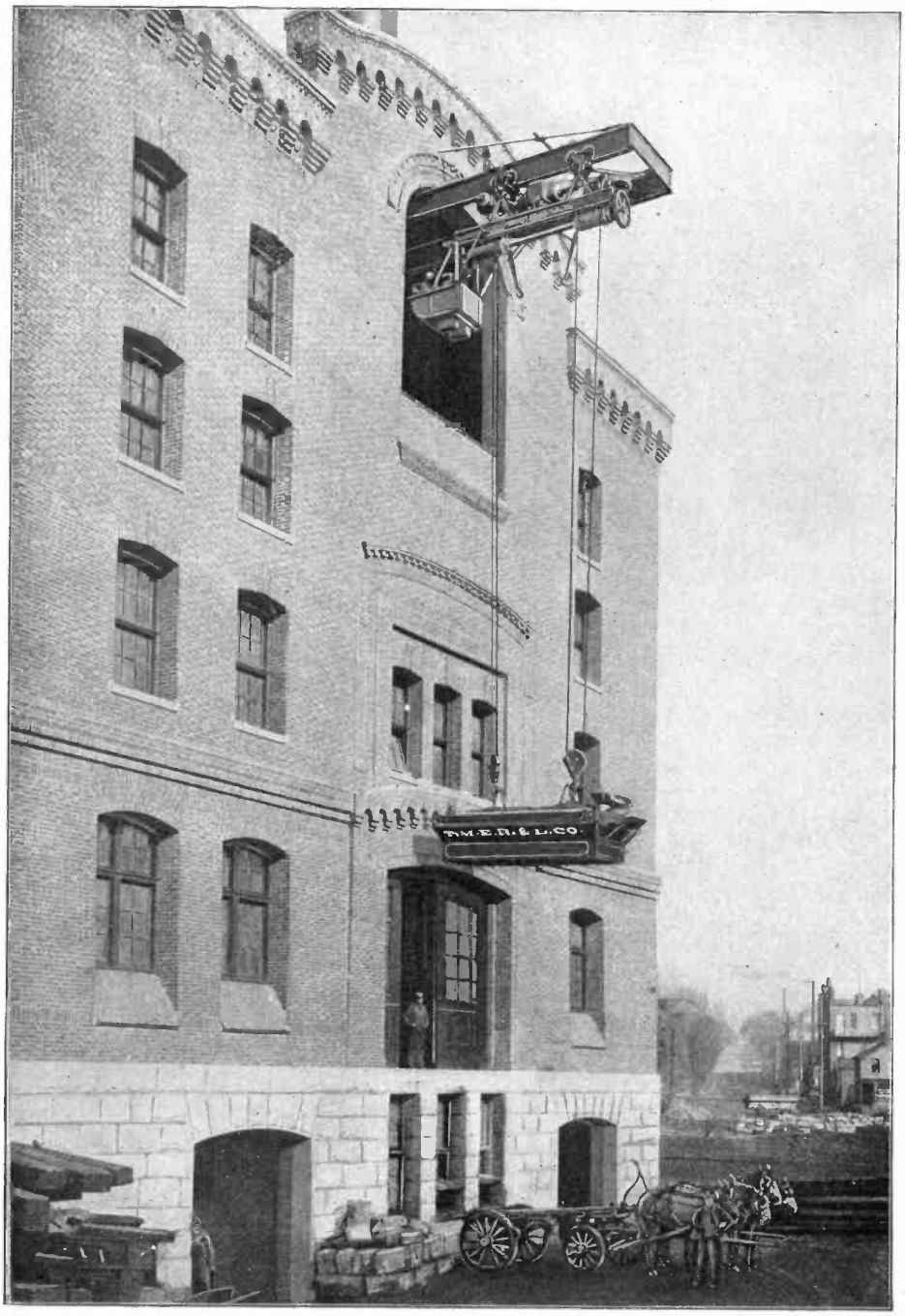
Lifting Magnet

It would be a laborious and skin abrading task to handle the scrap metal bales shown in the picture, if the work were done by hand. A medium sized lifting magnet will, however, pick up several bales at a time and drop them the instant that current is shut off from the coils of the magnet. The magnet is attached to a crane and is lowered down into contact with the metal, whatever it may be. pig iron, scrap iron, nail kegs, or steel rails. Then current is switched on giving the magnet its lifting power.



LIFTING MAGNET HANDLING SCRAP

ELECTRICAL APPLIANCE SECTION



ELECTRIC CRANE LIFTING A WAGON LOAD OF COAL

A Wagon Load at a Time

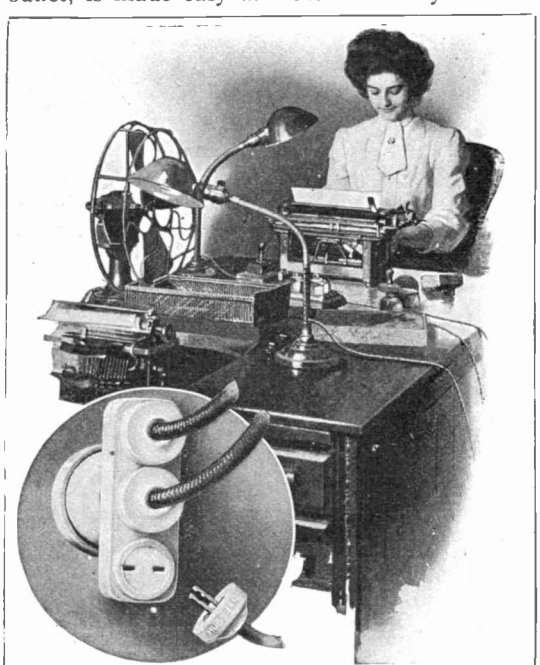
Few electrical devices have a more general and ever widening field of usefulness than the hoisting crane.

A journey through the industrial plants of a large city would offer many surprises and suggestions for in all places where heavy weights whether molten or solid metal, lumber, stone, coal, ashes, junk, engines, boilers, or motors are to be handled the electric crane is the lifting and carrying device.

The picture on the opposite page shows a Pawling and Harnischfeger two-motor hoist handling coal at the power house of the Milwaukee Electric Railway and Light Company. A wagon load at a time is lifted to the top of the building, run inside and there dumped into hoppers ready for gravity to do the rest when the coal is needed.

Three in One

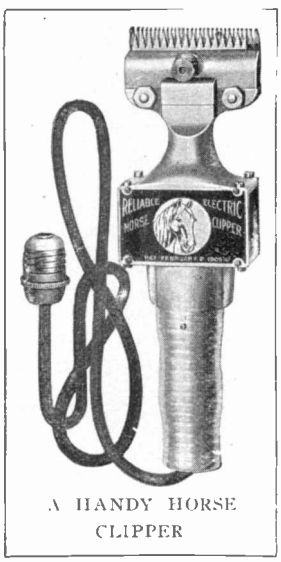
To supply two or three household or office devices, taking little current, from a single outlet, is made easy and convenient by the use of the Hubbell multiple plug. Just screw the plug into an ordinary lamp socket and three outlets become available, the illustration showing a table lamp, an electric fan and a ceiling wax heater in service. The cap is connected in each case with as much ease and safety as putting a cork in a bottle.



THREE-IN-ONE SOCKET

A Handy Horse Clipper

Of special interest to horse and livery men is the clipper here illustrated. A clipper and small motor are combined in a three and one-half pound instrument so light that it can be operated with one hand. The current necessary is less than that required by a sixteen candle power incandescent lamp, this amount of power making the knife operate at the rate of 1,500 movements per minute. The clipper requires no special installation. Simply attach the plug to an ordinary socket. The device runs on either alternating or direct current. It is manufactured by a Chicago concern, the Reliable Electric Company.



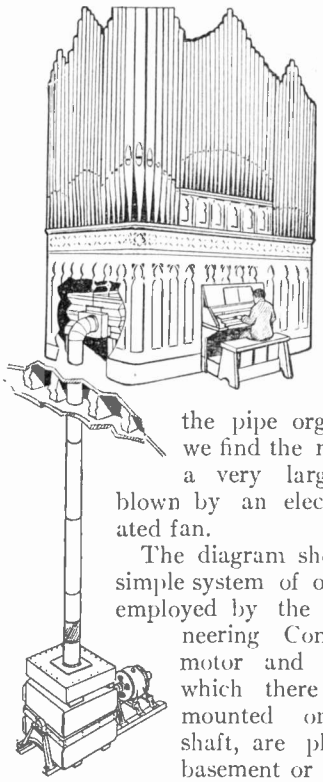
A HANDY HORSE CLIPPER

Ozone on the Increase

The use of ozone machines abroad is much more universal than in the United States. In one country in Europe last year over $7,000,000 was expended in ozone apparatus. In England one company has been turning out between 700 and 800 generators a month. Their catalogue is printed in eighteen different languages. Ozone, manufactured on a very large scale, is used in Paris, Berlin, St. Petersburg, Nice, Lyons and about 40 other cities to purify their water supply, wholly or in part.

ELECTRICAL APPLIANCE SECTION

Kinetic Organ Blower



MOTOR DRIVEN ORGAN BLOWER

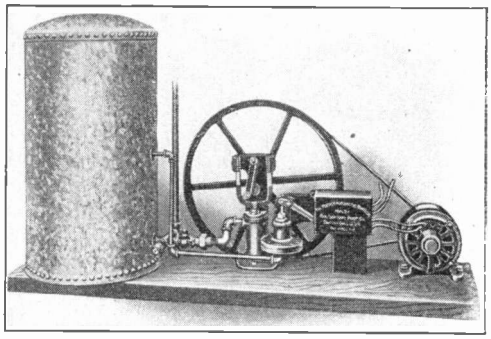
Since the days of the syrinx or "Pipe of Pan," which was simply a series of hollow reeds bound together and blown by the breath, there has been a constant evolution in the the pipe organ until now we find the modern organ a very large affair and blown by an electrically operated fan.

The diagram shows the very simple system of organ blowing employed by the Kinetic Engineering Company. The motor and the fans, of which there are several mounted on the same shaft, are placed in the basement or floor beneath the organ. The fans are mounted in a wind-tight casing and add their wind pressures, step by step, until the final pressure is sufficient to operate the organ through the large upright pipe and bellows-like regulating attachment.

Sanitary Automatic Pump

The Sanitary automatic pumping system is designed for house service where the requirements are not over 120 gallons an hour and where the source of supply is not more than 22 feet lower than the point where the pump is located. It is suitable for small residences, cottages, etc., having one or two bath rooms and the usual fixtures. The outfit consists of a one-eighth horsepower motor which drives a double acting pump. The tank at the left acts as a pressure regulator. When water is drawn from a faucet the pressure in the tank naturally falls. The moment this occurs an automatic arrangement operated by a pressure diaphragm closes a switch which starts the motor.

The Sanitary Pump Company which

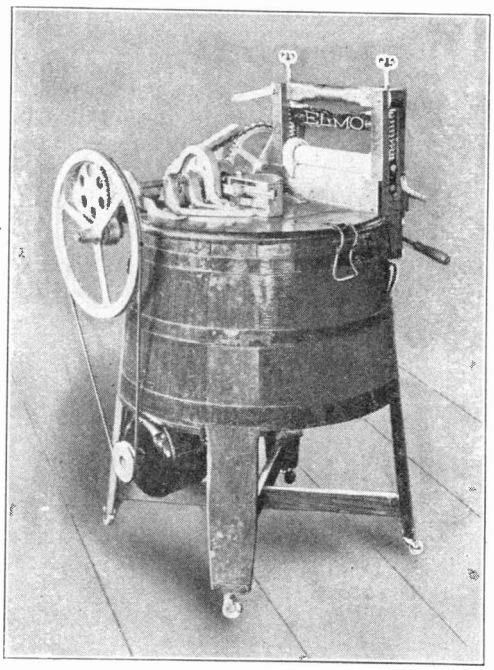


SANITARY HOUSE PUMP

makes this outfit also makes others of various sizes suitable for all buildings from small cottages up to the largest public institutions.

Exit Washday Drudgery

Washing machines are like automobiles in a way. Each type of machine possesses



THE ELMO WASHER AND WRINGER

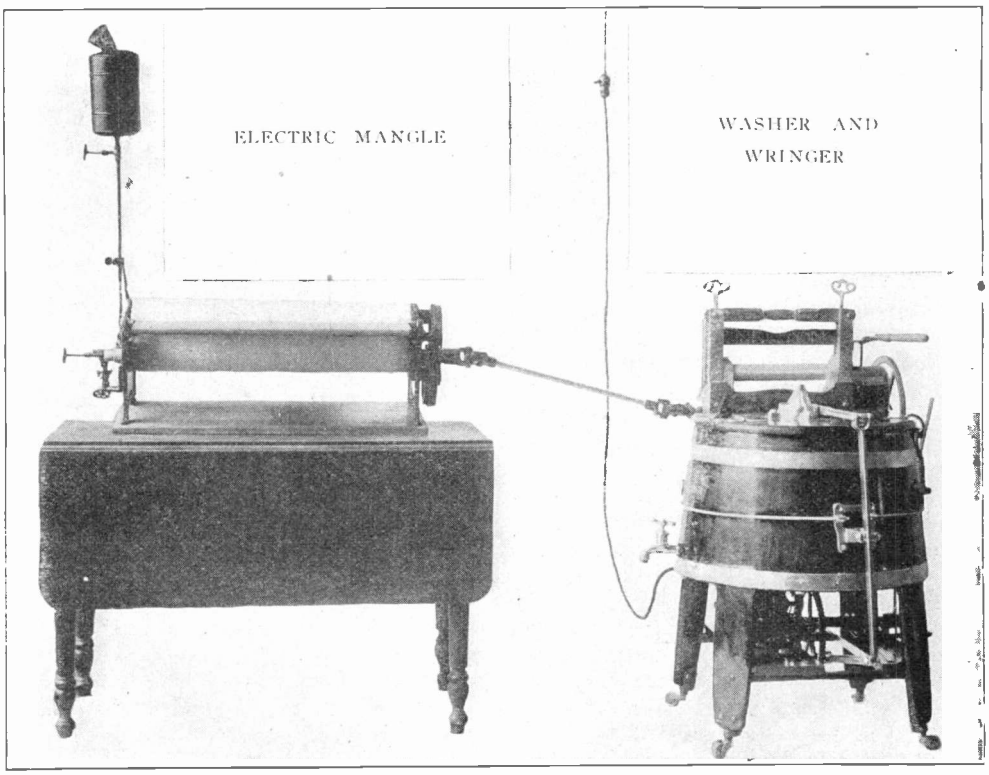
some feature in which it differs from all the others. The Elmo power washer here illustrated has the easy-opening lid. It is not necessary to turn off the power before raising the lid for the gears are disconnected automatically when this is raised. The Elmo is also equipped with a reversible wringer so that whenever the clothes get tangled in the rolls a simple turn of a lever throws the wringer to a forward or a reverse motion as desired. The power transmission from the motor to the washer is so well arranged that a very low current consumption is claimed while another good point is the enclosure of all gear wheels.

Washing and Ironing Outfit

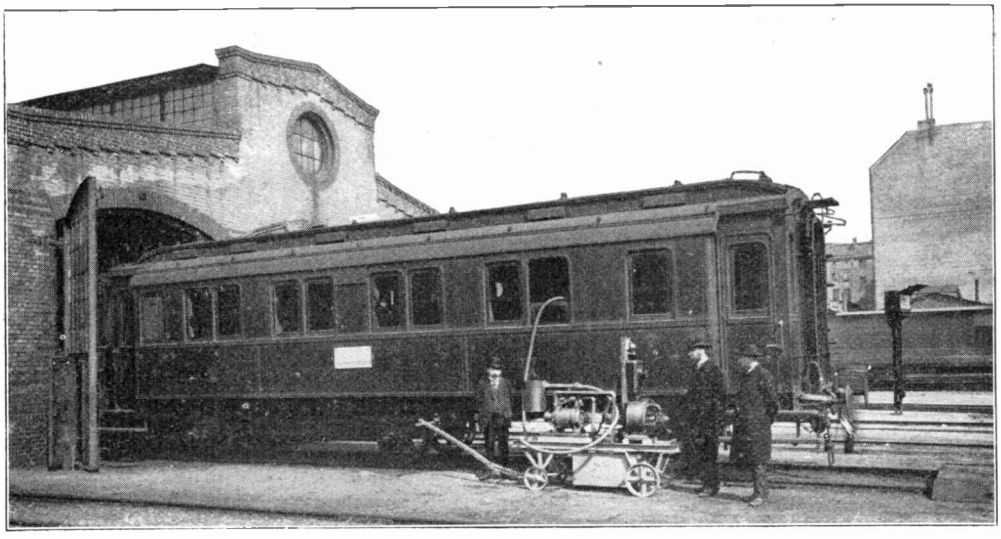
With a washing outfit such as the one shown herewith, and the addition of an electric flatiron, all the utilities ordinarily provided in a commercial laundry are made available. The outfit of the Automatic Electric Washer Company embodies a small motor mounted in the framework beneath the tub of the washer. This motor runs direct from the lamp socket. Through an ingenious arrangement of gears and rods the motor is made to operate the washing machine, wringer, and a good-sized mangle suitable for ironing coarse work.

Pure Air in Schools

Recent tests made by a ventilating engineer, J. E. Mayer, in over 200 school rooms showed that while the air might be quite pure at the start of the sessions, it was sufficiently vitiated in about half an hour to be considered undesirable. Mr. Mayer therefore suggests the use of ozonizers operated automatically by clock switches which would put them into service for five or ten minutes during the middle of each class session, it being assumed that the windows can be opened and the air radically changed at the end of the session. He also suggests that a similar installation in churches would lead to a larger proportion of the wide awake among the auditors at the close of the sermon.



ELECTRICAL APPLIANCE SECTION



CLEANING A RAILWAY COACH BY THE VACUUM PROCESS

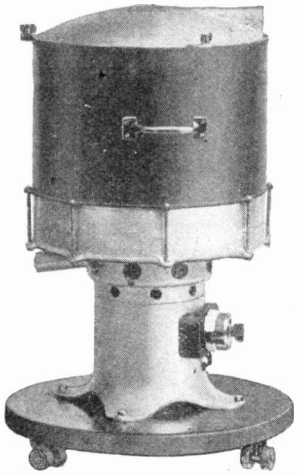
Cleaning Railway Coaches

The vacuum process is now largely used for cleaning railway coaches, where it is particularly effective in removing dust from the upholstery. It will be of interest to note the construction and method of operation of a novel electrically driven rotary pump outfit, of the Siemens-Schuckert design, as largely used abroad for this service. A direct current electric motor is directly coupled to the pump and mounted with the air and dirt receptacle together with the starting switches and rheostat on a truck so that the outfit can be easily moved from one car to another. A reel is provided with a long armor covered electric cable for supplying the necessary electric current to the motor, together with a coil of armored hose for conducting the dirt by vacuum from any part of the car to the receptacle, on the truck.

Portable Vacuum Cleaner

Among the various types of Westinghouse vacuüm cleaners is one called the Invincible Junior. It is constructed on the centrifugal principle and the motor is mounted on the vertical shaft which drives the fan. The collector is on top and the motor at the bottom, and the latter being the heavier, great stability is given to the apparatus.

The air is received at the very top of the machine and is drawn down through the dust receiver where all the dirt and dust are removed. It then passes through the centrifugal fan and is discharged into the atmosphere. The elimination of the dust before passing the air through the fan is a great gain in increasing the life of the bearings.

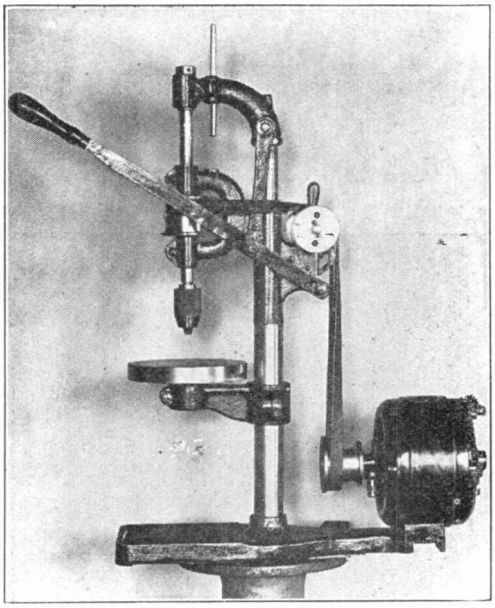


PORTABLE VACUUM CLEANER

About one-quarter horse-power is required for the operation of the cleaner, and it is light enough to be carried easily from one room to another.

Electric Bench Drill

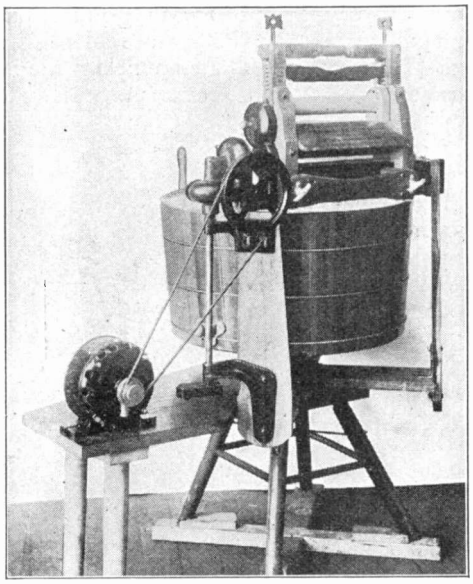
An easily operated and economical bench drill is shown in the cut, the motive power being a small ⅛ horse-power G. E. motor mounted on a shelf which is part of the machine base. As the drill is raised and lowered by the lever the pulley driving the drill spindle remains stationary, the spindle sliding up and down through it.



ELECTRIC BENCH DRILL

Belt Driven Washer and Wringer

A "1900 Washer" and wringer, operated by a 1-10 horse-power G. E. motor, will do all the hard work on wash day with very little

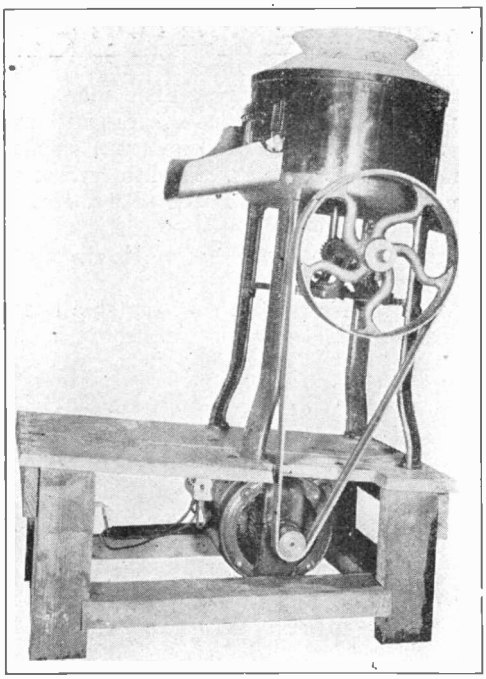


BELT DRIVEN WASHER AND WRINGER

supervision. The motor in this instance is mounted on a small extension to the bench which carries the machine and a simple belt drive is employed.

Potato Peeler

The potato peeling machine here shown is suitable for restaurants and hotels. The G. E. motor, which is of ¼ horse-power, revolves the inner surface of the potato holder. This surface is rough and grinds off the skins of the tubers as they are thrown against it by the centrifugal force.



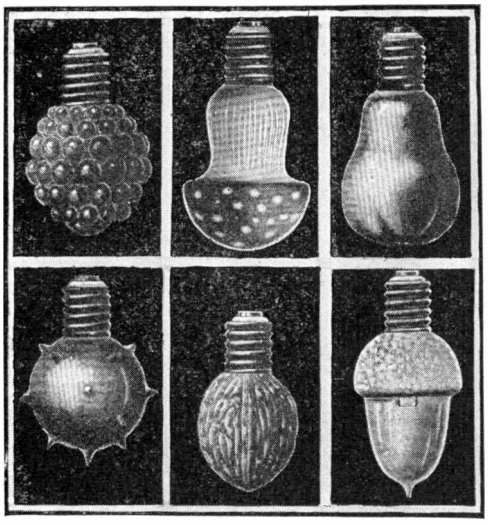
POTATO PEELER

ELECTRICAL APPLIANCE SECTION

ELECTRIC LIGHT

Fancy Decorative Lamps

European manufacturers are particularly skilled in the production of novelties of all kinds and their artistic creations extend into the field of lamp making. The Fletcher-

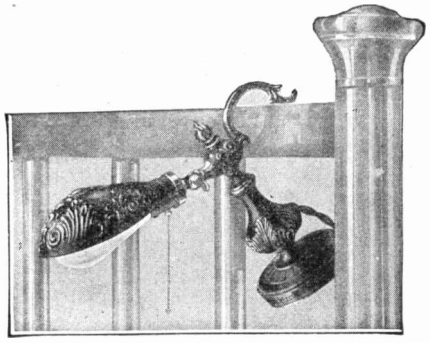


FANCY DECORATIVE LAMPS

Stanley Company are importers of a large number of pretty designs. The miniature lamps are made in various shapes and have the appearance of blackberries, mushrooms, pears, chestnut burrs, English walnuts, acorns, etc., as shown in the illustration.

Desk Lamp Used As a Portable

An attractive electric desk or table lamp which may be readily converted into a port-

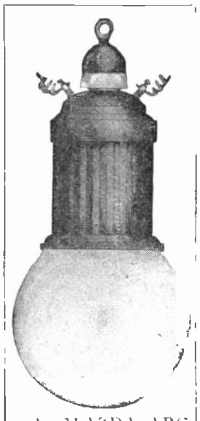


DESK LAMP AS PORTABLE

able is here illustrated in the Federal couch bracket. The shade and base are of heavy cast brass neatly finished and the adjustable handle allows the lamp to be hung up as shown, over the head of the bed, making a very convenient light for reading at night. Eight feet of silk cord and a plug for connecting to a near-by socket complete the outfit.

A New Arc Lamp

The Tungsten arc is one of the most modern appliances for lighting with tungsten filament lamps. This device illustrated herewith was developed recently to meet the demand for an appliance to replace the ordinary arc lamp. These are now made in various styles to suit special purposes and can be fitted for almost any candle power desired.



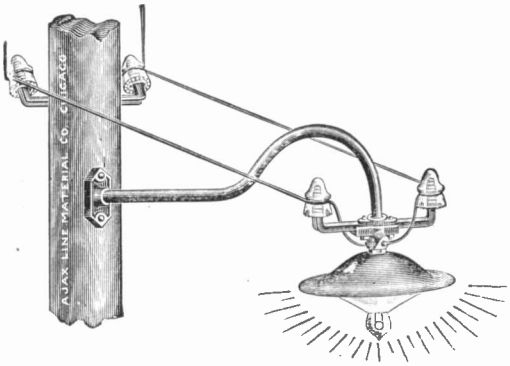
A MAZDA-ARC

The type of lamp shown in the accompanying illustration is the product of the George Cutter Company and is intended primarily for lighting factories, offices and store fronts. It consists of a cast iron casing similar to that of an ordinary arc lamp to which is fastened a globe. The whole is supported by a high voltage insulator with a metal ring. The ring may be replaced by an iron pipe for suspending from the ceiling or for inner-wired brackets. Tungsten lamps are supported within the metal casing and wired for series or multiple circuits. The casing is large enough to contain a transformer when it is not convenient to operate the lamps at the voltage delivered.

The expense of replacing ordinary arc lamps with tungsten arcs is small. The beautiful white light produced by the tungsten filament lamps is more like daylight than any other kind of artificial light and the power consumed is very small.

Tungsten Bracket Fixtures

While about equal to arc lamps in the amount of light furnished for a given amount of electrical energy, tungsten lamps offer the advantage that this same amount of

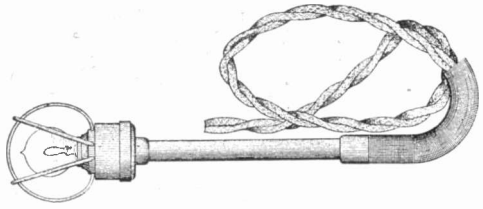


TUNGSTEN BRACKET FIXTURE

light can be distributed in four or five units along the block, instead of having the light all concentrated at the corner. This makes the street lighting more uniform and avoids the deep shadows common with the corner arc lamps. Each tungsten lamp is usually supported by a bracket fixture with a reflector to scatter the light widely, as in our cut of a type made by the Ajax Line Material Company of Chicago.

Automobile Trouble Lamp

It is usually an easy matter for the automobilist to determine whether trouble in his machine can be easily remedied once the trouble is located, but to find what is the

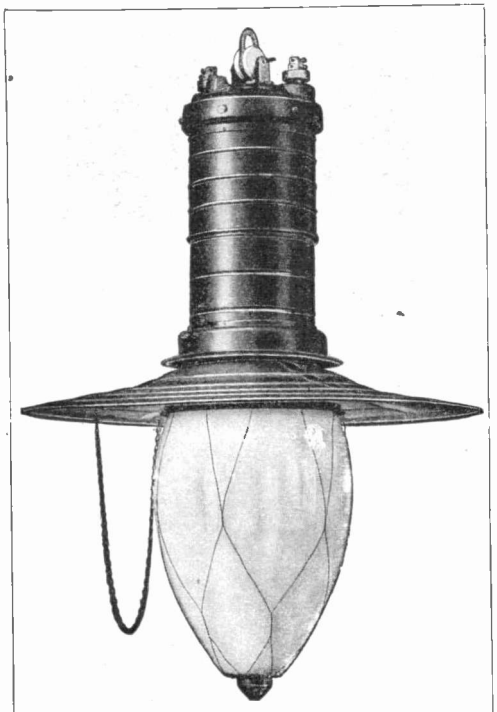


AUTOMOBILE TROUBLE LAMP

matter, especially in the evening, is often impossible without a light. The illustration shows the Vesta trouble lamp. By attaching the ends of the flexible cord to the sparking battery the lamp may be used to light up any part of the machine. A guard prevents the little lamp from breaking if it is dropped or hit and the coil of spring wire on the end of the handle protects the insulation of the wires by guarding against a sharp bend.

Vertical Carbon Flaming Arc

The flaming arc lamp is one of the most efficient lights yet developed since it is capable of penetrating fog and smoke and withstands bad weather conditions. The General Electric vertical carbon lamp is made for direct current circuits and can be



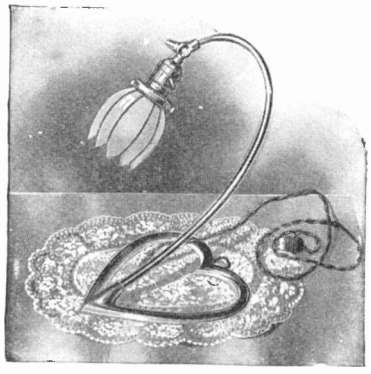
VERTICAL CARBON FLAMING ARC

installed on circuits supplying 6.6 amperes without the usual large and wasteful resistance. A light opal globe, a diffuser, and a substantial copper casing in two parts make unnecessary the removal of the entire case in trimming. The lamp burns about 20 hours with one trim, giving an average of 2,800 candle-power.

ELECTRICAL APPLIANCE SECTION

A Dainty Table Lamp

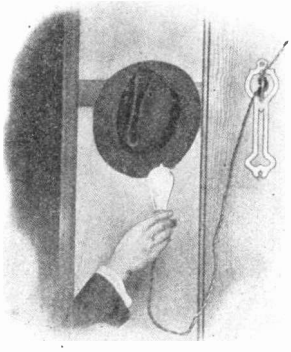
A very graceful design in the way of a hall or desk lamp is afforded in the inexpensive Federal electrolier. The heart-shaped base and stem are finished in brushed brass and a frosted glass globe is attached to the lamp which may be tilted to any desired angle. An attachment plug and silk cord are furnished with the lamp.



DAINTY TABLE LAMP

Portable Wardrobe Lights

Probably no other place suffers more from lack of a convenient light than the clothes closet or wardrobe. Candles and matches are most objectionable. In fact, 454 fires occurred last year in the City of Chicago from "carelessness with matches." The Federal wardrobe light here shown is designed with the double purpose of eliminating the danger from fire and providing a convenient light. The socket is made with a ring at the top for hanging the lamp on a wall plate hook furnished with it. A wire guard may be provided around the lamp in cases where it is liable to be left lighted and in contact with clothing or other combustible material.

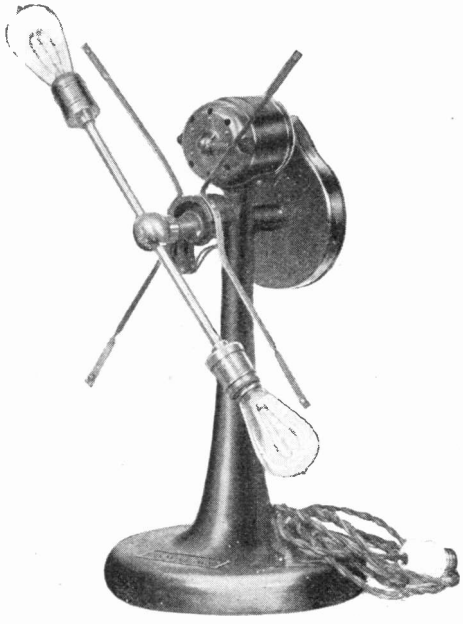


WARDROBE LIGHT

Whirling Window Sign

The fakir on the street corner fumbling a pocket handkerchief as the crowd gathers to watch his actions and satisfy their curiosity as to what is to come next demonstrates what electric sign manufacturers are just beginning to put into practice—the power of motion, or its semblance, to attract.

The Reco whirler here illustrated consists of a substantial arm and lamps secured to a shaft which is revolved rapidly by a small motor. By placing one red and one green lamp in the device and operating it, a very pleasing rainbow effect is produced. Back of the whirling portion a metal frame affords a support for a lettered sign, the whole offering a neat show window attraction.



WHIRLING WINDOW SIGN

Ornamental Posts for Tungsten Lamps

During the last few years civic pride has shown itself in the decorative street lighting systems of our large cities. Boulevards and private driveways have been beautified as well as illuminated and the business districts have been greatly improved by the installations of cluster lighting systems. In many of the small cities and suburban towns private installations have been made.

The fixture shown in the accompanying illustration is a cast iron pole of artistic design and especially adapted for tungsten cluster illumination. The middle globe is

ORNAMENTAL LAMP POST

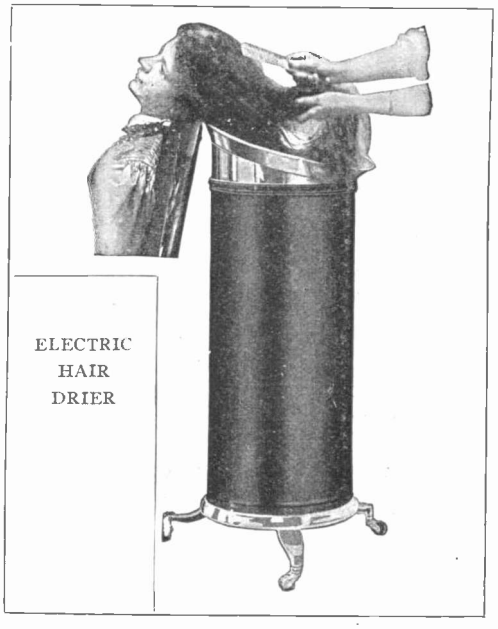
13 feet from the ground and the lower globes 11 feet. The pole is bolted to a ground section which makes the fixture rigid.

Forty of these artistically designed lamp posts were recently installed in the retail district of South Bend, Indiana. They were designed with the idea of having the proper distribution of light, decorative effect at night and an artistic appearance by day. These are the requirements for good designs for street illumination, whether with tungsten lamps or any other illuminant, and those at South Bend fill the bill.

ELECTRIC HEAT

Electric Hair Drier

Hair dressing establishments now employ electric hair driers., and the American type here shown is unique among them. As shown, it is a sort of tall can of the right height to be placed back of an ordinary chair and holds the tresses as the head is tilted back. In the bottom of the receptacle are a number of electric heating elements and of course the hot air rises from these and takes the moisture out of the hair in a short time. A wire screen prevents the hair from coming into contact with the heaters.



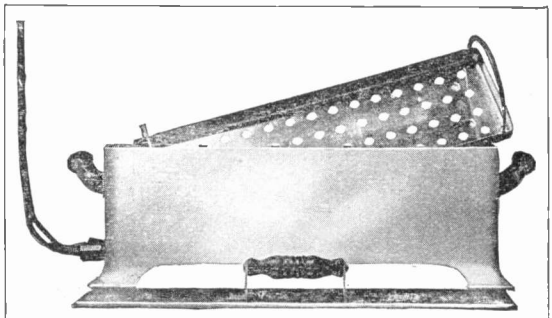
ELECTRIC HAIR DRIER

Sterilizing Surgical Instruments

In these days of modern surgery the patient is prepared for an operation in the most painstaking manner—by careful scrubbing and wrapping in sheets and bandages. The surgeon washes and re-washes himself a dozen times and then appears in the operating room like a ghost in his grotesque head wrappings and white garments. In keeping with all these other precautions it is of course necessary that the instruments be made absolutely sterile by boiling and the use of antiseptic solutions. For this purpose an electric instrument sterilizer is often used, and has many advantages.

ELECTRICAL APPLIANCE SECTION

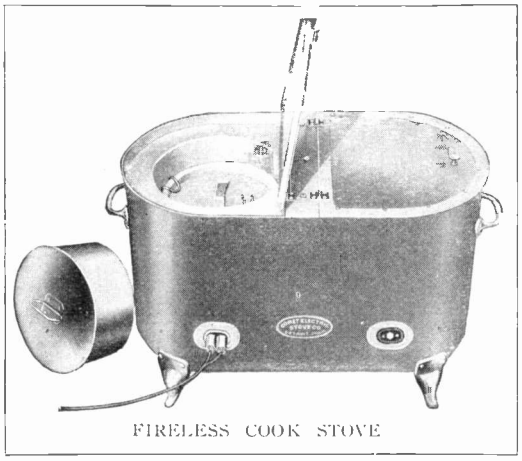
The American instrument sterilizer is made with steel-clad heating elements attached directly to the bottom, and all the other parts are of aluminum. Inside the outer casing is a perforated tray which holds the instruments. There are three heats available. The maximum one brings the water to a boil very quickly, and the minimum heat is sufficient to keep the water boiling continuously.



INSTRUMENT STERILIZER

A Fireless Cookstove

The electric stove here shown, called the "Comet," is built in various styles and sizes, and with it you can boil, bake, roast, fry or do anything possible with the ordinary wood, coal or gas stove at a fraction of the cost for fuel and with no more trouble than the turning on of an ordinary electric light.



FIRELESS COOK STOVE

The standard two-oven stove stands 18 inches high, is 24 inches long by 13 wide, and is beautifully finished in white enamel, making it not only an ornament to the kitchen but suitable for the small flat or apartment where it can be used as a window seat even while in use. The thorough insulation prevents any heat reaching the outer surface, while the close-locked covers prevent any odors of cooking escaping into the room. Each oven is fitted with a four-quart aluminum pot with sunken cover, and the outfit is equipped with the necessary attachment to connect the stove to the regular electric light socket. This attachment is shown at the left and is in the form of a double plug. At the right is snap switch which controls the current.

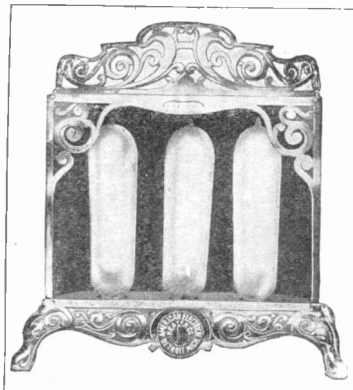
Warming Pad

The electric warming pad takes the place of the ordinary troublesome and cumbersome hot water bottle. A snap of the switch accomplishes the same results as running to and fro heating water and getting the hot-water bag ready. The American pad is furnished ready for use, with 10 feet of cord, switch and lamp socket attachment plug. The heating element is in the form of a fabric, and the outer covering, which is removable and washable, is either of eider down or rubber cloth.

WARMING PAD

Luminous Radiator

The new Detroit luminous radiator, made by the American Electrical Heater Company, is a portable fire place, without fire but with all its advantages. It is suitable for drawing rooms, staterooms, hallways, bathrooms, cold corners in offices, etc. The heat is derived from large frosted lamps made in tubular form. Behind the hot lamps is a polished copper reflector which throws the heat out into the room. Thus the heat is by radiation rather than circulation. The luminous elements (lamps) are made for a consumption of either 250 or 500 watts to each lamp. They are somewhat similar to ordinary incandescent lamps, very much elongated.

