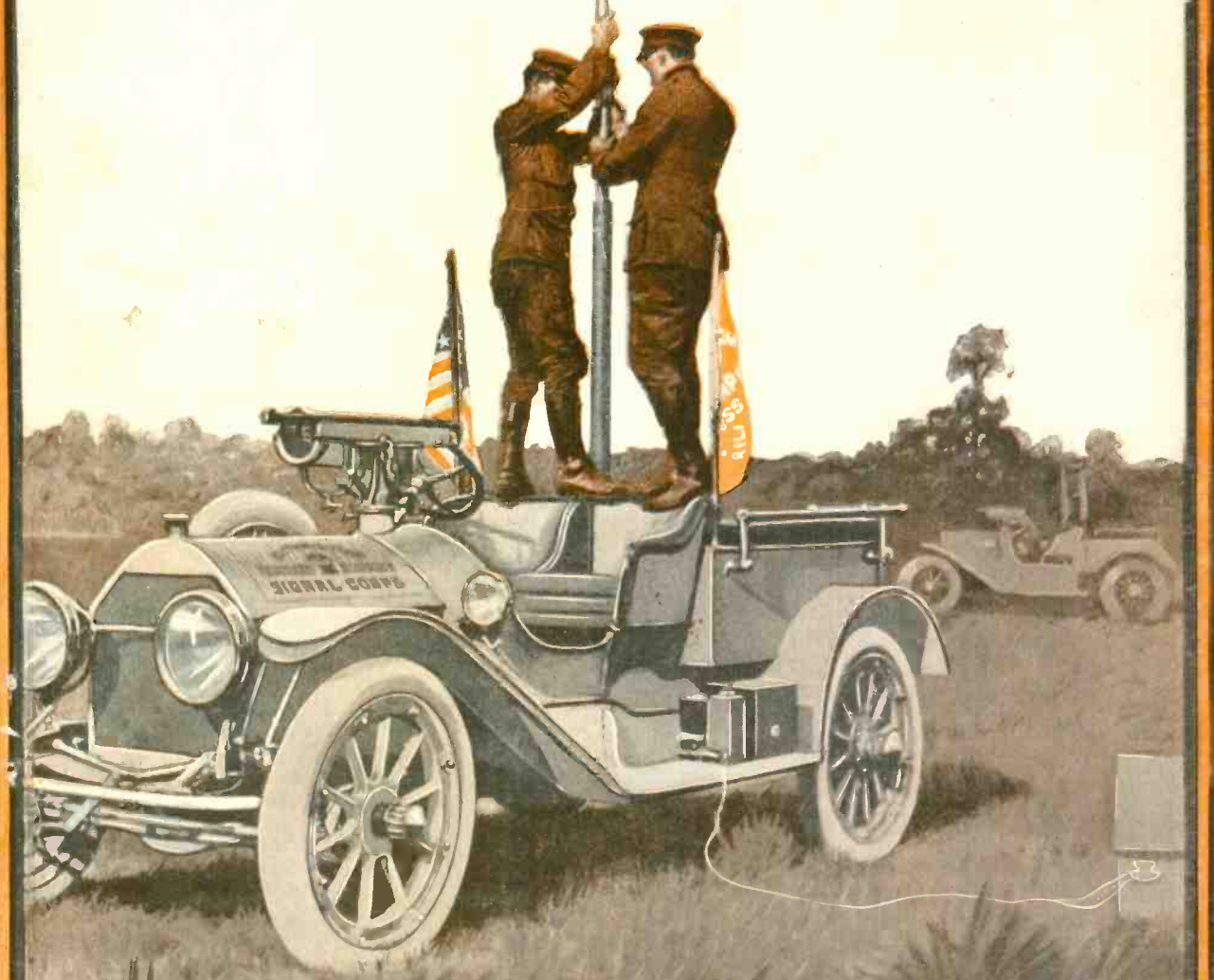
Popular Electricity Magazine



OCTOBER 1911

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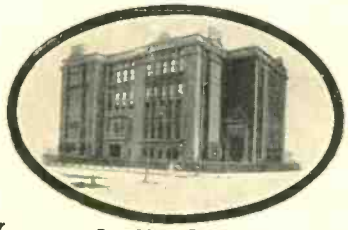

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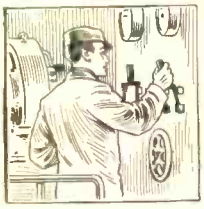

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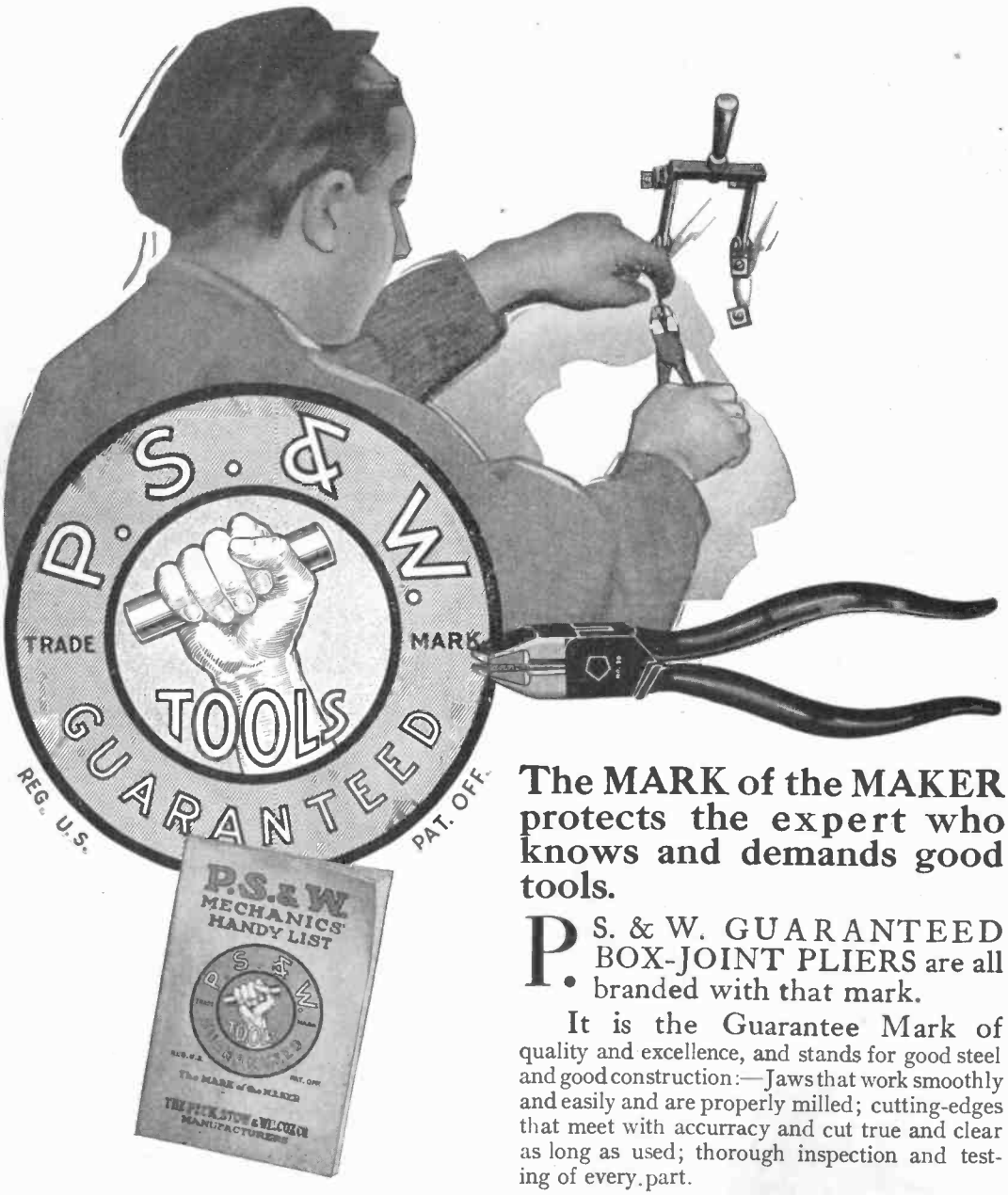