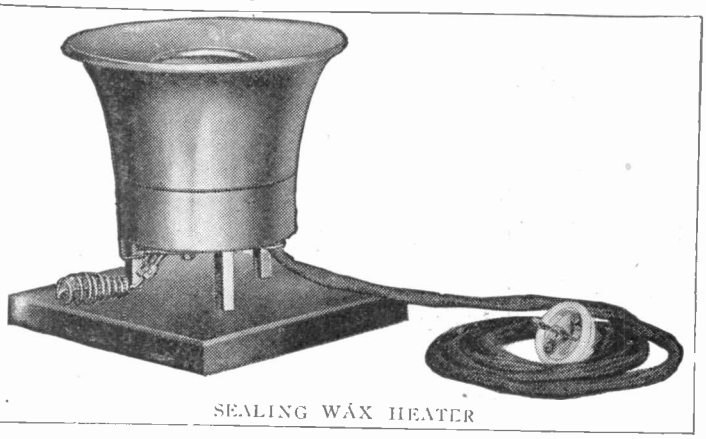


LUMINOUS RADIATOR

EXPOSED

Electric Sealing Wax Heater

In express offices, banks, shipping departments, stores, and business establishments of all kinds, sealing wax is used freely in making up packages. The G. E. wax heater here shown is fitted with a removable sheet metal cover, the surface of which slopes downward to a center hole which provides access to the melted wax. This feature of design also allows all drippings to drain back into the pot. It has a maximum capacity of three pounds, and is arranged for three degrees of heat control.

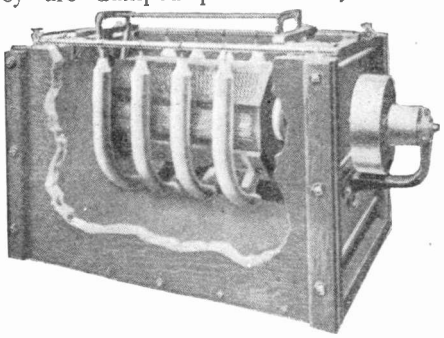


SEALING WAX HEATER

MISCELLANEOUS APPLICATIONS

Electroplating Machine

Time and labor may be saved in electroplating shops by using a machine for small work, similar to the one shown in the illustration. Instead of hanging the small articles independently in the plating bath they are dumped promiscuously into the

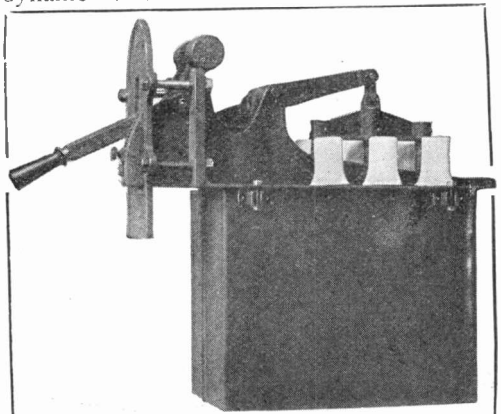


ELECTROPLATING MACHINE

revolving cage, which is situated between a number of anodes. The cage is perforated so that the electrolyte may fill it and is kept constantly revolving during the process. The machine is made by Hanson & Van Winkle.

Breaking the Circuit in Oil

When a dynamo is delivering current to a line suppose the line becomes short circuited, that is, an unusually easy path is inserted, by accident or otherwise, through which a large amount of current may pass. The dynamo then becomes "overloaded" in trying to make current fast enough and danger to the apparatus may arise. To protect the apparatus what is called a circuit-breaker is inserted in the line, which opens automatically upon a certain given load.

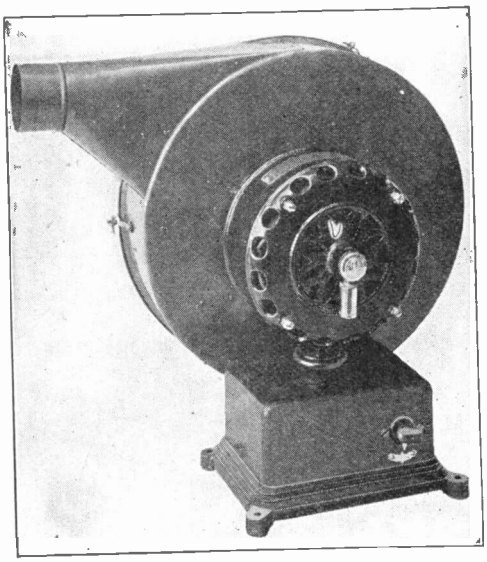


OIL CIRCUIT-BREAKER

Some of these circuit-breakers open the line inside of a bath of oil and no flash occurs. The picture will give you an idea of what a Westinghouse oil circuit-breaker looks like from the outside. On the lever at the right are suspended six contacts, down underneath the oil in the tank. When you set the circuit-breaker by pulling down the lever at the left, these contacts are drawn up and meet six others, closing the two sides of the line. When the current gets too strong an electro-magnet trips the breaker.

Centrifugal Hair Drier

A small centrifugal fan similar in design to the ordinary forge blower, driven by a motor of 1-20 horse-power and embodying

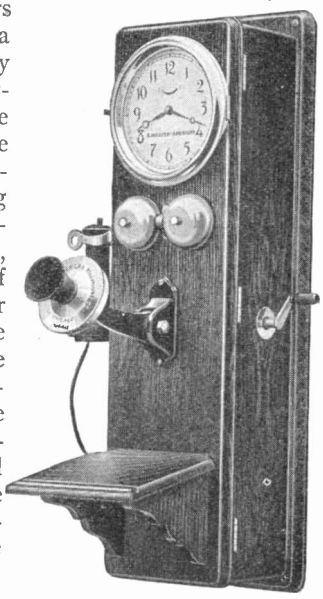


CENTRIFUGAL HAIR DRIER

a heating element to raise the temperature of the discharged air are the elements which comprise the new G. E. hair drier. The heating element is so situated as to affect the air just as it leaves the nozzle and a steady stream of hot air is secured.

Combined Telephone and Time Service

Nearly every business office now-a-days is supplied with an electric clock which does not require winding or regulating and always indicates standard time. This is a special service, however, and requires special wires. Thus it occurred to telephone manufacturers to get out a clock whereby this time service might be given by the telephone companies along with the telephone service, making use of the regular telephone wires. The picture herewith shows the combined telephone and clock of the Swedish-American Telephone Company. There is no master clock necessary for its operation—no extra wires; just the ordinary telephone wires, whether the circuit be grounded, common-return or metallic.



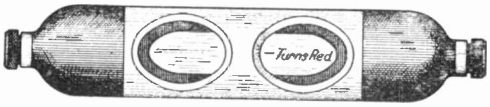
COMBINED TELEPHONE AND CLOCK

The Automatic Flagman

A newly invented device for use as a safety appliance at crossings of highway and trolley lines consists of a large disk suspended like a pendulum from a steel support, on the top of which is installed a regular trolley car bell. The disk bears the words "Look Out," while at night two white lights at the top of the pole serve to light the crossing and a red light illuminates the center of the disk. Two rails 1,500 feet each way along the track are arranged so that the wheels of the approaching cars form an electric contact causing a small motor to swing the disk back and forth. A. C. Hunt is the inventor of the system.

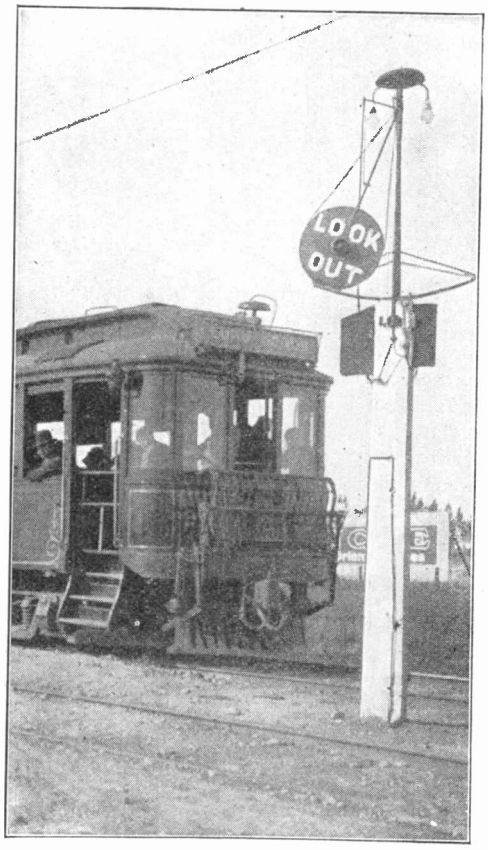
Polarity Indicator

A simple instrument to determine the polarity of a direct current is made by the Witherbee Igniter Company. It is a small cylindrical arrangement with connectors at each end which are attached to the circuit, the polarity of which is to be determined.



POLARITY INDICATOR

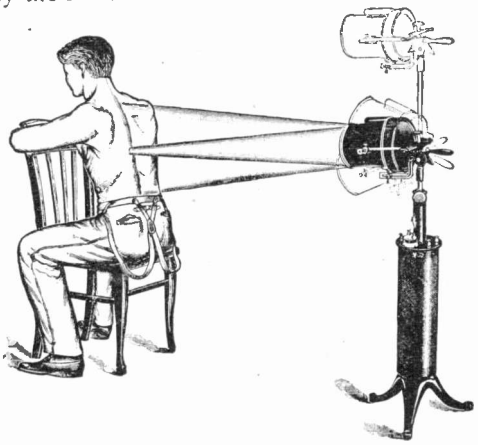
The current then flows through a glass tube containing a liquid. When the current has passed through for a moment the solution turns red at one end of the tube. This end indicates the negative pole of the circuit. This is a practical instrument where storage batteries are to be charged, as in automobile garages.



THE AUTOMATIC FLAGMAN

Light Rays Penetrate the Body

An eminent physician says that we must look to electrical forces and animal serums in the future to cure many diseases that are now classed as incurable. The power of the sunlight bath to drive out the germ of tuberculosis has led to the use of the electric or "therapeutic arc lamp" as it is called as an effective substitute for the sun. There are many who might be inclined to believe that rays from an arc lamp stop on the surface of the body in the form of heat or are reflected by the skin. Both of these actions do occur



THERAPEUTIC LIGHT TREATMENT

but physicians agree also that light penetrating the tissues is there turned into heat and stimulates the nerves and congested or ailing internal organs.

An interesting test, in which the rays from a powerful arc lamp were used to show that light rays are capable of penetrating the body, was made by Doctors Gottheil and Franklin.

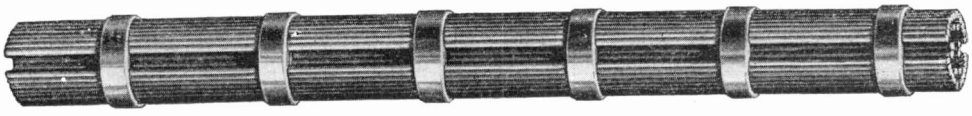
Already-developed negatives were taken and on one side of each a sensitive film these plates, one at a time, were then placed with the negative side next to the skin of the body of a subject in a dark room, and a black cloth added as a cover to the plate so that light could now reach the plate only by passing through the subject's body. When all was ready the subject was seated in front of the arc and the light directed through the body toward the plate on the other side of it. Exposures of from ten to thirty minutes were taken on several plates, the image of the negative being printed more or less distinctly on the film, the following conclusion being reached:

Light in proper concentration from a source of sufficient actinic power, can be made to penetrate the entire thickness of the human body including both surfaces of the skin; hence all the internal organs are accessible to its influence.

The Straight-Away Lightning Rod

One of the most commonly accepted theories about lightning is its tendency to follow a straight path. In fact the ground wire from an arrester is always where possible run to ground without kinks or turns.

The old lightning rod with which we are most familiar contains a number of spiral grooves, and considering this as against a straight path, a United States weather bulletin says, "Sharp turns and spiral windings present hindrances and cause lateral discharges." Following this common sense way of looking at the matter the straight-away lightning rod shown in the illustration fullfils conditions not found in the spiral variety. The conductor is a cable made up of a number of bundles of copper wires. These bundles are held together by metallic holders in such a way as to allow air space



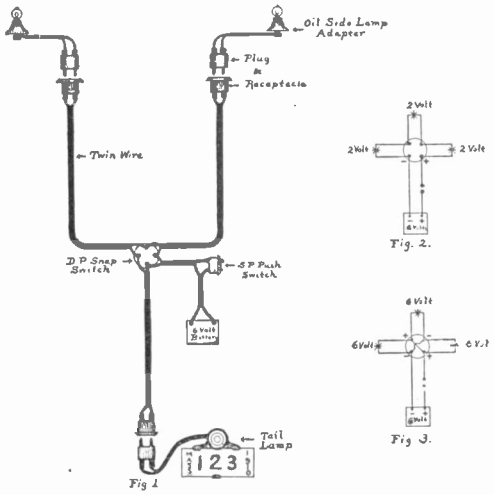
LIGHTNING ROD OF COPPER STRANDS

applied and fastened along the edges by paste and tape. A thick black paper was then laid on over the film so that the only possible way for light to act upon it was through the negative, in which case a picture would be printed upon the film. Several of between each bundle and its neighbor. The Ohio Lightning Rod Company who manufacture this rod believe the absence of twists and spiral windings make the device a much safer conductor than the old twisted type.

Electric Lighting for Automobiles

The accompanying diagrams show a very simple and convenient way to wire an automobile for electric lights so that various voltage lamps and batteries may be used, the six-volt battery being the most common.

The plan with the necessary materials is furnished by the Stuart-Howland Company. The permanent wiring on the car consists of two small flush receptacles in the dash near the side lamps and one in the back of the car near the tail lamp. The



METHOD OF LIGHTING AUTOMOBILES

twin wire from each of the three receptacles is connected to a double-pole snap switch which should be placed in a concealed position under the seat where it cannot be tampered with, as it is not used to light or extinguish the lamps. The twin wire from the battery is also connected into this same switch —thus avoiding all soldering.

From the receptacles any style of electric lamp may be plugged in. With the double-pole switch on the "off" position, Fig. 2, the wiring is arranged for series lamps, while with the switch in the "on" position any multiple lamp which will match the voltage of the battery can be used. The advantages, however, are greatly in favor of the series lamps for if three of the two-volt lamps be used, the total current consumption will be but three-fourths of an ampere, as against three to five amperes in the multiple system, and the series arrangement has the additional advantage of instantly notifying the driver when the tail lamp becomes extinguished, since the side lights also go out immediately.

The single-pole switch in the battery circuit enables the driver to light or turn off his lamps without stopping the car.

Ear Drum Massage

Application of vibration to ailing or weak parts of the body as a means of rousing them to healthy activity is made possible by massage instruments with which we are nearly all familiar. An unusual and interesting development of this treatment is

EAR DRUM MASSAGE APPARATUS

called "sound massage" and is applied to the drum of the ear. The two telephone receivers of the outfit, which is made by the Victor Electric Co., are worn over the ears, are similar to the head-band receivers worn by the operators in a telephone exchange. By connecting these to a wall plate containing a coil and vibrator, loud and sharp or low and soft sounds may be thrown upon the ear drums with stimulating effect. Each receiver is regulated independently of the other thus making it possible to apply stronger treatment, if necessary, to one ear than to the other.

ELECTRICAL APPLIANCE SECTION

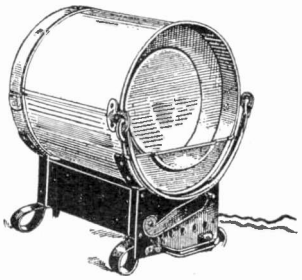
Self-Winding Clock

Like the electric lamp and the automobile the electric clock comes forward with the claim that it is here to stay. The Imperial clock requires no winding and operates for a year at least on the energy from two dry cells. Many of the delicate parts of spring wound clocks are absent, a weight on the end of a lever supplying the needed power. As this "winding arm" drops to a certain point it closes an electric circuit and energizes an electro-magnet. This magnet, by attracting its armature, pulls the "winding arm" up ready to gradually fall again, applying its weight to running the clock. This "winding" occurs at regular intervals of seven or eight minutes and on this account an electric clock keeps better time than a spring clock in which the spring is under extreme tension when first wound and under slight stress before time to wind it again.

SELF-WINDING CLOCK

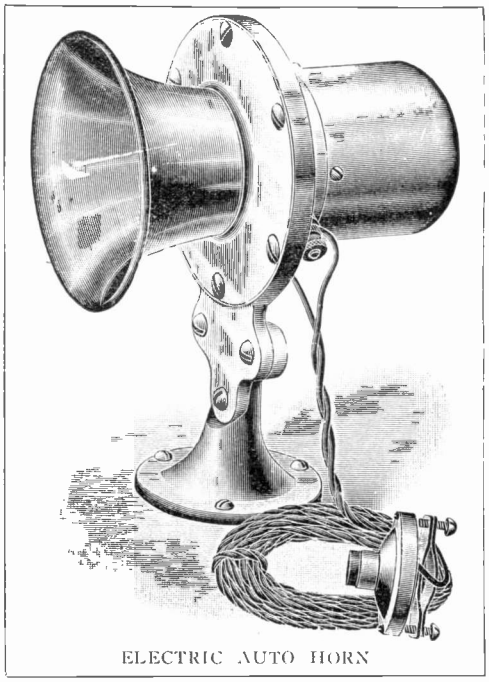
Electric Heaters for Chicken Food

The old joke about the efficiency of electric lights in making hens lay egg-sactly twice as often by getting them to think that night is day, keeps going the rounds and finding new hearers. Meanwhile electricity is proving a real aid to chicken raisers aside from its well-known application to incubators, namely as a means for warming food and drink. It is easier to enclose a pair of wires so that no chicken's claws can damage them than it is to arrange any sort of lamp or stove so that it will neither smoke nor upset under the ordinary conditions of the chicken farm. The amount of heat required to take the chill off either bran or water is quite small, and the result is not only an increase in the rate of laying, but also a prevention of ailments that can be traced directly to the eating of frozen food. In either case the vessel holding the food or drink can be separable from the base containing the heating coil, and where only a part of the liquid is exposed, the heat can be concentrated on this portion so as to keep the current used down to an almost nominal amount.


ELECTRIC CHICKEN FOOD HEATER

Electric Auto Horn

The automobile enthusiast will appreciate a signal horn which does not require removal

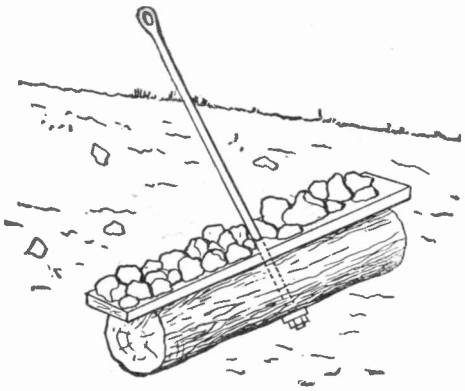

ELECTRIC AUTO HORN

of his hand from the steering wheel. Such a device is the Mesco electric signal horn of the Manhattan Electrical Supply Co. which consists of a buzzer equipment made up of four electromagnets. A specially made push button and flexible cord make it possible to attach the button to the rim or a spoke of the steering wheel, leaving both hands at the wheel in case of sudden danger or emergency.

The Passing of the "Dead Man"

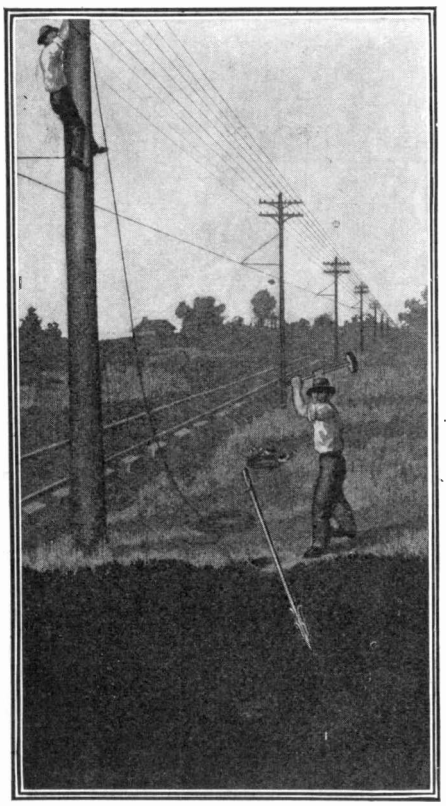
Wherever a pole line changes direction or is apt to be subjected to severe strain it becomes the duty of one or two men to "bury a dead man," and those to whom this work falls are often the mark for many a jest as they are frequently behind the main crew and the job takes time. The dead man consists of a log buried six or eight feet in the soil and having an iron rod passing through it to which the guy wire is attached.

Various better methods are now employed one of which, the Crouse Hinds harpoon guy anchor, is here illustrated. Four-hinged blades allow the anchor to be driven into the soil but any attempt to withdraw the anchor as when the guy wire is tightened

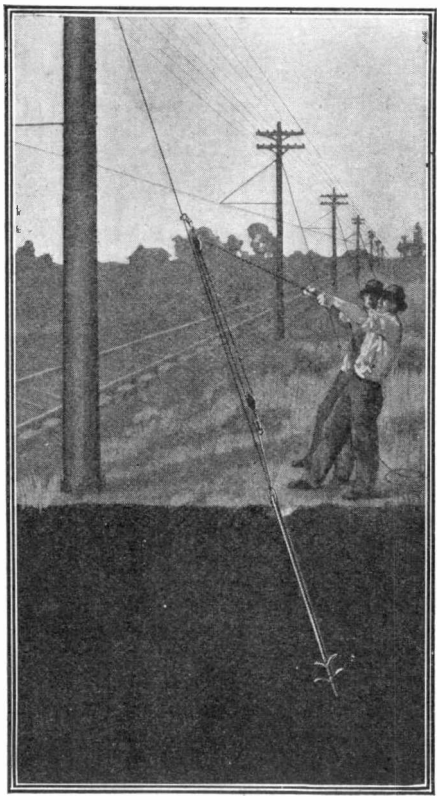


THE OLD STYLE "DEAD MAN"

spreads the wings against the surrounding undisturbed earth in the manner shown, resisting the pull. A heavy sledge is the only tool needed to install it.



ANCHOR FOLDED



ANCHOR SPREAD

ELECTRICAL APPLIANCE SECTION

A Vibrating Chair

One of the unique applications of the vibratory principle as a therapeutic stimulant is the vibrating chair. After the ordinary vibrator had been pretty well developed and of recognized value some one conceived the idea of extending its application so as to make a chair in which the subject is

A VIBRATING CHAIR

sitting vibrate, thus giving the whole body a stimulating treatment instead of only some local part. Such a vibrating chair is shown in the picture and is the product of the Lindstrom, Smith Company. In this instance it is operated by batteries contained in a neat case with the necessary switches for the control of the vibrator motor.

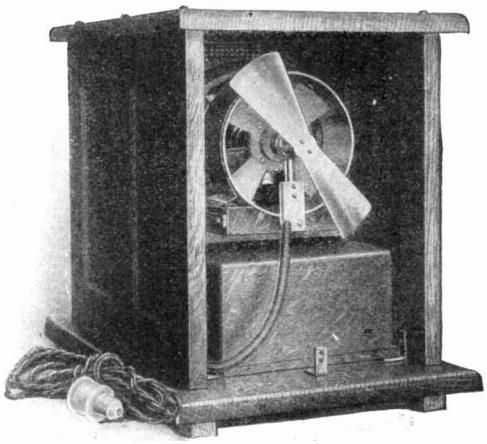
Electric Vibration

The electric vibrator for home use is no longer a fad but simply another one of the electrical conveniences that were once a luxury and now of common use. Vibration has certain well known stimulating and soothing properties frequently employed for therapeutic purposes and, besides, vibratory massage can be employed to put off that day of crows feet and wrinkles which is dreaded by most people. The Swedish electric vibrator here shown contains a perfect little motor which will operate on either direct or alternating current. The power of this motor is sufficient to give a very strong and positive action to the stem which carries the vibrating attachments of which there are a number of different forms for facial massage, scalp treatment and treatment of the more deep-seated muscles and nerve centers.

NEW TYPE OF THE MOTOR VIBRATOR

Ozonizer With Fan Electrodes

One of the essential features of the Vohr ozonizer of the Standard Electro-Utilities Company is the use of a small electrically driven fan as an electrode. This is the second, or inner, fan shown in illustration,



OZONIZER WITH FAN ELECTRODES

where the outer fan is simply a suction-fan to help pull the air through the ozonizer. This inner fan constitutes one electrode of the apparatus. Surrounding it is a ring of glass six inches in diameter and 2½ inches wide. On the outer surface of this ring, or annulus, is placed a metal band, which is the other electrode.

Elementary Electricity

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

CHAPTER XXX.—ELECTRIC ARC LIGHTING

The light of the electric arc lamp is produced by the passage of current between pieces of carbon generally in the shape of short pencils or rods. The pencils are first brought into contact and then gradually separated. If a suitable current and electromotive force are employed, a brilliant arc or bow called the voltaic carbon arc, producing light closely resembling that of sunlight in its color values, will be established between the two carbons.

The voltaic arc produces the most intense artificial light known. This is owing to the fact that the formation of the arc is attended by the production of a cloud of carbon vapor between the electrodes. This vapor is raised to an incandescence far above any temperature possible in any of the incandescent electric lamps that have been described in a preceding chapter; for this temperature is probably about 6332° F., the temperature at which carbon is volatilized.

With reference to the direct current arc, during the maintenance of the arc the intensely hot carbons are gradually consumed or burned by oxidation by the air. Besides this, the positive carbon, or that from which the current passes, is volatilized. For this reason the rate of consumption of the positive carbon is greater than that of the negative, the difference being about two to one.

If the voltaic arc be examined through a colored glass, since the light is too intense to permit it to be safely examined directly, it will be seen that after the arc has been established for some time, a change occurs in the shape of the carbons. The positive carbon is hollowed out in a small crater or cavity at its free end, while the negative carbon, or that into which the current passes, is provided at its free end with a small hillock. The hillock on the negative carbon as well as the crater in the positive carbon consist of practically pure graphite.

What has occurred is as follows: The positive carbon is much hotter than the negative. Under the intense heat produced by the passage of the current the extremity of the positive carbon, or at least that part out from which the current passes, is volatilized, thus leaving a tiny crater. The carbon vapor fills the gap or space between the two carbons and constitutes the medium through which the electric current passes. At the same time the carbon vapor is raised in temperature to the high incandescence produced by a temperature near the boiling point of carbon. When the glowing carbon vapor reaches the relatively cooler surface of the negative carbon, it is condensed on it and assumes the form of graphite or plumbago.

Since the light emitted by a heated body increases rapidly with its temperature, the crater in the positive carbon forms the principal source of the light of the direct current carbon arc. Consequently, an arc lamp emits more light in a direction away from the crater than in any other direction, so that, when the light is employed for the illumination of extended areas, such as streets, yards, etc., the upper carbon is made the positive carbon, for, it is in the upper carbon that the crater is formed at which the greatest amount of light is produced.

The two carbons employed in arc lamps are placed in a variety of positions, with respect to each other. Generally they are

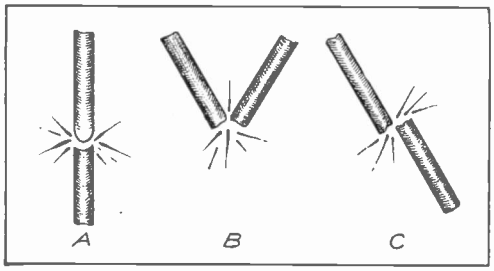


FIG. 193. RELATION OF CARBONS IN VARIOUS ARC LAMPS

placed one above the other as shown at (A) in Fig. 193. At times they are placed slightly inclined to one another shown at (B). When employed in searchlight the carbon arc is placed in front of lenses for the purpose of obtaining an approximately parallel beam of light. They are then placed as shown at (C).

Since during the operation of an arc lamp the carbons are gradually consumed, suitable mechanism must be provided for maintaining the carbons a constant distance apart; otherwise the lamp would be extinguished from the distance between the carbons becoming so great that the arc could not be maintained. In order to do this the lamp is provided with mechanism for feeding the carbons.

In all the ordinary forms of arc lamps, in which the carbons are placed vertically one over the other, only one carbon is fed. This is the upper or positive carbon. When the lamp is provided with full sized carbons the arc at starting is nearer the top of the lamp globe. After maintaining an arc for a fairly considerable length, the arc will be found nearer the bottom of the globe. This makes but little difference for the ordinary arc lamps, but this is not the case where the lamp is employed for searchlights or projectors, since here in order to obtain an approximately parallel beam of light the arc must be kept approximately at the focus of the lens, and to do this both carbons must be fed. Since the positive carbon is consumed about twice as rapidly as the negative the rate of feeding of the positive carbon is necessarily about twice as rapid as that of the negative.

It was Humphrey Davy who first exhibited on a large scale the beauties of the carbon voltaic arc. He did this by causing the current of a large voltaic battery to pass between two small pencils of hard carbon sawn from the carbon produced in the retorts in which illuminating gas is formed by the destructive distillation of coal. This was in 1809, or some time after the invention by Volta of the voltaic battery in 1796.

The splendid illumination produced by the carbon voltaic arc resulted in the production of many excellent forms of lamp mechanisms capable of maintaining the carbons the required distance apart. Although many of these lamps were well constructed, and were capable of efficient operation, yet none of them were employed commercially, owing to the fact that the voltaic batteries were unable economically to produce the current required. As in the case of the electric motors the systems of arc lighting were obliged to wait their fuller development, until the dynamo was capable of producing the large currents necessary for their commercial operation.

Among some of the improved forms of arc lamps that followed the improvement of the dynamo-electric machine by Gramme and others was the Jablohkoff arc lamp or candle. This was an exceedingly simple device consisting as it did of two slender rods or pencils of carbon placed side by side and parallel to each other but prevented from coming in contact by a small quantity of kaolin placed between them. The voltaic arc was struck or formed between the ends of the carbons by a small quantity of carbonaceous material known as the igniter, placed between them at the upper ends. On the passage of the current this material was volatilized, thus establishing the arc. Since, however, the positive carbon is consumed twice as rapidly as the negative, candles so arranged were soon extinguished from the distance between the carbons becoming too great for the current to pass.

Jablohkoff and others spent considerable thought in improving this form of arc lamp. By omitting the kaolin between the pencils and separating them by an air space only it was easy to start the arc by bringing the carbons together and then separating them the required distance by the action of an electro-magnet. Then, too, the difficulty arising from the unequal consumption of the carbons was avoided by using alternating electric currents. With such currents each carbon would alternately become positive and negative so that the two would be maintained the same length during consumption.

The pencils employed in the Jablohkoff candles were comparatively slender, so that a pair of carbons was soon consumed. In order to maintain the light for a number of hours it was necessary to place a number of separate pair of candles in the same globe with a device that automatically shifted the current from one candle to the other as soon as one became extinguished.

The Jablohkoff electric candle is no longer employed, having been replaced by the cheaper light of the enclosed arc lamps.

There are various ways of employing arc lamps for the illumination of large areas and factories. These consist practically of circuits in which the lamps are placed either in series or in multiple.

In series arc circuits the current passes successively through each lamp. The length of such circuits may be from 15 to 20 miles and the number of lamps connected with a

single circuit may be 100 or more. When each lamp requires a pressure of 45 volts and a current of about 10 amperes, the dynamo, or as it is called, a series arc light generator, must be able to produce a pressure at its terminals of at least 4,500 volts, and, as we have seen in the chapter on dynamos, in order to maintain constant the current strength of 10 amperes, there must be provided some regulating device whereby the line voltage may be increased in proportion to the number of additional lamps introduced into the circuit, or decreased in proportion to the number removed from the circuit.

Arc lamps are also connected in multiple or parallel to constant-potential mains. Here, dynamos must be employed that are capable of increasing the current in proportion to the number of lamps introduced into the circuit, or decreasing it in proportion to the number of lamps removed from the circuit, and this without affecting the pressure on the line.

In the early history of arc lighting considerable difficulty was experienced in producing a lamp mechanism that would main-

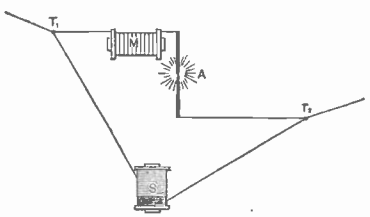


FIG. 194. ARRANGEMENT OF THE DIFFERENTIAL ARC LAMP

tain the two carbons a constant distance apart notwithstanding their consumption during use. This important problem was finally solved in 1885, by the invention of what is known as the differential arc lamp. This mechanism, as shown diagramatically in Fig. 194, consists of two separate electro-magnets placed in the feeding mechanism of the lamp. One is a series magnet (M), placed in the main circuit. The other is a shunt magnet (S), placed in a shunt or derived circuit around the arc. The series magnet is wound with a few turns of coarse wire, the shunt magnet with many turns of fine wire. Since the resistance of the shunt magnet is many hundreds of times greater than that of the series magnet when the lamp is started the greater proportion of the current flows through the series magnet. When, however, by consumption, the distance between the carbons is increased the resistance of the circuit increasing permits a greater proportion of the current to flow through the shunt magnet. As soon as this increase of current reaches a certain point some simple feeding device, generally a clutch, acting directly on the rod that holds the upper carbon, permits it to drop. As the distance between the upper and the lower carbon is thus decreased the resistance decreases, more current flows through the series magnet, the upper carbon is fed towards the lower carbon and the constant distance is thus maintained.

The carbons employed for most arc lamps are approximately 12 inches in length and five-eighths of an inch in diameter. In an ordinary 10-ampere, 45-volt lamp, such carbons will last about 10 hours. When protected by electro-plating with copper they will last for about 14 hours. During the winter months the number of hours the lamps must be kept in operation, from shortly before or after sunset to sunrise the next day, is longer than the time the carbons last, so that in order to avoid the necessity of recarboning the lamps, or supplying them with fresh carbons various devices known as all-night lamps are necessary. In some of these a greater length of life is given to the carbons by making them in the shape of two rectangular plates, placed vertically over one another, the lower being fixed and the upper movable. As in the case of the ordinary lamp, the arc is struck between them by the action of a series magnet and the carbons are fed by the action of a shunt magnet. Nearly all that can be said in favor of this form of all-night lamp is that it is cheap. It is far from satisfactory as regards steadiness, since the arc is apt to travel from one part of the carbon plate to another, disappearing mysteriously from one place and appearing at the opposite place in a very annoying manner that tends to keep one guessing when it will next appear.

A far more satisfactory form of all-night lamp is known as the Brush carbon all-night lamp. This consists of two pairs of carbon, and is therefore called a double-carbon lamp. The carbons are so arranged that the current is automatically switched from one pair to the other as soon as one pair has been completely consumed. This lamp is admirable in its operation.

In the early days of arc lighting and indeed not so long ago the carbons were surrounded by a glass globe open at both top and bottom. The globe was employed for the purpose of protecting the arc from winds which would result in unsteadiness, as well as to ensure their less rapid combustion. The form of lamp known as the open air lamp has been replaced by an enclosed arc lamp.

In the enclosed arc lamp a small air-tight inner globe capable of withstanding a high

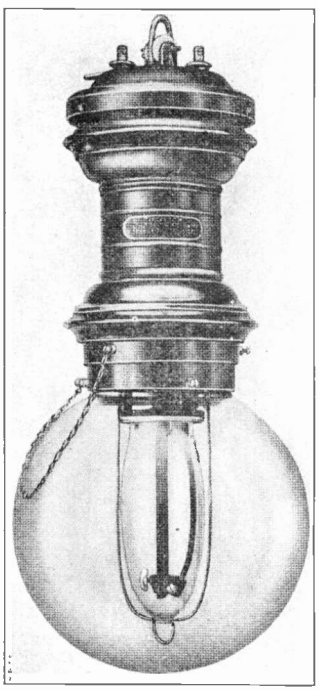


FIG 195. ENCLOSED ARC LAMP

temperature is made to surround the arc, as shown in Fig. 195, and is itself surrounded by a larger glass globe. The inner globe is of an ellipsoidal or egg-shape. After burning for five or six minutes, the inner globe becomes filled with carbon monoxide and carbon dioxide which not only decreases the rapidity of consumption of the carbon but also shortens the length of the arc and permits a higher pressure to be employed without greatly increasing the actual length of the arc.

The decrease in the rate of consumption is sufficiently marked to cause a pair of ordinary carbons to last from 80 to 125 hours instead of the 10 hours for bare carbons and 14 hours for electro-plated carbons. Moreover, in the enclosed arc lamp the distribution of the light is far more satisfactory than in the old open arc lamp. This is due largely to the fact that the inner globes are made of opal glass which thus ensures a more general diffusion of the light.

Even with the best construction and operation of the lamp mechanism a variation in the intensity of the light emitted by the voltaic arc is noticeable. For the greater part this flickering or unsteadiness is caused by changes in the position of the crater at the end of the positive carbon. It is also due to impurities in the carbon. The purer therefore the carbons the less will be the shifting of the arc due to a change in the amount of vapor produced from time to time. As soon as during their consumption the softer portions of the carbon are reached, a greater amount of carbon vapor will be produced. The arc will therefore tend to shift its position to the part containing the softer portions. The greater the area of cross-section of the carbons, the greater the probable shifting, so that an advantage is gained by burning thinner carbons. There is a practical limit, however, in the extent to which the carbons can be decreased in diameter owing to the more rapid consumption of the thinner carbons.

A great improvement in the steadiness of the light is obtained by the use of what are known as cored carbons. These consist of carbons the cores of which are formed by softer materials than the rest of the carbons. The use of cored carbon ensures a steadiness of the light because the greater amount of carbon vapor being liberated from the core ensures the fixing of the crater at the core of the carbon.

There are other causes of unsteadiness of the arc light, such as those due to the improper operation of the generators, but these difficulties are now so well understood that it is not necessary to refer to them.

Arc lamps are now frequently fed by alternating currents both from constant-current mains and constant-potential mains. No positive crater and opposing negative hillock are formed on the carbons of alternating-current lamps, as each carbon is alternately positive and negative.

Since the arc tends to be extinguished with each reversal it might be supposed that the use of alternating currents for arc

lamps would be attended by a marked flickering. Indeed with low frequencies there is a marked unsteadiness especially at a frequency of thirty-five periods or double reversals per second. As, however, the frequency increases, this unsteadiness disappears until when 60 cycles per second is reached alternating current arcs produce a light that is far steadier than direct-current arcs.

A little thought will explain the cause of the apparent inconsistency that an arc lamp in which the arc is actually extinguished at practically each reversal of current is able to produce a light free from the most marked flickerings. The explanation is found in the fact that the sensation produced on the retina of the human eye by light tends to persist or continue after the disappearance of the light. Consequently, although the light is extinguished so far as the arc is concerned, its luminous effects continue on the retina, so that long before the intensity of illumination has died out sufficiently to be noticeable the arc has again been re-established. The result is that the rapid successions of lightings and re-lightings produce an average effect on the eye that results in a light far steadier than that of the direct-current arc; for, the smaller variations in intensity or flickerings due to the travelling of the arc are lost in the greater differences due to the excessive extinguishments and re-lightings.

(The End.)

Where Electricity Stands in the Practice of Medicine

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

CHAPTER X.—ELECTRO-DIAGNOSIS

The many uses to which electricity has been placed in enabling us to recognize abnormal or diseasesd conditions merit a chapter devoted to them.

The most astonishing use of electricity for diagnostic purposes is, of course, the X-ray. To be able with the fluoroscope to see the fragments of a broken bone, or a needle, bullet or similar foreign body is seemingly miraculous. With the photographic plate this condition is shown better than with the fluoroscope and is in a form to be consulted by the physician when setting the fracture or removing the foreign body.

So valuable is the X-ray in these matters, that today a physician would be culpably negligent who failed to confirm or refute his diagnosis of dislocation or fracture by means of a radiograph (X-ray picture), provided the same is accessible.

I have made many X-ray plates that showed the most egregious blunders in diagnosis, made by surgeons of skill and reputation. These blunders do not reflect upon the surgeon, because the thickness or swelling of tissues, pain, etc., frequently make an absolute diagnosis impossible. But if the ray is available to the surgeon he should not neglect to verify his diagnosis by means of it or to have a picture taken after the

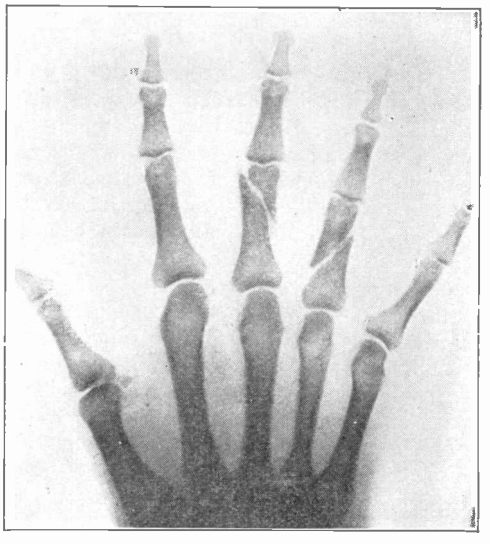


FIG. 1. BROKEN FINGERS WHICH WERE DIAGNOSED AS "SPRAIN"

bones have been replaced, in order to show whether correctly done or not.

The importance of the point I make will be appreciated by reference to Fig. 1, where the fractured fingers are immediately recognized.

So simple a thing as a broken finger would seem to permit of no mistake in diagnosis, without the use of the X-ray, yet the case shown had been treated for three weeks as a "sprain" and when the picture was taken the bones had united with the shortening shown and still remain that way. An earlier use of the ray would have saved this deformity.

I might cite many similar cases if I had the space.

At the same time I would not be doing justice to the subject if I neglected mentioning that an incorrectly taken X-ray picture under certain circumstances may be made to grossly exaggerate the condition remaining in a fractured bone. For this reason there is a growing belief that this work should only be undertaken by an expert who has made a careful study of the nature and use of the ray. In other words, purchasing an X-ray machine mill not make an X-ray expert any more than purchasing a set of instruments will make a surgeon.

A great many people believe that with the X-ray a physician can look inside of them and see the condition of their internal organs in the same manner that he would inspect the tongue, or scrutinize any accessible portion of the body.

This is an entirely erroneous idea, but it has frequently been taken advantage of by charlatans and fakers who pretend thus to diagnose all forms of disease by the "instantaneous method." The patient has been placed before the tube and the fluoroscope passed over the body while the physician has calmly announced the condition of the various organs, such as "Your stomach is a little enlarged and has an ulcer on the lower surface; the bile duct is too narrow, etc."

The X-ray shows superimposed shadows corresponding to the varying density of parts penetrated. Some successful results have been obtained in showing the condition of soft parts, but this is still in a largely experimental stage and requires a skill beyond that of the average operator. That satisfactory pictures of soft parts will ultimately be obtained I have no doubt, but it is not uniformly accomplished now.

At the present time the principal diagnostic value of the ray is limited to fractures, dislocations, the location of needles, bullets, and other foreign bodies, and including a reasonable percentage of cases where the foreign body has formed in the system, as in stone in the kidney, etc.

Another method of using the ray which is being used extensively is the outlining of the stomach and intestines, and also disease channels, by making use of bismuth.

In stomach cases a "bismuth meal" is taken and the bismuth being a metal and opaque to the rays enables a picture to be taken which clearly shows the size and outline of the organ. By this same method the movements of the stomach and the course of the food in it have been observed and studied and some of our previous views revised accordingly.

The usual form of administering the bismuth is in the form of a milk of bismuth, composed of an ounce of the subnitrate or carbonate mixed with a pint of milk. It has also been satisfactorily employed when mixed with apple sauce. Cases of poisoning resulting from the use of impure bismuth have been reported and arsenic-free bismuth should be obtained.

This method of taking X-ray pictures has been employed of late to show narrowing of the pyloric end of the stomach, and also the presence of cancer.

Reverting to the galvanic and faradic currents, which formerly monopolized the field of electro-diagnosis, I will outline briefly the "Reaction of Degeneration," which is ordinarily expressed by the abbreviation R. D. This test was so named by Erb and applies to the manner in which a muscle contracts or fails to contract, when electricity is applied to it.

Normal muscles and nerves respond immediately and promptly both to the direct and interrupted current, but when involved by disease, or changes resulting therefrom, contract sluggishly to galvanism and fail to react at all to faradism. This is the reaction of degeneration and may be complete or partial.

To go into the technique of the method of taking the reaction of a muscle or nerve and the various diseases indicated by the different findings, is too technical for this general paper and is found in any standard text-book on nervous diseases or on general electrotherapy.

One of the most interesting fields of electro-diagnosis is that involving the use of diagnostic lamps, employing the electric

light either for the direct or reflected illumination of cavities, and also by causing the light to penetrate the tissues of the body (trans-illumination).

As an example of the first class we now find in use by nose and throat specialists a small lamp held in place on the head by a spring clip, and attached by a conducting cord to the nearest light socket. See Fig. 2. Back of the lamp is a reflector while in front

FIG. 2. PHYSICIAN'S HEAD LAMP

of it a lens concentrates the light and enables the operator to focus it on a small area and produce an intense illumination. This is used for direct examination or in connection with a mirror showing the reflection of parts that cannot be observed directly, owing to their location, as the vocal cords.

Another form of diagnostic lamp is shown in Fig. 3, where an ordinary lamp acts as a rheostat and interposes sufficient resistance to permit the small lamp to be used on the 110 volt current. The small lamp may be used to illuminate various cavities.

With other forms these tiny incandescent lamps have been introduced through tubes into the stomach, the largest bronchial tubes, the bladder, etc. In these cases its use has been to afford a view through reflected light.

Another method of value is through the use of trans-illumination by the passage of the light through the parts examined.

If you will take one of the little one or two volt lamps and press your thumb on the lighted bulb, you will find that it becomes translucent and the light passes through so readily that you would have no difficulty in noting the presence of a sliver or bit of steel.

One of the first methods of using trans-illumination was in the case of disease of the antrum, a cavity in the upper jaw bone, which is not infrequently the seat of infectious processes which cause it to be filled with pus.

When there is no disease, the light held against the roof of the mouth, penetrates through bone and cheek readily, but is interfered with or stopped by the presence of pus. A comparison with the antrum on the other side shows the condition clearly.

In the frontispiece of the February number of POPULAR ELECTRICITY is shown the trans-illumination of the skull as employed to

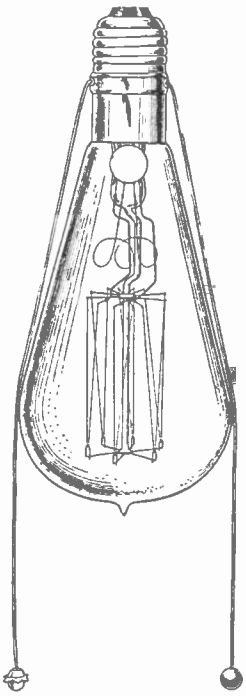


FIG. 3. "TURN-DOWN" LAMP WHICH MAY BE USED IN DIAGNOSIS

examine the retina of the eye from the back.

Vibration has been used for diagnostic purposes to some slight degree, basing its use on the fact that with an irritated or diseased condition of an organ the nerve centers controlling the same are found to be tender and sensitive to vibration. This has not been worked out to the point that it possesses unquestioned utility, but it often serves to clear up a point when other methods are vague. For instance, tenderness of the fifth to ninth dorsal centers on the right side would indicate involvement of the liver. On the left side, same centers, would refer to the condition of the spleen.

(To be concluded.)

Talks With the Judge

WHY LIGHTS MAY FLICKER

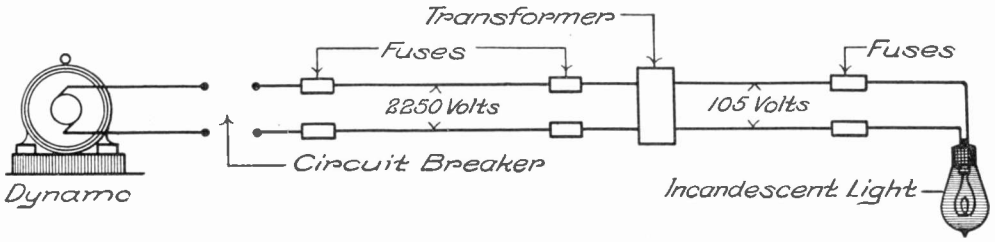
"Why is it that the electric lights sometimes flicker or even go out for a moment?" said the Judge. "I am not one of the kind to put up a big holler every time a little thing like that occurs, but still I want to know. My wife asks me the reason every time it happens and now, since we have the automobile and I have let on that I know everything about electricity because I can juggle the battery wires, it keeps me busy inventing reasons. She's beginning to catch on that I don't know what I am talking about half the time."

"Well, it's this way, Judge," I replied. "When the electric lights sometimes grow dim and hang like so many will-o'-the-wisps to wreck our nerves, or go out all of a sudden and leave us in a mood ready to say 'Oh, pshaw,' or worse, we—or that is, those who do not understand the workings of the electricity—not too mildly condemn the electric people from management down to the engineer in charge, or lay the trouble to the machinery or dynamo.

"If we only knew and understood the causes we would show more sympathy for the manager and the men at the switchboard; for they are more worried on such an occasion than anyone else. At such times they are called upon to locate the trouble which may be at the farthest extent of the electric system or at a short distance from where they are, yet unknown to them; and the dim and blinking lights will stay dim or continue to blink until this trouble is found and repaired. No matter what amount of experience or ability there is at the electric plant, or what the quality of strength of the machinery or dynamo is, it will not prevent poor lights or keep the lights burning so long as there is what is termed in electrical parlance, 'trouble on the line.'

"Alternating electric current is the current most generally used for lights and it is this kind of current we will keep in mind. To deliver electric current, two insulated copper wires are run from the dynamo at the electric plant to where the furthest electric light is to be located. Here, this little pencil sketch will help you to understand.

"Alternating electric current is generated by the dynamo at the plant at a very high voltage, which means in the science of electricity, high pressure. This pressure is usually about 2250 volts. This is too great and too dangerous and besides it is too impracticable to be used for lights in the stores or dwellings, and to make it serviceable for that purpose, it is reduced by a transformer that is placed on the line as near as possible to where the current is to be used.



HOW THE WIRES RUN FROM POWER PLANT TO LAMPS

This transformer simply reduces the pressure or voltage in keeping with the strength of the common incandescent lamp which it is to supply and which is generally made for 105 to 110 volts.

"If the two wires running from the dynamo to the lamp, or any other lamps that might branch off from these two wires, should by any cause get together inside of the house, it would be what electricians call a 'short circuit' and it would melt out the fuses which are placed on the lines on the inside of the house generally where the wires enter the building. These fuses are nothing more than small wires made of lead and tin or aluminum, large enough to only carry the amount of electricity that will be required of the wires in the building. When a fixture gets out of order or a lamp socket breaks and

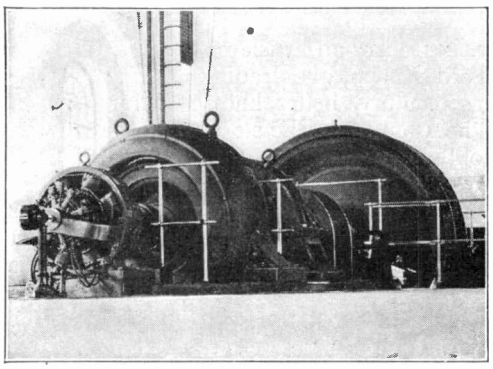
thereby joins the two electric wires, the fuses which are able to stand less heat than the copper wire itself, melt, cutting the current off from the premises. If this safeguard were not put in and anything should cause the wires to get together, they would heat up to such a degree as to ignite any inflammable material near by. When the wires outside of the house—between the house and the transformer—get together, by the falling of a branch or tree or telephone wire, or the fuses inside of the house are too strong, fuses placed near the transformer will melt and the lights go out. If the trouble is on the main lines, or between the dynamo and transformer, then that trouble is felt at the plant where there are fuses that melt and the lights all over town on that entire circuit go out.

"In most cases a circuit-breaker, which is an automatic machine for cutting the lines leading from the electric plant, is located on the switchboard in the plant. Trouble on the line causing an overload of the dynamo, will cause this automatic switch to open, which puts out all the lights operated by the dynamo that that switch controls. This sometimes happens when it is lightning. Then it is that the engineer or dynamo tender watches the circuit-breaker closely, and as charge after charge of lightning throws it out, he throws it back into place. If it is thrown out by any of the main wires being crossed with each other, the operator puts it back and holds it there and the dynamo will begin to groan, the lights flash up to a great brilliancy, and if he should continue to hold it and not let it open, the probability would be that the dynamo would be overheated and damaged to a great extent, so rather than have this occur, he lets the automatic switch open itself and he continues to close it as it is opened automatically, and the lights go out and come on again until the trouble on the line is burnt out or found and rectified. It is an impossibility to prevent the blinking or going out of the lights until this is done.

"Rarely ever do the lights go out or grow dim and remain so because of reasons attributable to the machinery at the plant. On the contrary, nearly all the causes can be laid to something along the lines outside of the generating source, necessitating almost every time, a close hunt by the whole force of electricians. When the trouble is found and the lights again come on, they heave a more thankful sigh than you do yourself

An Enormous Flywheel

In the coal fields of Liege, Belgium, there is an electric generator having such a heavy flywheel that it will run by its own momentum for 48 hours after the power is shut off. This is said to be one of the heaviest flywheels in the world.



FLY-WHEEL (IN REAR) RUNS 48 HOURS FROM MOMENTUM

Night Telephone Shopping Service

"When the evening mail brings a letter which invites you to an automobile drive the next day, don't say, 'Pshaw! I have no automobile veil or bonnet!' Just go to your telephone at any hour of the night, call 'Grammercy 6900, please,' and ask for the mail order section and tell us what you want and your order will be promptly delivered.

"If the dressmaker is to come tomorrow morning, and you have forgotten hooks and eyes and cotton or pins or needles, or the lining, or some embroidery or lace, telephone at 12 o'clock at night or at any hour and they will be sent to your house by the first delivery in the morning."

This is the way one of the managers in Wanamaker's big department store in Philadelphia described the recently installed all-night telephone shopping service. Many of the orders received are from persons who in response to a message must leave the city by a morning train making it impossible for them to visit the store to purchase some needed article or wearing apparel. Orders received as late as five o'clock in the morning are sent out on the first delivery.

The Human Side of a Great Physicist

By THOMAS COMMERFORD MARTIN

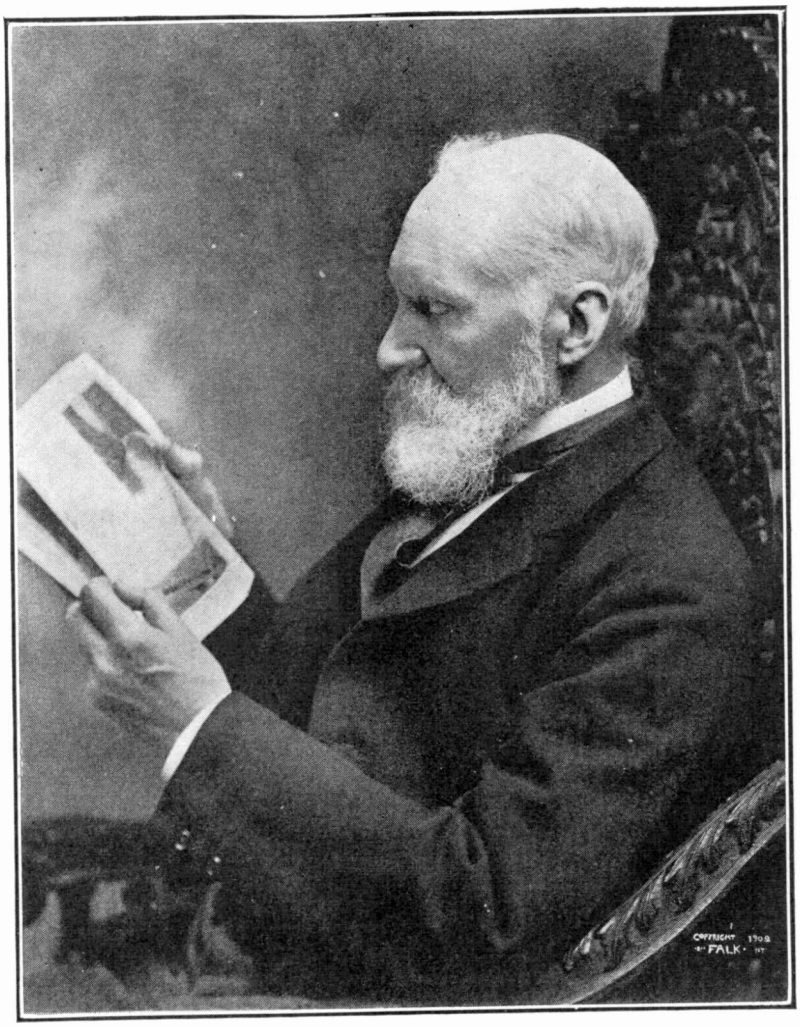
It was the great pleasure of the writer to contribute to a recent number of POPULAR ELECTRICITY an article on the biography of Lord Kelvin, the leading physicist of the last century, better known as Sir William Thomson. The life story of that great man told with such brilliant and exhaustive detail by Prof. S. P. Thompson, is one of the books of the year, and it will be long before it is surpassed in value and importance. Kelvin was not only one of the leading men of his century, but he touched thought and progress at so many points, it was difficult alike for his biographer to embrace in the narrative the whole field of action and for a reviewer to do anything like justice to such a vivid and graphic treatment of a noble career.

It may be interesting and not amiss to note here, more particularly, some of the references to America and Americans in this biography, in addition to such as were mentioned previously in connection with Kelvin's splendid work in making the Atlantic cable "talk." That in itself was an immortal contribution to the forces for the development of this country, for which we must ever be grateful; and it will loom bigger as the ages go by and the Americas rank in wealth and population with the older divisions of the earth. Said Carlyle: "The true epic of our time is not 'arms and the man' but 'tools and the man,' an infinitely wider kind of epic," and Kelvin was essentially an epic maker of these later industrial days. To him it was a beautiful thing to utilize Niagara; and when the meeting house in London where Faraday preached as an elder was turned into a telephone exchange, Kelvin dedicated the bronze tablet put there, and gloried in the conversion of a place of worship to such beneficent uses, with the remark: "This is a splendid monument to Faraday."

Lord Kelvin, after his submarine cable work and experiences, resumed his acquaintance with the United States in 1876, when he acted as a juror at the Philadelphia Centennial Exposition, praised highly the work of Edison as a telegraph inventor and took back to England in a rather crumpled but still vocal condition, the first Bell telephone. Then came the swift development of the electric light, so that when Kelvin came back in 1884, to attend, as one attraction, the first American Electrical Exhibition at Philadelphia, a new heaven and a new earth had been opened up in illumination. He was greatly pleased with all that he saw of the development, renewed his personal friendship with Edison and other celebrities, and gave a memorable course of physical lectures at Johns Hopkins University, in Baltimore. In a lecture at Philadelphia on the wave theory of light, he furnished a curious illustration of the bold grasp with which his mind seized the largest problems of Nature. In remarking that he found it hard to agree with people who could not understand a million million, he said: "I say finitude is incomprehensible; the infinite in the universe is comprehensible. What would you think of a universe in which you could travel one, ten or a thousand miles, or even to California, and then find it come to an end? Can you suppose an end of matter or an end of space? The idea is incomprehensible."

Then came the lectures at Baltimore, when Lady Kelvin with a peculiarly British touch spoke of the perpetual blue sky as quite fatiguing, and regretted they had "never been able to keep in cool regions." The subject was still the wave theory of light, and the audience was composed chiefly of professors from American universities, all eager to sit at the feet of the Master, who as usual made each lecture a process of thinking aloud, an audible display of his wonderful gift of divination applied to the secrets of Nature. Here the characteristic discursiveness showed itself, and even became ominous: "How long will these lectures continue?" asked President Gilman of Lord Rayleigh one day while walking away from the lecture theatre. "I don't know," was the reply. "I suppose they will end some time, but I confess I see no reason why they should."

The last visit of Kelvin to America was made in 1902 in the spring of the year, to look into the processes of the Eastman photographic works at Rochester, N. Y.—as vice chairman of the Kodak Company of England—and to study the problems of



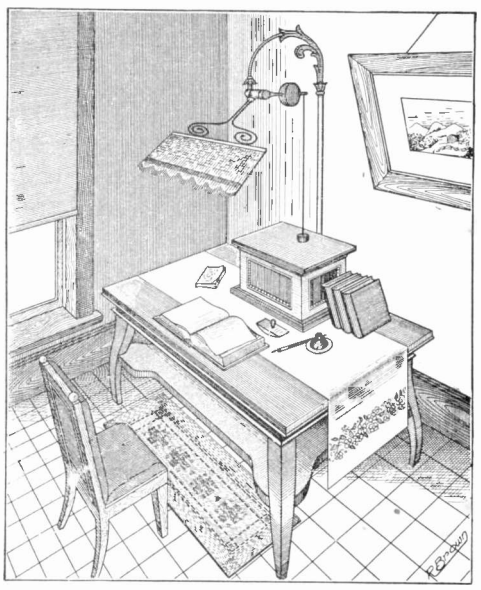
Last Photograph Taken in America of Lord Kelvin

hydro-electric development at the same city. He visited the great General Electric Works at Schenectady; assisted at the inauguration of President Butler at Columbia University, New York, and was given a notable reception at the University by the American Institute of Electrical Engineers and kindred societies. He was the guest of Edison and Westinghouse, and at Jamestown, N. Y., paid a beautiful compliment to his old friend Cyrus Field, as one "who possessed an admirable and unapproachable quality, an attribute of heroes: he never knew when to give in." At Cornell he told the students: "A unilversity is a place that fits some men for earning a livelihood and that makes life better worth living for all men." At Philadelphia he spoke in praise of the Rhodes scholarships at Oxford for American students and went so far as to say: "We have shown that it is possible to get on well together under separate flags, but I wish we were all under one flag and one government." At Yale he commended research laboratories, and the need of giving professors time and means for investigation, but not cutting them off from their students: "A man comes away from his class room with a new impulse to continue his work of research." And in view of Zeppelin and other recent developments in air-flight, the following is certainly of interest: "The airship on the plan of those built by Santos-Dumont is a delusion and a snare. A gas balloon paddled around by oars, is an old idea, and can never be of any practical use. Some day, no doubt, some one will invent a flying machine, that one will be able to navigate without having to have a balloon attachment. But the day is a long way off when we shall see human beings soaring around like birds." Yet the day has come.

One interesting little item may close this brief summary of the various points at which Kelvin came in friendly contact with America and its people. Just before he sailed for England on his last voyage across the Atlantic, he sat to Falk, in New York, for his photograph. An article had been published by the present writer on the long distance transmission of electrical energy in California—over two hundred miles. He was tremendously impressed when he heard of it, and asked for the article. It was given to him just before the photograph was taken, and his impatience was so great that he read the article as he posed, rather than wait. He may thus be seen in the well-known picture, and the incident may be regarded as typical of that keen thirst for knowledge that characterized him all his life and was with him to the end of his illustrious career.

Embroidered Electric Fans

To the unspoilt and slowly progressive oriental the term fan suggests either a sprig of wide palm leaves or a spread of peacock feathers held by a servant and slowly swayed to and fro. To the Hindoo or Arab such a slow swaying of a broad fan means a zephyr while the breeze from one of our rotary electric fans would seem an unpleasant



AN EMBROIDERED ELECTRIC FAN

hurricane, and consequently the latter have been slow to gain the expected foothold in some of the hottest countries of the globe. But whatever prejudices there might be in favor of the waving fans, each requires a human motor, and such purely mechanical man-power is seeing its day even in the tropical countries, hence the era of electric fans is dawning there though the types adopted will surprise most of us of the western hemisphere.

For, unlike all our ideas of electric fans, the oriental types do not rotate at high speed but slowly sway back and forth, just as

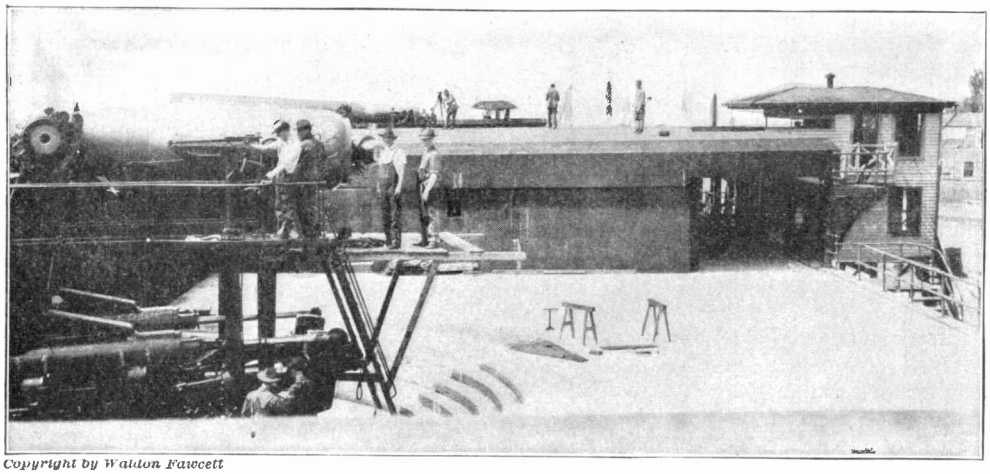
has been done to some extent in India by the cord-pulled vanes or "Punkahs." The motor itself reminds one of the magnetic engines which amuse each young generation, for like them they are designed to give a reciprocating motion to an armature carrying a hook or eye. If a cord is hitched to this hook or eye, the armature will pull it whenever the current is switched on, while a weight or spring at the other end of the cord can pull the armature and the swaying vane back while the current is off.

For general purposes (as in a store or bedroom) the motor is usually mounted high on the wall and the cord runs to one or more of the vanes which are hung like pendulums from the ceiling. These vanes or Punkahs are from 30 to 80 inches long and from 12 to 18 inches wide and are often trimmed with fringes. For desk or table use the motor is in the base of a fixture from the top of which the Punkah is pivoted, this being usually about 30 inches long. The vanes or fans proper may be nicely decorated with needlework, giving the ladies of the house the decidedly un-American opportunity of embroidering electric fans.

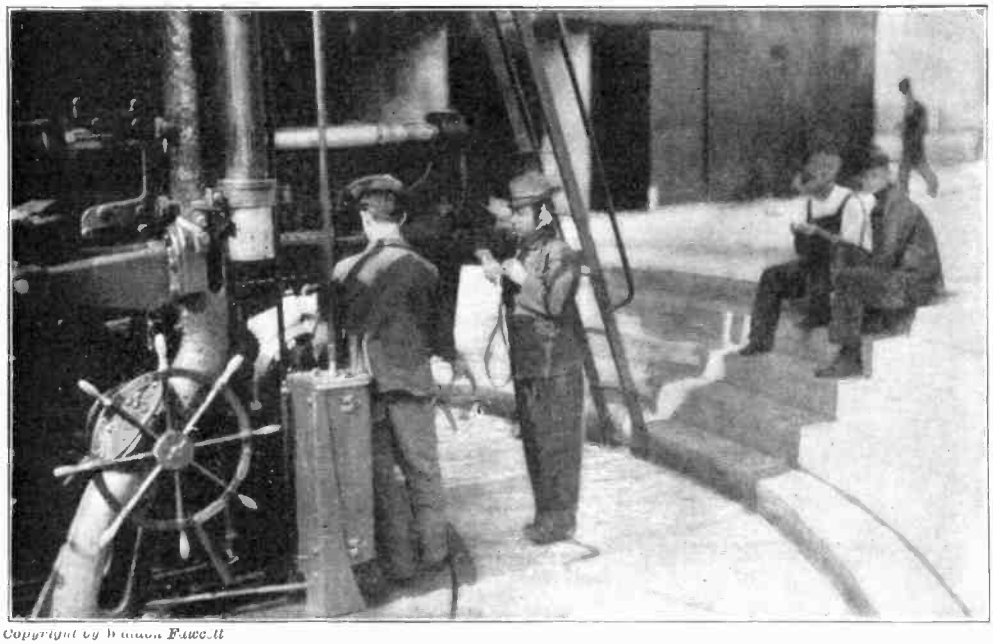
Training and Firing a 60-Ton Gun

Recent years have witnessed a continual extension of the dependency placed upon electricity at the modern military post until now we find the magic current relied upon as the chief aid to human intelligence in all the operations of a unique and highly specialized activity. At every United States fort or military post—even the infantry and cavalry posts in the interior of the country—we find electrical energy depended upon for a variety of important functions such as signaling. However, it is at the strongly fortified posts on the seaboard of the country—Uncle Sam's costly secret coast defenses—that the silent, instantaneous toiler is most extensively utilized and has the greatest opportunity to prove its marvelous efficiency.

At the great fortifications that line the Atlantic, Pacific and Gulf coasts electricity is used for lighting, for communicative utilities, and for all the more conventional power purposes, but it is the varied uses of the current in connection with the operation of the great guns with which these strongholds are equipped that is most novel and notable. The severest exactions would govern the operation of our coast batteries in time of war. Absolute accuracy, economy of time and labor and efficiency in the minutest detail are demanded to a degree unparalleled elsewhere. Certainly there could



TYPICAL UNITED STATES COAST DEFENSE BATTERY



RECEIVING TELEPHONE INSTRUCTIONS IN THE GUN PIT

be no more forceful recognition of the dependability of electricity than that it is employed almost exclusively in this sphere of operations where the fraction of a minute or the fraction of an inch may represent the difference between success and failure.

First of all, electricity is employed for the manipulation, training and firing of the heavy guns that guard the entrances to American harbors and navigable channels. All the guns of large calibre are of what is known as the disappearing type. That is, they are loaded and trained out of sight of the enemy, behind walls of sand and concrete and then, when all is in readiness, the loaded gun is quickly elevated by mechanical means to a position above the ramparts, is fired simultaneously with its appearance in the open and as suddenly drops back out of sight behind the sheltering barrier. Now it goes without saying that the highest imaginable refinements are necessary in an application of power that lifts a sixty-ton gun quickly to a height of twenty or thirty feet and yet does it with a nicety that does not jar this 42-foot shooting iron from the alignment, with reference to the target, which has been established by means of mathematical calculations. The em-

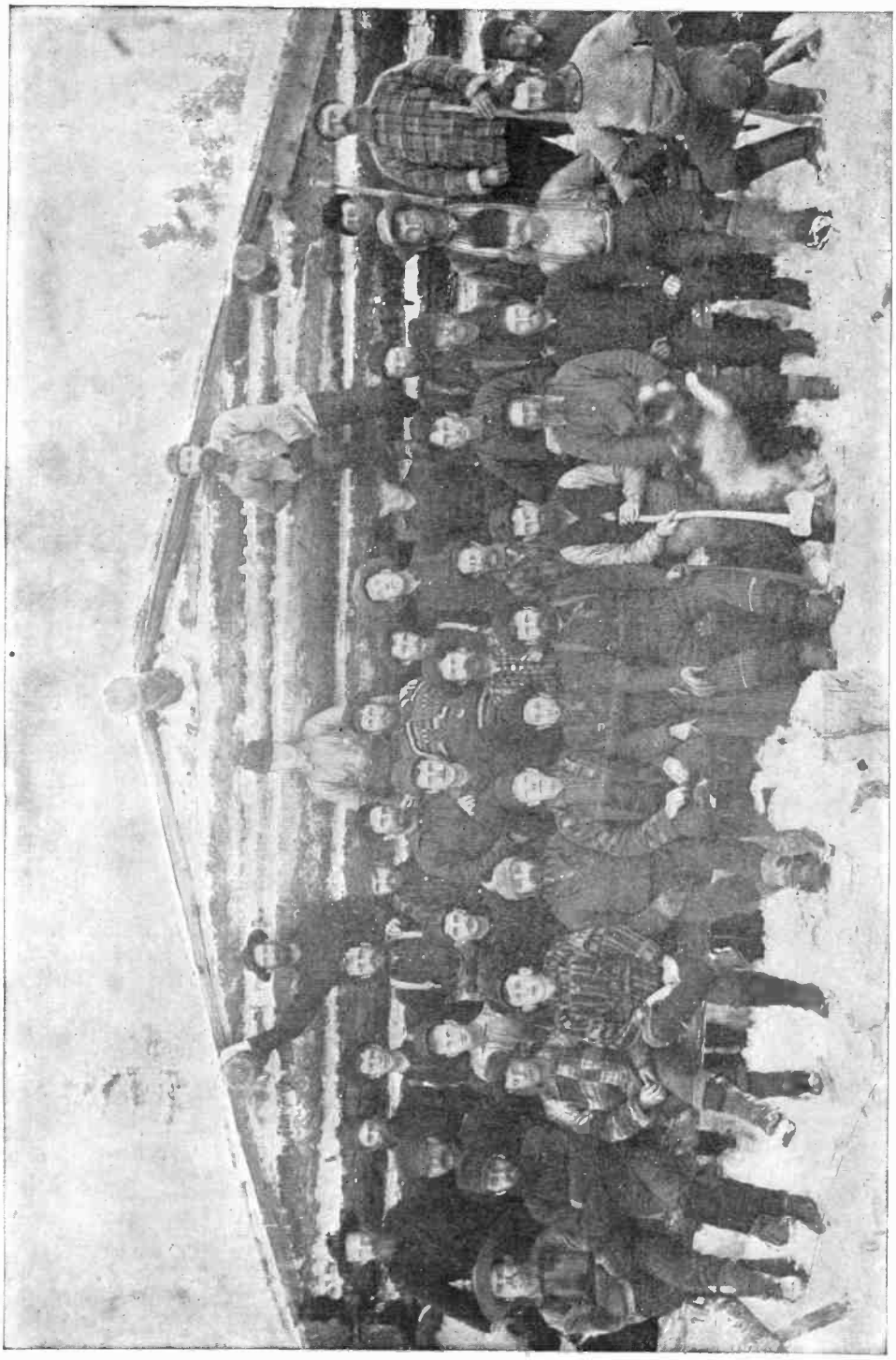
THE GUNNER'S TELEPHONE SET

ployment of electricity in connection with this phase of coast artillery work exemplifies its adaptability for delicate yet arduous tasks just as does its employment for firing the gun indicate the advantages of instantaneous response to a human or automatic impulse when combined with absolute reliability.

However, interesting as is the resort to electricity for energy in the practical handling of the guns of our coast defense batteries, it is scarcely as significant as the part played by the magic current in directing the fire of these destructive agents. As most of you are well aware it is no longer the custom to train cannon on a moving or stationary target as a small rifle is sighted or in the primitive way in which cannon were manipulated during the Civil War. Nowadays, as above explained, guns and gunners are shut off from the sight of the enemy behind a breastwork and the aiming of the "peacemaker" is accomplished by mathematical means just as its discharge is effected by mechanical, or, rather, electrical means. What is more, the "range finding," in so far as it involves the securance of data for these mathematical calculations, is not a task imposed upon the gunners of each battery. Rather is this information obtained by experts in a special, centrally-located observatory tower—sufficiently lofty to enable their instruments to sweep the horizon. Obviously the knowledge acquired at this central intelligence station must be communicated as quickly as possible to all the different batteries and it is just here that the efficiency of electrical communication finds one of its most convincing demonstrations.

The interior of the modern American coast defense is a perfect network of wires. The telegraph is used to some extent but for the most part the telephone is depended upon to keep all the units of the fighting institution continually in close touch with one another. By means of this comprehensive nerve system the "Battle Command Station,"—presumably in charge of the colonel or other officer in command at the post—is in touch with the two "Fire Command Stations," in charge of majors, and through them with all the different batteries in the fortification so that even though the big guns of the defense system be scattered along more than a mile of waterfront the officers in command are enabled to exercise the closest supervision over the operations of all the different gun squads.

Electrical links likewise connect all the individual batteries with a common source of technical information essential to effective gun fire. The center of this system is found in the two "Position Finding Stations," known respectively as the Primary and Secondary Stations. The experts at these two stations working in conjunction on the system of the azimuth determine the exact location of a vessel or other target. This information is telephoned to the "plotting room," which occupies a small frame building in the rear of each battery. Here, experts compute the range for the particular battery to which they are attached and this information, in turn, is telephoned to the guns. One man in the plotting room and one man in each gun pit has a telephone receiver in position at his ear at all times so that there is little chance of the slightest delay in the transmission of instructions or the corrections of errors. The latter are necessary when the observers on the ramparts or in the towers report that the shots from any given battery are failing to reach the target as desired.



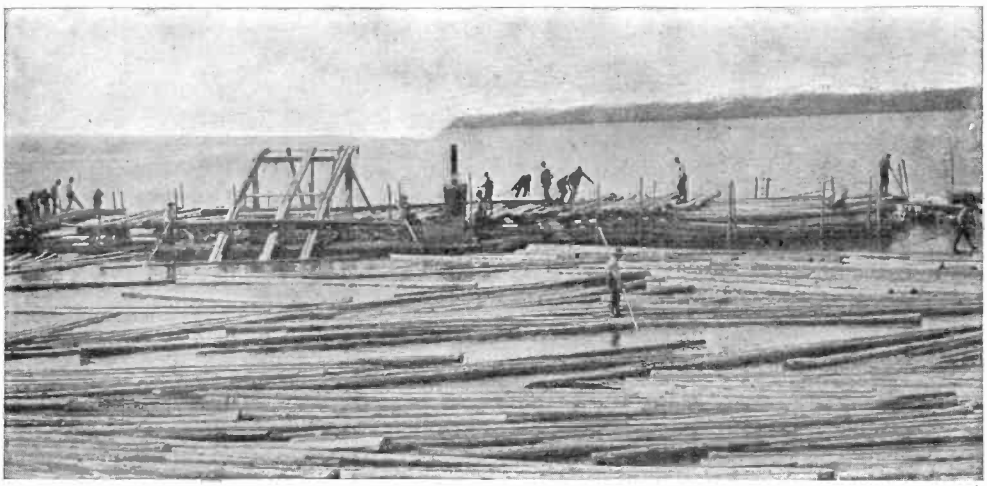
POLE CAMP IN A NORTHERN MICHIGAN CEDAR FOREST

Story of a Telephone Pole

In beginning the story of anyone's life it is usual to describe the place where they were born. To do this with reference to that telephone pole over on the corner would take us back to at least 50 years before the men and wild animals, for it requires 190 years, according to Government statistics, to grow a 30-foot cedar pole.

There are more than 800,000 miles of pole line in operation in the United States and

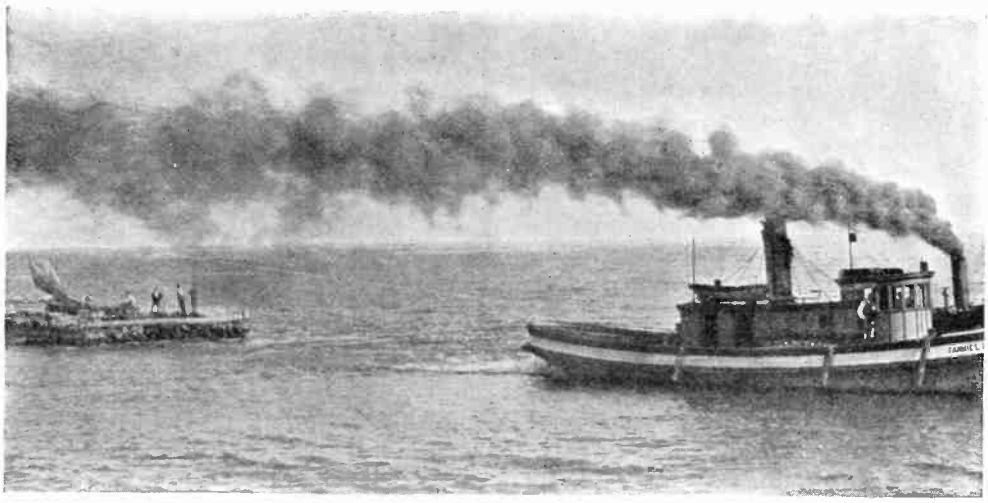
STARTING THE POLES



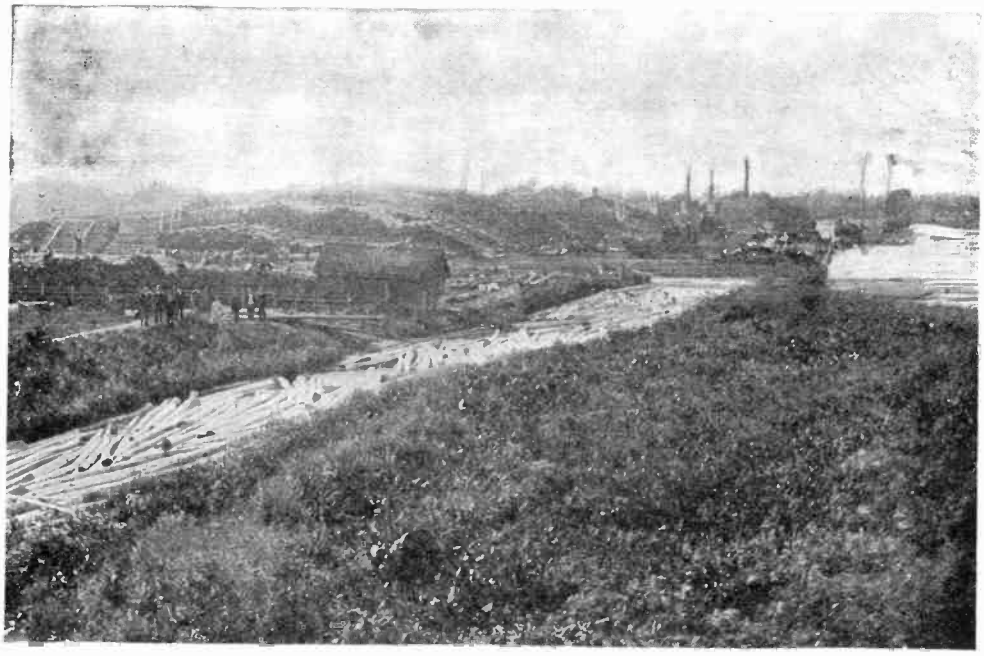
BUILDING THE CRIB RAFT

signing of the Declaration of Independence, back to a time when the cedar forest from which this pole came was peopled with Red-

something like 32,000,000 poles in use. As the average life of a pole is 12 years, 2,650,000 are required annually to take the place of



TOWING A CRIB RAFT DOWN THE GREAT LAKES



CONCENTRATING YARD ON THE BANK OF A STREAM

poles that are worn out, while many more are used in new work.