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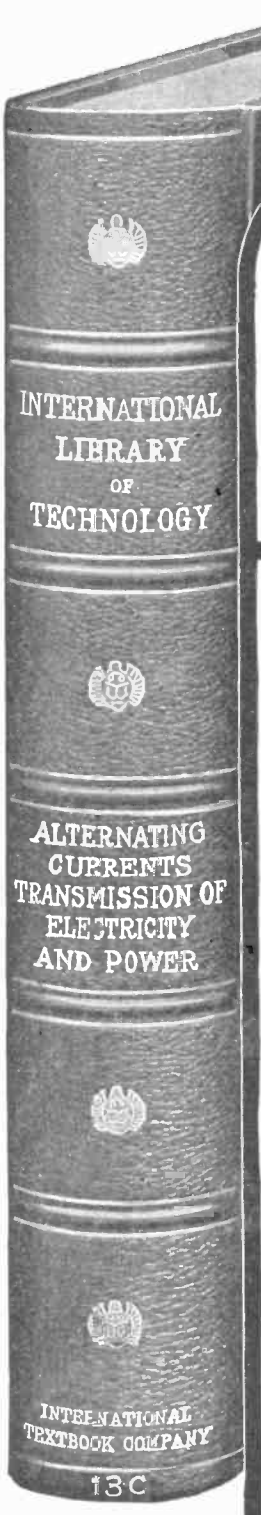

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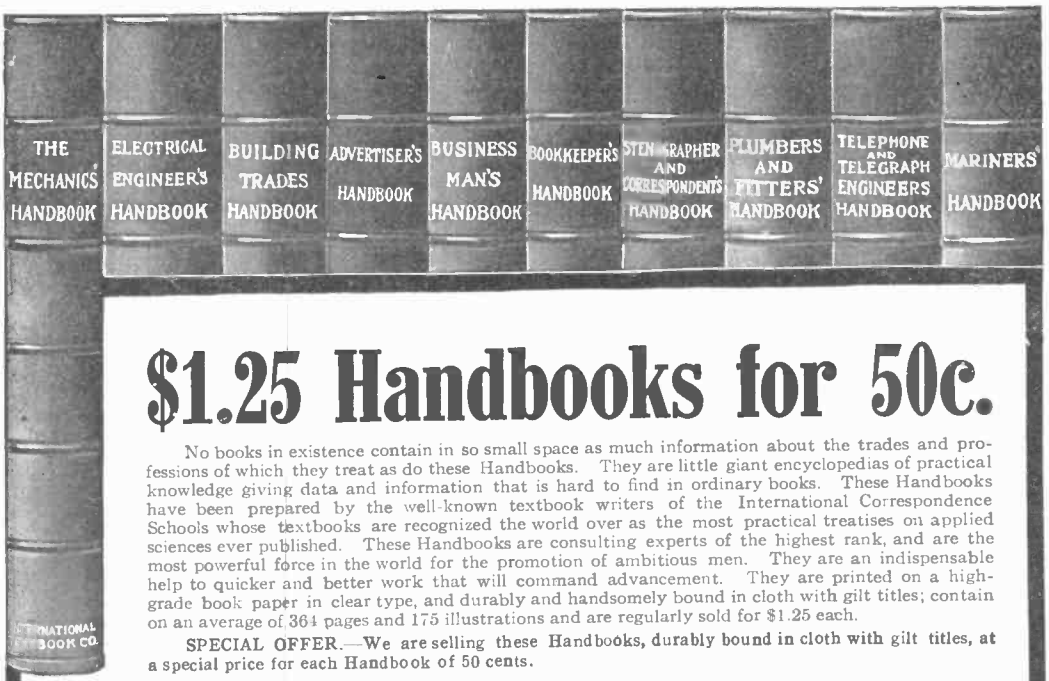

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Are forms of amusement so lacking in this Twentieth Century that people will write to advertisers and pay out money for postage simply for fun? The sales manager who tries to think so wants to get away to the ball game. In every case the inquiry is the result of a desire to buy. The ability to cultivate that desire and turn it into determination is the big end of any successful advertiser's duty.

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Popular Electricity
In Plain English
Henry Walter Young, Editor

Vol. IV | October, 1911 | No. 6

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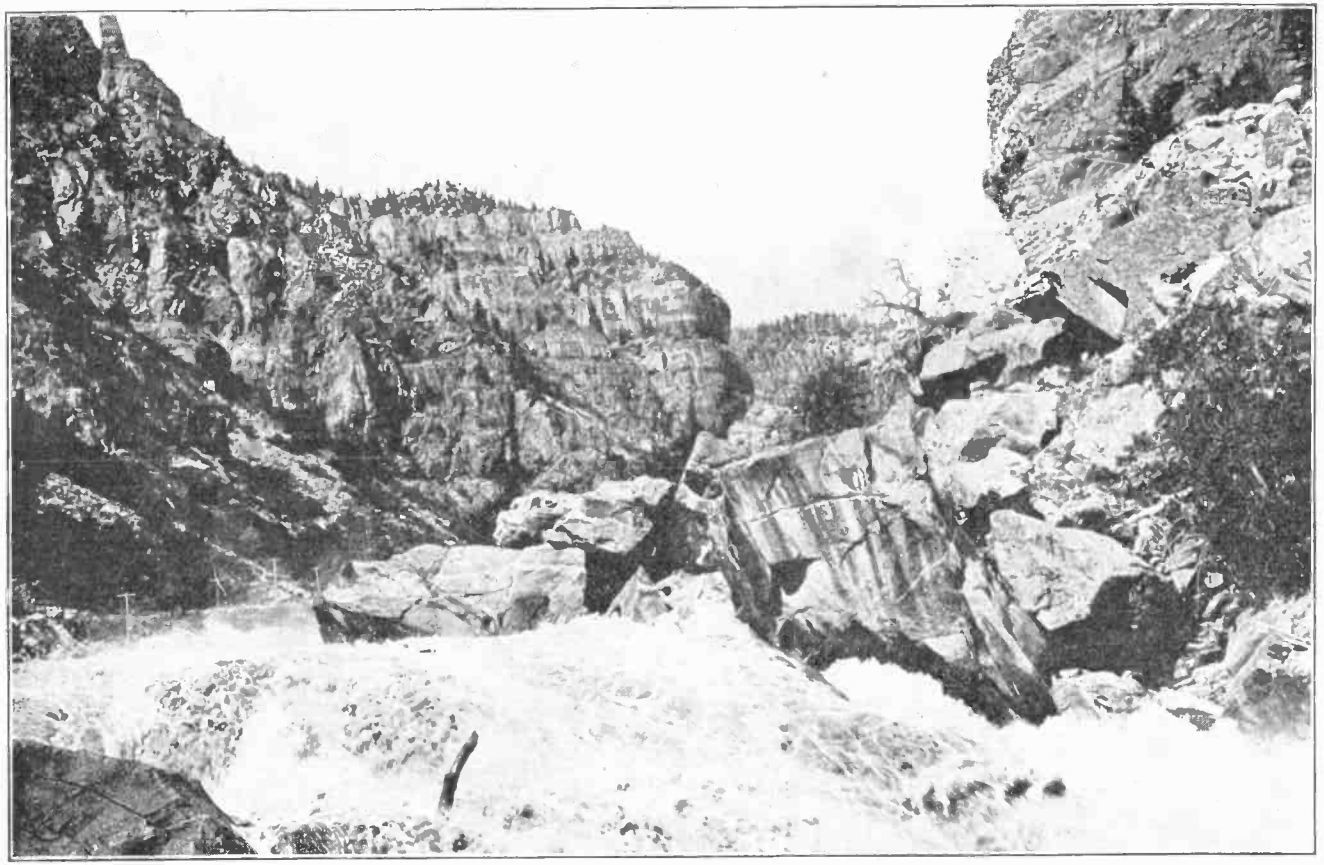