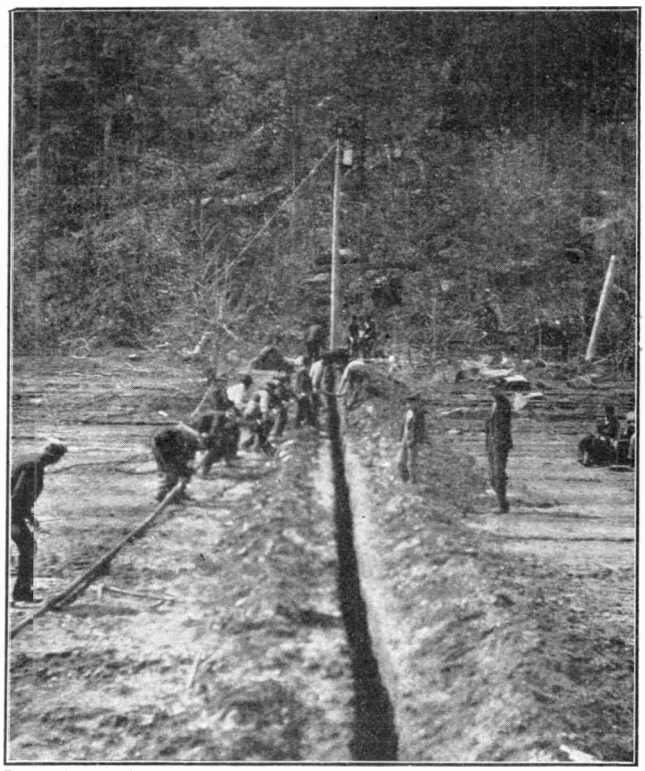
From where do these poles come? When is the harvest and what is it like? The answers to these questions are full of interest. The story is partly told in the accompanying pictures obtained through the courtesy of W. C. Sterling & Son Company whose gangs of lusty lumber jacks and log drivers scour the woods and "drive" the streams of northern Michigan.

Clad in rough, warm clothing in keeping with the hard but healthy labor in cedar forests, these men are a vigorous and jolly lot. Work in the woods begins in early Fall, and large tracts are cut clean before the "drive" begins in the Spring. The smaller trees are cut into posts, shingles and ties,

while trees that will make poles from 20 to 60 feet long are the most valuable. These are hauled by sleds and horses over the snow to railroads in some cases, but often to rivers to be floated down to deep water and towed then by vessels to "concentrating" yards.

The bark is taken off the poles in the woods, and the tops and butts are sawed off square. In the concentrating yards the poles are sorted and piled where, if possible, they are seasoned for at least ten months during which time they loose one-third of their weight and last much longer when finally set in the ground. Cedar poles last the longest, their average life being 15 years as against chestnut, nine years; cypress, eight years; yellow pine about six.

In the early days of the industry poles were brought from Canada and northern Michigan by means of crib rafts containing 15,000 to 20,000 poles. The poles were cut along the banks of streams and driven down during high water to the lake and built into crib rafts, usually three in number, 36 feet wide, several hundred feet long, drawing nine feet of water and projecting some eight feet above the water. The crib was first constructed of timbers fastened together by chains, wire and stakes, and then filled with cedar poles. The cribs were then coupled together and towed several hundred miles down the Great Lakes by the largest lake tugs.

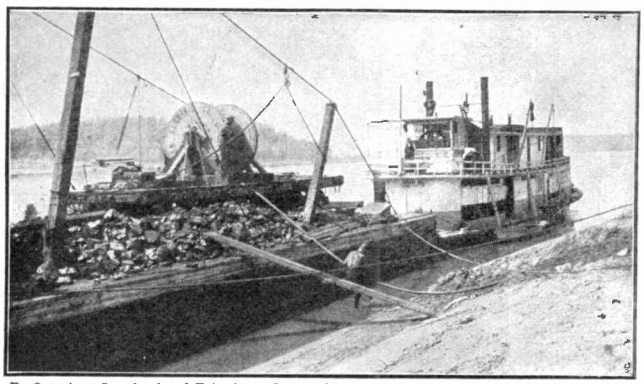


By Courtesy Cumberland Telephone Journal

TRENCH ON THE KENTUCKY SIDE

Laying Cables in the Ohio River

These pictures were taken on opposite banks of the Ohio river while a submarine telephone cable was being laid between Carrsville, Kentucky, and the Illinois shore. The cable on the Kentucky side was laid in a trench from the cable pole to the bank of the river 165 feet away. After this had been done the barge, with the cable on a reel, was towed across the river by the steamer, paying out the cable as it went. In twenty minutes the cable rested on the bottom of the river. Another trench on the Illinois side received the cable up to the pole where a test of each pair of wires indicated no mishaps. The cable measured nearly one-half mile in length and weighed 28,000 pounds.

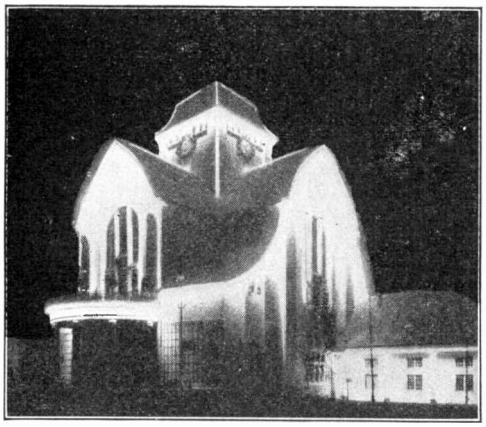


By Courtesy Cumberland Telephone Journal

LANDING ON THE ILLINOIS SIDE

Illuminating the Exterior of a House

The quaint "German House" at the Brussels Exposition had its exterior lit at night in a most remarkable manner, for in addition to two-candle-power lamps outlining the roof and windows the eaves were studded with lamps of 25 to 50 candle power, shielded from the eyes by reflectors which poured the light in a white stream down the walls. Our illustration, taken from the "Mitteilungen der Berliner Elektricitaetswerke" shows that the softly blended effect was quite artistic.

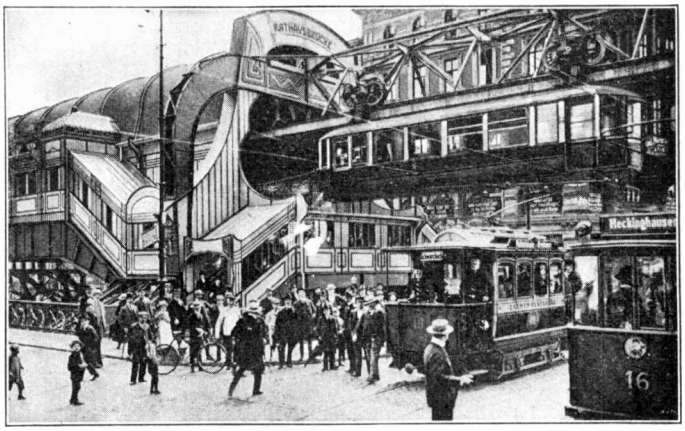


NIGHT VIEW OF HOUSE ILLUMINATED FROM WITHOUT

A Suspended Railway

The Schwebeban Electric Railway is in the Rhine Province, Germany. It extends from Barmen to Rathausbrücke, a distance of 30 miles. Steel posts in a sloping position hold up the heavy rail. The current is supplied to the motor by a wire running along side of the rail.

As it is smoother running, faster and cleaner than any other railway system, there will probably be similar ones built in this country. The cost of contructing these railways is of course greater than that of ordinary trolley lines.



SUSPENDED MONORAIL CAR

Use of the Telephone in Foreign Countries

The city of Stockholm, Sweden, stands at the head of the cities of the world in the number of people in proportion to the population who have telephones, 180 out of every 1,000 persons being telephone subscribers.

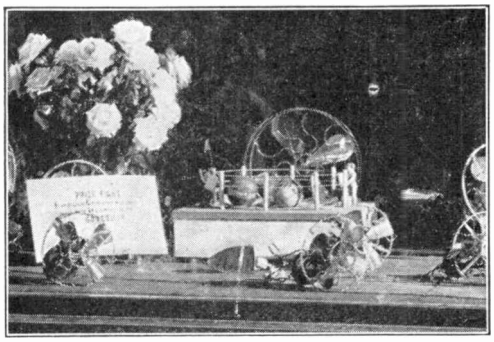
In Europe there are 1,800,000 telephones, in Asia 56,000, in Africa 9,000, in Australia 53,000, while America leads with 7,700,000, of which 7,590,000 are in the United States. Denmark leads the countries as to telephones per capita by having 32.2 telephones for every thousand inhabitants, Sweden being a close follower with 31.8 telephones per thousand people.

Benzine-electric Railway Cars

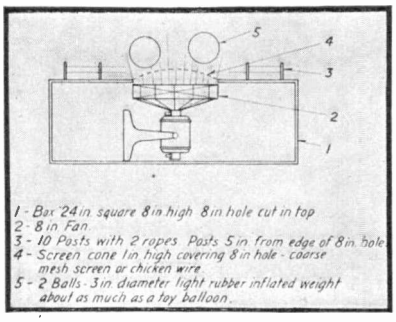
The prevailing notion that government ownership of railroads would put a stop to any progressive experiments or developments, is not borne out by the latest report from Duesseldorf, a progressive city in Rhenish Prussia, where six self-propelling passenger cars are soon to be tried on the state railway system. Each is designed to carry 100 persons and has the rear axle geared to a pair of electric motors, each of 82 horsepower. The front axle supports the weight of a benzine engine of 100 horsepower, built with a 50 kilowatt 300 volt dynamo on the same shaft. This dynamo supplies current to the motors which run normally at a speed of 700 revolutions per minute but which can be slowed down to 200 revolutions so as to reduce the shock of starting and stopping.

An Effective Window Attraction

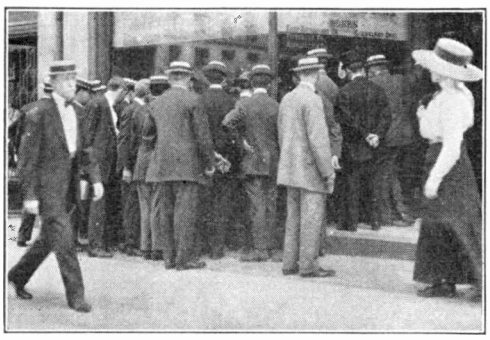
Two light rubber balls decorated with white and black smiles respectively were made to dance back and forth in a diminutive arena set up in the window of the Westinghouse Electric and Manufacturing Company's Baltimore office, about the time of the Jeffries-Johnson affair. Their energy was imparted to them by the breeze of an eight-inch fan below a screen in the center of the arena. The balls were driven to the rail by the draft and bounced merrily back to bump into each other in the center. The window novelty, how it worked and the results which it brought are very clearly shown in the pictures.



THE WINDOW



ARRANGEMENT OF FAN



THE RESULT

The effectiveness of reflecting current events in an advertising "stunt" is well known, and this window was no exception to the rule. There was a constant crowd about it, which could not help but notice the electric irons, fans and other things displayed prominently near the central attraction.

Electric Power for Balloons

Among the dirigible balloons of which working models are being tested by the Military-Aeronautical Institute of Berlin is one built by F. and A. Weingartner with a cigar shaped balloon which in the full sized craft will be 164 feet long and 33 feet in diameter. It is remarkable in that the gasoline engine which furnishes the propelling power is not connected mechanically to the propellors of which there are to be eight on the full sized product. Instead, the engine drives a dynamo from which wires transmit the energy to eight motors, thus doing away with the gears and shafts which have already wrecked so many airships. The inventors claim that the separate motors, each having its own propellor, can be more easily controlled in this way than they can with mechanical transmissions and that a greater variety of combinations of motions can readily be obtained by the operator. The model tested at Berlin had only three motors but these produced the desired range of motions both promptly and effectively.

Electrical Fertilizers in Japan

If any further evidence of the progressiveness of the Japanese is needed, it is seen in the formation at Tokio of the "Nippon Cisso Hiryo Kabushikiki Kaisha," which is not the title of a new comic opera or patent medicine. It is the name of a new company for making fertilizers from the nitrogen of the air by electrical means, is capitalized at a million yen, and is sure of a large market for its product right in Japan itself.

Denver's Prismatic Fountain

Denver, the "City of Lights," can boast of one of the most beautiful electric fountains ever constructed and at the same time one of the most economical in its operation. It is located in City Park and is a product of the engineering skill of F. W. Darlington. Its color effects and wonderful spray and stream shapes cannot be reproduced in the cold black and white of a half tone, although the illustrations give a slight foundation upon which the imagination may build.

The total cost of this remarkable attraction was $19,500 and the expense of operation is something less than $10 a night.

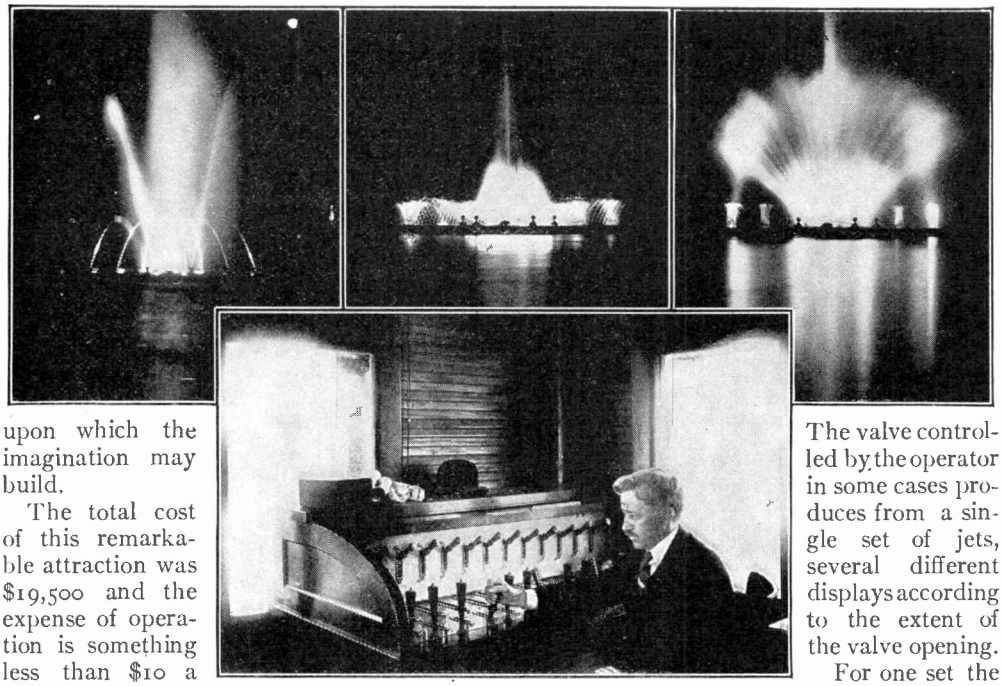
The intensive light is obtained from eleven large search lights, located in a cross-formed chamber beneath the fountain. In its wider part this chamber is 66 feet and in the narrower part 30 feet.

Each of these eleven lights is of 8,000 candle-power. The operation of the fountain requires the total of 88,000 candle-power during the whole of the two half hours in which its effects are shown nightly throughout the season.

The beautiful color effects are produced by interposing the proper shades of colored glass over the search lights.

Of the colored glasses there are nine plates or panes over each arc lamp. The operator at the switchboard by the movement of proper switches can alternate the colors, moving each of these plates in turn from its recessed place into position in the rays of the search light.

The spray effects are produced from 2,012 nozzles, arranged in twelve different groupings, each controlled by a separate valve.

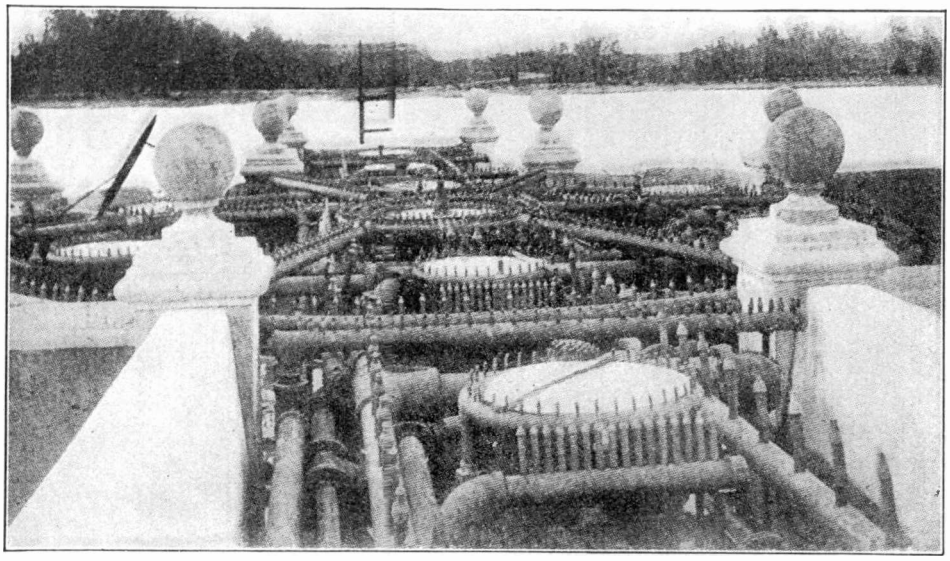


DENVER'S PRISMATIC FOUNTAIN AND MANNER OF ITS OPERATION

The valve controlled by the operator in some cases produces from a single set of jets, several different displays according to the extent of the valve opening.

For one set the valve is opened very slightly and produces what are termed "beehives." When opened somewhat wider the effect is called "sheaves of wheat." When opened still wider the effect is that of enormous vases. This is the design which appears when the valve is opened to its fullest extent.

Combinations of displays are made by opening two or more valves, and variations in these combinations are made at will, the operator opening one wide and the other part way, and then reversing the operation. In each case the displays are totally different.



VIEW OF DENVER'S FOUNTAIN SHOWING THE HUNDREDS OF NOZZLES

The fountain throws about four thousand gallons of water per minute.

The operator is located in a tower of the pavilion and can see exactly what effects he produces, and can vary them at will in minor as well as in larger details for color and degree of opening required for each valve to produce the most effective display.

The color slides and water valves are moved by compressed air, which is controlled by electric magnets operated from handles in a roll top desk in the pavilion tower.

The duties of the man under the fountain are simply to see that the air compressor works properly all the time, and as well to see that the search lights are not extinguished.

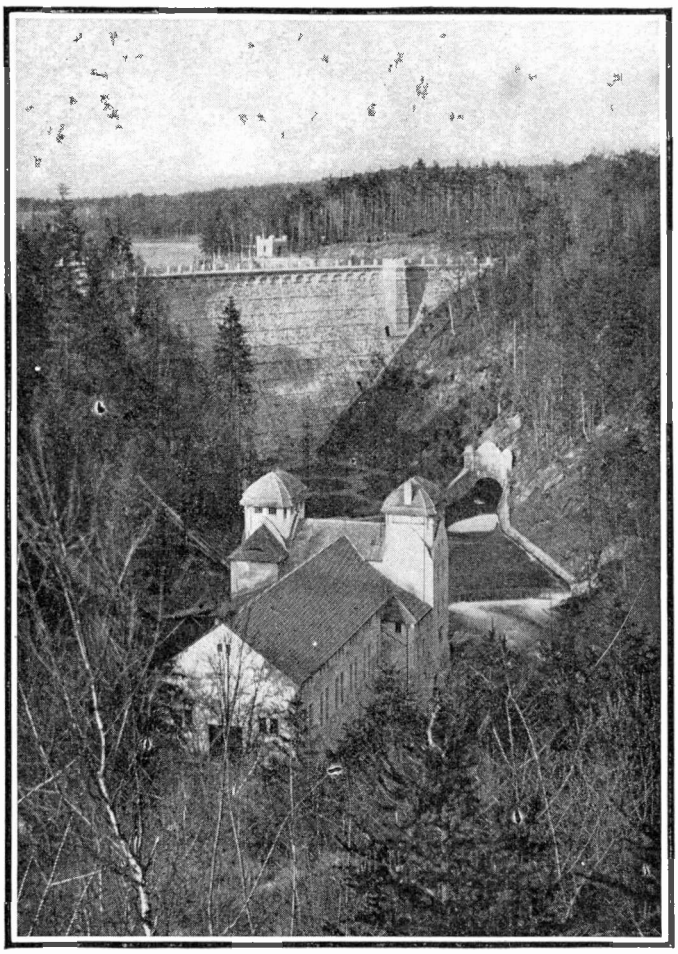
Electricity in Fire Fighting

Just why the use of electrical devices in fire fighting has been so largely overlooked, is hard to understand, as both the firemen and the underwriters (whose influence they often need in the large cities to secure needed changes or improvements) are progressive as well as aggressive. With hose carts and ladder trucks as well as engines the room taken by the horses adds greatly to the difficulty of dodging cars and teams, thereby decreasing the speed while increasing the risk of accidents. And if the path is clear, the galloping horses still will not equal the electric auto in speed. Anyone who has watched the firemen get started when an alarm comes into the engine house knows that very little of the delay is caused by getting the crew aboard; it is the time required to hitch the horses.

As for pumping the water, the use of a storage battery would not be economical for any long periods; but if a source of current were available, a motor driven pump would be inexpensive to operate. It would do away with the extra fuel supply teams and with the occasional running out of coal. The one great requisite would be a dependable supply of current (involving underground circuits, as overhead wires might be ignited by the fire itself or cut by the men to afford access to buildings) which would be accessible at many scattered points corresponding to the present fire hydrants. With current thus available, a light auto carrying a motor, a small storage battery, on which to run to its destination and a pump would be ample. Were the pumping current taken from the circuits of the local street railway or central station, the amount used could be measured by a meter carried on the auto. Thus a series of suitable tapping places on the electric light company's circuits, each located near a water hydrant, would allow of quicker and probably more economical pumping of water than is common with the methods now in use.

Conserving the Power of a German River

About two miles from the city of Marklissa in Germany, on the Bover River, is one of the many hydroelectric developments which of late years have been built to conserve the natural resources of the land of the Kaiser. The old castles on the Rhine may be picturesque, and dignified by years, but in this Twentieth Century, architectural achievement, with its mighty dam of concrete and masonry, the substantial power house just below, the neatly laid out grounds and wild and rugged scenery surrounding all, lie both beauty and sentiment not to be outmatched by crumbling towers and dungeons of ages gone by.



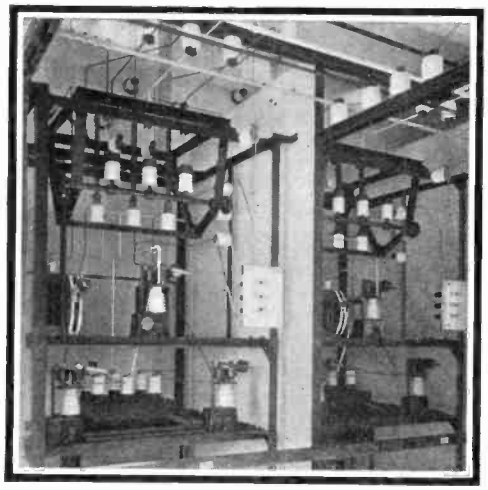
DAM AND POWER HOUSE ON THE BOVER RIVER

At the point where the plant is built the Bover runs in a deep narrow valley or ravine. The great dam is built directly across this from hillside to hillside, and empounds 15,000,000 cubic feet of water in the reservoir above, forming a beautiful lake with ample reserve for the dry season of the year.

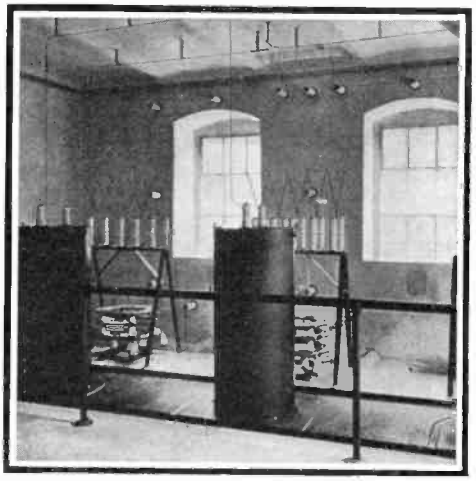
A little way down stream from the reservoir is the power house, the water which furnishes the motive power for the big turbine being led to it by two penstocks of steel, each about four feet in diameter. Close scrutiny of the picture of the plant will show the penstcoks coming down the hilside at the left and rear. The tunnel-like opening at the right is the spillway from the dam, where all the surplus water escapes.

The head of water is 85 feet, sufficient to develop 3,575 horsepower of electrical energy. This transformation takes place in the main generating room of the powerhouse. In one picture three of the water turbines are shown at the extreme right and they are of the centrifugal type, the blades within the circular casings turning at 375 revolutions a minute and driving the long shafts to which are attached first the extreme heavy flywheels and then, at left the moving parts of the electric generators.

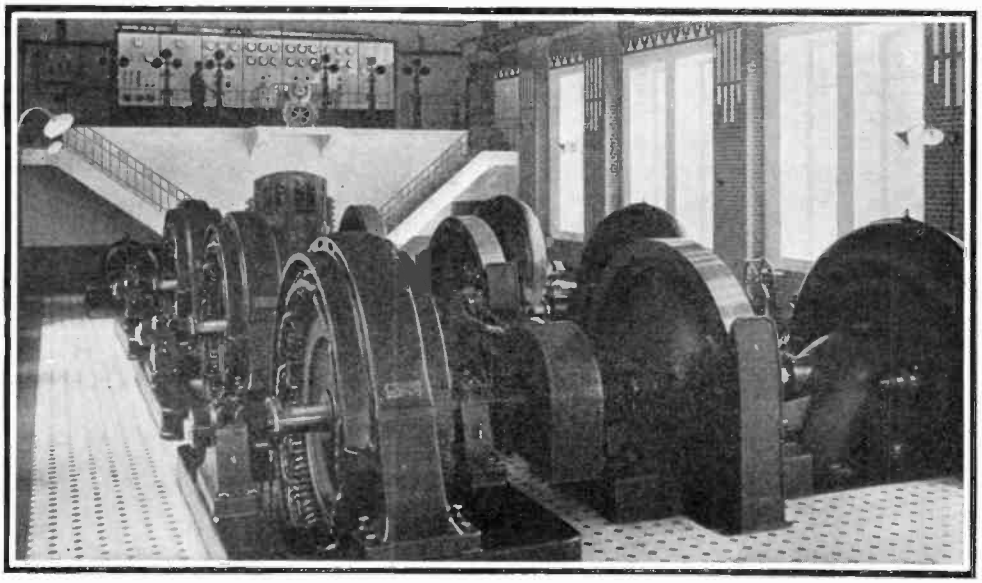
In a gallery above and overlooking all the machinery is the switchboard with its controlling devices. The generators produce current at the very high pressure of 10,000. volts which is further stepped up by trans-



HIGH TENSION WIRING IN THE BOVER RIVER PLANT



TRANSFORMERS IN THE BOVER RIVER PLANT



INTERIOR OF THE BOVER RIVER PLANT

formers shown in one of the illustrations, to pressure of 20,000 and 30,000 volts for transmission to distant points.

Great precautions must be taken in carrying the wires inside the building when these enormous voltages are employed and the upper picture at the left is an interesting view of this "high tension work," as it is called, all current-carrying parts being carefully insulated on porcelain.

A Monument for Ampere

The French Association for the Advancement of Sciences, recently in session in Ampere's native city of Lyons, recognized his achievements by voting to erect a monument to this eminent physicist and mathematician. The needed funds for this undertaking are to be raised by popular subscription.

The Fastest Mile

Editor, Popular Electricity:

Your note in the August issue, concerning signals and speeds in railway work, and also the recent achievement of Barney Oldfield in making an automobile record of two miles at a rate of 131.75 miles per hour, bring to my mind a thrilling experience which I had as a youngster. It was during the famous Berlin-Zossen tests, which have now become a matter of history, and I was permitted, by fortunate circumstances, to ride on one of the test trips, though not the record trip. It was plenty fast enough for me, however.

Not all may remember these famous tests which were made to determine how fast an electric car could travel. To refresh the memory it may be said that the tests were made in Germany in 1901, the German government putting at the disposition of certain German manufacturing concerns the military railway between Marienfelde and Zossen. It is a short line 20.5 miles long with a very small number of curves of 6,500 feet radius and gradients never higher than five per cent.

The line was reinforced, ballasted and straightened, for a designed speed of 125 miles per hour.

The current furnished was alternating three-phase current at a voltage from 10,000 to 12,000 volts and 50 cycles. The transmission line was made up of three wires disposed vertically and the trolley pole was a vertical and rigid one with contact makers of peculiar design so placed as to touch each of the wires.

Two cars of about 200,000 pounds weight and about 75 feet long were used. They had two trucks with six wheels each, the wheels being about 46 inches in diameter, and four motors, which could furnish when coupled together, from 1,100 to 3,000 horsepower.

As I said, the line was designed for a speed of 125 miles per hour, but when a speed of 99 miles was reached the experiments had to be stopped to reinforce the line and solve problems of motor suspension, etc. Eventually a speed of a trifle over 125 miles per hour was reached, and until Oldfield's performance, the fastest man had ever traveled, unless dropped from a balloon.

And that brings me to my personal experience, which I shall never forget.

I took a trip on that line—once. I was very much of a young fellow then and did not know much about electricity and how things were running. So I was not greatly interested by the technical side of the question, and my impressions, still vivid, recall only the terrific speed at which we were whirled along.

As a matter of fact, on that particular trip we probably did not reach 125 miles per hour. Somebody was singing out numbers but I did not know German. My impression was that we were going fast—too fast to feel comfortable—and I still remember a lingering query that was in my mind then: "Could we stop quickly enough if we had to?" The poles were fairly flying by. Ballast was sucked up from the track and pelted the back platform, and the landscape was nothing but a blur for rods on either side.

Suddenly everybody lost his dignity and grabbed hold of something and looked intently ahead while the motorman was frantically manipulating brake handle and controller.

The line was very carefully guarded, but some peasant had just stepped in on the track and loomed up about a thousand feet ahead of the car going in the same direction.

Well, we stopped—some inches from the fellow—giving the motorman a chance of expressing his opinion of the walker, who did not seem to understand why a man could not walk on the track at a safe distance from an old trolley car, without giving rise to such a fuss.

We got off at Zossen—and my final impression was "never again."

Now to conclude—such high speeds are possible, but not economical. They would require an air line track, strong and specially built and specially reserved for fast trains. It is more than an operating difficulty; it is an economical question.

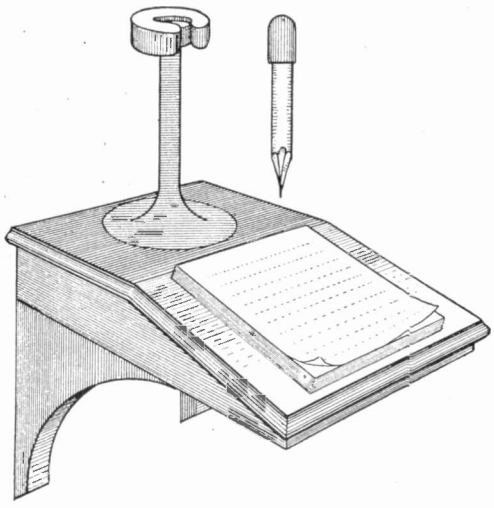
A short heavy traffic line, viz., New York to Philadelphia, could be probably built and operated profitably, but in that case the distance is so short that the time saving would not be considerable, and would probably not justify the considerable expense for what is practically nothing but a whim.

P. S. PAGANINI.

Chicago, Ill., July 11, 1910.

Magnetic Pencil Holder

A pad of paper close to the telephone is a great convenience provided a pencil is also at hand. If left loose, the pencil is apt to roll off the desk or table and be minus a



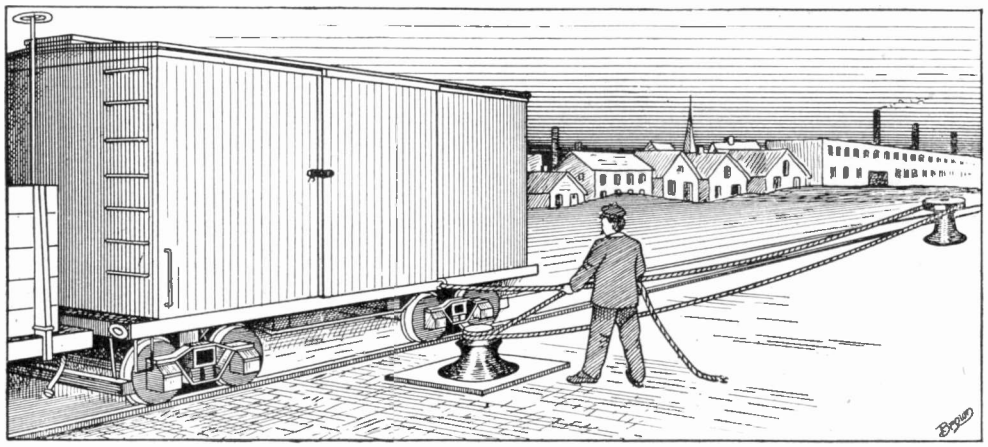
MAGNETIC PENCIL HOLDER

point when most needed, and if tied to a string the latter interferes with the free use of the pencil. The ideal scheme would be to have a device which would hold the pencil firmly when not in use but which would leave it free when used for writing. This is accomplished by slipping a light steel cap over the end of the pencil and letting this cap form the armature or keeper of a magnet mounted on the same stand that holds the pad of scribbling paper. By making the magnet in the shape of a split cylinder, it can easily be strong enough to support a weight of half a pound, thus insuring a good grip on the pencil holder, even if the magnet should gradually lose some of its initial strength. Such a device is made under a German patent by Kleinig and Blasberg, of Leipzig, Germany.

Moving Cars without a Locomotive

Unless an industrial plant is large enough to employ its own switch engines (either steam or electric) it is dependent on the railroad company for the moving of any cars placed on its sidetracks, and much time is often lost by not having these moved more frequently. In teaming practice, wagons are always moved away from the platforms as fast as they are loaded or unloaded, and for economical handling the same should be done with the heavier cars on rails. Some manufacturers have gone to the extreme of using gangs of men with steel levers to move the cars, but this is a slow and costly method.

Now comes the electric capstan and says: "If I can move ships, why not cars?" Why not, indeed? A strong hawser with a hook at one end is easily attached to the head of the capstan so that a single man can move the car at the rate of from 50 to 100 feet a minute. By mounting a pulley alongside the track and passing the rope over it, the car can just as easily be moved away from the capstan, thus making the car users independent of all switch engines while close to their works.



ELECTRIC CAPSTAN FOR MOVING CARS

Electricity Aboard the "George Washington"

The steamship, "George Washington," which is the largest of the German merchant fleet, carries 2,941 passengers and a crew of 525 men. Electricity is largely used aboard, and is generated by dynamos directly connected to compound high speed vertical engines. The ventilating apparatus requires an energy of 150 horse-power. The light is given by 4,300 carbon filament lamps of 25 candle-power. There is a Marconi wireless station on board and the heating—all done by electricity—requires 170 kilowatts or over 225 horse-power.

Autos as Show Windows

Is there a stylishly dressed woman in any of our large cities who has not bemoaned the fact that her costume is practically concealed from view while she is on the way from her home to the ball or theater and back? If there is, it probably would take a

AUTO USED AS SHOW WINDOW

modern Diogenes with a searchlight as a lantern to find her, for as much as the well gowned woman wants to be seen even in the modern autos or taxicabs the occupant can hardly be distinguished at night by those in other vehicles or on the sidewalks. To avoid this hiding of exquisite finery a New York cab company is now building taxicabs with the sides made of beveled glass and with reflectors throwing the light of tungsten lamps on the occupants so as to make the costumes and their fair wearers even more conspicuous than they would be in the daytime.

That these "taxicabs de luxe" will appeal to the gentler sex and their admiring companions goes without saying. Indeed the effectiveness of the innovation seems so certain that a Chicago electrician is already extending it into an advertising proposition for ladies' tailors, modistes and milliners by adding the name of the concern whose finery is being displayed.

Electric Stairs at Depots

In doing away with the dangerous grade crossings, our railroads are gradually adding to the amount of stair climbing for their passengers. With so many other conveniences added in the modern depot, this annoyance of the stairs might be overlooked were it not for the slow rate at which people move up the steps and therefore clear the way for the exodus from the next train.

To facilitate movement of the crowds the Orleans Railroad (Chemin de fer d'Orleans) has installed a moving stairway or so-called electric escalator at its Paris terminal, the Quai d' Orsay. The steps are 50 in number, and nearly six feet wide and are mounted on links of an endless chain which is driven at the rate of 75 feet per minute by a 15 horsepower electric motor.

To see whether or not the installation would pay, a count was made of the number of people passing in a single minute of the busy periods from the foot of these moving stairs to their top, and likewise of the number climbing a fixed staircase of the same width. The count showed that for every hundred people climbing the fixed stairs in a given time, 214 were taken up by the electrically moved stairs, so in a congested railway station the increase in depot capacity due to the more rapid exit of the passengers will well repay the investment, besides adding to the comfort of the railroad's patrons.

Cabling Japanese Words

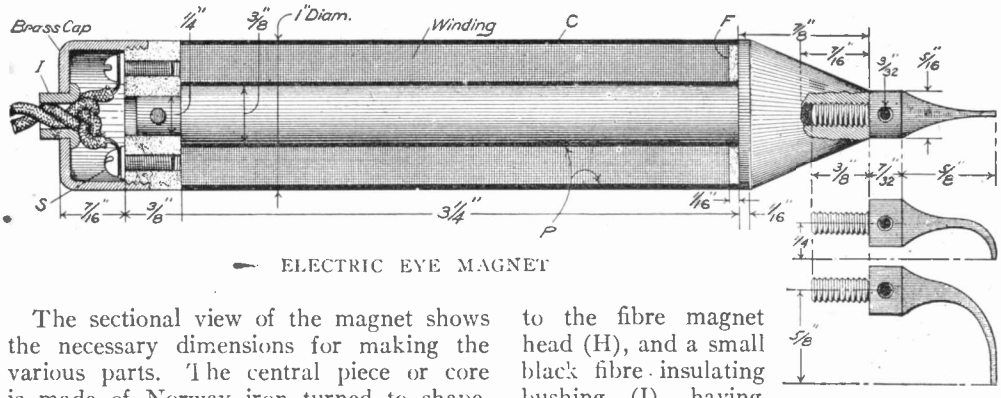
Under the new agreement between China and Japan regarding the cable between Dalny and Chefoo (of which 81 miles are owned by Japan and the other 7½ nautical miles by China) the rate for messages has been reduced from 48 cents per European word to 8 cents. Messages are also accepted in Japanese "Kana," counting seven "Kana" characters as equal to one European word.

FOR PRACTICAL ELECTRICAL WORKERS

HOW TO MAKE AND OPERATE ELECTRICAL DEVICES

Electric Eye Magnet

For the removal of steel and iron chips, and other magnetic substances from the eyes, there is no quicker and less painful method than by the use of a small and powerful electromagnet. Such a device suitable for use in the shop and also for general purposes is here described and illustrated, and full instructions given which will enable anyone possessing average mechanical ability to construct it successfully.

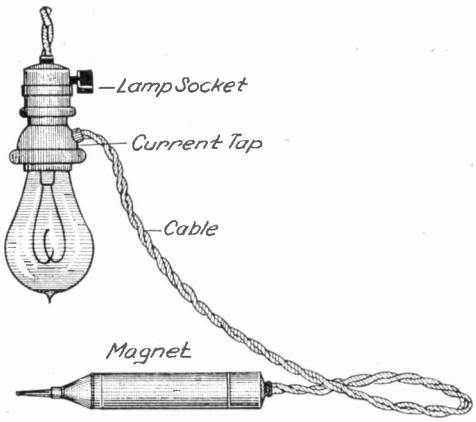


ELECTRIC EYE MAGNET

The sectional view of the magnet shows the necessary dimensions for making the various parts. The central piece or core is made of Norway iron turned to shape, and tapped out at the right-hand end to receive the various shaped tips, which are used to suit different cases, and which should also be made of Norway iron, as it possesses much better magnetic qualities than ordinary iron or steel. The core is provided with a black fibre, or hard rubber washer (F) at each end, which serve as insulators and also to form a spool upon which to wind the energizing coil. The core should be insulated by wrapping it between the fibre ends with two thicknesses of good quality wrapping paper (P) shellaced in place, and on the spool thus formed wind 40 layers of No. 34 B. and S. gauge double silk-covered magnet wire (W), being careful that the insulating covering of the wire is not injured during the winding process. The starting and finishing ends of the winding should be at the left-hand end of the spool, and should be brought through small holes in the black fibre head, and connected to the brass binding screws (S). Over this winding wrap two layers of the same kind of wrapping paper, previously mentioned, and then cover the spool between the fibre ends with a layer of bookbinder's black cloth (C) which may be purchased at almost any stationery store. A brass cap (B) of the dimensions given in the illustration, should be made, and threaded to screw on to the fibre magnet head (H), and a small black fibre insulating bushing (I), having a central hole of sufficient size to permit the passage of the lamp cord (L), which is to be used for a connection cable, should be made and fitted to the brass cap (B). Before assembling the various parts, the tips, core, and brass cap should be nickel-plated and polished. The edges of the black fibre washer and magnet head, and the insulating bushing may also be polished to advantage, if a nice appearance is desired.

Now procure about six feet of incandescent lamp cord (L), and after placing one end through the fibre bushing and cap tie a knot in it to prevent its pulling out, and then connect each of the ends of the conductors to the brass binding screws, as shown. The other end of the cable should be attached to a Dale current tap, which may be purchased at any electrical store, and

comprises a screw plug attachment and lamp socket for receiving an incandescent lamp, which will act as a resistance and protect the magnet from receiving too much current. The method of connection is



HOW THE EYE MAGNET IS CONNECTED

plainly shown in the second illustration, it being merely necessary to screw the current tap into any lamp socket on the proper voltage circuit, and then place the proper voltage incandescent lamp in the current tap, turning on the current with the lamp socket key in the ordinary way. This causes the magnet to be strongly magnetized, and after attaching the tip to the core the end should be brought close to the object in the eye, which will jump to the magnet tip and be thus readily removed. The current should not be left on the magnet longer than necessary, and never after the magnet becomes uncomfortably warm to the hand.

The coil winding previously given is adapted for use on 110-volt direct current, with a 16 candle-power, 110-volt lamp in the current tap.

For use on 220-volt direct current wind with 40 layers of No. 34 double cotton-covered magnet wire, and use a 16 candle-power, 220-volt lamp.

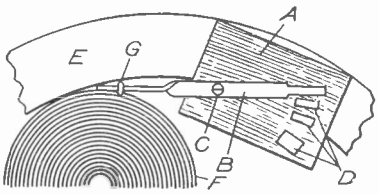
For use on five dry batteries wind with six layers of No. 20 double cotton-covered magnet wire, with no current tap on the connection cable, but merely provide suitable terminals for attaching to the terminals of the batteries. Do not leave the magnet connected to the batteries except while actually in use, as the batteries will be rapidly exhausted.

C. NOSRAC.

Repeating Alarm Clock

The accompanying sketch shows the construction of a simple attachment for an ordinary alarm clock, to ring an electric bell. The device is said to be better than the usual form of trigger arrangement on the winding key of the alarm spring because no setting is required, the contacts are concealed and consequently "fool-proof," and besides are not sprung by an accidental jar which may be given to the clock.

A small wooden or hard leather base is cemented to the framework (E) of the clock near the alarm spring so that it will not interfere with the works. A small brass bar (B) is pivoted by a screw (C). One end is



REPEATING ALARM CLOCK

twisted at right angles and secured rather loosely to the outside of the spring (F) by the wire (G) so that when the spring is wound the switch is automatically set. Contacts (D) make connection with (B) as the spring unwinds. The first contact should be so situated that when the spring is wound up, it is not quite in contact with the bar (B).

If it is desired to have the bell ring until turned off by hand, one contact only should be used and made long enough, so that as the spring is unwound the circuit will stay closed. The contacts are all connected together and a wire may be run from them to an insulated binding post on the back of the clock. The other binding post may be connected directly to the clock. It is well also to run a copper wire from screw (C) to some part of the frame work as not very good electrical connection is made between the switch and steel spring (F).

By placing a small vane or fan on the axle of the last wheel of the train used to give motion to the clock's bell clapper, its speed may be much retarded and the period during which the electric bell may be made to repeat will be much lengthened.

JAMES P. LEWIS.

Insulating Materials

MARBLE

Marble is very much used in switchboards and switch-panel work. Its insulating properties are good if it is free from metallic veins. Great care should be taken not to spot the slab with oil or grease.

SLATE

Slate is cheaper than marble but it must be enamelled to fill up the surface pores and keep the moisture out. It must be free from metallic veins and its surface must be kept thoroughly clean.

LAVA

Lava is a mineral talc which has come to be important as an insulating material. It is not attacked by acids or alkalies, except by hydrochloric acid, and then only slightly. It neither shrinks nor expands under the influence of moisture, and high temperature has only a small effect on it. In its natural state it can be machined as easily as brass, and after machining it is baked at a very high temperature (2000° F.) which makes it very hard. Its dielectric strength is high and varies with the thickness.

MICA AND MICANITE

Mica is one of the most valuable insulating materials. It is a silicate of aluminium and potassium or sodium. It is found in laminated form and may be split to very thin sheets. It has a very high dielectric strength and can withstand very high temperatures. When it is very gray or black in color it contains iron in excess. Magnesia also tends to darken its color. In its natural state it is not flexible or uniform and permits a large surface leakage. Consequently most mica is reconstructed and put on the market in the form of "micanite."

"Micanite" is one form of reconstructed mica. The sheets of mica are stuck together with an insulating compound which renders them impervious to humidity (at least for a very long period of time) and enables them to be bent when heated.

"Micanite" plates are made in varying thicknesses and in two qualities, one which softens when heated and is easily moulded and one which is intended for commutator segments.

Flexible "micanite" plates are made in two styles. One style A will retain its flexibility for years, is non-hygroscopic and is used for insulating armature slots and coils, armature and field magnet cores, etc. Style B, is a cheaper quality, made from selected pure India sheet mica split very thin.

"Micanite" cloth and paper are made, the former with fine muslin on one side and paper on the other, the latter with paper on both sides. Each is made in three thicknesses with one, two and three layers of mica.

PARAFFINE

This substance is used for high tension apparatus. To be of good quality it must be white and not give out any odor. Squeezed between two paper sheets it must not leave any trace on the paper. Its must begin to fuse between 104° F. and 122° F.

Its insulating resistance is very high but it completely loses this when subjected to the action of X-rays or radium emanations.

OILS

The dielectric resistance of oil at normal temperature is high and reaches a maximum value when the oils are very pure. This resistance decreases with an increase in temperature till it nears a constant value at the temperature at which the oil begins to decompose. Linseed oil has the least insulating resistance.

The oils which are used in oil switches must have special properties to avoid dangerous accidents. Their resistance must be the very highest and they must not contain acids, sulphur or other substances that may combine with the metallic parts of the switches. The oil must not be too heavy or have any tendency to gum, and always be transparent enough to enable the attendant to determine the presence of foreign matter without withdrawing the oil. Their flash and burning points must be high (at least 400° F.) to avoid the danger of fire.

Resin oil is slightly better from the dielectric point of view than mineral oil—but on the other hand its burning point is very low and it absolutely cannot be used for high tension switches.

Humidity decreases the insulating resistance of oils. Oil exposed to a moist atmosphere shows after two days a decrease in dielectric power of about 25 per cent.

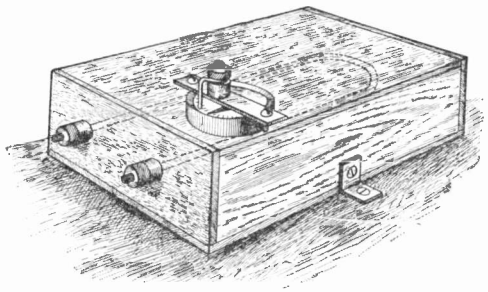
The oil used in transformers is very heavy. Its purpose is not to allow humidity to enter into the transformer. It must not contain water or acids and must be heated before using to eliminate the water or air it may contain.

Oils are used not only in their natural state but in the composition of many insulating varnishes.

Inexpensive Battery Tester

If an electric current is passed through a coil or loop of wire we know that lines of force thread their way through the loop and like a bar magnet it has a north and a south pole. A magnetized needle brought into this field of lines will try to arrange itself parallel to the direction of these lines.

The accompanying sketch illustrates a battery tester applying this principle. It



BATTERY TESTER

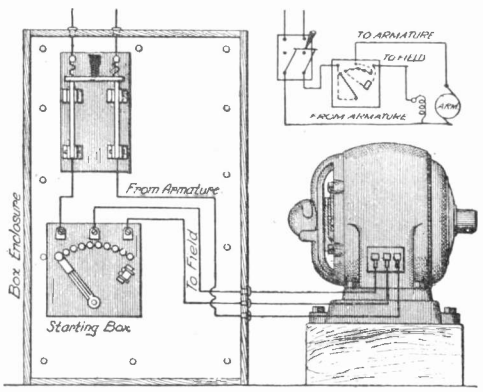
may be made with a cigar box, a short piece of No. 14 copper wire, either insulated or not, three binding posts taken from the carbon post of discarded dry cells, and a twenty-five cent compass. Binding posts are inserted at the end of the box and upon the inside a loop of wire is fastened to them. The compass is secured to the cover by a flat brass piece and wood screws. A binding post on this brass piece holds a piece of bare wire bent to serve as a stop for the needle. When in use set the compass and box so that the needle points directly north and is parallel to and nearer to one leg of the loop than to the other. Secure the box to a board or table by a screw in the metal straps. Place the binding posts of a good battery in contact with the posts on the cigar box. The deflection of the needle then indicates the effect of a good cell and other similar cells may be tested by comparison. The wire loop may be bent towards or away from the needle when making the first adjustments. The lowest point at which a cell will do certain work may be determined also. Where a whole battery "goes bad" I have often found by testing individual cells that several were still good. Although not so accurate this tester is a good substitute for an expensive instrument.—A. A. WEISS.

That Third Wire

When we look at open wiring on a ceiling and see that each drop light is connected between two wires, and then find, at some other point, that the two wires are branched off to make three, a question arises in our minds as to the cause, as it did in the case of one of the readers of POPULAR ELECTRICITY who writes in as follows:

"The other day I went into a shop that had just installed a small power lathe. On the wall was a box with a switch mounted in it. At the top of the box two wires entered, while three came out of the box and were connected direct to the motor. What was that third wire for and how was it connected with the work of the other two?"

The illustration shows the condition mentioned with two wires running to and through the switch. If these two wires were connected directly to the motor the armature would be burned out. In a one horse-power motor, for example, the resistance in the armature is about two ohms, and by Ohm's law $C = \frac{E}{R}$, with $E = 110$ volts and $R = 2$, C would be 55 amperes, enough to at



ARRANGEMENT OF MOTOR AND STARTER

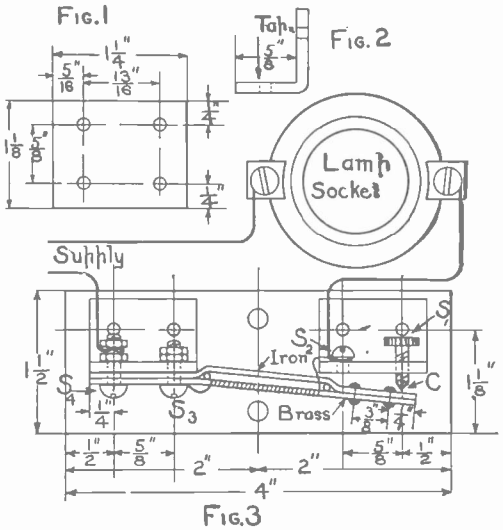
least badly injure the motor. Hence a "starting-box" which contains resistance is placed in the motor armature circuit to choke back the current on starting. In the small diagram the path of the current is from the switch to one terminal of the starting box, then to the lower end of the arm, and through this to the open contact. When the arm is moved to the first contact button the current goes through all of the

starting-box resistance and to the motor armature, while the field coils are taking a strong current from the middle terminal of the box over the "third" wire, the other end of which is connected to the opposite side of the circuit inside the motor. Referring again to the starting-box in the small diagram, as its arm is moved over the contact buttons, the resistance in the box is gradually cut out of the armature circuit and added to the field coils, thus reducing the field flux flowing from the poles pieces through the armature and allowing the motor to speed up, but in place of the resistance of the starting-box a counter-electromotive force is now created in the armature which opposes the line voltage and prevents an excessive flow of current when the motor is in operation.

Electric Flasher

A simple and inexpensive electric light flasher, that may be used in operating a ten, sixteen, or thirty-two candle-power lamp, may be constructed as follows:

Procure two pieces of metal, one of brass and the other of wrought iron, $3\frac{1}{2}$ inches



ELECTRIC FLASHER

long, $\frac{3}{8}$ inch wide and about 1-32 inch in thickness. Solder two pieces of No. 8 copper wire across one side of the brass strip, Fig. 3, then bend the iron strip over the pieces of wire so that the surfaces of the brass and iron pieces rest perfectly flat upon each other beyond the wires, being separated a distance equal to the diameter of the wires between the points where the wires are soldered to the brass strip. Clamp the pieces together and drill two 3-32-inch holes through both of them at one end and also two $\frac{1}{8}$-inch holes through them at the other end, as shown. One of the pieces of copper wire should be 1 3-16 inches from one end and the other $\frac{7}{8}$ inch from the opposite end, Fig. 3. Now wrap one layer of thin asbestos paper around the brass strip between the copper pieces and wind on 250 ohms of resistance wire of such a size that it will carry $\frac{1}{4}$ ampere. After the wire has been put in place fasten two small rivets in the 3-32-inch holes.

Cut from a piece of $\frac{3}{8}$- or $\frac{1}{2}$-inch slate a piece $1\frac{1}{2}$ inches wide and four inches long to serve as a base to mount the metal strips on. Drill six holes in this piece as indicated in Fig. 3. The four end holes should be counter sunk so that the screws used in mounting the brass supports will be below the under surface of the slate.

Cut two pieces from some $\frac{1}{8}$-inch brass $1\frac{1}{8}$ inches wide and $1\frac{1}{4}$ inches long. Drill four holes in each as indicated in Fig. 1, and bend them into the form shown in Fig. 2. All of the holes should be tapped. Mount these pieces on the slate base and fasten the brass and iron strips to one of them by means of two bolts as shown in Fig. 3. Place a screw (S1) in the outside hole of the other piece. This screw should be platinum pointed and the surface of the iron piece with which it comes in contact should have a small piece of platinum fastened to it at the point of contact.

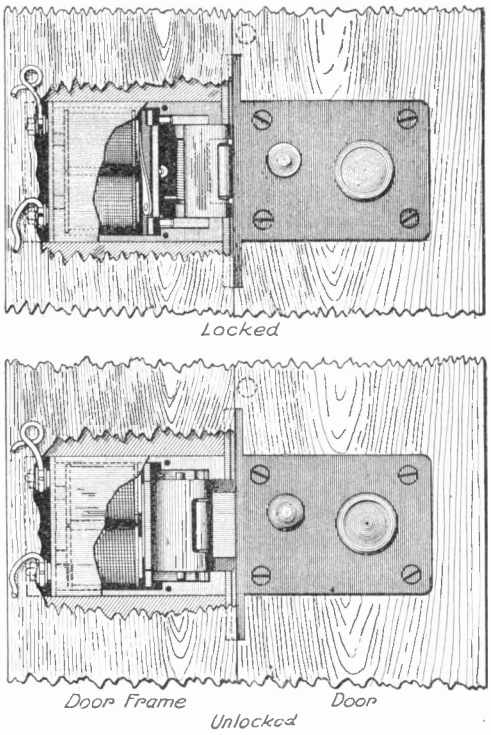
One terminal of the winding on the brass strip should be connected under screw (S2) and the other under screw (S3). This winding is then in series with the lamp until the contact (C) is closed, due to the brass expanding and forcing the piece of iron over against the point of the screw (S1). When the contact (C) is closed the winding is shortened and the brass cools off, drawing the iron away from the screw, thus opening the circuit again. The resistance of the winding is such that the lamp will burn very dimly when connected in series with it but will burn up to full candle-power when the contact (C) is closed.

You should provide this flasher with a substantial enclosure so that it will pass electrical inspection.

D. P. Moreton.

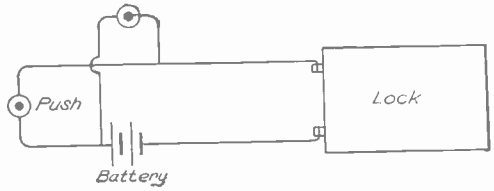
Magnetic Door Lock

The convenience of the electric lock or door opener is most appreciated in flat and apartment buildings, and when installed in connection with a speaking tube system



MAGNETIC DOOR LOCK

saves much stair climbing. As shown in the diagram the lock may be operated from a simple battery and push-button circuit from one, two, or more points, so that the convenience may be extended to any room in the house. The lock mechanism consists of two



CONNECTIONS OF DOOR LOCK

electro-magnets and an armature against which the revolving latch cannot open until a button is pushed and the armature drawn out of the way. As this is done a little plunger operated by a spring in the door frame pushes the door open an inch or so and the caller does the rest.

Seams on Rubber Covered Wires

Those of our readers who regularly handle rubber covered wires may have noticed that some of these have a seam along one side of the rubber and may have wondered why the seam was there, as it certainly plays no part in the ordinary use of the finished wire. This seam or ridge merely shows that when the rubber was being "cured" it was surrounded by a thin metal jacket having a seam somewhat like that on ordinary iron stove piping. When rubber covered wires were first put on the market, it was found that in order to secure a high grade of insulation in the rubber, this would have to be cured under pressure instead of being left free to expand. For this purpose one manufacturer started the practice of wrapping the uncured rubber wire with a strip of tin foil which was closed by a seam running lengthwise of the wire. Then when the rubber expanded during the curing, it forced itself well into the seam, thus forming the ridge which is still to be seen on wires made in that way. (The covering of tin is always removed at the factory after the rubber has been thoroughly cured.)

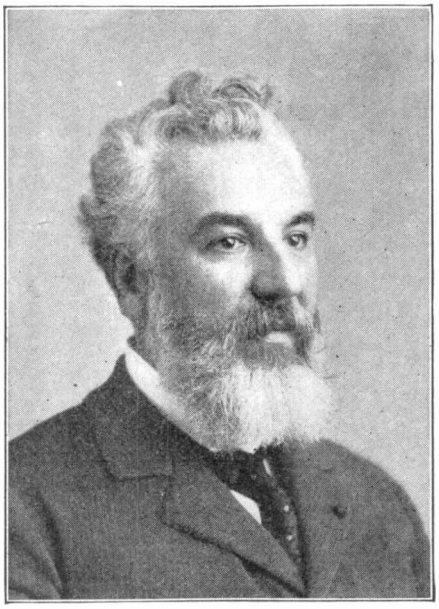
This method of surrounding the rubber with a strip of metal so as to make a seamed tube within which it would compress itself, was patented; but another Easterner soon found an equally ingenious way of accomplishing the same result. He ran the wire with its crude rubber coating through a bath of molten lead and squirted this lead over it as the wire issued through a nozzle in the side of the vessel. Thus he surrounded the rubber with a seamless jacket of lead which also could be sliced off and remelted after the rubber was cured.

Later on, other makers of insulated wire found that by tightly braiding the threads which are usually put around the rubber, the braiding itself (if put on the unfinished rubber) would be unyielding enough to form a tight jacket for this rubber, thus compressing it while it was being cured, so they avoided the patents on both of the other methods. However there are many who still swear by the method which uses the seamed tube and this accounts for the ridge or fin which you may find along the outer edge of the rubber core in some brands.

Electrical Men of the Times

ALEXANDER GRAHAM BELL

A few months ago Alexander Graham Bell celebrated his sixty-third birthday anniversary, and celebrated it by plunging with renewed enthusiasm into a series of experiments which have engrossed his attention off and on for several years past and the object of which is the solution of the problem of aerial navigation along unique and original lines. With the energy of a much younger "globe trotter," Prof. Bell has of late devoted considerable time to travel and scientific research in Europe and, inspired by that interest in aeronautics which is so prevalent abroad, he has returned imbued with a determination to perfect a practicable airship, embodying the principle of his tetrahedral kite.

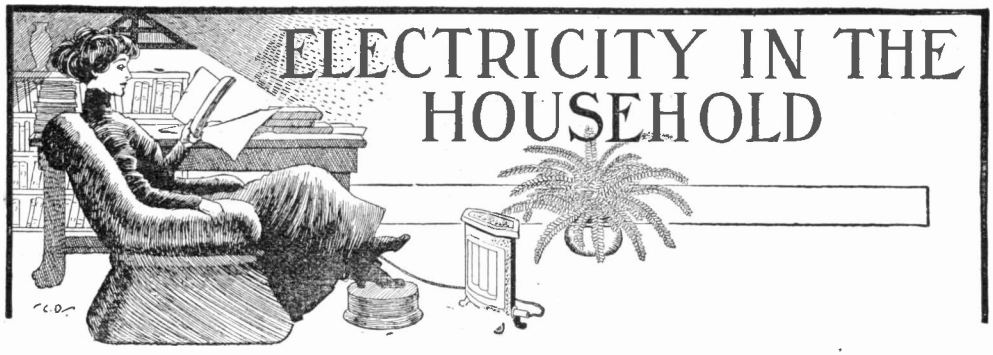


It must not be supposed, however, that the famous inventor of the telephone has in any measure lost interest in things electrical. On the contrary not only does he keep in close touch with all phases of progress in the electrical world but his mind is occupied much of the time with prospective innovations and inventions in this realm where he won fame and fortune.

Save perhaps for the suggestion contained in a snowy beard and hair, Alexander Graham Bell does not, today, look his three score and odd years. On the contrary it is not too much to say that he is today in his physical and intellectual prime. For all that he is a tall man there is scarcely a hint of a stoop in his figure; his step is elastic and he has a quickness of movement that appears to endorse the promise made by a pair of exceptionally bright eyes. That Dr. Bell takes no account of climatic conditions which many a man of his years would consider a hardship is best attested by the fact that in his anxiety to push his current scientific research he has in effect transformed his "summer residence" at Baddeck, Nova Scotia, into an all-the-year residence.

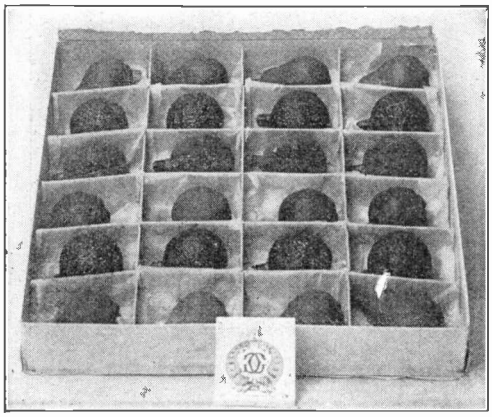
On an estate of a thousand acres on Lake Bras D'Or in northern Nova Scotia are located Dr. Bell's principal laboratories and such is his passion for work that of late years he has spent much time in this isolated locality. Moreover, despite his advancing years this human dynamo continues his habit of reversing the usual order of things and doing his serious work at night. Dr. Bell's favorite hours for work are from 10 o'clock p. m. to 4 o'clock a. m. He never goes to bed until after 4 o'clock in the morning and his usual sleeping hours are from 4 o'clock until 11 o'clock in the morning.

Many persons who are prone to regard Dr. Bell as an American electrician, which he is in fact, may be surprised to learn that he was born in Edinburgh, Scotland, and was educated in that city and in London. He spent two years in Canada ere he came to this country in 1872 as professor of vocal physiology at Boston University. This was just four years before the telephone was patented. Dr. Bell's father was the inventor of visible speech for the deaf, and Alexander Graham Bell chose as his wife the former Miss Mabel Gardiner, who had been deaf almost from birth—two circumstances which explain in great measure Dr. Bell's well known interest in the cause of and inventions in behalf of the deaf and dumb. This same sentiment impelled Dr. Bell when he some years ago received the "Volta Prize" in France to devote the fund to the establishment at Washington of the Volta Bureau—a most inportant institution designed to promote in every way possible the interests of the deaf.



The Latest Decorative Novelties

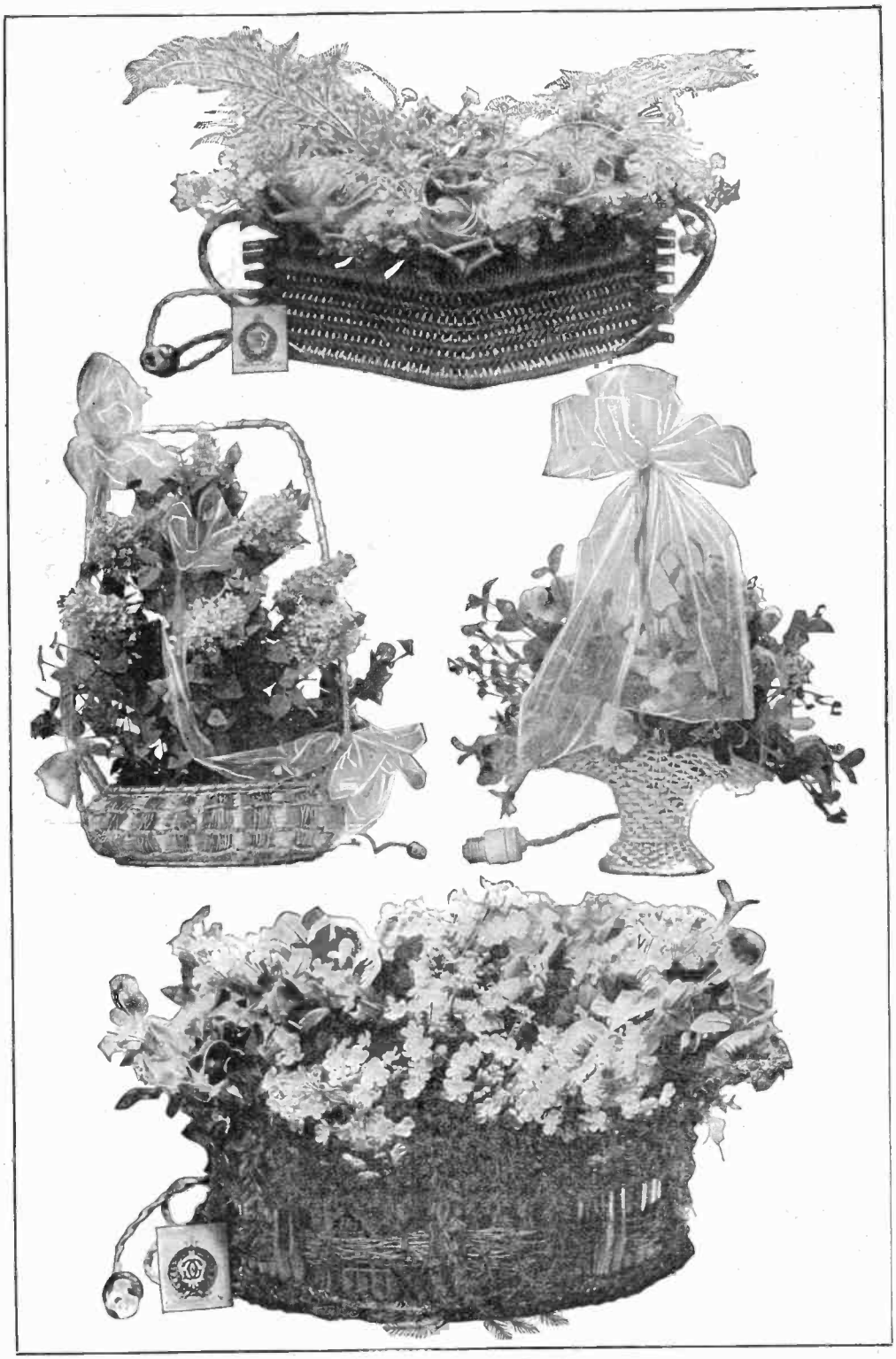
A dozen American Beauty roses costs anywhere from four to twelve dollars, the common varieties half that much. A few bouquets of sweet peas or carnations may easily form one of the large items of expense for a luncheon or dinner party—but in a day or two they are withered and gone. They are beautiful while they last and those who inhale their fragrance and feast their eyes on the delicacy of the blossoms and foliage are no doubt refined to a certain extent through satisfaction of the aesthetic sense. But it is true also that the desire to have beautiful flowers out of season, at tremendous prices, is another manifestation of the extravagance of the age, and the labor of the thousands who are required to rear these hot-house products, that they may bloom for a day and die, is taken away from the production of the necessities of life and is another of the many factors which enter into the high cost of living.



THE BULBS COME PACKED LIKE FANCY FRUIT

Is there a pleasing and at the same time an imperishable substitute for flowers available; something which can be used for interior decorations many times over and always possess the charm of flowers themselves? Those of you who have seen the cunningly formed lilac baskets, rose baskets, flower jardinieres, strawberry beds, floral festoons, Christmas wreaths and the hundred and one other kinds of electrically decorated novelties which are now produced will know that there is. As the names of Peacock and Tiffany have become nation wide as standing for perfection in gems and the goldsmith's art, so has the name of Gudeman come to be recognized among those who seek originality and beauty in decorations embodying the use of electric lights.

These designs of flowers and foliage are as true to Nature as human skill will permit—and it is hard to distinguish that they are artificial. They are not only imperishable but fire proof and absolutely safe in that respect. Partially hidden within the leaves and vines are tiny electric bulbs which are perfect imitations of flowers and fruits and which derive their current through an ordinary lamp cord attached to the nearest socket. The picture on this page shows a box as it is packed with assorted bulbs in the form of fruits, such as oranges, peaches and pears and looking for all like a box fresh from the orchards of California.



SOME ELECTRIC FLOWER DESIGNS

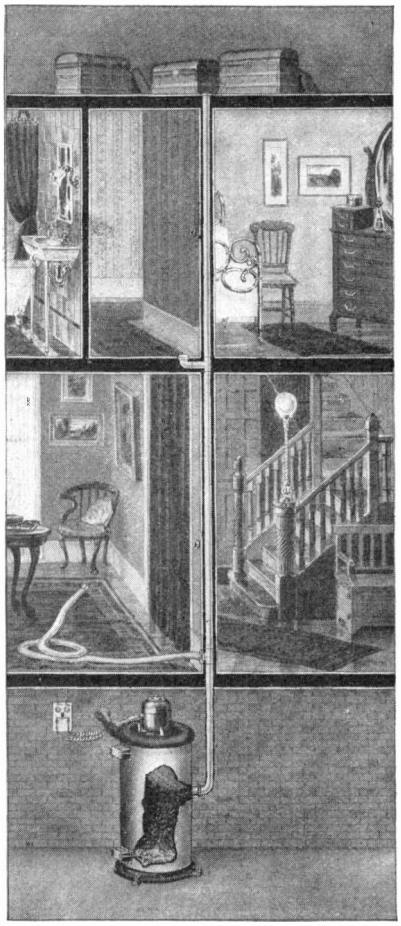
The designs on the preceding page are only a few examples. The top one represents a rose basket which is made in various colors. It is one of the most popular centerpieces for table decorations. In the middle at the left is a lilac basket in the natural colors, the lights being hidden in the flowers. At the right is a small orchid basket containing not only illuminated orchids but sweet peas and ferns. At the bottom is a flower jardiniere containing sweet peas, thorn-apple blossoms, narcissus, etc.

Of course, the half tone illustrations without the coloring can give but an imperfect idea of the beauty of these decorative pieces, but, as said before, they are very true to life and will often solve the problem of a suitable decorative scheme, with the advantage that you or some one else can use them over and over again.

Evolution of the Vacuum Cleaner

The principle underlying vacuum cleaning has been understood for many years, but it is quite safe to say that few people know the interesting circumstances that led to its first commercial application. Like many other inventions, it seems to have been the result of accident.

One of the earliest and most authentic accounts of the use of air for cleaning is as follows: About 1894 a railroad porter, to facilitate his cleaning of the coaches, attached a hose to the compressed air valve of an engine and used it to blow the dust from the corners and crevices of the car. One day another employe after filling the ice water tank threw down the bag in which the ice had been carried and one end of it was caught on the jagged end of the nozzle of the hose. Later the porter arriving to complete the cleaning, turned on the compressed air and drew the hose along the length of the aisle. Observing that the bag had become inflated during its course through the car, he examined it and found it saturated with dirt He also noticed that the path traveled by the nozzle of the hose had been cleaned better than ever. The result was the construction of a device in which a strong current of air was forced out of a small opening, hugging the floor or article to be cleaned. This blew the dust and dirt into a surrounding bag where it remained, the exhausted air passing through the meshes of the bag.



STATIONARY VACUUM CLEANING SYSTEM

Experts began now to work upon the idea, some retaining the use of compressed air, while others inverting the process sought to produce a suction of air by which dirt and dust could be drawn up and deposited in a receptacle. The portable devices now used for this purpose are known as vacuum cleaners.

Following the evolution of the device, the next step seemed to be that of making certain parts of the equipment stationary just as the coal stove has given way to the furnace and radiator; the portable oil lamp to the electric light fixture, and the portable bath tub to the bath room with its stationary heater and tub.

The illustration shows the stationary idea applied in the vacuum cleaning system of the United Electric Company, the machine itself being installed in the cellar. Piping, running between the studding or in obscure

corners of closets or halls, connects with each floor. To clean any part of the house all one has to do is to attach the hose with the cleaning tool to the pipe-opening on that particular floor, turn on the current and the cleaning begins. A half horse power motor operating a centrifugal fan draws the air down the pipe into the basement receptacle where the heavier dirt drops to the bottom, the finer dust being caught on a screen as the impure air and germs pass on through a pipe into the chimney or to the outside of the building.

Current Cheaper Than Kerosene

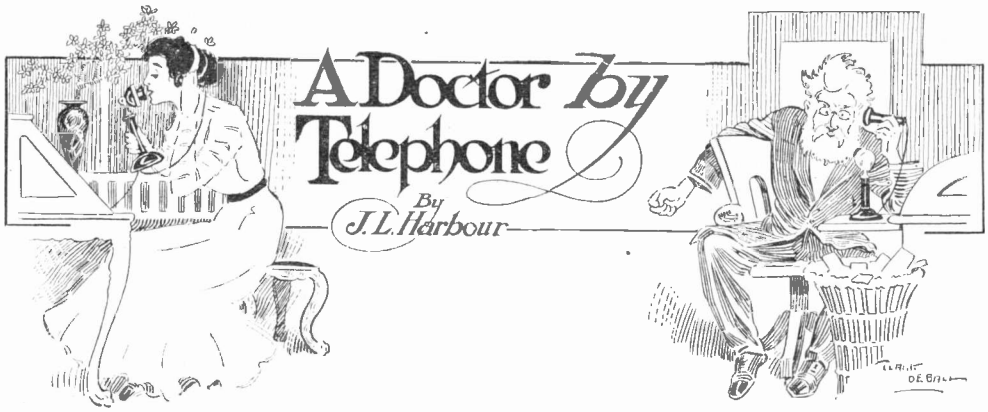
Do you remember grandmother's kindly dictum? "Better light the oil lamp, dear. It is cheaper." There was reason for it, coming in the bygone years when everything electrical was much dearer than now and when even rough figuring showed that lighting by oil lamps was cheaper than by incandescents. Since that time the cost of current has steadily decreased, but thanks to the Standard Oil Company the price of oil has also gone down, so how do the two compare now?

In grandmother's day the comparison was merely as to the amount of light obtained at the lamp at the same cost, for the use of reflecting and diffusing mediums was then practically unknown. Today all logical comparisons must be as to the effective lighting on tables, counters, desks, or in show windows; in other words, what comparative illumination can be obtained from each illuminant for the same money?

Theoretically, according to one of our leading authorities on illumination, Dr. Louis Bell, a gallon of the highest grade of kerosene burnt in the most improved type of lamp will give 800 candle hours, which means that it will supply a 20 candlepower lamp for 40 hours. To obtain the same 20 candlepower in a tungsten lamp (requiring 25 watts) for the 40 hours would take 40 times 25 watt-hours, or just a kilowatt hour. Therefore a gallon of the best kerosene can give theoretically as much light as a kilowatt-hour of current. In practice the common grades of oil fall from 10 to 30 per cent shy of the best grade, so that it will take about 1 ¼ gallons of oil to equal a kilowatt-hour of current in the light obtained at the lamp.

But when it comes to the effective light at the places where it is needed, a 20 candle oil lamp is by no means equal to a 20 candle power incandescent. The oil lamp cannot be inverted, hence the large oil reservoir is always in the way so that both this and the chimney interfere with the effective use of reflectors. On the other hand, the modern Tungsten lamps may be used in any position and by means of suitable reflectors the effective illumination from them may easily be twice what can be obtained from oil lamps of the same candle power. Indeed, in some classes of work such as show window-lighting the proposition is as high as four to one. Allowing for the commercial kerosene, which is below the grade on which Dr. Bell based his figures, this means that it will take anywhere from 2½ to five gallons of oil to give the same illumination as a kilowatt-hour of current. Thus at Chicago, where kerosene retails at 13 cents per gallon, oil lamps would be effectively as cheap as the incandescents if the current for different classes of indoor lighting costs from 32½ to 65 cents per kilowatt-hour, or an average of perhaps 40 cents. As a matter of fact it costs less than a third of this rate, so that even the much less efficient carbon filament lamps figure out cheaper in service than kerosene lamps.

Besides, the incandescent lamps can be instantly turned on and off, thus saving wasteful times of burning, and they do not have the other annoying features of the kerosene lamp: the labor of cleaning and filling lamps, the difficulty of keeping them from smoking if exposed to drafts, the fire risk in lighting them, the vitiation of the air both by the smell or fumes and by consuming oxygen, or the much greater radiation of heat (for what is the ordinary oil stove but an overgrown kerosene lamp?). If the lighting costs were equal, these objections would count seriously against the kerosene lamp, but with our modern high-efficiency incandescent lamps we have so far outstripped the oil in economy of operation that we can simply disregard its handicaps and look upon it merely as an interesting, but now outgrown factor in the historical development of illuminants.



A Doctor by Telephone

By J. L. Harbour

"Hello, there! Is this six-five-three, ring one? It is? Is Dr. Pillbag there? You are Doctor Pillbag? Why, I didn't recognize your voice at all. Somehow it sounded so strange over the wire, but then I think that often happens. I was talking to my own sister yesterday afternoon and I wouldn't have known it was she if I hadn't really known.

"Well, Doctor, I just rang you up to speak to you about the baby. I don't think that he is really quite well, and yet I don't think that he is hardly ill enough for you to take the trouble to come away out here, although of course I would have you come if I thought it really necessary. I don't believe in taking any risks in real sickness, and I don't think very much of home doctoring. One of my cousins has a home doctor book and a little medicine chest and a 'first aid to the injured' box, and all that, and she treats her children herself, but I think that it is dreadfully risky. I think that if one is sick enough to take medicine it is always best to take it under the direction of a doctor, and I wouldn't undertake to give any of my family treatment for——you there, Doctor?

"About the baby: As I say, he isn't really ill, but he isn't quite himself, and I thought it might be better for me to just speak to you about it, for it would be easy to do so by 'phone, and——I was thinking this morning what a help a 'phone must be to a doctor. What a lot of time it must save him, and of course it saves his patients' time. Here I can stand right in my own home and talk to you instead of changing my dress and going away over to the other side of town, as I would have to have done a few years ago. I was in the country a short time ago visiting a cousin of mine—or, to be more exact, a cousin of my husband's, but I call her *cousin* just the same and I really think more of her than of some of my own cousins.