SHOSHONE RAPIDS OF THE GRAND RIVER JUST AHEAD OF THE SHOSHONE POWER PLANT

Popular Electricity
In Plain English

VOL. IV OCTOBER 1911 No. 6

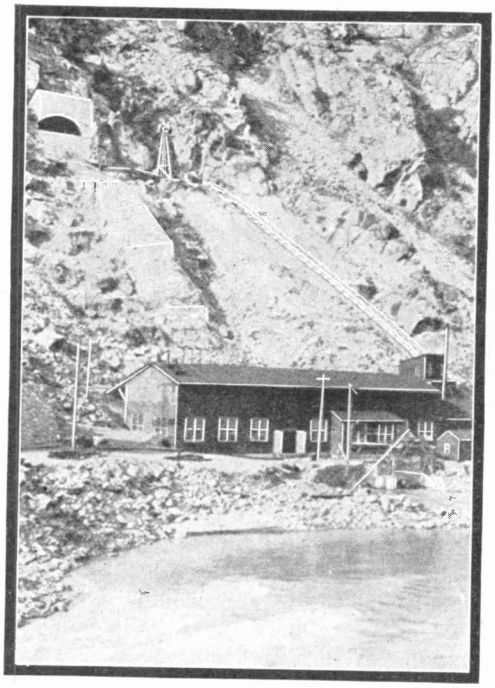
Light and Power for a State

By FLORENCE L. CLARK

Some ten years ago J. R. Du Reimer of Glenwood Springs, Colorado, returned home from a trout fishing expedition up the Grand River, went into his woodshed and hunted out an old cracker box. He split up the box with an axe and tucked the pieces under his arm. Then he tramped back up the river. When he reached the part twelve miles from Glenwood Springs where the red rock walls of the canon rise most high, most perpendicular, and the river comes raging, frothing, roaring through the narrow space between them in the "Rapids of Shoshone," he stepped off a claim up the right side of the canon and drove in his stakes at the four corners. A year later he fashioned a water wheel and placed it in the rapids alongside his claim.

That was the meager beginning. The colossal outcome is the Shoshone power plant whence a current of electricity pressed on by a hundred thousand volts now flows over the mountains to the north, south, east and west throughout the state of Colorado, carrying light to scores of cities and towns and power to hundreds of rich mining camps.

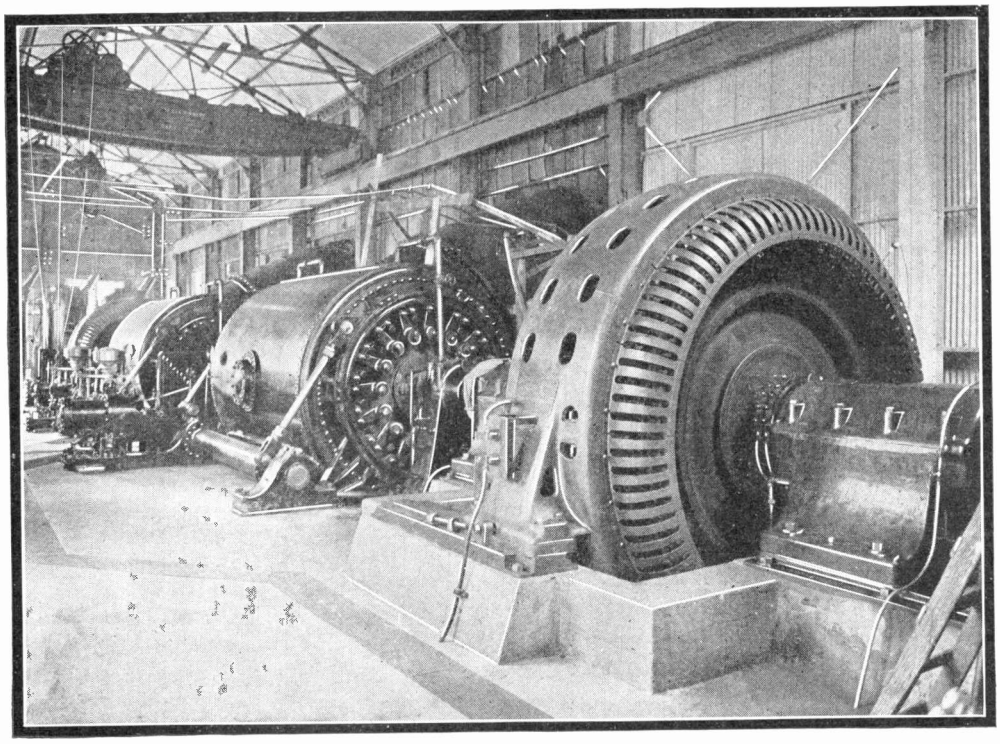
Go to Denver. Watch the streets flash forth light at dusk and know that in part it happens because the waters of the Grand are pounding on the turbines at Shoshone 200 miles away. Go to Leadville, the highest modern city in the world. Watch the tram cars come whizzing out of the tunnels of Silver Mountain, see the electric hoists slip up and down, watch the livid streams of metal running in the smelters, hear the beat, beat of the mills and know that the motive power of it all is flowing up the mountain from that same Shoshone. Go to Breckenridge. Follow down the trail through old French Gulch, renowned in early placer days. See there huge, queer boats stretch out gigantic steel arms and lift up whole sections of the bed of the river. Watch them shake out gold and



LOWER END OF THE MOUNTAIN BORE THROUGH WHICH THE GRAND RIVER FLOWS

know that here is placer mining on an immense new scale because the wires from Shoshone have been carried down that way. Go to a hundred other places in Colorado and inquire whence the light and power for a multitude of things, and "Shoshone" is the unvarying answer.