"Well, she lives———, her name is Johnson, and I think you met her last spring when my husband was so ill and you were here every day for a week—a tall, rather spare lady with such lovely dark eyes. I think I recall introducing you to her. Anyhow, I was visiting her and she lives five miles from the nearest town and her husband was taken very ill—oh! *very* ill in the dead of night, and, as it happened, their hired man was away for the night and the nearest neighbor lived more than half a mile away and it was raining and just we two women alone in the house with this very, *very* sick man and no one to go for the doctor, but there was the telephone! My cousin—or my husband's cousin—just rang the doctor up and he was out to the house in about an hour. It made me appreciate as I never had before how useful the 'phone can be, and yet I suppose that it does get to be a nuisance sometimes when people ring you up and talk and talk over the 'phone. Why, Doctor, you know that we have a four-party line and there is one woman on this line who thinks nothing of holding the line 40 minutes simply visiting with some of her friends, and——you there, Doctor? What is that? You have patients waiting for you in the office? Why, of course you must have, and I mustn't keep you any longer than necessary.

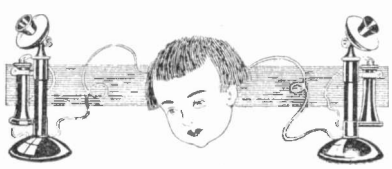
"About the baby: As I say, he doesn't seem to be quite himself. My husband spoke of it this morning and thought the dear little

fellow looked a trifle pale and asked if he was 'off his feed.' I don't approve of slang, and yet it is often very expressive, don't you think? Then I remembered that baby hadn't taken quite all of his last two bottles and that he seemed a little listless and——what is that, Doctor?

"Has he a temperature? I suppose so. I suppose a baby *always* has a temperature of some kind, hasn't it? I have tried to count his pulse, but you know it isn't as easy for an inexperienced person to count the pulse as it is for the doctor to do it, and, anyhow, I have forgotten just what is normal in a child's pulse, but I didn't detect anything unusual in his pulse or I would have 'phoned for you at once, for I think that it is always best to——what is that? Has he any fever? I don't know that he has, and yet he might have some internal fever that I wouldn't discover, and he——is his tongue coated?

"Not that I know of. As I say, he isn't really ill, and I simply rang you to ask if it might not be best for you to give him something to keep him from getting ill.

"You might send it by mail, or I could come around and get it, although, as I say, he may not need anything. I think that sometimes a baby's appetite is not very good when there is really nothing the matter with it and I don't believe in——you there, doctor? As I say, I don't want it to run on, if there is really anything the matter, although there cannot be anything very serious the trouble or the symptoms would be more marked. I don't believe in——you think that there is nothing the matter with the baby? I am so glad you think so. As I say, I felt sure that he was not really ill, but then ——shall I let you know if he shows signs of being really ill? I never let an illness of any kind run on, for I feel that——you there, Doctor? Hello! Hello, there, Doctor! You there? I guess they have cut me off, or else he has hung up his receiver. That is one disadvantage of the telephone. They are apt to cut you off and keep you from saying what you want to say. I'll ring the doctor up again soon for there is really something I want to say to him about the baby."



Household Electric Fountains

Just as the brass band of our outdoor concerts has its more delicate counterpart in the chamber music of our string instruments, so the mammoth electric fountains of our parks now have dainty parallels for indoor use. The charm of the water spray has always been attractive to both old and young, but any general use of indoor fountains was blocked by the difficulty of providing suitable water connections at the desirable locations for the sprays.

This handicap has been overcome by placing an electric pump in the base of the fountain to provide the pressure without the need of any connection to the water pipes.

In the handsome designs now made each has a motor with a vertical shaft placed below the basin and driving a centrifugal pump which forces the water through suitable spouts. The same water is used over and over again, hence it only needs to be replaced as it evaporates. A simple lamp cord supplies current to both the motor and the lamps which may be either incandescent or Nernst types, and the whole device is as portable as a table lamp or a fan motor. It can therefore be moved at will to the conservatory, the drawing room or even the porch, wherever its soft glow of colored sparklings may be most desired.

On hot days the delightful cooling effect of the spraying water will also be appreciated, so that the indoor electric fountain will prove an unusual combination of the useful and the beautiful. Its practical value alone will insure it a place in summer homes as well as in city residences, in either of which its esthetic charm will make it a steady source of enjoyment.

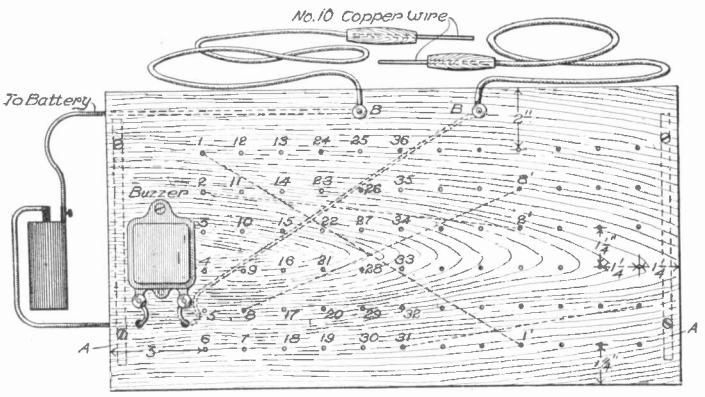
A Fan and Ice to Cool a Room

On an extremely hot day when there is little air stirring, it is often a difficult matter to so ventilate one or two living rooms of the house that they are comfortably cool. A crude but very effective way, especially for sick rooms, is to place a cake of ice in a wash tub or dish pan and set this in the room in such a position that an electric fan will blow the air upon the ice. In a very few minutes a decidedly lower temperature will be secured and will remain for a long time without further operation of the fan. Try it.

Electric Fortune Teller

Much fun and amusement may be had from this "fortune teller" which can be constructed as follows: Provide a board 10 by 18 by $\frac{3}{8}$ inches. Plane, sandpaper and paint it. Now draw lines on the under side of the board spacing apart and from the edges as indicated in the plan. With a push drill make a hole through the board at each place where the lines intersect, the holes to be a little smaller than the nails which are to be driven through these holes from the under side so as to project $\frac{1}{4}$ inch on the upper side. Before driving the nails, however, secure at each end by screws wood strips (A), 8 by 1 by $\frac{3}{4}$ inches to serve as legs. Next attach a buzzer and two binding posts (BB) to the board. We are now ready to wire up the board on the under side. No. 22 B. & S. gauge single cotton covered or silk covered wire may be used and each nail head should be connected by wire to some other nail until the 72 nails are arranged in 36 pairs. With ordinary lamp cord make connections from the binding posts and buzzer to the battery, and also use 20 inches of this cord to connect from each binding post to a wooden handle into which the cord should run and be attached to a piece of No. 10 copper wire on the inside as shown. Connecting the battery we are now ready to "feel out" our connections if we did not trace these as wires were strung on the under side. Hold one pointer in contact with (1) and touch the other to the various pegs. When (1′) is touched the circuit is completed and the buzzer indicates this. On a piece of bristol board already prepared show this connection by a line between (1) and (1′) and so continue until a map is made of the whole board. This map will serve as an aid in preparing questions and answers.

Next take several pieces of bristol board, $6\frac{3}{4}$ by $14\frac{1}{2}$ inches, rule off and punch holes so that the bristol board will drop on the board and allow a peg to project through each hole. Now with the map before you write or print on the clean bristol board a question around each peg hole, and around the hole to which the corresponding peg is connected by wire write the answer. This bristol board may now be placed on the board. The player chooses a question he wishes answered, and touching one pointer to this peg feels around until the buzzer indicates the answering peg. Several sheets of bristol



ELECTRIC FORTUNE TELLER

board may be prepared containing riddles, conundrums, etc.

The board may be made to answer many questions by writing very general answers, such as: "Yes—Perhaps—No—I think so —Certainly," etc., on a piece of bristol board prepared as before, making sure that each answering peg has the one to which it is connected left blank. The player now touches one of the pointers to a blank peg, asks a question and then proceeds to hunt for the answer until the buzzer indicates that he has found it.

EARL GARDNER.

Mechanical Boys

By GEORGE RICE

Success of the popular mechanical and electrical publications throughout the country is due to several reasons. The principal of these may be put under the head of "mechanical boys." It is getting to be quite the fad for the boy to have some kind of a workshop in the basement of his home. A bench is made and some tools are put in. In a few weeks after operations begin the boy has quite a number of woodworking or metal working devices available for use about the home. A little later he enters the local market with his products and oftentimes he is able to do quite a good business.

In one case a lad of 15 years built up a demand for little toy electrical motors that proved to be good sellers in the neighborhood. Soon some of the models got into the hands of the large dealers and today the boy is running quite a good-sized shop with a number of men employed turning out mechanical and electrical toys.

The electrical, building, and engineering publications in which a section is devoted exclusively to beginners are obtaining increased numbers of subscribers of this class every season.

The general introduction of concrete articles for the markets resulted in encouraging numerous young men to engage in the making of marketable devices with the cement, gravel and sand mixtures. There are some boys in one town making considerable money by turning out flower boxes and stands made of concrete. It is their practice to buy the usual Portland cement. Then with the proper proportions of sand and gravel, the mixture for concrete is produced. The concrete thus turned out is molded in flasks for the desired forms. The boys showed the writer some well-designed flower boxes. Many of the box-fronts are figured. Flower boxes costing but 10 cents for material are sold by these boys for one dollar each; and the demand is equal to the product right along.

In many of the little shops of the boys you will find a file of the popular electrical and mechanical publications. The boys and the public in general do not care so much for the more technical publications, containing articles on making complicated things, all of which is beyond the comprehension of the average novice. The simple publications of how to make and how to market little toy engines and little bob sleds and the like are doing a world of good in the country.

I know of hundreds of lads who used to prefer to go fishing or to waste their time about the streets, who are now working industriously in a home shop. The father derives the benefit of this state of affairs because the lad usually ceases to beg for spending money as soon as he gets his equipment with which to work.

There are boys who are equal to making little toy hoisting and other forms of steam engines. The little hoisting engine can be used to good advantage in the toy world for the reason that it is easy to make a small derrick and fit it with cord lifting cables for hoisting miniature boxes or barrels.

It is well said that most boys like to work with tools. One reason why parents hesitate to fit up a shop for the son is because they do not understand how to go to work to do it. The advertising pages of the publications devoted to this subject carry the advertisements of makers and dealers of the tools and devices most necessary. By writing to any of these advertisers the desired information can be obtained. By looking through the newspaper directories the names of the different popular scientific publications can be secured. Most newsstands also carry them.

It is possible to fit out a boy with a shop for anywhere from 10 dollars to 100 dollars. If the lad is inclined to work in wood only, then the usual tool chest with its assortment of tools will answer all purposes. The makers of these assorted tools for boys know just about what is wanted. A plain form of foot power drill can be put in for a few dollars. Sometimes second hand tools and turning machinery can be obtained at a low price. I would procure any one of the woodworking publications and from the advertising columns get the addresses of the companies putting up chests and machinery equipments for boys. Then one or more of the woodworking journals should be subscribed for. Every issue of the journals will contain descriptions of how to make certain useful articles for the home or the market. All of the details of measurements are worked out in the plans. The lad will have no trouble in following the plans. He can sell his products about as fast as he makes them if he follows the directions.

The same ideas apply to the lad who desires to work in metal. Little models of devices may be made. A small forge can be obtained suitable for the boy. Often the instruction received at this kind of work is the stepping stone to a high position in a few years. Then there is the lad who wants to be an electrician.

The father or the mother soon finds out what the inclination of the boy may be. If along electrical lines, then electrical publications should be subscribed for and some electrical devices of simple character put in for the lad to work with. The parents will be surprised at the advancement made by the boy. In a few months he will talk of electrical things and can explain in detail all about amperes and carbons.

An Electrical Laboratory for Twenty-Five Dollars

By DAVID P. MORRISON

PART X.—EXPERIMENTS ILLUSTRATING THE PRINCIPLE OF THE MOTOR

Every action is accompanied by an equal and opposite reaction; or action and reaction are equal and opposite. As an example, you apply a force of a certain number of pounds to the end of a spring; the spring will exert an equal force and it will act in the opposite direction. A magnetic needle, if supported in such a way that it is free to move, will be deflected when a current is flowing in a conductor parallel to its axis. There is a force acting on the conductor tending to turn it from its position as well as the one acting on the magnetic needle. If the conductor were to be so arranged that it could move it would change its position were a current in the wire.

The above statement can be verified by the following simple experiment: Take a piece of hardwood 12 inches long, eight inches wide and $\frac{3}{4}$ inch thick and drill a $\frac{3}{8}$-inch hole to a depth of $\frac{1}{2}$ inch in its exact center. Cut a groove $\frac{1}{4}$ inch wide around this hole to a depth of at least $\frac{1}{8}$ inch and separated from the inner opening by about a $\frac{1}{4}$-inch wall. This hole and groove should now be connected to two binding posts (B_1) and (B_2), Fig. 94, with copper wire placed in grooves cut in the under side of the

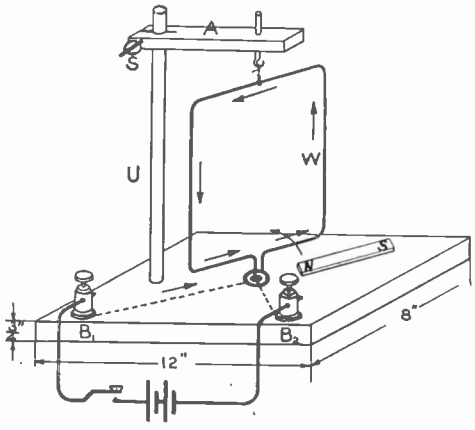


FIG. 94. APPARATUS FOR A SIMPLE EXPERIMENT

board. The wires should be sealed into the holes where they pass up through the board in the groove and cup, and there should be

a short piece of bare wire exposed. Mount a $\frac{5}{8}$-inch upright (U) about 15 inches in length, on this base. Cut from some $\frac{1}{2}$-inch wood a piece eight inches long and $1\frac{1}{4}$ inches wide. Drill a $\frac{5}{8}$-inch hole through this piece two inches from the end. Saw a groove from the end of the piece into the hole you just bored, and put a round-headed brass screw through the piece perpendicular to the slot. This can be used in clamping the piece on the wooden support. Solder a piece of sheet brass in the groove in the top of the screw which will avoid the necessity of using a screw-driver in making the adjustment of the arm (A).

Now bend a piece of bare copper wire into the form shown by (W) and hang it to the arm (A) by means of a piece of thin thread so that the two ends are in the hole

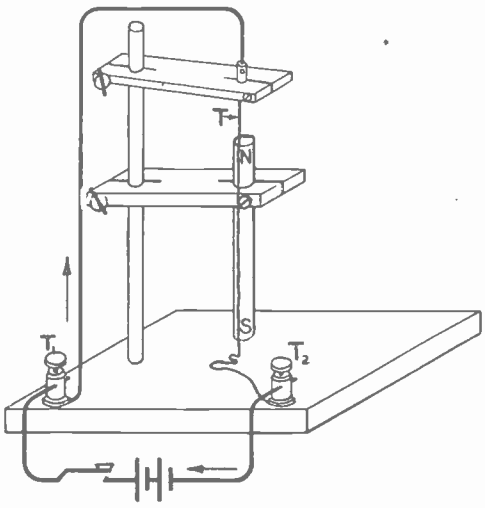


FIG. 95. EXPERIMENT WITH A BAR MAGNET

and groove in the bottom piece. Place a small quantity of mercury in the groove and cup so that the electrical circuit is complete between the binding posts through the rectangle of wire. Bring the coil to rest so that its plane corresponds to the direction of the earth's field, or it is parallel to the compass needle. Place a small permanent magnet under the rectangle of wire as shown, with its north pole toward the center of the block. Close the circuit and allow a current to flow through the wire and you will find it is deflected to the left.

Now explore the magnetic field surrounding the wire both inside and outside of the rectangle, noting the direction the wire moves when the magnet is brought into its vicinity. You will find the wire always tends to move into such a position that its magnetic field will be parallel to that of the permanent magnet.

This last statement can be further demonstrated as follows: A bar magnet about

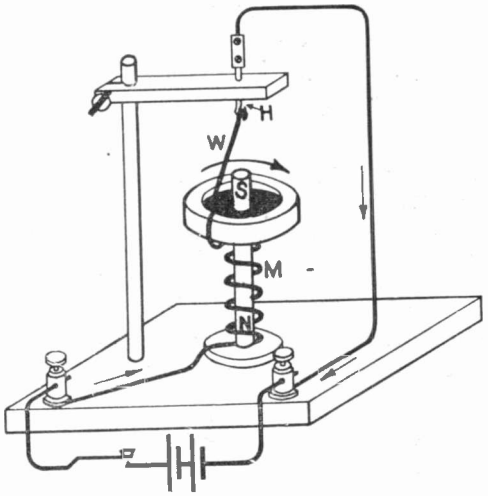


FIG. 96. HOW CONTINUOUS ROTATION CAN BE PRODUCED

seven or eight inches in length should be clamped in a stand in a vertical position as shown in Fig. 95, with its lower end five or six inches above the surface of the table. Place a connector above the upper end of the magnet and fasten to it a piece of tinsel (T), which is an exceedingly flexible conductor, and allow it to hang down along the side of the magnet. The two ends of this tinsel should now be connected to a battery or some suitable source of electro-motive force, so that a small current will flow through it. Allow quite a bit of slack in the tinsel wire at the lower end so it will be free to move about the magnet.

When a current is sent down the wire from (T_1) to (T_2) the wire will wind itself around the magnet in a left-hand spiral which results in the current circulating around the south pole of the magnet, as viewed from the lower end, in a clockwise direction. The current in the wire sets up a magnetic field in the same direction as that of the permanent magnet and tends to increase its magnetism. If you now reverse the current in the circuit the wire will unwind and again wind itself around the magnet in a right-hand spiral which results in the same condition as before. The two fields are in

the same direction, and the current is increasing the magnetism of the permanent magnet.

The coil shown in Fig. 94 will cease to move when the field surrounding the wire becomes parallel to the field of the permanent

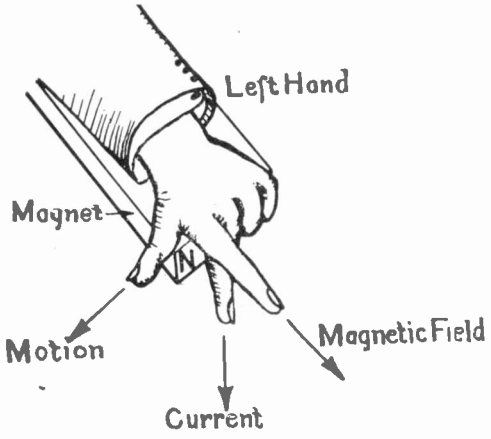


FIG. 97. THE LEFT HAND RULE

magnet. Continuous rotation of the wire could be produced if it was so arranged that it was free to move under the influence of the magnet but never attained a position where its field and that of the permanent mganet were parallel. Such an arrangement is shown in Fig. 96. A small electro-magnet (M) is placed on the wooden base of your stand with one terminal connected to one of the binding posts. Make a small wooden trough that will slip down over the upper end of the core of the electro-magnet, as shown in the figure. Connect the second end of the electro-magnet winding to a small quantity of mercury placed in this wooden trough. Hook one end of a piece of small copper wire on a hook (H) in the horizontal arm, which is connected electrically to one of the binding posts on the base. The other end of the copper wire should dip in the mercury and complete the electrical circuit between the two binding posts.

Current will now flow through electro-magnet (M) and the wire (W) in series. The direction of the magnetic field of the magnet is practically vertical while that of the wire is almost horizontal, and the wire will rotate about the pole of the electro-magnet, when a current is flowing through it, according to the simple principle that a magnetic body free to move, tends to move into such a position that its lines of force will be in the same direction as the lines of the field in which it is placed.

You can determine the direction in which the wire will rotate about the end of the electro-magnet by the following rule which is known as the "left-hand rule." Place the thumb, first and second fingers of the left hand all at right angles to each other, as shown in Fig. 97, and the hand so that the first finger indicates the direction of the lines of force of the magnet; and the second finger the direction of current in the wire; the thumb will then indicate the direction of motion of the wire. By applying the above rule to Fig. 96 we find the wire will rotate in a clock-wise direction, as you look down upon the mercury cup. Its motion around the pole is identical to that in the previous experiment, so that, the field of the wire tends to increase the magnetism of the electromagnet.

The moving wire, in Fig. 96, is the same as the armature of a motor and the electro-magnet corresponds to the field of the motor. Hence this simple rule can be applied in determining the direction of rotation of the armature of a motor.

By reversing the connections of the binding posts in Fig. 96 with respect to the source of electro-motive force you will reverse the direction of the current in both the wire and

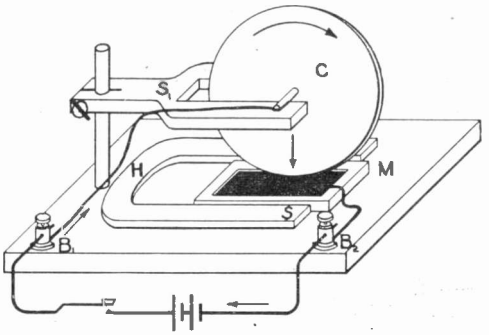


FIG. 98. BARLOW'S WHEEL

the electro-magnet and the wire will rotate in the same direction, as in the previous case, since the same relation exists between the three quantities, current, field and direction of motion. This can be verified by applying the left-hand rule. If, however, you reverse the current in the wire and do not change it in the electro-magnet, the direction of rotation is reversed and can be shown by the use of the left-hand rule. In the operation of a motor if it is desired to reverse the

direction of rotation, the current through either the armature or the field magnet must be reversed, but not through both.

A permanent magnet could have been used instead of the electro-magnet as shown in Fig. 96. The cup should, however, be lowered to about the middle of the magnet and the wire increased in length. By lowering the cup a greater part of the field surrounding the wire would be in the field of the magnet. If, however, the cup were lowered to the base and the wire increased in length so that it was in the field of both poles of the manget, one pole would tend to cause it to move in one direction and the other pole in the opposite direction, so that there would be no motion if the two effects were equal.

Continuous rotation of a conductor in a magnetic field can be illustrated by a simple

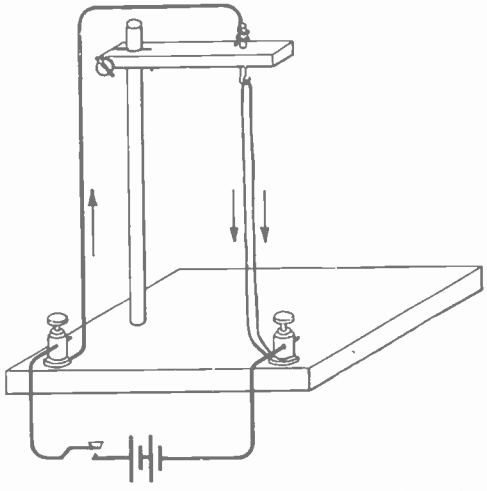


FIG. 99. EXPERIMENT TO SHOW RELATION OF MAGNETIC FIELD ABOUT TWO WIRES

device called Barlow's wheel. A copper disk (C), Fig. 97, is delicately balanced on the support (S1) so that it is free to rotate. Its lower edge dips in a small trough of mercury (M) placed between the poles of a strong horseshoe magnet (H). The electrical circuit is complete from the binding post (B2) to the mercury trough (M) to the center of the copper disk and by a conductor to the binding post (B1). The direction of the magnetic field of the permanent magnet and the field due to the current, which flows from the edge of the disk to its center, are at right angles to each other and the disk will rotate according to the left-hand rule.

The above experiments all deal with the relation between a conductor carrying a current and the magnetic field of a permanent magnet. It might be well at this point to show the relation between the magnetic fields surrounding two parallel conductors both carrying current. Hang from the arm on your stand a piece of tinsel with the two ends of about the same length. These pieces should hang close together and should be

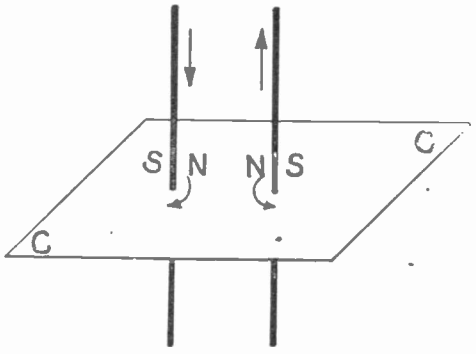


FIG. 100. ANOTHER WAY OF SHOWING RELATION OF MAGNETIC FIELDS

connected to a source of electro-motive force, as shown in Fig. 99. In this case the two wires carry currents in the same direction and they will be attracted toward each other. If the current flows through the two wires in opposite directions they will repel each other or move apart.

The above statements can be better illustrated perhaps by the diagram shown in Fig. 100. Let it be assumed that a line of force is of north polarity when it is toward you and of south polarity when it is away from you. With this assumption in mind the polarity of a straight conductor can be determined. The direction of the current in the two wires and the direction of the magnetic field are indicated by arrows. When the current flows in two adjacent wires in the opposite direction the adjacent sides of the wires are of the same polarity and there is a force of repulsion between them and the wires tend to move away. If now the current in the two wires flows in opposite directions the polarity of the adjacent sides will be opposite and there will be a force of attraction tending to draw the wires together. A small piece of cardboard (CC) can be so arranged that the wires pass through it and the resultant magnetic field can be shown graphically by means of some

fine iron filings sprinkled on the cardboard when there is a current in the wires.

While it is not essential that you perform all of the above experiments in order that you be able to construct a small motor, such as the one described later, you will nevertheless find them very instructive. Before taking up the actual construction of a motor you should understand fairly well the purpose of what is termed a commutator. A simple turn of wire, as shown in Fig. 101, is placed between the poles of a magnet and so arranged that it can rotate about the axis (X). The terminals of this coil are connected to a split metallic ring (R) upon which two brass strips (S1) and (S2) rest. These two strips are connected to some source of electromotive force and there will be a current flowing through the coil when the external circuit is complete. The coil will move until its plane is perpendicular to the direction of the magnetic field between the north and south poles of the magnet.

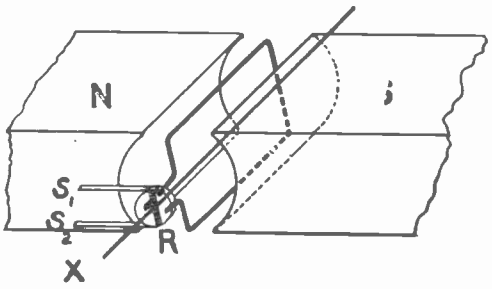


FIG. 101. ILLUSTRATING THE PRINCIPLE OF THE COMMUTATOR

If the coil moves beyond this position there is a force tending to bring it back to the perpendicular position unless the current is reversed in the coil as it passes from one side of the perpendicular position to the other. By properly arranging the strips (S1) and (S2) with respect to the split ring (R) the current will be reversed in the coil at the proper instant and the coil will continue to rotate.

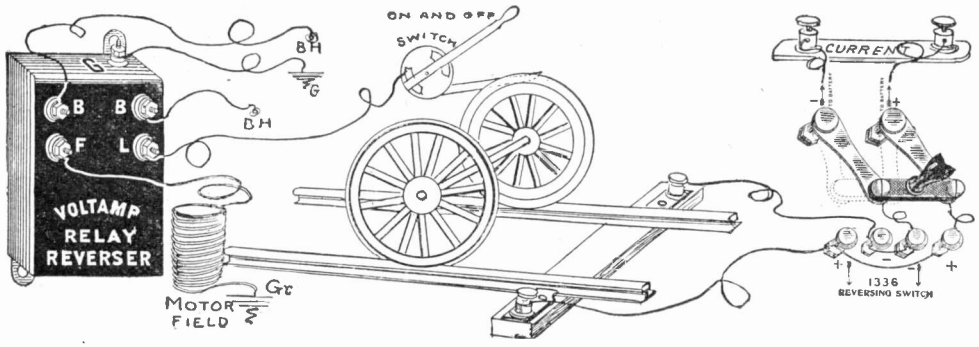
The split ring (R) is called the commutator and it is the simplest form possible. Such an arrangement serves only to show how the current is communicated and would be a very poor motor as there would be practically no force producing rotation when the coil was near the perpendicular position. The above disadvantage is overcome by placing a number of coils on the same shaft with their planes making angles with each and have them all interconnected so that there will always be some coils exerting a turning force. The ring (R) must be split into more segments as you increase the number of coils and these segments must all be insulated from each other.

The strength of the magnetic field existing between the poles (N) and (S) can be greatly increased by making a form from iron and winding the coils on it.

(To be continued.)

Toy Railway Car Reverser

The illustration shows the "voltamp" reverser, a patented device by which a toy electric train may be made to stop, start or run in either direction by throwing a two-point switch in the supply circuit. The little metal box which is only 2¼ by 1½ by one inches contains the reversing contacts which are operated by an armature between the poles of an electromagnet on the principle of the polarized relay. This box is placed out of sight in the car or engine and it is quite impossible for the onlooker to discover how the trick is done unless told.



TOY RAILWAY CAR REVERSER

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.

A High-Power Wireless Equipment

By ALFRED P. MORGAN

PART VI.—TRANSMITTING HELIX

We considered in the first paper the manner in which electrical oscillations are generated and how they set up electro-magnetic waves. But we must also take into consideration the conditions under which such actions take place as well as the apparatus necessary to produce them.

When a condenser discharges through a high resistance the current passes in one direction only, like a normal current. If the discharge takes place through a coil of wire, it will consist of a large number of exceedingly rapid alternations which we have learned were *oscillations*. Fig. 62 represents these actions graphically. In (A) the curve shows how the current dies away gradually through a high resistance without oscillating. (B) shows by the wavy line the form of the current when it discharges through a coil of wire. The wire possesses a peculiar property called *inductance*. Inductance is a foreshortened term for the word "self-induction" which may be likened to a sort of "electrical inertia." Inertia is defined as the property of matter by virtue of which it tends to remain at rest, when at rest, and when in motion to continue its motion. Inductance is the property of an electric current in a circuit to produce a magnetic field surrounding the circuit. This field, when changing, induces an electromotive force in the circuit itself or in a neighboring circuit.

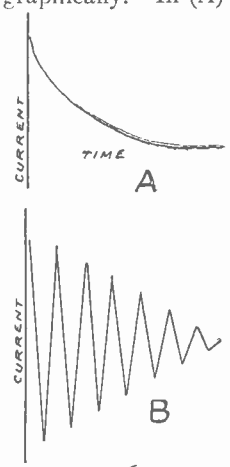


FIG. 62
CURRENT CURVES

However, even though there may be inductance in a circuit certain conditions must be fulfilled before oscillations can take place and so the "fundamental equation" of wireless telegraphy is that there will be oscillations in a circuit provided the resistance in ohms is not greater than the square root of four times the inductance in henries, divided by the capacity of the condenser in microfarads.

The instrument employed in wireless telegraphy to furnish the inductance in the transmitting circuit is usually called the transmitting helix. It consists of a large spiral of heavy copper or brass wire. High frequency currents exhibit the curious property of traveling or flowing near the surface of a conductor, i. e., they actually do not permeate the wire very deeply. For this reason the resistance of conductors to such currents is several times the resistance to direct and ordinary alternating current.

The helix also serves another purpose besides furnishing the inductance. It acts as an auto transformer to raise the voltage of the high frequency currents in the aerial circuit. Fig. 63 will explain this. An induction coil, spark gap, helix and condenser are connected to the aerial as shown. When the induction coil is in operation the secondary current flows through the leads, through the condenser down the clip (A)

and lower part of the helix back to the coil. During this process the condenser becomes charged. At the same time it tends to discharge but can not do so because of the counter e. m. f. of the induction coil. To

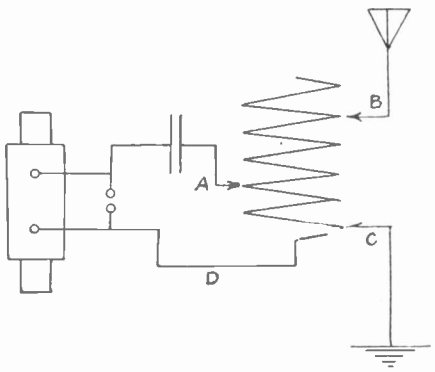


FIG. 63. TRANSMITTING CIRCUIT

discharge, it is necessary for the current to pass across the spark gap. If the latter is properly adjusted, the circuit formed by the gap, condenser, flexible lead, lower part of the helix and return wire (D) becomes the seat of electrical oscillations. This is known as the closed circuit. Such high frequency currents form a powerful magnetic field in the immediate vicinity of helix and so

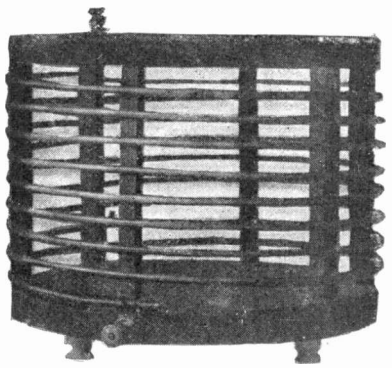


FIG. 64. TRANSMITTING HELIX

generate oscillations in the other turns from (B) down to (C) by induction. This latter part of the helix constitutes a sort of secondary coil and the high frequency currents generated in it are usually of a higher voltage than those in the closed circuit. The oscillations in the "secondary" are free to flow out into the aerial and ground and generate electro-magnetic waves. The aerial, ground and helix from (B) to (C) constitute the open circuit.

The amount of helix wire necessary for a transmitting circuit is most easily determined by coiling up some wire around a form and then tuning the circuits with a hot wire ammeter. A few extra feet should be allowed in case it is ever necessary to make changes or alter the wave length of the station. Too much inductance beyond that necessary to receive energy from the closed circuit will weaken the radiation and shorten the period. In such a case it will be necessary to increase the capacity of the aerial by adding wires to it.

Fig. 64 is a picture of a helix suitable for use with the apparatus which already has been described. The circular heads are cut out of mahogany one inch thick, and are 15 inches in diameter. Six rectangular notches 1 by $1\frac{1}{2}$ inches are cut 60 degrees apart in each head as shown in Fig. 65. The heads are separated a distance of 10 inches by six struts placed in the notches. The struts are 1 by $1\frac{1}{2}$ inches in section and 12 inches long. Each strut is notched to receive the wire and prevent it from slipping.

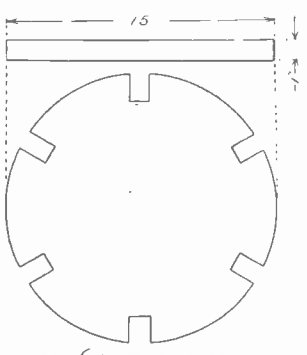


FIG. 65. HELIX HEAD

The wire is composed of eight complete turns of bare round brass $\frac{3}{8}$ of an inch in diameter. It is fastened at frequent intervals to the helix frame by small round headed brass screws passing through the wire into the wood. The ends of the wire are connected to heavy binding posts by large brass straps.

The helix is raised above the level of the table by four legs. These are two inches high and $1\frac{1}{2}$ inches thick. They are cut out of wood and fastened to the under side of the lower head as in Fig. 66.

Fig. 67 shows the clip for making contact with the wire. The handle is three inches long and is turned out of a piece of hard rubber rod $\frac{3}{4}$ of an inch in diameter. Fig. 68 shows a cross section of the handle. The contact is made out of a strip of phosphor bronze $7\frac{1}{4}$ inches long and $\frac{5}{8}$ inch wide. A piece of flexible rubber covered wire is

soldered to the middle and passed through the handle. The contact is then bent in the middle and forced into the handle. It may be fastened and prevented from pulling out by means of a pin or screw. The free ends are bent as shown so as to be easily

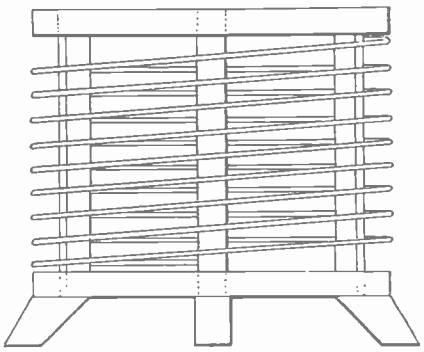


FIG. 66. COMPLETE HELIX

forced over the helix wire and to grip it firmly. Three such clips are required.

SPARK GAP

Fig. 69 is a picture of the spark gap. The base is a slab of polished Italian marble. In selecting the marble avoid colorings and dark streaks. Color in marble is due to

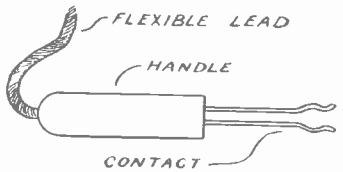


FIG. 67. HELIX CLIP

the presence of iron and greatly reduces its insulating qualities. The base should be $8\frac{3}{4}$ inches long, four inches wide and $\frac{3}{4}$ of an inch thick. Four 3-16-inch holes are bored along the centre line in the positions indicated in Fig. 70. They are countersunk from the lower side to permit the heads of the screws which fasten the standards and binding posts to come below the surface. The holes may be filled with plaster of paris and allowed to stand until set after the screws are in place. The upper edge of the marble base may be beveled if desirable. This considerably improves the appearance.

The standards are turned out of solid brass rods $\frac{3}{4}$ of an inch in diameter. They are $3\frac{1}{4}$ inches long and shaped as shown in Fig. 71. The hole in the bottom is threaded with a 10-24 tap so that a screw having a similar thread may be used to fasten the standard to the base. The side hole near the top is threaded with a 5-16 tap having 20 threads to the inch.

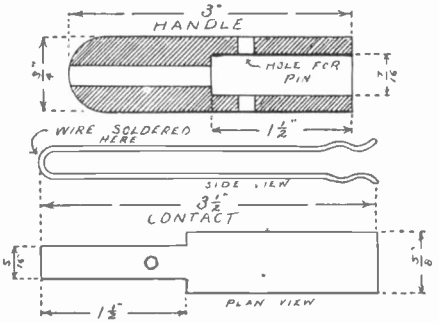


FIG. 68. DETAIL OF HELIX CLIP

The foot plate is detailed in Fig. 72. These plates are placed beneath the standard. They not only better the appearance of the instrument but also serve to connect the standard with the binding post.

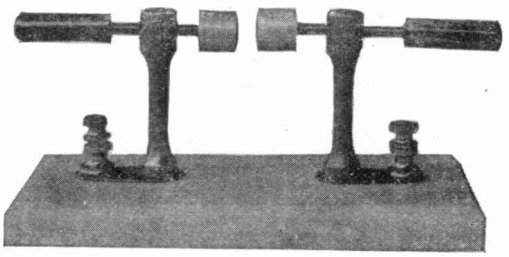


FIG. 69. SPARK GAP

They are two inches long, one inch wide at one end, $\frac{3}{4}$ of an inch at the other and 1-16 inch thick. The exact shape is best determined from the illustration. The holes are located and bored so as to permit the screws to pass through into the standards and binding posts.

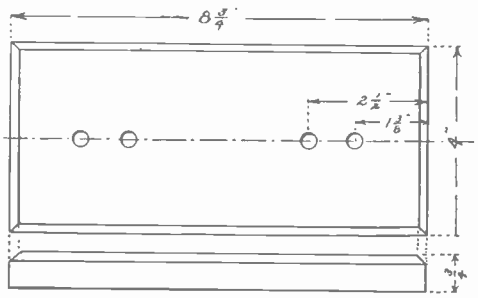


FIG. 70. MARBLE BASE OF SPARK GAP

The spark electrodes Fig. 73, are zinc cylinders, one inch in diameter and $\frac{7}{8}$ inch long. The front surfaces are slightly convex so that the sparks will tend to jump evenly from the whole surface and not from one

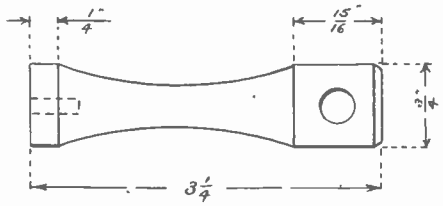


FIG. 71. STANDARD

side and the edges. The back face is perfectly flat and has a hole bored $\frac{1}{2}$ inch deep and threaded with a 5-16 tap having 20 turns to the inch. The stems are brass rods 5-16 of an inch in diameter and $3\frac{1}{4}$ inches long. They are threaded throughout their entire length with a die to fit the hole in the electrodes and the side holes in the standards. It is best to make the stems first, screw the electrodes on them and then centre in a lathe by taking a light cut off the zinc.