To generate this great power of Shoshone, the Grand River a short time ago was taken out of its canon bed and carried for two and a half miles through a bore in the mountain. Picking a river up from its bed and setting it down in a channel of their own making has become a rather common pastime of engineers, yet, the diversion of the Grand was for several reasons a unique as well as a titanic undertaking.



INTERIOR OF THE SHOSHONE GENERATING PLANT

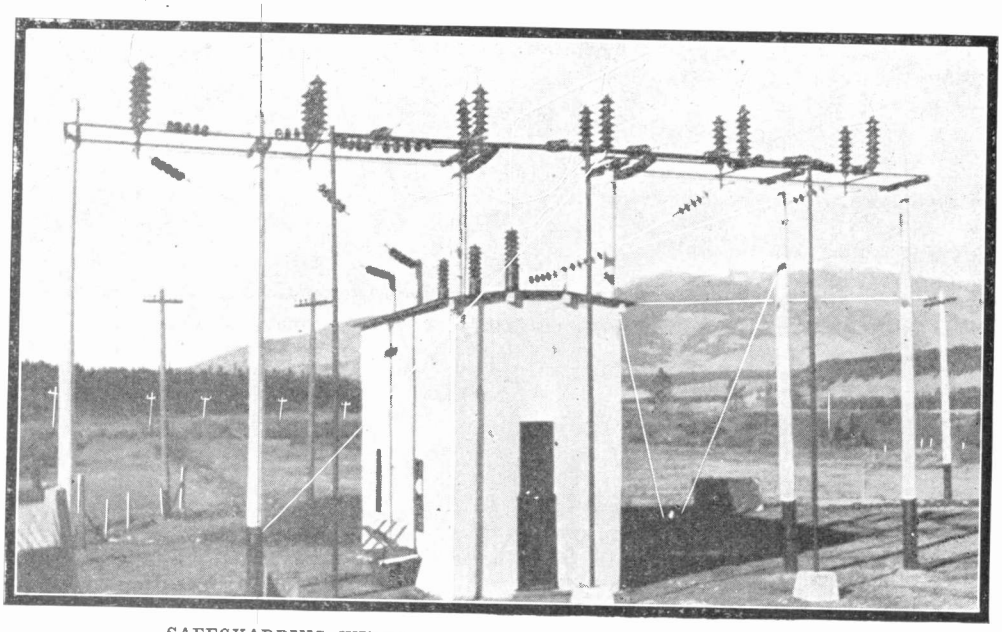
In order to accomplish it, the solid rock walls of one of the deepest canons in the world had to be tunneled through and the work of the tunnelling had to be done with nothing but perpendicular walls and a wild river as a base of operations.

A dam was placed across the Grand above the rapids and the bore through the mountain was begun at that place. The tunnel was cut from there down through the canon wall parallel to the river. The lower end of it was brought to the surface just below the rapids 165 feet up the side of the canon. A power plant was built on the river bank below the terminus and the two pipes of a diameter equal to the width of a fair-sized room were laid between it and the end of the bore in the mountain.

The Grand River now leaves its channel, a part of it in high water times, most all of it in the low water season, and races through this tunnel at the rate of 1,300 cubic feet a second in a solid volume sixteen feet high and twelve feet wide. After tearing along for two miles and a half in the black depths of the mountain, it comes to the surface, plunges down the immense pipes to the power house, strikes the 9,000 horsepower turbines with a velocity of several miles a minute, and, having generated enough power in the striking to light a state, it returns to its wonted course to irrigate a great valley some miles below with those same waters.

Great an achievement as the diversion of the Grand River was, the transmission of the electric power out of the canon over the

mountains throughout the difficult regions of Colorado was a greater achievement. Here the Central Colorado Power Company, owners of the Shoshone plant, were pioneers. In carrying power to Denver the wires cross the Continental Divide and two other mountain ranges at altitudes varying from 12,000 to 14,000 feet. Argentine Pass, the highest point touched, is but a few hundred feet lower than the top of Pike's Peak.



SAFEGUARDING WIRES FROM LIGHTNING IN THE MOUNTAINS

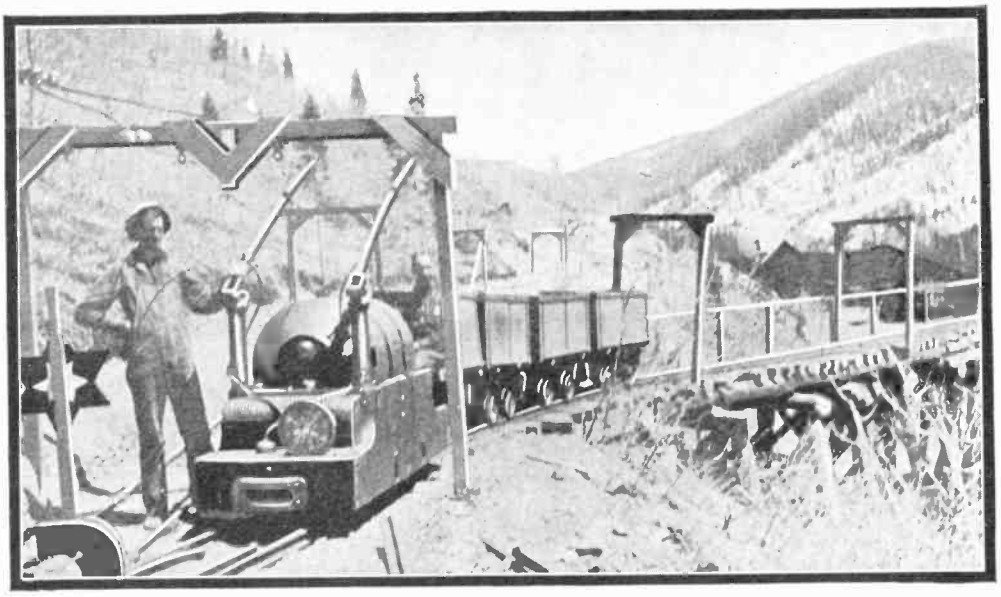
The steel towers which support the wires literally hang on the upright sides of canons, are silhouetted here and there against the sky on the crags of precipices and not seldom are buried deep in snow. In one place there is a span of more than a half mile between towers.

Added to the difficulty of building the lines was the other greater difficulty of carrying an electric current of great voltage through such altitudes. In order to do this the company was obliged to devise and construct numerous ingenious protective contrivances. One of these is the queer looking lightning arrester which may be seen frequently along the system. The wild play of lightning in the mountains during storms is guarded against by these arresters. Because of the practical impossibility of doing repair work in the mountains during the winters, emergency lines were put up in the highest altitudes to be used in case of trouble on the main lines.

The system is safeguarded in other ways. In fact the company boasts that it has the best protected plant in the world. The works at Shoshone are only a part of its property. At Boulder, Colorado, a hundred miles east of Shoshone, is another power plant only a little less in size than the one at Shoshone. If the Shoshone plant should fail at any moment, power from Boulder could be transmitted to every part of the system. Should a break come in the middle of the system, electric current would flow from the Shoshone and the Boulder ends of the line up to the break, causing no loss of service. This is possible because of the location of the Boulder plant on the east side of the Rockies, whereas the Shoshone plant is far down on the western slope.

Besides these hydro-electric plants at Shoshone and Boulder, the company has a third plant at Leadville where electricity is generated by steam. If need arises this can take the place of Shoshone in supplying power to the mining region in and around Leadville.

The company is gradually extending its lines and supplying larger and larger areas of the state with light and power. Yet, not content with its present wide usefulness, it

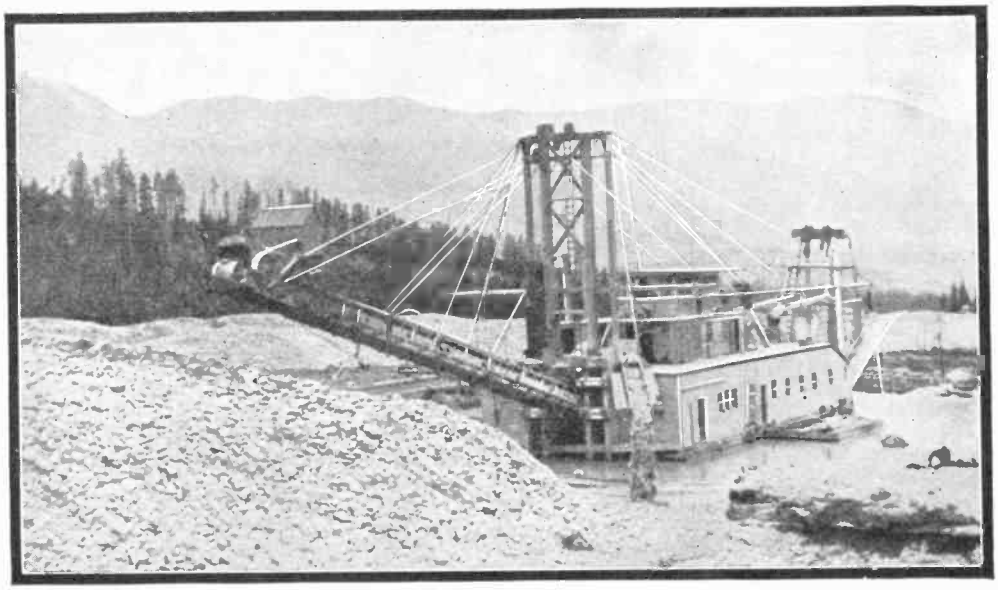


HAULING ORE OUT OF THE WELLINGTON MINE BY ELECTRIC LOCOMOTIVE

anticipates adding another source of great power in the near future.

By the time the day arrives when the last bit of electricity that can be generated at Shoshone has been marketed, another transmission line will leave the Canon of the Grand under even greater voltage than the one from Shoshone. It will come from several miles higher up the canon. There the company is about to erect another plant in part similar to Shoshone but with an addition of enormous value. An immense reservoir will be a part of the new plant. In this the waters of the Grand will be stored. Work is already begun on this project. When it is completed the company will be ready to send its lines into the most inaccessible parts of Colorado.

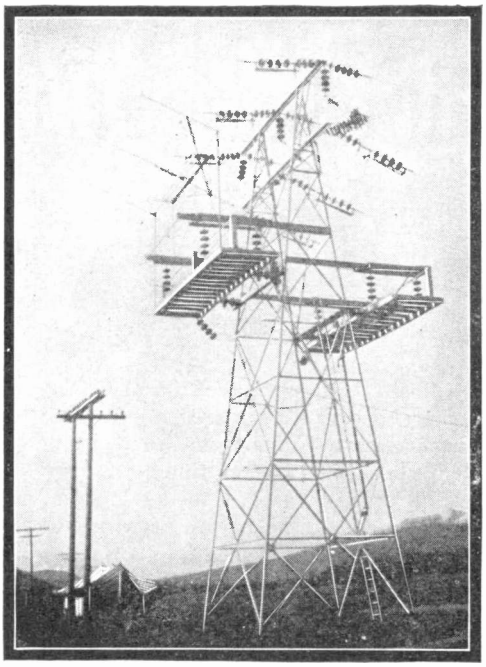
What this conversion of the hitherto unused energy of the Grand River into a public



PLACER MINING ON AN IMMENSE SCALE WITH ELECTRIC POWER

utility means to the state of Colorado can scarcely be overestimated. Steam power owing to the cost of hauling coal over difficult mountain railroads is extremely expensive in many localities in the state. The substitution of cheap hydro-electric power for this expensive steam power has been a distinct benefit to many communities. In some places they rejoice over a coal bill cut in half.

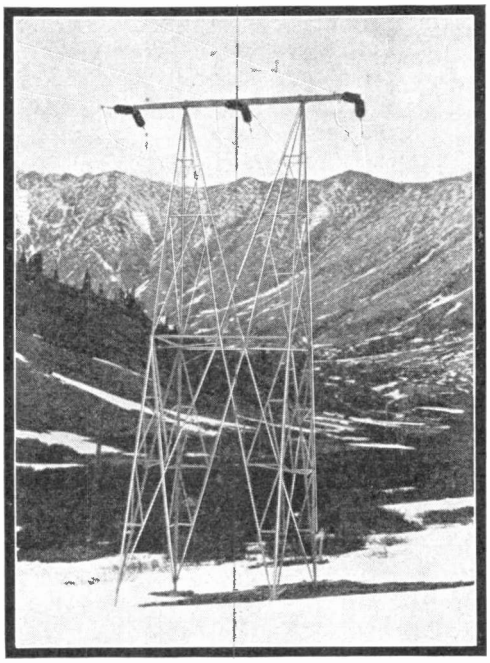
In the mining regions it has proved a veritable boon. Profit and loss in mining is largely a matter of cost of power. The introduction of cheap power from Shoshone has made possible cheaper mining, cheaper milling, cheaper smelting. This has given a great impetus to mining activities. Closed mines have been opened, new ones opened up and low grade ores heretofore considered profitless are now being handled with profit. Thousands of miners and their families are reaping the rich benefit.



GROUNDING TOWER ON THE MOUNTAIN LINES

Electric Autos Guard Convicts

In choosing self-propelled vehicles for their fire departments, one city after another is adopting electromobiles even for trucks carrying steam or gasoline driven pumps. One of the chief reasons for this choice of storage battery propulsion lies in the fact that an electric vehicle is always ready to start instantly. There is no delay in cranking up an engine, adjusting spark plugs and oil supply, or the like—merely the avoidance of possible delays in starting is a factor which counts for electrics wherever vehicles are apt to be called out in emergencies. This is the reason why electric automobiles were chosen for guarding the road gangs sent out from the Illinois State Penitentiary at Joliet. There the guards in charge of each gang of men are supplied with an automobile with which they can speed along the highway in pursuit of any convict that might make a rash attempt to escape. Ordinarily, the guarding auto is stationed at some fixed point on the road for many hours at a time and the continued chugging of a gasoline engine would be a costly nuisance, while any delay in starting the machine might give a daring convict a chance to escape. The instantaneous starting of the storage battery vehicle makes this by far the safer for the purpose.