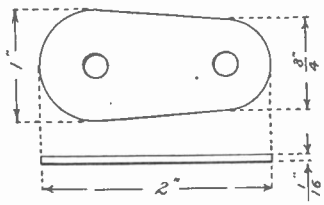


FIG. 72. FOOT PLATE

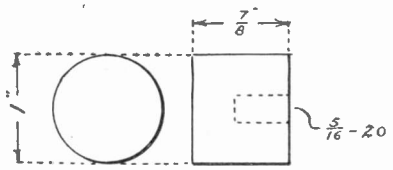


FIG. 73. ZINC ELECTRODE

The handles, Fig. 74, are turned out of hard rubber rods, three quarters of an inch in diameter and $2\frac{1}{8}$ inches long. One end is rounded while a hole one inch deep is bored in the other and threaded to fit the stems. The metal parts are completed by buffing and giving a coat of lacquer to the brass.

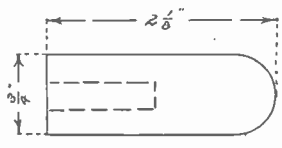


FIG. 74. GAP HANDLE

The gap is now ready to assemble and be lined up, as in Fig. 75. The opposing surfaces of the spark electrodes should be

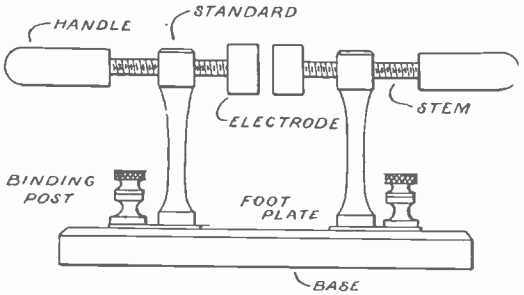


FIG. 75. GAP ASSEMBLED

perfectly parallel and revolve on the same centre when the handles are turned to adjust the length of the gap. If the stems screw into the standards firmly but easily no lock nuts will be required to maintain the adjustment.

If the gap is to be used for long periods at a time it may be well to fit the stems with radiation plates as shown in Fig. 76, and so dissipate some of the heat. These parts can be made out of sheet brass and fitted to the stems immediately behind each zinc electrode. They are $1\frac{1}{2}$ inches in diameter and are spaced 5-32 of an inch apart by means of small brass bushings. This forms a very effective radiating surface which will keep the gap fairly cool.

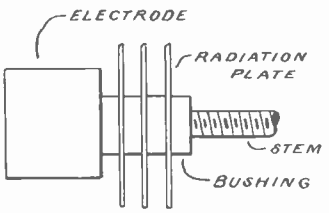


FIG. 76. RADIATOR PLATES

(To be continued.)

Central California Wireless Association

The Wireless Association of Central California was organized on May 27, 1910, with the following officers: President, G. De Young; secretary, B. K. Leach. The purpose of the Club is to promote wireless telegraphy and telephony in California. When organized the club had a membership of ten. Any one in the state who has a station is eligible to membership. Address the association at 860 Callish street, Fresno, California.

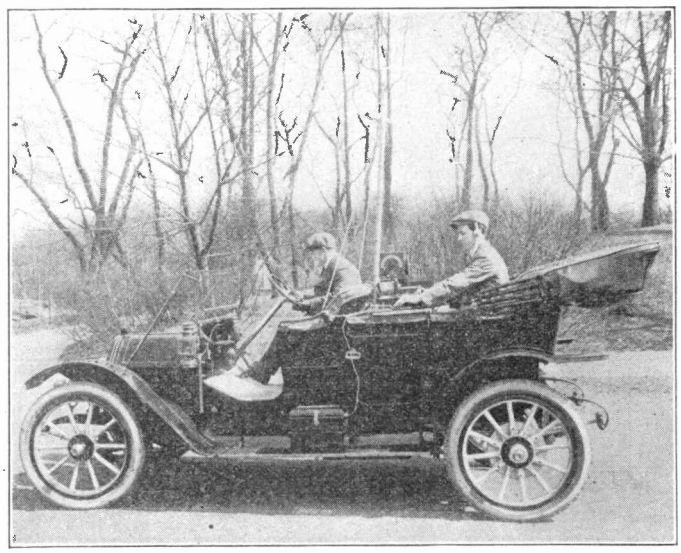
Automobile Wireless Telegraphy

The adaptation of wireless telegraphy to use on automobiles during a tour has been experimentally worked out by Dr. Lee DeForest and Carl H. Page. The real object of the experiments was to provide, if possible, a means of securing news on the Glidden tour.

The idea is to have an official wireless automobile carrying an operator and press representatives from which messages and news may be sent without stopping the car. Two "scout" cars will be sent ahead to receive messages from the official car. While one of these is receiving news at some point and transmitting it by local telephone or telegraph the other car is hastening ahead to a point where its masts may be set up ready to begin receiving messages when its companion car finds it necessary to move ahead again.

The apparatus which Dr. DeForest used is a duplicate in miniature of the Metropolitan Tower station in New York City, and with it the occupants of two automobiles 25 miles apart are able to talk with each other when running at a moderate speed.

One of the pictures shows a complete station installed in an automobile while the other is of the portable or field set, which may be taken out of the vehicle and set up in a very few moments.



SENDING MESSAGES FROM AN AUTOMOBILE WHILE UNDER WAY

SENDING WITH AUTOMOBILE FIELD SET

Westchester Wireless Association

The Westchester Wireless Association has been formed in Westchester County, N. Y., and is just entering on its second year with every success. At a recent election the following officers were chosen: Stanley R. Maning, president; Ernest B. Moorhouse, secretary and treasurer. Any amateur having a successfully working station and residing in Westchester County is eligible for membership. For further particulars apply to Ernest B. Moorhouse, (Sec.) 37 W. Main St., Tarrytown, N. Y.

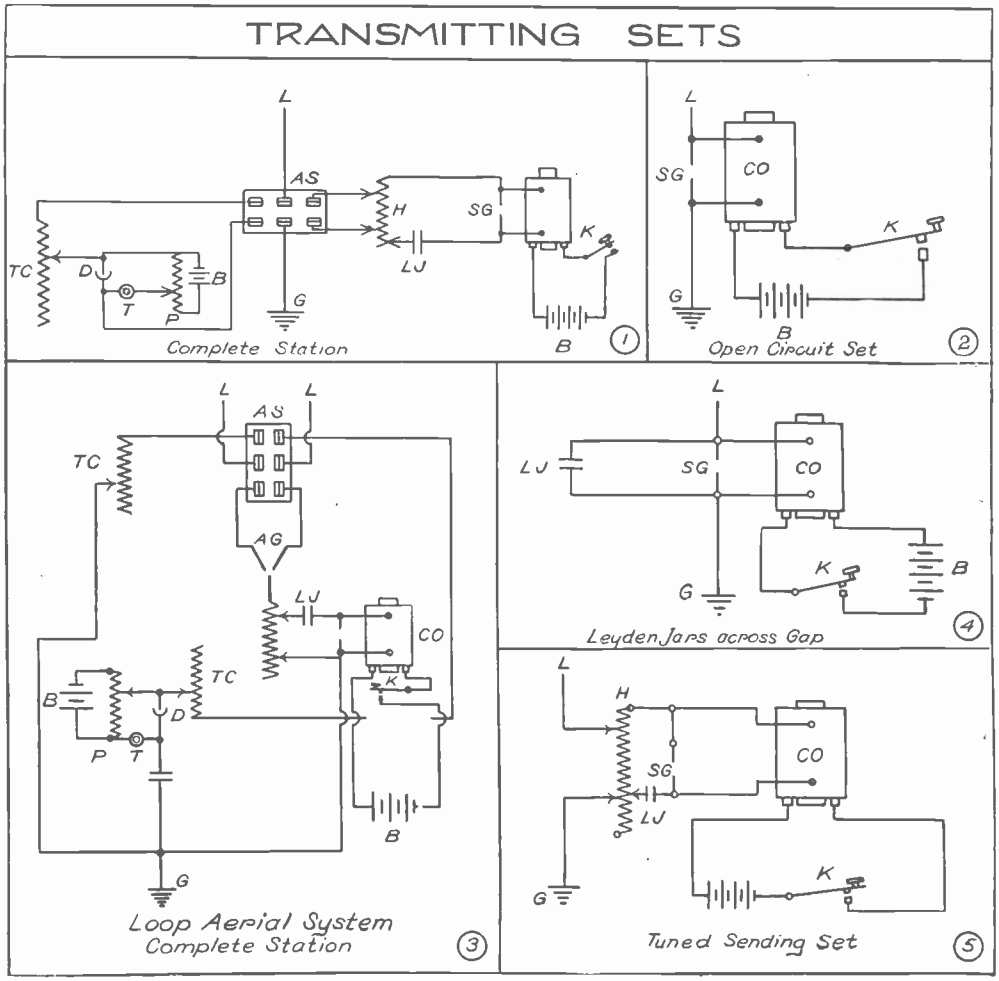
Connections for Transmitting and Receiving

A large number of the queries which we receive concerning wireless relate to connections of apparatus. As these connections are more or less standard, publication of the following diagrams will anticipate a large number of these questions.

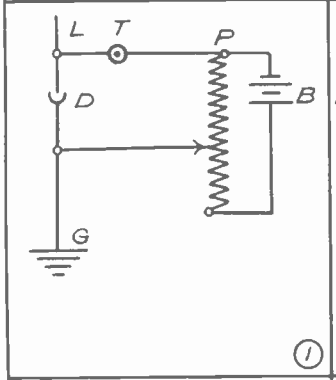
In reading the drawings the following key should be employed—:

L—Leading-in wire from aerial.
G—Ground (Earth Connection)
D—Electrolytic Detector.
C—Fixed Condenser.
V—Variable Condenser.
P—Potentiometer.
B—Battery.
T—Telephone Receivers.
TC—Straight Tuning Coil.
VT—Loose Coupled Tuner.
LJ—Leyden Jar or Plate Condenser.
CO—Coil.
H—Helix.
K—Key.
SG—Spark Gap.
S—Switch
AS—Aerial Switch (D.P.D.T Porc. Base).
AG—Anchor Gap.

The various thermo detectors, such as silicon, perikon, etc., may replace the electrolytic type in these diagrams. The potentiometer may then be replaced by a copper wire, and the battery may be omitted.



RECEIVING SETS



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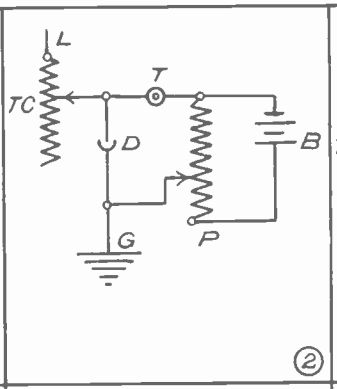

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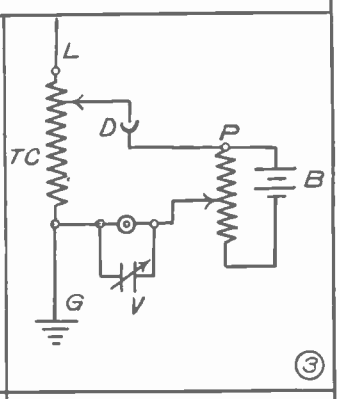

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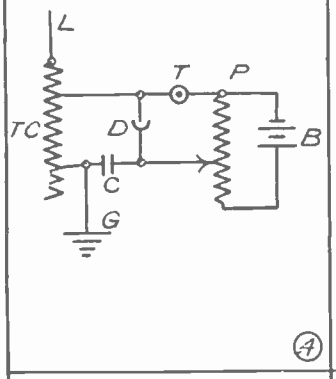

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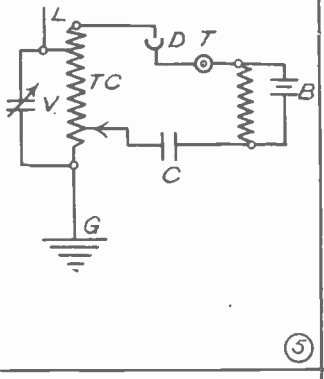

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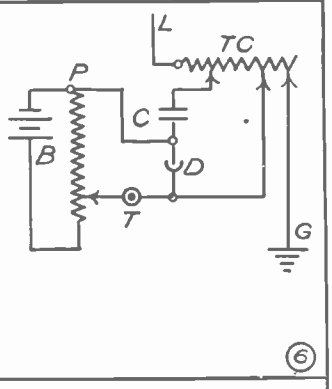

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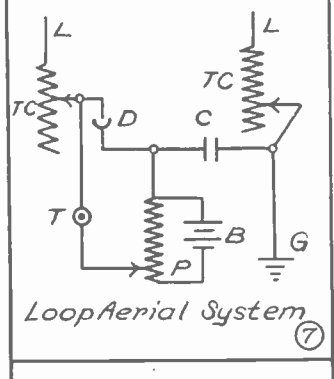
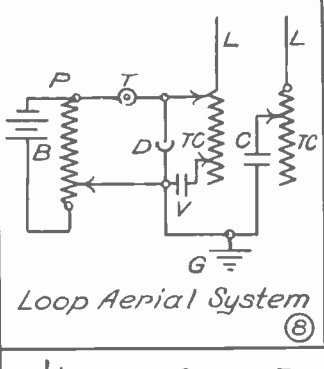


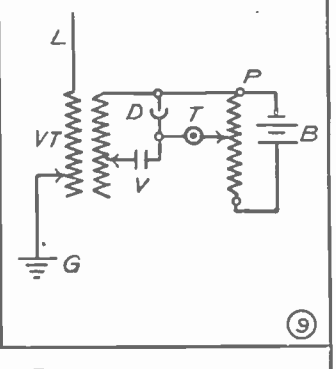
Loop Aerial System

(7)



Loop Aerial System

(8)



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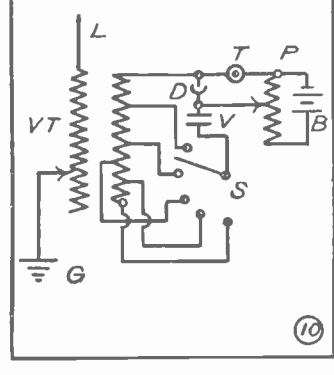

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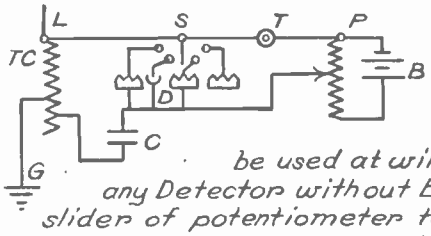


To Connect any number of Types of Detector, so that any one may be used at will. To operate any Detector without Battery, move slider of potentiometer to end of rod corresponding to no voltage

(11)

Oddities in Detectors

By GEORGE F. WORTS

Since the origination of the first simple, auto-restoring detector, there have been many introduced into the wireless field. The number has greatly increased recently, till now almost every crystalline mineral with a heavy percentage of metal for a basis has been adopted and used as a detector of etheric disturbances. Since the beginning of the research very ingenious ideas have been put in practice with usually gratifying results, as practically any high resistance conductor will respond to electric currents of an oscillatory nature.

SIMPLE FORMS

Perhaps the simplest of all self-restoring detectors is the microphone. Almost all

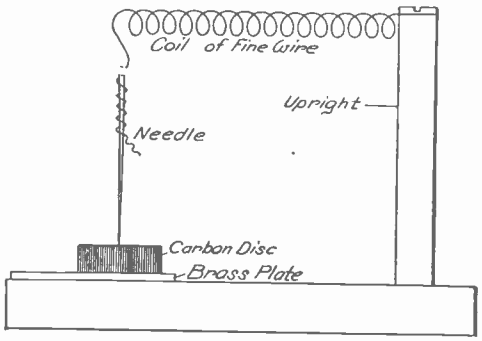


FIG. 1. MICROPHONE

amateurs have used this detector in its simplest form—a needle across knife-like carbon edges. Fig. 1 depicts a modified form of this type. Contact is made very lightly with the point of a fine needle on a flat carbon surface. It is more sensitive than the "needle and knife edge" type, but like all microphone detectors gets out of adjustment too quickly for practical use. A drop of water between carbon surfaces (Fig. 2) is responsive to wireless waves. This form is only experimental like the microphone. The electrolytic of which the foregoing is a very simple type, has gained widespread popularity on account of its adaptiveness for long-distance work. Fig. 3 shows a simple form of the electrolytic detector, a modification of which is used in the U. S. navy. The bulb of a small spherical incandescent lamp is chipped off at the top and the filament broken off at its juncture with the terminals. The cup is filled with a 10 per cent solution of nitric or sulphuric acid. Though not as sensitive as the bare point detector, the results obtained are ample reparation for the small trouble in making it. Bare point detectors will not produce satisfactory results unless the anode consists of a wire, two one hundred thousandths (.00002) of an inch thick. Electrolytic detectors can not be given a fair test unless a wire as small as this is used. This size wire costs about 50 cents per inch.

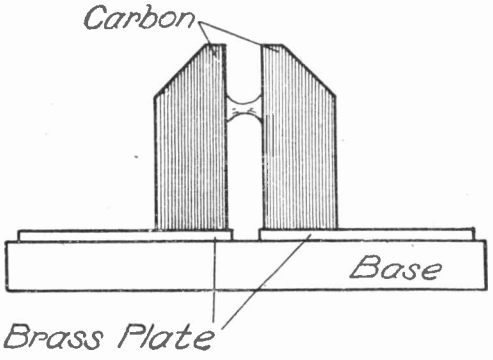


FIG. 2. WATER DETECTOR

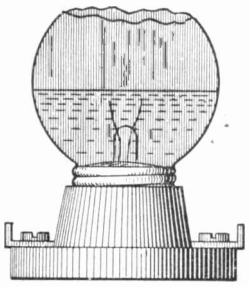


FIG. 3. SIMPLE ELECTROLYTIC DETECTOR

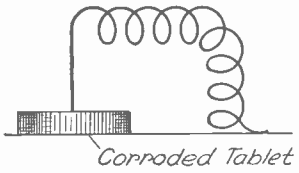


FIG. 4. CORRODED TABLET

It is possible to treat metal surfaces to give results as thermo cells. Immerse a tablet of iron or steel in a nitric acid solution for five minutes. Then wipe away all traces of acid. Bring to bear upon its surface the point of a very light helical spring as shown in Fig. 4. Messages can be received if a well corroded part of the tablet is used.

Coal can be used as a detector of etheric disturbances, owing to its carbonic base.

The crystal should be held between metal surfaces with considerable pressure, as by the method illustrated in Fig. 5. The pressure is regulated by adjusting the screw.

Mercury used between proper contacts is

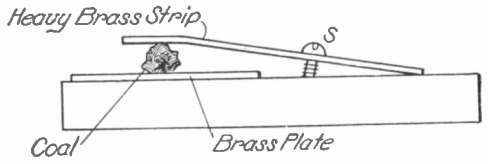


FIG. 5. COAL DETECTOR

suitable for receiving. It is not as sensitive as the crystal or electrolytic types for long distance work, but for local work cannot be surpassed, as the incoming signals are much louder and sharper than with the more sensitive types. The globule of mercury should be held in a small brass cup, as in Fig. 6, and contact made with a fine graphite point (from hard lead pencil) or a tantalum wire (this form known as the tantalum detector). The adjustment is difficult to maintain.

THE FLAME DETECTOR

The principle of the flame detector illustrated in Fig. 7 has been embodied in De-

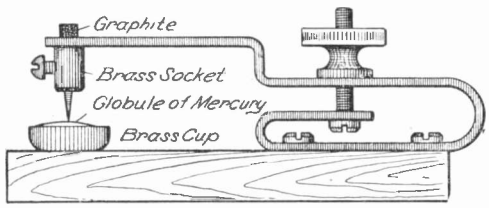


FIG. 6. MERCURY DETECTOR

forest's "audion." It is satisfactory for experimental purposes and marvelously sensitive, but, owing to the fluctuating quality of the flame, is not reliable for practical work. A strong battery current is necessary for its successful operation. The audion detector has proven sensitive enough to be adopted for use in long-distance wireless telephony. In operating the flame detector it is evident that a steady flame should be employed, as one fluctuating would of course register the fluctuations in the telephone receivers. A Bunsen burner is admirably suited to this purpose.

Two metal disks should be held in the flame at the point where the heat is greatest. The metal should be cut in disks one inch in diameter, 3-16 inch thick and the center of one side of each disk is tapped to fit a small threaded rod. The disks are held in the flame by these rods from brass posts seven inches in height fashioned from ½ inch rod. The posts should be mounted on a rubber or hard wood base and the Bunsen burner placed between them. The metal

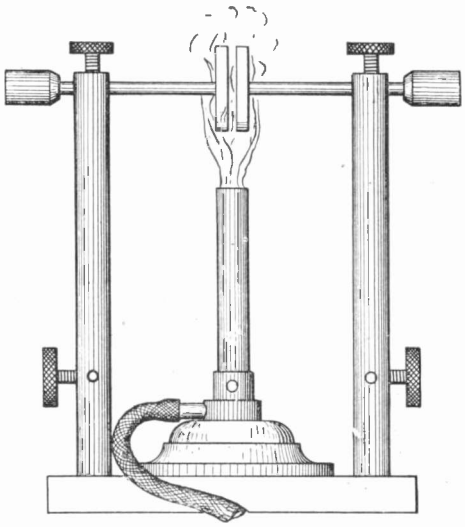


FIG. 7. FLAME DETECTOR

disks are next put in place. The round brass rods to which they are fastened should terminate in rubber or fibre knobs for adjusting purposes. The correct distance between the disks will be found to be 1-64 to 1-32 of an inch. For best results shunt a condenser of .005 mf capacity across it. A condenser of this capacity will consist of about 300 square inches of tin foil between paraffined paper. A variable condenser is of course more desirable than one of fixed capacity. The tuning system used should be designed to eliminate all local disturbances such as arc lights, street car flashes, high tension, etc., as the "detector noise" is quite loud in itself. Fig. 8 shows connections using a loose coupler and a single slide tuner with looped aerial. This "hook-up" will cut out most undesired disturbances.

CRYSTAL DETECTORS

Ferro-sulphide in pyrite form, known as "fools gold" to the layman and as iron-pyrites to the experimenter, can be very successfully used as a detector. The crystal should be fastened on lead in a brass cup and the contact made by a phosphor bronze or brass wire about No. 18. As ferro-sul-

phide pyrites vary a great deal in sensitiveness, it is best to test several crystals before selecting the one to be mounted in the cup. Testing can be done by using the brass wire and placing the crystal upon a nickeled surface. The cup in which the crystal is mounted should be movable, as the most sensitive point is not always found at first.

Fig. 9 shows a detector stand, easily made by anyone at all familiar with tools. It is suited to iron pyrites. The spring (S) is fashioned from a rather heavy strip of brass as the pyrites give best results under considerablepressure. This stand may be used for iron pyrites, cuprite, zincite and stibnite. By replacing the heavy bronze contact for a lighter one such as a light spring or needle it may be used for silicon, chalcopyrite, galenite or any of the "light contact" minerals.

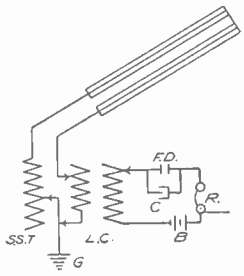


FIG. 8. CONNECTIONS FOR FLAME DETECTOR

CARBORUNDUM; THERMO-COUPLES

Fig. 10 shows a detector stand suitable for carborundum crystals. Brass disks are fastened on small rods supported by brass

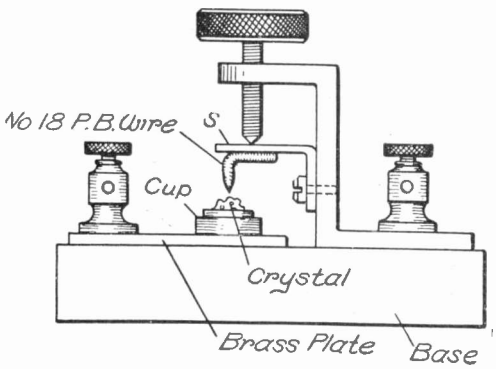


FIG. 9. FERRO-SULPHIDE (PYRITES) DETECTOR

binding poles. The crystal should be placed between the faces of the disks and the tension regulated by the thumb nut which influences the helical spring. Some carborundum crystals work better between carbon surfaces. It is a good idea to have carbon disks on hand in case the brass contacts are not satisfactory. This stand may be used as a thermo-couple by substituting cups in which the elements are mounted in place of the disks. Bornite and zincite constitute the most sensitive elements of a thermo-couple to this date. There are many others such as chalcopyrite and cuprite, galenite and cuprite, etc.

A list of minerals, more or less suitable for wave detection, is given below:

Carborundum.
Silicon. Fused.
Galenite. Sulphide of lead.
Graphite. Carbon, more or less pure.
Cuprite. Sulphide of copper.
Stibnite. Sulphide of antimony.
Sphalerite. (Blend). Sulphide of zinc.
Pyrrhotite. Essentially a sulphide of iron. (Iron 60.4; sulphur 39.6.)
Pyrites. Sulphide of iron. (Iron pyrites. Iron, 46.6; sulphur, 53.4.)
Chalcopyrite. Sulphide of copper and iron.
Corundum (variety of emery). Oxide of aluminum plus iron oxide.
Hematite. Oxide of iron. (Oxygen, 30; iron, 70.)
Magnatite (variety of loadstone). Oxide of iron. (Oxygen, 27.6; iron, 72.4.)
Cassiterite. Oxide of tin.
Siderite. Carbonate of iron.
Malachite. Carbonate of copper.

A UNIVERSAL DETECTOR STAND

It is a good idea to have a universal detector stand, in which any crystal may be tested. It should be equipped with a

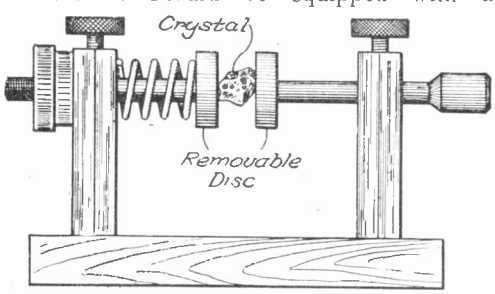


FIG. 10. UNIVERSAL DETECTOR STAND

variety of interchangeable contacts, so that the ones most suitable to the various substances can be ascertained. A sketch is given in Fig. 11 of a universal detector stand. It is equipped with carbon disks, one type of contact for carborundum. It may be used for a variety of substances by merely changing the contacts for ones most suitable to the crystal used.

In the digaram (A) is the adjusting screw: (B) phosphor bronze spring; (C) brass block; (D) and (E) removable cups; (F) carbon blocks; (G) crystals; (H) hard rubber base; (I) polished brass plate; (J) fiber "pill."

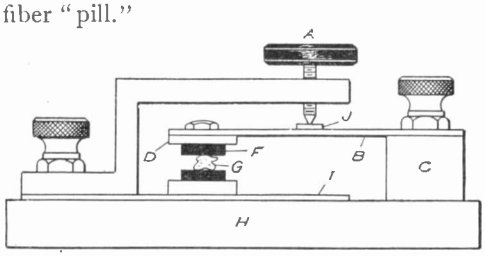


FIG. II. UNIVERSAL DETECTOR STAND

Green carborundum (translucent, not opaque) crystals are more sensitive than blue or red.

Electrolytic Interrupter

An electrolytic interrupter, to be used in connection with an open core transformer (or induction coil) on 110 volts 60 cycles A. C., can be made at a cost of about $1.00.

The material necessary is as follows: one large battery jar (or one-gallon crock); one porcelain insulating tube (like those used in the salammoniac battery); a piece of wood for a cover; one piece of glass tubing 14 inches long, and ¼ inch in diameter; one piece of sheet lead eight inches long, two inches wide and from ¼ to ⅛ inch in thickness; one large binding post, and a piece of bare copper or aluminum wire, No. 12, 15 inches long.

Cut the wooden cover large enough to allow it to extend past the jar one inch on each side, as shown at (8), Fig. 1. In the center of the cover a hole should be bored large enough to allow the porcelain insulating tube to be inserted. Three inches from the hole in the center of the cover, bore another hole ¼ inch in diameter, for the binding post. Drill a ¼-inch hole in the lead strip (6), one inch from the end. Bend the lead as shown and insert the binding post (5) and tighten the lead against the wooden cover.

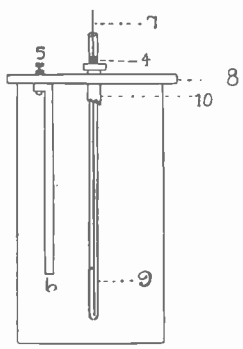


FIG. 1. ELECTROLYTIC INTERRUPTER

Insert the insulating tube (10) and glass tube (9) allowing the glass tube to extend three or four inches from the bottom of the jar. Now wrap a piece of tape (4) or a rubber band around the glass tube to hold it in place. Take the glass tube (9) and hold the end farthest from the tape in the flame of a blow torch, or in a gas flame. The end of the tube will begin to close up of its own accord; allow it to close leaving only a small hole. Two or three of these tubes should be made, with different sizes of holes, from the size of an ordinary little pin to that of a large hat pin.

If you use a tube with too large a hole, you will find that the lamps in the house will flicker every time you work your telegraph key in sending. This means that you are using too much current, and should have a tube with a smaller hole. Good results should be obtained without having the lamps flicker at all.

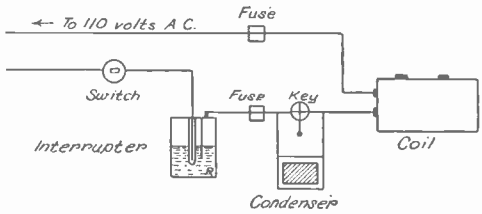


FIG. 2. CONNECTIONS FOR ELECTROLYTIC INTERRUPTER

The solution for the interrupter is: one part sulphuric acid to nine of pure water. Pour the water into the jar first, and then the acid, otherwise you are apt to break the jar, as acid generates a great amount of heat when coming in contact with water. This solution should come up on the lead plate about three inches, and the wire (7) and glass tube (9) should be almost even with the lead plate (6). The operator can adjust this to meet requirements.

It is not advisable to use the interrupter on a coil giving less than a one-inch spark, owing to the fact that small coils as a rule are not built to carry very heavy current. I have drawn a diagram of connections, showing interrupter, coil, key, two fuses, a switch and condenser shunted around the key. The object of the condenser shunted around the key is to diminish the sparking at the platinum points.—H. I. REISER.

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.

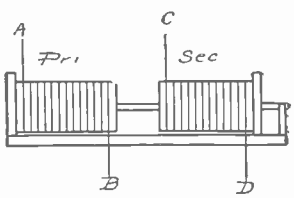
Tuning Coil Dimensions

Questions.—(A) What are the dimensions of a 1,500-meter, single slide tuning coil using No. 20 enameled wire? (B) What are the dimensions of a loose coupled tuning coil of 1,500 meters wave length having a slide on both primary and secondary? (C) What size enameled wire shall I use for (B)? (D) In the diagram herewith which end of the primary should be dead, (A) or (B), and which connected to the binding post; which end of the secondary should be dead and which connected to binding post (C) or (D)?—M. B. Van W., Hampton, Va.

Answers.—(A) See answer to F. K., Jr.

(B) Primary—diameter four inches, length of winding four inches; wire, No. 22 enameled.

Secondary—diameter $3\frac{1}{2}$ inches, length $3\frac{3}{4}$ inches, wire No. 28 enameled.



CONNECTION DIAGRAM

(C) See (B).

(D) (A) and (D) should be dead, and (B) and (C) should be connected to binding posts.

Bridging a Tuning Coil; Detector

Questions.—(A) If the wave length of a tuning coil is 1,000 meters and its resistance three ohms and it has a piece of German silver wire bridged across it having a resistance of three ohms, what would be the wave length of the combination? (B) What detector would be more sensitive and satisfactory than a gold pointed silicon detector, using no potentiometer or battery?—L. T., Chicago, Ill.

Answers.—(A) The combination would have an inductance corresponding to zero wave length, and practically none of the received energy would pass through the coil.

(B) The Perikon detector.

Peroxide of Lead Detector

Question.—Please describe the action of the peroxide of lead detector.—H. A. W., Chicago, Ill.

Answer.—The peroxide of lead detector consists of a small piece of compressed lead peroxide, held between one lead and one platinum electrode. The negative (zinc) pole of the battery is connected to the lead electrode, and the positive pole to the platinum. It is supposed that the current of the local battery decomposes the lead peroxide into lead and oxygen gas, the former appearing at the lead, and the latter at the platinum electrode. The lead, the peroxide and the platinum form another battery of themselves, and whose tendency is to counteract the local battery, since the electromotive force developed is found to be in the opposite direction.

When the voltage of the local battery is adjusted to the most advantageous point, it is supposed to be very slightly in excess of that developed by the lead, lead peroxide, platinum battery. The oscillations are supposed to destroy the state of equilibrium between the two batteries, and to allow the local battery current to pass, after which the equilibrium is restored. As to whether this detector acts as a rectifier, or a relay, or a combination of both, we are not prepared to say, for there are many factors to be considered.

Receiving Set; Potentiometer; Double Slide Tuning Coil

Questions.—(A) What instruments are necessary for a small receiving set using an electrolytic detector? (B) Can a small 20-ohm rheostat be used for a potentiometer, and if not can one be made using $\frac{1}{4}$-pound No. 28 German silver wire single cotton covered, on a core 3 by 7 inches? (C) How can a small double slide tuning coil be made?—F. K., Jr., Oklahoma City, Okla.

Answers.—(A) The instruments necessary are a detector, potentiometer, two dry cells, and telephone receiver.

(B) The rheostat can be used, but much better results may be obtained with the potentiometer which you describe.

(C) Wind one layer of No. 20 enameled copper wire on a cardboard tube two inches in diameter and twelve inches long. The winding should be eleven inches long. One-half pound of the wire will be required. Arrange two sliders so that they will always maintain electrical connection with the wire of the coil. They should touch only one wire at a time.

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.

Definitions; Pupin and Tesla Coils; Mercury Vapor Lamps

Questions.—(A) What is the difference between a spark coil and an open core transformer? (B) (1) What is inductance? (2) Impedance? (3) Reluctance? (4) Admittance? (C) What is a Tesla coil? (D) What is a Pupin coil? (E) Are mercury vapor lamps made to work on both 110 volts alternating and direct current? How many watts per candle-power do they consume?—M. S., Fort Worth, Texas.

Answers.—(A) A spark coil is built along the same lines as an open core transformer, and is a transformer. The ratio of transformation is usually much lower in the ordinary transformer than in the spark coil. In the latter a make-and-break contact with a condenser connected across this contact greatly increases the length, thickness, and brilliancy of the spark which is intermittent, while in the transformer a steady flow of current from the secondary is usual.

(B) (1) In general by inductance we mean that inexplicable formation of lines about a wire or coil of wire which a magnetic needle tells us are there when a current flows in the wire or coil. These lines represent energy and exercise an inductive effect on adjacent wires. (2) Circuits always have resistance as well as inductance. The combined effect of the two is called impedance and is expressed by the formula:

Impedance in ohms =

$$\sqrt{R^2 + (2x3.1416xfxL)^2}$$

in which

R = resistance of the circuit
f = frequency
L = inductance.

(3) The term reluctance applies to the resistance offered by a magnetic path to the flow of lines of force. For example, the reluctance of wrought iron is less than that of cast iron, the former requiring less ampere-turns to produce a given flux. (4) If I represents the impedance of a circuit in ohms, $\frac{1}{I}$ is its admittance. Used in figuring problems regarding A. C. circuits in parallel, into which calculations resistance, inductance and capacity enter.

(C) A form of induction coil built to give high potentials and high frequencies. This coil and the method of operation is described fully in the January, 1909, issue.

(D) In a long telephone cable the speaking current is distorted, due to the static capacity of the conductor, and is also blurred if the frequency is high. To balance this capacity and get rid of the blurred sound effect, Professor Pupin places an ordinary coil of wire containing a laminated iron core in each circuit at intervals one-eighth of a mile apart. By the introduction of this inductance the talking current is modified so that the proper sounds are registered at the receiving end.

(E) Mercury vapor lamps are made for either direct or alternating current, but the same lamp can be used only upon the kind of current for which it is designed. Lamps requiring 110 volts take 3.5 amperes or 385 watts, the candle-power ranging according to type from 300 to 800.

Empire Cloth

Question.—What is empire cloth?—L. S., Rochester, N. Y.

Answer.—Empire cloth is made of linen-finished muslin, muslin, or special silk coated with films of pure oxidized linseed oil. The finished cloth is very strong and according to design is capable of resisting a puncture on as high as 15,000 volts.

Return Call Bell Circuit

Questions.—(A) Give diagram showing how to connect a call bell with a bell and button at each end of the line so that if the party at one end rings the party at the other end may answer. (B) Can this be done using only two wires?—L. B., The Bronx, New York City.

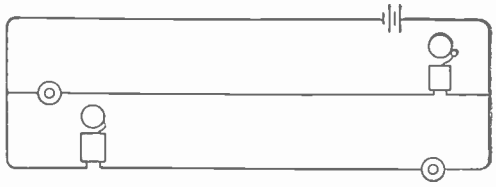


FIG. 1

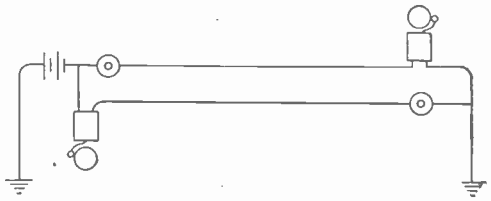


FIG. 2

Answers.—(A) See diagram, Fig. 1.

(B) By grounding at each end as shown in the diagram Fig. 2 only two wires are necessary.

Battery Overcharging; Ampere-Turns; Frequency and Slip

Questions.—(A) What effect does it have on a storage battery to overcharge it? (B) What is meant by ampere-turns when referring to a coil? (C) Knowing the frequency of a circuit, the voltage and the number of poles on an a. c. motor how do you find the speed, and what is allowed for the slip? —A. S. C., Webb City, Mo.

Answers.—(A) Most storage batteries are not injured by a slight overcharging at a moderate rate and it is well to let this occur occasionally because this tends to remove sulphating. An excessive overcharge should be avoided as it causes a formation of gas bubbles in the active materials, is very apt to heat the cell and even cause crumbling and buckling of the plates.

(B) The number of amperes flowing through a coil multiplied by the number of turns of wire, give the number of ampere-turns. For example, two amperes flowing through 10 turns of wire would be designated as 20 ampere-turns. Tables referring to windings on magnets to produce a certain flux and resulting pull are arranged with relation to the number of ampere-turns per inch length of the magnet. See "Common Electrical Terms Defined" in the May, 1910, issue.

(C) $$N = \frac{F}{P}, \text{ where}$$

N=revolutions per second of armature.

F=frequency.

P=number of pairs of magnetic poles.

From one to five per cent is usually allowed for slip in induction motors. Slip, as is evident, is inversely dependent on the voltage.

Automobile Jump-Spark Coil; High Tension Magneto

Questions.—(A) Please explain the principle of the non-vibrating automobile jump-spark coil. (B) Is an induction coil used in the circuit with a high tension automobile magneto?—R. P., Roswell, N. H.

Answers.—(A) With the jump-spark produced from a secondary circuit there are no movements of the electrodes the primary circuit being periodically broken by a contact breaker, this resulting in a current in the secondary which arcs from the spark plug to the engine frame, or from one spark point of the plug to the other.

(B) In a high tension magneto the current generated in the low resistance of the armature is transformed by a high resistance winding usually on the same armature and distributed to the cylinders from a rotating contact commutator. The device is, therefore, a generator, induction coil, and distributor all in one.

Rating of Standard Socket

Question.—For what voltage and current is the ordinary brass shell standard key socket rated?—W. A. L., Syracuse, N. Y.

Answer.—The standard lamp socket is suitable for use on any voltage not exceeding 250 and with any size carbon lamp up to 50 candle-power. For carbon lamps larger than 50 candle-power or requiring more current than such a lamp a standard keyless socket must be used; or, if a key is necessary a special socket designed for the current required must be made. Recent Code rulings require sockets to be marked with the capacity in watts rather than in candle-power as formerly.

Remedies for Patent Infringement

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

REMEDIES FOR INFRINGEMENT.—*In General.*—A patentee may sue either at law or in equity, according as the relief demanded is of a legal or an equitable nature. If damages for an alleged infringement are sought, an action at law is the proper action; and if a patent has expired at the time when suit is brought, so that an injunction cannot be awarded, it is ordinarily the exclusive remedy. But if the patent has not expired, and the patentee wishes to restrain acts of infringement, he may sue in equity for an injunction, and, as incident to that form of relief, the court has power to decree an accounting as to profits realized by the defendant. A person may sue for an infringement of any one of the separate and distinct inventions that may be covered by his patent.

JURISDICTION.—*At Law.*—If only the recovery of damages for the injury is sought in an action for an infringement, or if, in an action *ex contractu* arising as to a patent, the recovery of damages or compensation is the only object, the remedy at law is adequate, and a court of equity has no jurisdiction.