LINE THROUGH THE REGION OF PERPETUAL SNOW—ARGENTINE PASS

The Ghost and the Wireless

by Alfred Williams

Ghostly visitants have no place in my comprehension. They are, to me, but shadowy escorts of minds exalted by religious fervor or dominated by timidity. Still, we are all prone to ascribe to the supernatural any phenomena the nature of which we do not understand; and in these days of familiar ether ripples, of disembodied electrons and invisible light, none but a thoughtless or ignorant man would say that anything is impossible. There is a lot of truth in Hans Brietmann's remark that "if you have learned to believe you haf learned somedings."

Some of my friends, men who know me and my fancies, smile at the story and put it down to the psychological; others, more familiar with the wonderful realms of science and the mysteries of radiant matter, have attempted many ingenious electrical explanations. As for me, I bear in mind that we know nothing of the something that leaves the body at death; that it may be highly attenuated matter, or electric charges —electrons—from the atoms. Surely, such an assumption is not unreasonable. Given this as a starting point, and supposing the energy, the soul, the electric charge—or whatever you like to call it—to retain some of the individual's will, then the solution becomes less difficult. However, the reader must judge for himself.

It was one warm night in August. The yacht glided slowly through the long rolling billows of the Caribbean sea, and from a cloudless sky the starlight streamed like a celestial aurora, lighting the water, not with the white intensity of moonlight, but with a dim silvery glimmer that shimmered and sparkled on the tops of the waves and glossed the dark depths between with a pearly opalescence. Such a night the gods loved—a night for dreams and fancies.

Suddenly, above the throb of the engines, the sound of hurrying footsteps reached my ears; a sound unlike the measured tread of the watch or the pattering feet of the sailors. It was a sharp, nervous pace, like one mentally agitated. It proved to be Mearson, the wireless operator.

"There is something wrong, sir," he said in a voice that trembled a little. His face was pale, his eyes staring.

Mearson was a young, curly-headed New Englander, bright, efficient and the last man one would accuse of nervousness.

"Wrong! In what way?" I asked.

"I don't know, Mr. Everett. Maybe you'll think I'm crazy, but there's somebody in the wireless room—someone you can't see or hear. I felt him touch me."

"Sit down, Mearson," I said, indicating a deck chair, and touching the button at my back. When the steward appeared I ordered a bromo-seltzer. "Now," I added, as he swallowed the sedative, "tell me all about it."

"It was this way," he explained, more at his ease now. "There wasn't a thing in the air, not a stray wave or atmospheric static. The message you got from San Domingo at six o'clock was the last disturbance of the instruments. I was standing near the door when I felt something pushing, like a heavy wind on your back when you're walking. At first I thought it was a sudden breeze, but there wasn't a breath of air stirring. Anyway, I shut the door and walked to the instruments. I had no intention of sitting down, I was just trying to think. Suddenly, the Thing took hold of my shoulders and pressed me into the seat. Then it kept jabbing at my hand, pushing it in the direction of the receivers. I wasn't exactly frightened, I didn't know what to make of it, so I thought I would experiment by moving to

the door. If the Thing objected, then I could be sure about what it was after, and I felt a bit obstinate. Well, it objected all right. No sooner had I got half way to the door when the ghost, or whatever it was, hit me on the chest with a force that shot me right across the cabin like a cork. That settled me; I took the hint and clapped the telephones to my ears. There wasn't a sound, and I said so aloud. Maybe it was imagination but I thought I heard a sigh; anyway the ghost didn't bother me any more, so I came here."

"What time did the visitation occur?" I asked.

"Nine-thirty, exactly. I made a note of it on the sheet."

My first impression, to attribute Mearson's experience to a temporary lapse, I dispelled on looking at his strong, rational face. Seeing my glance, and probably guessing what was passing in my mind, he smiled, and suggested that the ghost would probably come again, in which case it would be as well if I was present.

"Very well," I laughed, and in a few minutes we were in the wireless room. Everything looked normal, the receiver was silent and no sign of the unusual appeared. The minutes passed while we smoked in silence until at two bells I suggested to Mearson that he should go to supper, as he and the first officer were in the habit of taking a light repast before turning in. No sooner had he gone than an amazing thing happened. Why I should have taken the operator's seat, fastened the receivers to my ears and listened, I do not know, though in the light of what took place it seems impossible that it was a mere whim. The telephones were hardly clamped into position when I started in amazement. A voice was talking on the aerial! In sad, low tones and trembling with anguish it came from somewhere in the vast expanse of ether. It was the voice of a woman, reciting, as if from memory, portions of the service for the Burial of the Dead.

"I am the resurrection and the life. . . . He that believeth in me, though he were dead, yet shall he live. . . . . We brought nothing into this world, and it is certain we can carry nothing out. . . . . In the midst of life we are in death. . . . . We bring our years to an end, as if a tale that is told."

Then all became still. I heard nothing except the voice of the sea at night and my quickened breathing. Perplexed, almost frightened, I tried to collect my thoughts, tried to think the matter out. That the voice was a woman's admitted of no doubt; that she was suffering was obvious. No one could simulate such sorrow. Had we been near an experimental wireless station I could have understood the ether vibrations energizing our aerial, for the yacht's installation was new and the series connections of the Artwell system perfectly adapted for the receipt of short distance wireless tele-

"There is something wrong, sir," he said

phony. But under the circumstances of our position that theory was untenable. Then, again, there was the experience of Mearson. Perhaps the two things were connected; perhaps, but my musings were interrupted. Mearson, in a state of intense excitement, entered.

"Better come on deck," he said quickly. "The man at the wheel refuses to stay at his post; he says there's a ghost aboard. Yes," he added as he saw my look of inquiry, "Yes, it's the same. The Thing is interfering with the steering."

Outside, the Captain's voice was raised in angry protest. A burly, shaggy man

from the Clyde banks, Captain MacDonald was the last man on earth to be affected by fear of the supernatural. As I neared the pilot-house I saw the steersman cowering in terror.

"Cap'n," the man said appealingly. "Cap'n, man and boy I've been at sea 20 year and more, and never disobeyed an order. I'm not skeered at any living man, but I draw the line at spooks. I tell ye, Cap'n, there's a ghost aboard and it wants to change the ship's course. It shoved an' hit me 'till I couldn't hold the wheel."

"Aw weel," answered the scornful skipper, lapsing into the dialect as he was wont under excitement. "Gang below and send the bo'sun to tak' yer place. It's a feckless sailorman ye are, scairt o' speerits. I'll ha' no mon at the wheel o' my ship wha' speirs things like a muirland gillie."

When I entered the pilot-house, the Captain, at the wheel, was bringing the ship back to the course from which in his terror Johnson had deviated. We were headed S. 5° E., making direct for Willemstadt, Curacao, where we expected to fetch up next day. With a final glance at the compass MacDonald looked up at me and smiled.

"What do you think of that, Mr. Everett?" he asked in his accustomed English. "A sober-headed sailorman like Bill Johnson getting an attack of nerves. He says that a ghost is trying to steer the boat."

"I don't wonder, Captain. Such a night as this is enough to play pranks with an imaginative man."

"That's it—imaginative—that's just the word. But a sailorman has no kind of right to an imagination when the wheel's in his keeping, though I'll grant you that a night in southern waters all lit up with stars and no moon is enough to put fancies in one's head. I remember—" The Captain's voice ceased abruptly, a look of incredulity came to his face; then it changed to bewilderment, and finally, as his eyes encountered mine, to one of utter amazement. With muscles corded and strained like a wrestler opposing the pressure of his antagonist, he drew a deep breath and put out all his strength in a mighty effort to control the wheel. Then, I knew he was struggling with Mearson's unseen Thing. With an oath he braced his feet against the locker and bore down on the spokes, forcing them downward. But his victory was but momentary; slowly the spokes rose until they resumed the normal condition desired by the uncanny visitor.

"Better give it up, Captain," I suggested. "We will steer the course the ghost indicates and see what it all means."

"No, sir," protested the perspiring skipper. "With your permission I'll fight this thing out. I'll take back all I said about ghosts, though."

With that he resumed the struggle by climbing on top of the locker from which position he threw his whole weight on the wheel, swinging it over until his body was almost horizontal. I could see that his huge bulk was being pressed upwards by the Thing underneath.

"There!" he exclaimed exultingly, the wheel being where he wanted it, "that shows the limit of the ghost's strength. I've got him beated."

The words were hardly out of his mouth when the Thing suddenly withdrew his pressure and the Captain fell heavily to the floor, half dazed and muttering profane expressions of surprise. The wheel, uncontrolled now, swung around. Then the Thing transferred its attentions to me. I can scarcely describe the sensation produced. Mearson's simile of a strong wind hardly suited; it was more like a mass of sluggish moving water thrusting me in the direction of the steering gear.

Obedient to my powerful foe I took my place at the wheel. I felt as though I was enveloped in an impalpable mist—a sort of ultra-gaseous stream like that felt in the neighborhood of a strong static machine. Mechanically, I put the wheel over, and as the yacht swung about I felt a tingling sensation in the muscles of my right arm. This continued until we were headed almost due west. Then a curious thing happened; the tingling ceased and started in the other arm! Acting on the prompting I reversed the wheel slowly, watching the compass as I did so. As the needle came to 12° west of south the muscular tremors ceased. Out of curiosity I deviated slightly from this course and instantly the pricking recommenced, now in one arm, now in the other, according to the position of the needle.

"The course our insistent visitor wishes us to steer is 12° west of south. Where will that bring us to?" I asked the Captain,

who stood at my side, awed and thoroughly subdued.

"Between Guajira and Paraguana peninsulas," he replied, after consulting the chart. "Yes, right into the Gulf of Maracaibo. I'll be hanged if I know what to make of it."

"Well, we'll soon find out; we'll go there and see what it all means," I answered as the bo'sun entered.

Not wishing the Captain or the operator to know about the voice I had heard, and half thinking it was, after all, a dream, I told Mearson I proposed spending the night in the wireless room, and suggested that he use other quarters.

"Guess I'll stay on deck and see what happens in the night," he said, leaving me at the door.

Sitting in the operator's chair, I listened to the receivers. An hour or more passed without a sound from the ether. Somehow, the words of the burial service worked on my mind and I felt sure I should hear more. About midnight, when half asleep, I started up. The telephones were silent, but a feeling of fear took hold of me. Then, without the slightest warning, I heard a woman's scream of terror; the cry of a woman in fear and horror. With a beating heart I strained my ears to listen, and as I did so I became sensible of an increased motion of the yacht. The engines pounded and strained under a full head of steam, and everything in the cabin shook under the stimulus. Rushing to the deck I clambered to the bridge.

"It's no use," said the skipper as he saw me. "That devil's taken charge of the engineroom and the stokehold. He scared the life out of the stokers, made 'em fire up all the furnaces would hold, and half killed the second engineer before he got him to open wide the throttle. Lord! It's as black as Egypt's night now the clouds have come, and we're going eighteen knots. I'll have to stay on the bridge."

"When shall we make the coast?" I asked.

"Noon. Suppose we must go there; nothing else for it as I see," he said gloomily.

"Yes, we'll go there. Keep a good lookout and let me know if anything new takes place. I'll be in the wireless room."

And so, throughout the night, the anxious crew obeyed the ghostly monitor's instructions, while I, while the yacht rushed through the darkness guided by the invisible hands, passed the slow hours in the instrument room listening closely. Half asleep, half awake, I waited for the dawn. At five I rang for coffee. I was looking through the open door, watching the sun rise from the sea, when the woman's voice came again. This time it was clear and composed; the quality of intense grief was absent, and in its place was a note of resignation—as if the owner had settled into a passive state. Yearningly, it said:

"Why, if the Soul can fling the Dust aside,
And naked on the Air of Heaven ride,
Were't not a Shame—were't not a Shame
for him—
For him—for him—"

The voice paused and repeated "for him" many times in an effort to recall the remaining words. Then it added:

"Oh, bother; I've forgotten."

Unconsciously, I shouted:

"Were't not a Shame for him,
In this clay carcass to abide."

Then all became quiet. No more of Omar Khayyam, no more words; all was still. Tired out I fell asleep.

At one o'clock the steward woke me up. The mist had blown away, he said, and the Captain had sighted land. From the deck I saw it, a streak of hazy blue, evidently an island.

"It's the Isle of Serpents," volunteered the skipper. "I wish that devil would let up on the speed as there are lots of rocks about. But I must say he steers well. Mearson's at the wheel, the crew are scared to touch a spoke."

The place was about a thousand feet long and thickly covered with tropical jungle, except at the spot toward which the Captain and I headed the boat. There a small beach lay on the side of a lagoon into which trickled a stream of fresh water. We had no sooner pulled the boat up on the sands when the Thing took hold of me and pushed me up the beach. Wondering, and in a great state of excitement, I ran towards a mass of weed-covered rock, the Captain following at my heels.

I stopped abruptly. There, sitting with his back against the rock, was a man, his

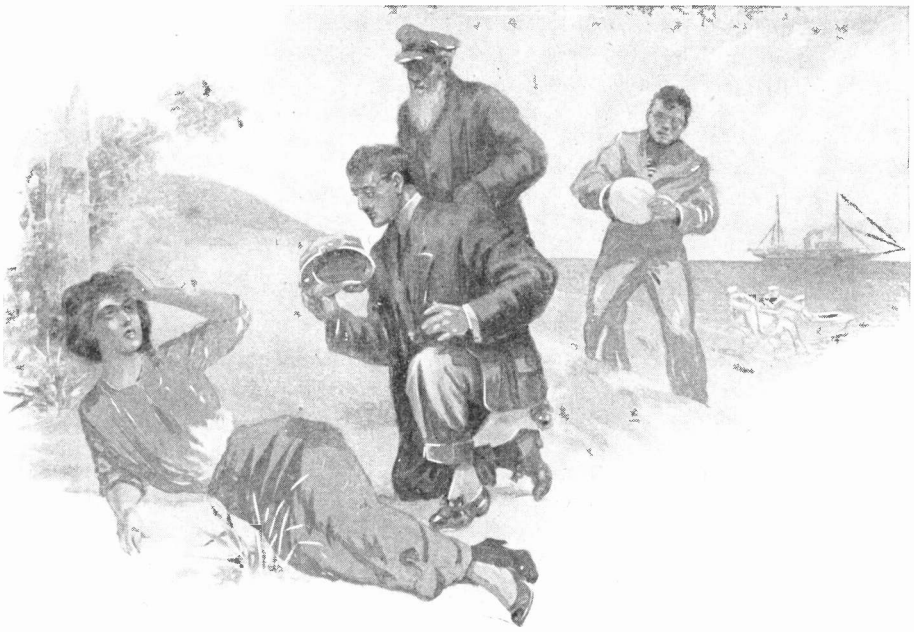
head sagging forward, and his arms spread stiffly one on either side.