IN EQUITY.—*In General.*—Jurisdiction in equity is usually predicated upon the right to an injunction, and so a suit in equity merely for profits and damages cannot be maintained. It must appear that the remedy at law is inadequate, and if the case is one in which equitable relief by injunction is inappropriate, as where a patent has expired, the suit will not be entertained for the mere purpose of an account of past damages and profits. It is well settled, however, that the expiration of a patent pending a suit for infringement does not defeat the injunction which was the basis of equity jurisdiction.

INJUNCTION.—*In General.*—The power is expressly conferred by Act of Congress upon the several federal courts vested with jurisdiction in cases arising under the patent laws to grant injunctions according to the course and principles of courts of equity. The writ of injunction issues in patent cases on the principle that the property in a patent is just as much under the protection of the law as property in land. The owner has the same right to invoke the protection of the court, and when he has made good his claim to his patent and has shown an infringement of it, it is the duty of the court to give him the same relief meted out to suitors in other cases.

DISCRETION OF COURT.—The granting of a preliminary injunction is a matter resting in the sound discretion of the court, to be determined upon the peculiar circumstances of the particular case.

PERPETUAL INJUNCTION.—The general rule that perpetual injunctions are awarded, or their issuance is directed, or the preliminary injunction already issued is made final or perpetual, by the final decree of the court, or when the rights of the parties, so far as relates to the subject of the injunction, are finally adjudicated or disposed of by the order or decree of the court, obtains in patent cases as in others.

WHEN GRANTED.—The general rules that an injunction will not be granted when the remedy at law is full, adequate, and complete, nor unless it clearly appears that the court's interference is required to prevent irreparable injury, obtain in patent cases. On an application for a preliminary injunction the court will consider whether a greater injury will be done by granting an injunction than would result from a refusal.

THREATENED INFRINGEMENT.—If the rights of a party under a patent have been fully and clearly established and an infringement of such rights is threatened, or if, when they have been infringed, the party has good reason to believe that the infringement will be continued, an injunction will issue.

CESSATION OF INFRINGEMENT.—The fact that the defendant has ceased to infringe the patent, or promises to abstain from infringing in the future, is no reason for refusing an injunction.

EXPIRATION OF PATENT.—As a general rule, an injunction cannot be obtained after the expiration of a patent. Where the complainant can be compensated in damages, a preliminary injunction will not be granted very shortly before the expiration of a patent. But an injunction may be

granted even though the patent is about to expire when damages would not usually be granted where the complainant's right is doubtful. Thus, in order to authorize a court to allow a preliminary injunction, not only must the infringement be without reasonable doubt, but the rights of the patentee must be clear; and failing prior adjudication in favor of the validity of the patent, there must be shown such continued public acquiescence in the exclusive right asserted as raises a presumption of validity, not arising from the letters patent alone. Where the right to a preliminary injunction is in doubt, it is always a material circumstance for consideration that the defendant is responsible for any damages which may be decreed against him upon the final hearing.

REFUSAL OF INJUNCTION WHEN SECURITY GIVES.—A court will sometimes, in view of the circumstances of the case, instead of issuing a preliminary injunction, allow the defendant to give a bond to secure damages; but this course will not generally be pursued when the validity and infringement of the patent are clear.

VIOLATION.—The general rule that it is the duty of parties to obey an injunction is applicable in patent cases, and the violation of an injunction is a contempt of the court from which it issued, and is punishable by it as such.

FEDERAL COURTS.—*In General.*—Under the Acts of Congress, jurisdiciton of all suits at law or in equity arising under the patent laws is conferred upon the federal courts. Under these statutes the federal courts have exclusive jurisdiction in cases where the infringement of rights granted by a patent issued under the authority of the United States is primarily involved, or in suits to declare patents void and the like, notwithstanding questions of contract or license may also arise therein. Cases of this character are not cognizable in state courts.

PARTICULAR FEDERAL COURTS.—The federal courts which, by statute, have original jurisdiction of suits at law or in equity arising under the patent laws are the circuit courts, certain district courts, and the Supreme Court of the District of Columbia.

THE COURT OF CLAIMS has jurisdiction of actions against the government founded upon contracts as to patents, whether such contracts are express or implied. It has no jurisdiction of actions in tort for infringement by the government.

STATE COURTS.—In cases where the rights of the parties depend altogether upon common-law or equity principles, the state courts and not the federal courts have jurisdiction. Thus, where a suit is brought on a contract of which a patent is the subject-matter, either to enforce such contract or to annul it, the case arises out of the contract, and not under the patent laws, and the jurisdiction thereof is in the state court. State courts have an undoubted right to adjudicate upon questions as to the rights of parties which do not come within the provisions of the law relating to patent rights. In such cases the right secured by the patent is collateral to the main purpose and object of the action, and when this is the case the state courts have jurisdiction to determine the controversy.

SWITCHBOARDS. By William Baxter, Jr. New York: The Norman W. Henley Publishing Company. 1910. 188 pages with 150 illustrations. Price, $1.50.

In the early days of arc lighting the wires from the dynamo were run directly to the lights without so much as a switch being used. With the introduction of the incandescent lighting system making the danger from an overload possible, the switchboard with its instruments and safety devices came along as a necessity, being looked upon as next to the generator in importance. Modern switchboards are complicated affairs, especially if the principles upon which they are based are not understood.

This book appeals to every engineer and electrician who wants to know the practical side of things and takes up all kinds of dynamos, connections, circuits and switchboard wiring. Diagrams are given showing construction of switchboards, and arrangement of switches and instruments in the use of both alternating and direct current and on high and low tension systems. Circuit breakers, lightning arresters, synchronizers and oil switches are also given due attention.

ON POLYPHASE SUBJECTS

An Interview with Edison

One of our readers wrote in a short time ago and said: "Give us more Edison." Not only he but all the rest of the POPULAR ELECTRICITY readers will doubtless rejoice in the fact that we are going to be able to give them "more Edison" in the November issue in the form of an exclusive interview with the great inventor.

Most people know by this time that Mr. Edison has been working perseveringly for many years that he might give to the world a storage battery which, in efficiency and reliability, would be worthy of the name of Edison. After nine thousand experiments he accomplished his purpose and the Edison battery is now a reality. Something of the patience required to make the tedious experiments and tests, more of the possibilities which he sees in his latest achievement will be told in his own words in the November number.

In the Chain of Bureaucracy

To the Editor of Popular Electricity.—In the May issue of Popular Electricity, on page 35, the slow introduction of the electric doorbell in smaller German and Austrian villages is referred to. As a matter of fact Germans *are* very slow in adopting modern conveniences, but the electric doorbell is as common here as in the United States. Regarding the inscription, "Bitte zu drücken," I wish to say that it is not to teach ignorant people how to use the push button, but it is simply a queer German habit to put names and signs on everything which is intended for public use. If, for instance, one looks at a German railroad station he will notice numerous signs and hands directing the traveler to the ticket office, baggage master, station master, waiting rooms, entrance to trains, etc.; but not enough with this, even the ex- and interiors of railroad cars are "decorated" with signs in German, French and Italian, giving directions and destination of each car. In many respects all this labeling is of some convenience to the traveling public, but it is also a link in the great chain of that awful bureaucracy, the plague of Germany.

Very truly yours,

JOSEPH E. SCHNECKER.

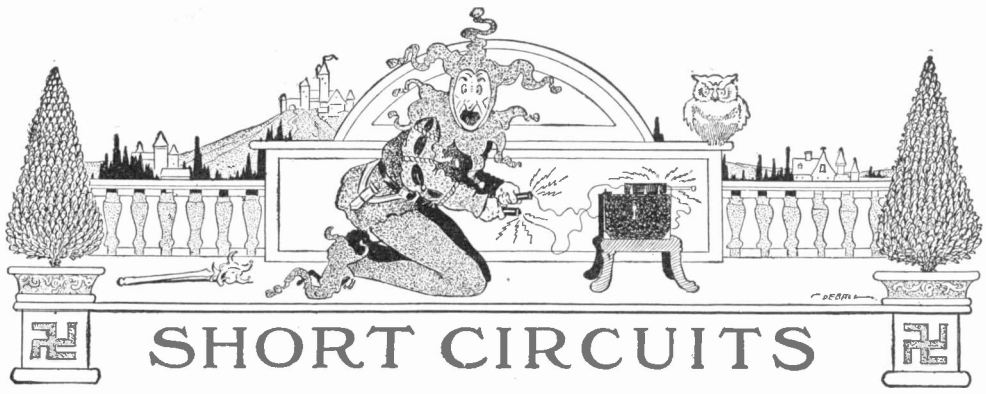
Bad Kreuznach, July, 1910.

Municipal Electric Clocks

Should the municipality itself overcome any disputes as to the exact time by maintaining a series of clocks scattered all over its precincts and electrically timed in unison? This question has been before the authorities of Berlin's electrically most progressive suburb, the city of Charlottenburg, and the answer there has been yes. Steps have already been taken towards installing 720 municipal clocks all connected to a central time station which will have an ultimate capacity of regulating 3,000 clocks. The specifications called for an allowable variation of only one second between the time of any of these secondary clocks and the master timepiece. Offhand this seemed like a rigid requirement, yet tests on existing clock systems have shown that in practice the deviation need not exceed one twelfth of a second. The entire installation is to cost about $12,500.

The New Cover

The question of a magazine cover is a hard one to decide upon. There are two ways of looking at the matter. One idea is to have a new cover every month, making the cover one of the features of the magazine. The other plan which may be pursued, of preserving the essential features of the cover in each issue, also has its advantages, especially in the case of a new magazine where the same dress each month helps in a measure to establish its identity. For the latter reason we have used, up to the present issue, almost the same design. However, the old cover has, we believe, served its purpose, and with this number a decided change has been made. We would like the opinion of POPULAR ELECTRICITY readers as to what they think of the new design.



SHORT CIRCUITS

The enterprising manager of one theater believes in profiting by the misfortunes of others. One day he displayed the following sign in his house:

DO NOT SMOKE
REMEMBER THE IROQUOIS FIRE!

Which led one of his friends to put up in the theater the next day another sign which read:

DO NOT SPIT
REMEMBER THE JOHNSTOWN FLOOD!

* * *

Kerrigan yelled: "O'Brien! O'Brien! Your dog is mad! Look at the foam coming from his mouth."

"He's not mad," said O'Brien. "He's just been eating a cream puff."

* * *

When Casey was promoted to the rank of detective on the police force he came home and said:

"Ellen, I'm a detective now. Hide something and see if I can find it."

* * *

A member of a State Legislature was very much impressed with the dignity of his position and it was always on his mind. One night his wife woke him and whispered:

"John, there are burglars in the house."

"You must be mistaken, my dear," said her husband; "there may be a few in the Senate, but in the House—oh, no; the idea is preposterous."

* * *

Finnigan tells of a friend of his who was awakened by his wife whispering hoarsely in his ear:

"Pat, get up quick; there's burglars in the house!"

"Get up yourself. You didn't marry a policeman," replied Pat.

* * *

A well-known business man attended his daughter's commencement exercises at an Eastern college recently. He had been greatly pleased with the beauty and dignity of the exercises and was discoursing to his wife upon the refining influences of college life. Suddenly his impressive monologue was cut short. A girl, in cap and gown, came dashing down the steps of the main hall, waving her diploma and shouting: "Educated, by gosh!"

* * *

The other day Pat went into a cafe and ordered a glass of beer. The waiter brought him a very small glass.

"I suppose if I called for a small one," remarked Pat, "you'd spray my throat with an atomizer."

* * *

"Myrtle has gone upon the vaudeville stage and has made an instant big hit because of her daring."

"What is her act?"

"She sings in a cage of mice."

* * *

Society Woman—I see by today's paper I am referred to as "one of fashion's butterflies."

Her husband—Considering the way you go through my clothes I should think "moth" would apply better.

Here are some extracts from real letters received by the San Francisco Gas and Electric Company:

"S. F. Gas and Elec. Co.—Gentlemen,—I wish you would send a gas leak at your meter.—Respectfully, Mrs. P. C."

From a Chinaman: "Please you call, fix meter, heap stink."

S. F. Gas Co.—"My gas meter is out of order; also my neighbour, Mr. Schmidt. Will you please send somebody to fix them?"

From another Chinaman: "We have been burning your gas for so many years and that usually to pay the bill from $3 to $5 a month with no excessive! However the bill claims so much in the future two months. It is hardly to satisfactory. We will mail these receipt to you kindly compare it at once whether its reighteous. Answer. Respectfully yours, ——."

* * *

An Irish politician had just returned from a trip abroad. A friend met him and inquired:

"Did you have a fine time, Mike?"

"Of course I did."

"Did you visit the theaters in Paris?"

"Sure, I saw all the plays."

"And did you go to the cafes?"

"Sure, I was in all of 'em."

"Well, tell me, Mike, and did ye see any pommes de terre?"

"No. I had the wife with me all the time."

* * *

O'Brien had one hundred and fifty cows on his farm and had only five men to do the milking. He bought some stools so as to make it easy for the men.

He gave Kerrigan a stool, and Kerrigan came back five minutes later all banged up.

"What's the matter with you?" asked O'Brien.

"I couldn't make the cow sit on it," said Kerrigan.

* * *

Mike and Pat were playing draw poker.

"I'll bet yez you have a spade before we draw," says Mike.

"Sure and who told you Oi had one?" says Pat.

"I see yez spit on your hands when you picked it up," says Mike.

* * *

The mother of the twins found them fighting furiously. Willie, the larger twin, was on top. He was beating Tommy about the face and head.

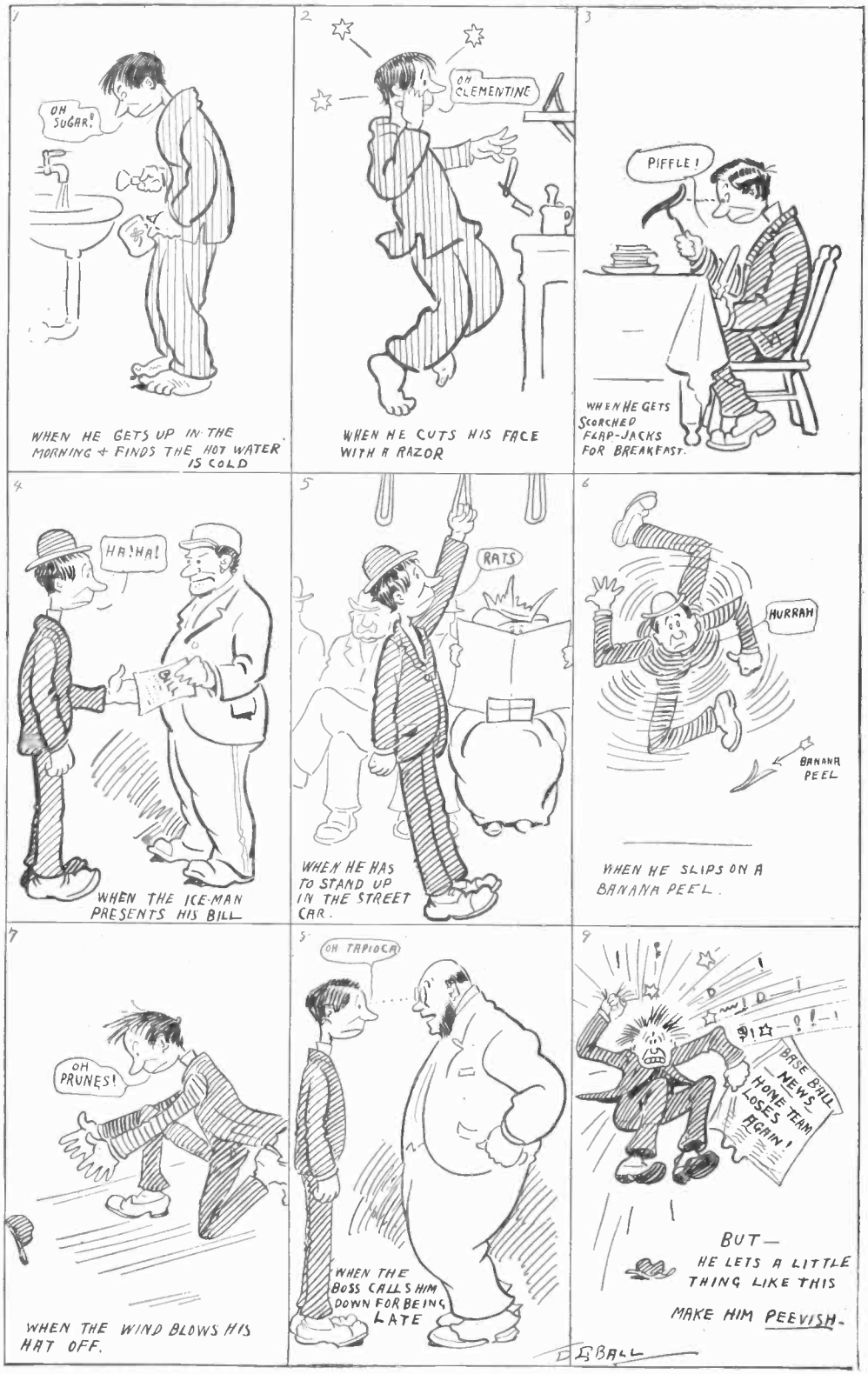
"Why, Willie, how dare you strike your brother like that!" cried the mother, taking the boy by the ear and pulling him off.

"I had good cause to strike him," answered Willie.

"What do you mean?" she asked.

"Why," said Willie, with a righteous air, "didn't I let him use my sled all last Saturday on condition that he'd say my prayers for me all this week? And here I've just found out that he's skipped three days."

THE BASE BALL FAN



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.

BRUSH.—The pieces of carbon, or copper, on generators and motors, bearing on certain points of the revolving commutator either collecting current or passing it to the machines. These brushes are made, some of rods or slabs of carbon, others of bundles of copper wire or strips.

BRUSH DISCHARGE.—A form of continuous electric discharge through the air from a conductor. A brush discharge reveals a steady pale blue luminous core and is accompanied by a hissing noise. When the discharge occurs from a positive electrode the brush effect is more marked than from the negative.

BRUSHES, LEAD OF.—At rest the magnetic fields of a dynamo pass directly from north to south poles, the position of tl e collector brushes lying midway between on the commutator. When the armature is revolved these fields are distorted by being drawn forward in the direction of the rotation necessitating a forward displacement of the brushes called "lead."

BRUSH HOLDERS.—Clamps or clutches for securing in place the brushes of a dynamo or motor. They are so arranged as to permit adjustment and are connected to the rocker. Springs under tension cause the holders to press the brushes upon the commutator.

BRUSH, PILOT.—By connecting one terminal of a voltmeter to one of the brushes of a dynamo and providing a small brush called the pilot brush on the other terminal a study of the distribution of potential may be made by applying the pilot brush to different parts of the commutator.

BUCKLING.—A warping of the plates of a storage cell by allowing a too heavy discharge rate. Quantities of gas driven from the plates at the time of sudden heavy discharges cause the injury. A temporary cure for buckling is the insertion of glass or wooden strips to prevent adjoining plates from touching. If plates are not arranged so that the resistance from every part of one plate to the corresponding part of the adjoining is equal, buckling will take place.

BUOY, ELECTRIC.—A floating signal equipped with an electric light fed by a cable from shore.

BUS BARS.—Heavy copper bars usually placed either on the back of the switchboard or in high tension work in a special room called a bus-chamber. To these bars the conductors from a dynamo or several dynamos are connected, and from them current is taken off through switches and fuses to be distributed by feeders to points where needed. The name seems to be derived from "omnibus" the first portion of which signifies "all." Each bus is known as positive, negative, or neutral, according as the positive, negative, or neutral leads from the generators are connected to it.

BUS ROD.—See Bus Bars.

BUSHING, SOCKET.—A threaded nozzle usually of hard rubber which is screwed into the hole through which the flexible cord passes into a brass shell socket. This bushing protects the cord from becoming worn and also acts as an insulator between socket and cord.

BUZZER.—An electric make-and-break mechanism or vibrator enclosed in a case so as to magnify the sound produced by the very rapid motion of the vibrator. Used as an alarm or calling device where a bell would be too loud.

B. W. G.—Abbreviation for the Birmingham Wire Gauge used in England for measuring electrical wires. Its range is from 0000 = .454 inch diameter to 36 = .004 inch diameter.

CABLE.—An electric conductor made up of several wires insulated and protected by sheathing, which latter is generally of lead. The enclosed wires may not be insulated from each other, the whole forming a single conductor; or, each wire may be insulated so as to make a large number of independent conductors. Cables are made for use either in air or water. The term is also applied to stranded conductors without insulation.

CABLE, ARMOR OF.—A covering of lead, steel or wire used to protect a cable from mechanical injury and corrosive action.

CABLE BOX.—The box often seen mounted on a pole and into which an underground cable runs, to be there divided up and continued as separate wires of aerial circuits.

CABLE CLIP.—A metal cable hanger by means of which an aerial cable is supported at frequent intervals from a suspending wire as illustrated. (See Cable Hanger).

CABLE, DUPLEX.—A cable containing two separately insulated wires laid side by side.

CABLE, FLAT.—A cable flat in shape so that it will project but little when placed on a wall or ceiling.

CABLE HANGER.—A metal or rope support for aerial cable. (See Cable Clip.)

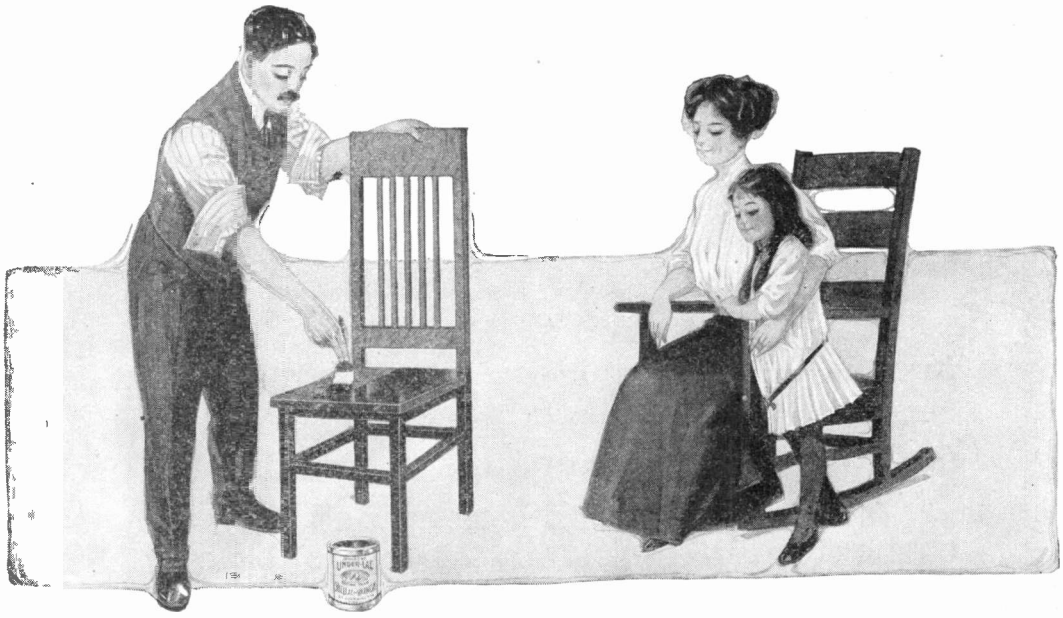
CABLE HEAD.—A water tight cast iron box placed at the end of a cable. Made also of lead or porcelain and called a pothead. (See Cable Box.)

CABLE TANK.—A tank containing water in which the submarine cable is carried on a cable-laying ship. While in this tank the cable is tested. In factories cable tanks are arranged so that the cable may be subjected to hydraulic pressure so as to approximate the pressure of deep water during test.

CALIBRATION.—In general the fixing by test of the scale readings on a new instrument. Applied also to the comparison of an instrument with a standard for the purpose of determining corrections to be made in order to have the readings of the tested instrument accurate.

CALL BELL, EXTENSION.—A system of bell wiring by which a switch, push button or magneto energizes a main line circuit, this circuit operating a local relay. The armature of this relay closes a local battery and bell circuit, this armature being arranged to keep the circuit closed indefinitely. Applied also to a bell circuit tapped on as an addition to an already existing circuit.

CALL BUTTON.—A push button used to close the circuit of a buzzer, bell or annunciator to call the attention of a person at some distant point.



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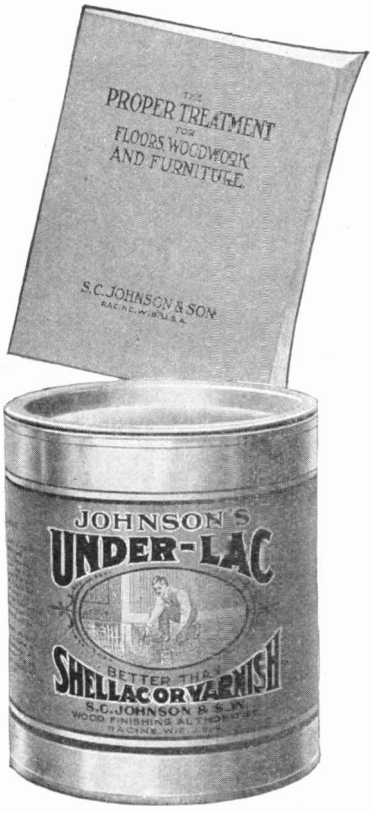

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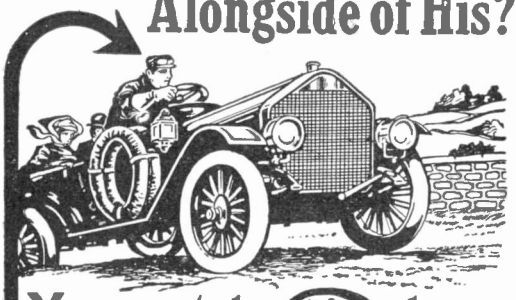

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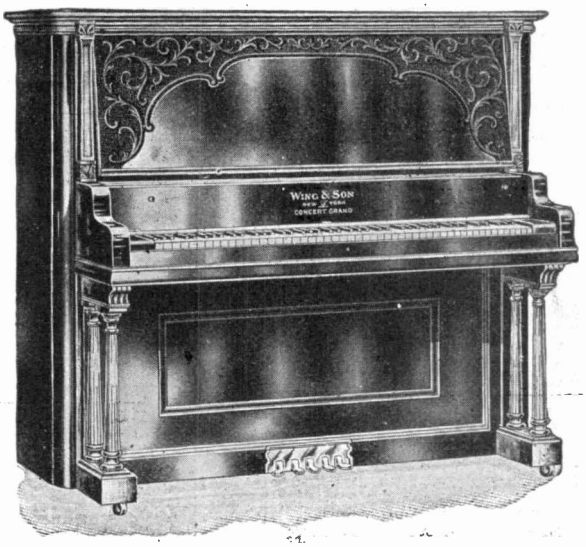

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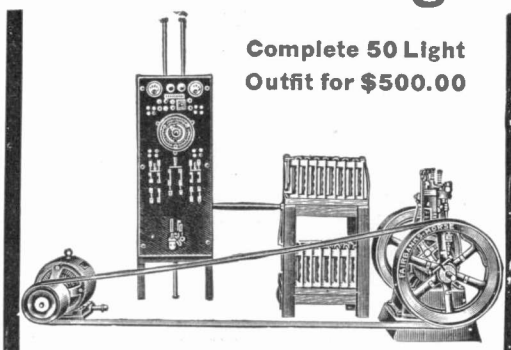

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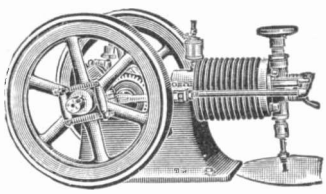

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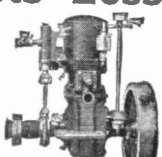

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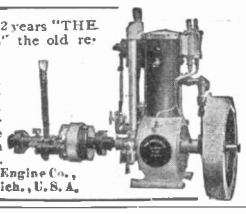

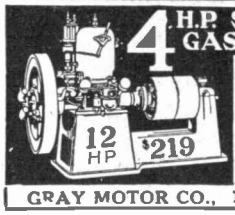

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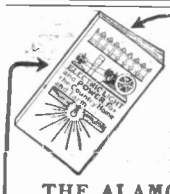

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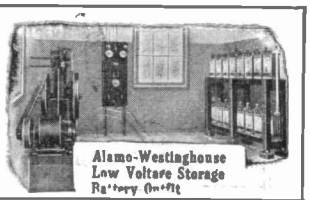

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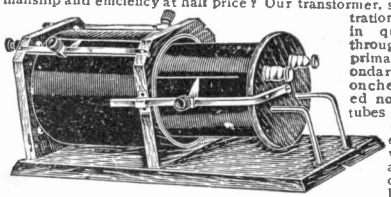

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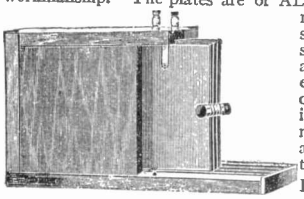

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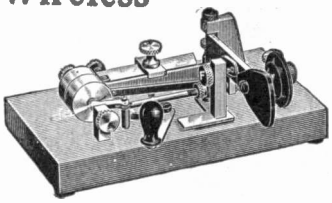

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MECOGRAPH CO., 321 Frankfort Ave., CLEVELAND, O.

Please send me descriptive literature of the Mecograph.

Name.....

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THE 20TH CENTURY WONDER

Miniature X-Ray

Mailed with full Instructions for 25c

An instructive and scientific device for old and young. Shows the bones in your hand, lead in a pencil, etc., same as a $150 machine.

SEND FOR CIRCULAR

WIRELESS

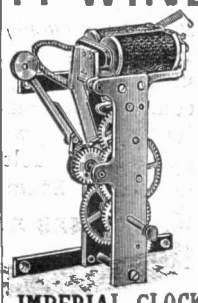
We also handle a full line of Wireless Outfits, Miniature Lamps and toys. Electrical Xmas tree outfit our specialty. Send for catalogues.

STAR ELECTRICAL CO., 1034 Broadway, Brooklyn, N. Y.

AGENTS PORTRAITS 35c. FRAMES 15c. Sheet Pictures 1c, Stereoscopes 25c. Views 1c. 30 Days' Credit. **Samples and Catalogue Free.**

CONSOLIDATED PORTRAIT, Dept. 1406, 1027 W. Adams St., CHICAGO.

IT WINDS ITSELF



This Movement used in our

CLOCKS

is so simple that it needs no repairs.

Used also to operate moving advertising

DEVICES

SEND FOR LITERATURE

IMPERIAL CLOCK CO., GRANITE CITY, ILL.

"That Coupon Gave Me MY Start"

"It's only a little while ago that I was just where you are now. My work was unpleasant; my pay was small. I had my mother to take care of, and it was tough sledding trying to make ends meet. I hadn't had much schooling. I didn't *know enough* to fill any better job than the one I had.

"One day I saw an advertisement of the American School. It told how other men got better positions and bigger salaries by taking their courses. I didn't see how a correspondence course could benefit me, but as long as it didn't *cost* anything to mark the coupon I thought it was worth investigating at least. I marked the coupon and sent it in on the next mail.

"That was two years ago last April, and **now I'm drawing more every week than I used to get in a month."**

If YOU want a **better position,** if YOU want to get into **congenial work,** if YOU want a salary that's **worth while—**

Sign the Coupon NOW

American School of Correspondence
Chicago, U. S. A.

Opportunity Coupon

American School of Correspondence

Please send me your Bulletin and advise me how I can qualify for the position marked "X."

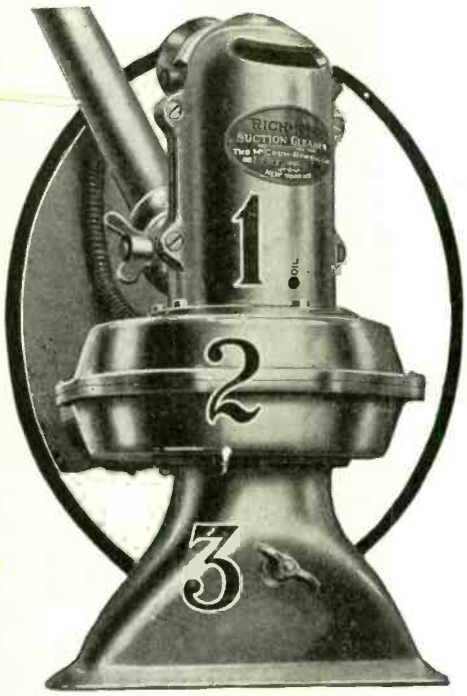
.....Book-keeper	.....Draftsman
.....Stenographer	.....Architect
.....Accountant	.....Civil Engineer
.....Cost Accountant	.....Automobile Engineer
.....Systematizer	.....Electrical Engineer
.....Cert'f'd Public Acc'nt	.....Mechanical Engineer
.....Auditor	.....Sanitary Engineer
.....Business Manager	.....Steam Engineer
.....Commercial Law	.....Fire Insurance Eng'r
.....Reclamation Engineer	.....College Preparatory

NAME_____

ADDRESS_____

OCCUPATION_____

Pop. Elect. 10



This is a reduced reproduction to show detail. The actual height of the machine is 12 inches.

YOU see here the lightest and simplest Suction Cleaner *ever* designed.

1 —is the motor—not a "stock" motor, but one built expressly to operate the powerful suction fan to which it is directly connected, under

2 —a suction fan which embodies the best of all that was learned in two years of steady, scientific experiment.

3 —is the suction nozzle which is pushed over the surface to be cleaned—or to which can be attached a twelve foot hose for high wall, drapery and upholstery cleaning.

Nothing to Wear Out

There are no gears, no diaphragms, no valves. Nothing to wear or to jiggle loose.

The complete machine weighs but ten pounds—two pounds less than the average carpet sweeper.

All that any vacuum cleaner or suction cleaner can do this one does. And it does, besides, some things which no other machine can do.

You can for example, use this "Richmond" Suction Cleaner either **with or without the hose.**

Wide Range of Uses

For use with the hose, we furnish special tools for cleaning portieres, walls, books, bedding, upholstery, clothing, hats.

Also a special attachment for hair drying, pillow renovating, etc.

The hose attachment slides on and off with the same ease that your foot slides into an easy slipper.

Slip on the hose and the ten-pound "Richmond" rivals any machine—no matter how much it weighs or how much it costs.

Slip off the hose, and you have a floor machine which weighs two pounds less than an ordinary carpet sweeper—which sweeps both forward and backward strokes and glides over the floor without pressure.

But light weight and easy operation are but two of the "Richmond's" exclusive superiorities. There are many more.

The Vibrating Brush

There is, for example, the vibrating brush, that you find in no other machine.

This brush taps the caked dirt out of the carpets and fabrics which no other machine could clean.

The brush slips in or out, without the use of tools. It is but the work of ten seconds to take it out or put it in.

And without the brush the "Richmond" will do all that any machine—vacuum or suction—can possibly do without working injury to even the finest fabric.

One Dollar Puts it in Your Home

One Dollar will bring you the "Richmond" Suction Cleaner complete—ready for instant use. The balance you pay for month by month, out of the actual money you save.

The Dollar Offer is limited. It is made to show our unbounded confidence in the "Richmond."

But by its very liberality it is bound to swamp the factory. And when the limit of factory output is reached, the offer must be withdrawn.

So send the coupon to-day while the opportunity is still yours! Do not wait. Do it NOW!

Manufactured Exclusively for the Richmond Sales Co. by

THE McCRUM-HOWELL CO.

Park Ave. and 41st St. NEW YORK

"Richmond" Boilers and Radiators
"Richmond" Enameled Ware, Bath Tubs, Sinks, Lavatories, "Richmond" Suds Makers.
"Richmond" Concealed Transom Lifts, and "Richmond" Stationary Vacuum Cleaning Systems

Five Factories: Two at Uniontown, Pa.—One at Norwich, Conn.—One at Racine, Wis.—One at Chicago, Ill.

Inquiries regarding built-in-the-house Vacuum Cleaning systems should be addressed to The McCrum-Howell Co., New York & Chicago

Richmond Sales Company

160 Broadway,

NEW YORK CITY

THE RICHMOND SALES CO., Dept. AA, 160 Broadway, New York City:

I hereby order one "Richmond" Suction Cleaner, complete with the following attachments: 1 Hose Attachment Shoe; 1 12-ft. covered Suction Hose; 1 Book and Wall Brush; 1 12-in. Drapery Tool; 1 3-in. Suction Tool; 1 Felt-faced Floor Tool; 1 Adjustable Wall Brush; 1 30-ft. Electrical Cord; 1 Complete Hair Drying Attachment—for which I agree to pay to your order, $1.00 herewith, and $6.00 on the first day of each of the next 12 consecutive months. Title to be given me when full amount is paid.

Name .....

Address .....

Autology

"Dr. Moras has written a Commonsense Book on Autology, and by so doing, placed the Standard of the Creed of Health farther to the front than any man who has lived for a thousand years."— ELBERT HUBBARD.

"We consider AUTOLOGY one of the most wonderful books ever written."—*Physical Culture Magazine.*

"Please Accept Our Thanks for the great work you have offered the public. The book is worth its weight in gold. We have followed instructions and are feeling like new persons. My husband had been a dyspeptic all his life, could eat nothing without feeling the greatest of pain, and now he does not know what such troubles are. I suffered with headaches since a little girl, doctored for it, and physicians told me it was neuralgia and could not be cured. I suffered untold agonies, but today I am well. Have not felt anything of those dreadful spells since I have followed instructions in Autology. We hope that humanity will open their eyes to the great gift that you have put in front of them."

MRS. DROZ, Torrington, Conn.

"Your Grand, Great Book at hand, and I have carefully read, and will continue reading and digesting your instructions. I have eliminated the old idea that we must be drugged, rubbed and robbed, electrified, burned and blistered in a vain hope of getting well. Autology is the nearest to being the guide to perpetual youth of anything I ever saw in print. Anyone who reads Autology will know more about curing their ills and keeping well than could be learned by reading all the medical books ever published."

PROF. E. B. DENHAM,
Fall River, Mass.

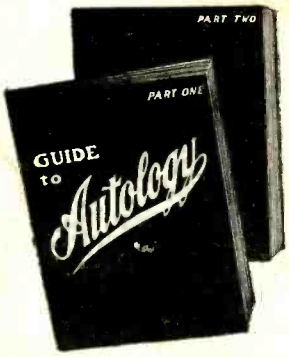
"No money could buy my copy."
MISS M.L. SMITH, 513 Grand Av., Milwaukee, Wis.

"Wife and I thank you so deeply for your Autology, for we have the brightest and healthiest baby from its precepts."
Hudson, N. Y.

"One Year Ago Today I began to be an Autologist. Last evening I was telling a friend about it, and she asked me if I would go back to the old way of living, and I answered her, 'No, not for all that is in this world.' I have not had a cold since last August, and not a hint of asthma since last December. I am often asked if I am not afraid it will return, and I say most decidedly, 'No.' I now know what perfectly good health is, and I expect to live one hundred years at least. I wanted to let you know that I have outwitted the doctors who told me that I could never be any better. God bless Autology and its noble author."

(MISS ADDIE M. BROWN,
New Woodstock, N.Y.

"I would not take $100.00 for your book."
D. B. ROBINS, Fredonia, Pa.



Well or Sick, You Need AUTOLOGY

Autology is no theory, no fad, no creed. It deals with the practical business of your body and brain as you have learned to deal with the practical business of your home affairs, plants and flowers, your land and grain, your dollars and cents. With it there need be no such thing as pain or sickness in your life. Do you realize what that means? That you may see and know for yourself, send for my

"Guide To Autology"

Valuable Books of priceless Information that everybody needs.

Write your name and address plainly in the coupon on the right, or on your own letter paper, and enclose 10c (a dime or five 2c stamps) and I will send you my "GUIDE TO AUTOLOGY," containing a wealth of information whose health and brain value can't be reckoned in dollars and cents.

NOTE—If you are not satisfied and wish to return it, I will promptly refund the ten cents. Address

E. R. MORAS, M. D., Dept. 788, HIGHLAND PARK, ILL.

Harvard University Medical School, '88; College of Physicians and Surgeons (Chicago) '89. Formerly House Physician and Surgeon in Cook County Hospital (Chicago); Professor of Obstetrics College of Physicians and Surgeons (Chicago). Member of Chicago Medical Society, etc.

CUT OFF HERE AND MAIL TODAY

E.R. MORAS, M. D.
Dept. 788
Highland Park, Illinois.

Dear Doctor: I am interested in your offer. I enclose 10c, for which please send me your "Guide to Autology."

Name.....

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Address .....