"Good God! a corpse!" cried MacDonald, raising the dead man's hand. He was quite right, it was a corpse, but my attention was arrested by something very different. Near by stood a clump of palms and on the sand under their shadow lay a woman. Even as I ran I could see that she was young—almost a girl, I thought, as I noticed the lithe outline of her body clad in a shrunken serge suit. The evaporating sea-water had left little trains of white salt in the folds and creases. For a moment I thought that she was dead, but as I brushed away the dark-brown tresses of hair from her face, I knew that she was alive and very beautiful. With her arm for a pillow, the sand her couch and the shadow of the palms her covering, she breathed deep in sleep.

"Puir lassie, and her father deid," the skipper exclaimed with moist eyes. He did not mention the ghost, and indeed I had forgotten all about the circumstances that had been responsible for bringing us to the rescue. It did not need a second glance to know that the girl and the dead were father and daughter. The resemblance was too striking.

The strong light, now that the disarray of chestnut hair was removed from her eyes, awakened the sleeper. Without the slightest expression of surprise, in a voice as matter of fact as if she were expecting us,—though the look of relief, of pleasure that came to her face as she saw us made up for her apparent indifference,—she said:

"Oh, at last! At last you came for me."



"For a moment I thought that she was dead"

"You—you expected us?" This from me.

"Of course," she said with a smile that faded into a look of sorrow. "Before he died father promised that he would send help."

I started, but MacDonald patted her cheek and helped her to her feet. "Come, lassie," he said kindly. He had daughters of his own. Neither would he allow her to talk more than was necessary, and I saw the prudence of his precaution for the girl was weak from worry and exposure. Little was said as the sailors dug the grave, and as I read the burial service from the Captain's prayer book, Margaret Willoughby leaned on the old man's arm.

That night, while the yacht ploughed her way for home and the girl had retired to her cabin, MacDonald joined me on the moonlit deck. Curious and interested as I

was, naturally, her grief so recent, I had refrained from asking questions, content to wait a more propitious moment. But the Captain, serene in his years, had, as he put it, been comforting the poor lassie.

"She was in a small sailboat with her father—he is, or was, John Willoughby, the naturalist. Her mother died when she was a child and he has been father and mother both to her ever since. She's been all over the country with him, helping him in his work. There was a squall the day before yesterday and their boat piled up on the reef off Serpent Island. While the father was swimming ashore, holding her up with one hand under her armpit, a big wave caught them. The girl landed on the beach sand, unhurt, but her father came down on that hog-back rock. It must have been a terror of a wave for it dropped him hard and broke his back. Then he fell where we found him, sitting up. He wasn't quite dead and whispered as she kissed him that there must be some way of sending her help; that he would die with that intention fixed on his mind and would find some way to rescue her. And she believed him, the dear thing."

"And what do you make of it?" I asked.

"Make of it! Why it's as plain as a pikestaff. John Willoughby's soul was the ghost and he made us come to the island."

I did not tell the good Captain of what I had heard over the aerial; I let him remain content with his explanation, which, so far as it went, must have been right. Nor did I mention it to Miss Willoughby when, in New York, I took her to my mother. But two months later, while we were on our honeymoon in Italy and looking at the blue sea from the terrace of the hotel, I asked:

"What made you scream that night on the island?"

My wife turned her wonderful eyes to mine. "I was thirsty, I went to the stream for a drink and stepped on a snake. But how do you know? I never mentioned it."

"And you recited the burial service," I added.

She looked at me in alarm.

"Also the 'Why, if the Soul can fling the Dust aside,' verse of Omar, but you faltered, uncertain of the finish, after the words 'for him.'"

"Ah!" she said, staring at me in amazement, "so you know of that, too."

Night had fallen before we finished talking of the mystery. And as we turned from the last look at the silvery, azure Mediterranean, she turned to me with a smile and said:

"The eternal Saki from that Bowl has pour'd
Millions of bubbles like us, and will pour
When you and I behind the Veil are past."

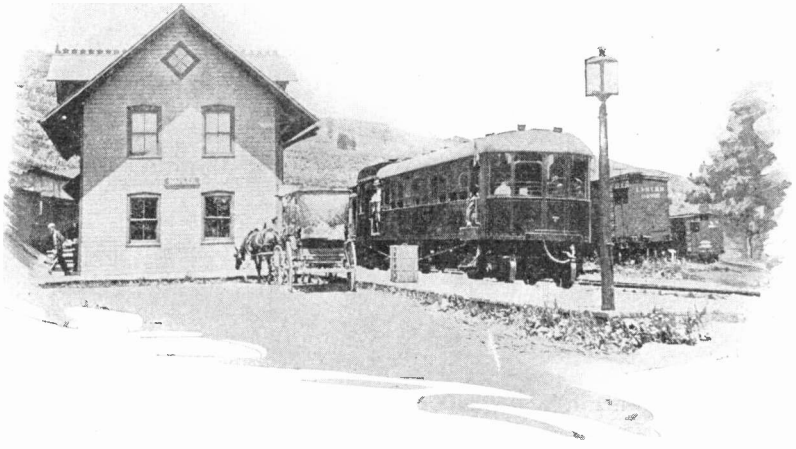
And my wife is right.

Electric Vehicles Less Hazardous

As pointed out by the committee on electric vehicles of the National Electric Light Association, the liability insurance companies are beginning to realize the difference between a gas car and an electric. The difference in speed of the two should make a material difference in rate. The commercial gas car can run, and often does run, twice as fast as the electric. The gasoline pleasure car frequently makes from 45 to 60 miles an hour, while the maximum speed of the pleasure electric car is between 20 and 25 miles. The electric is under perfect control, and its freedom from extra levers, intermediate gears, etc., makes it so simple of operation that, in case of emergency, the operator does not become confused as to which operation to perform.

Because of the lower speed, when collisions occur, the impact is less severe and the damage consequently slight. The heart of the machine, the motor in the electric, is under the car and out of harm's way, while the engine in the gas car is in front and subjected to serious damage when a collision occurs. Absence of inflammable fluid in the electric makes a fire practically impossible. The fire insurance companies recognize this latter feature, and allow electric trucks on wharves, docks, in sheds and warehouses, where the gas truck is prohibited.

The freedom from fire in a garage which is strictly electric, as compared with a gasoline garage, is almost self-evident, and the fire insurance companies are beginning to make a rate accordingly. The electric vehicle is no more hazardous from a fire standpoint than the horse and wagon, and, in fact, probably less so, for, with the electric vehicle, there is no inflammable hay stored to feed the flames when once started.



The Gas-Electric Motor Car

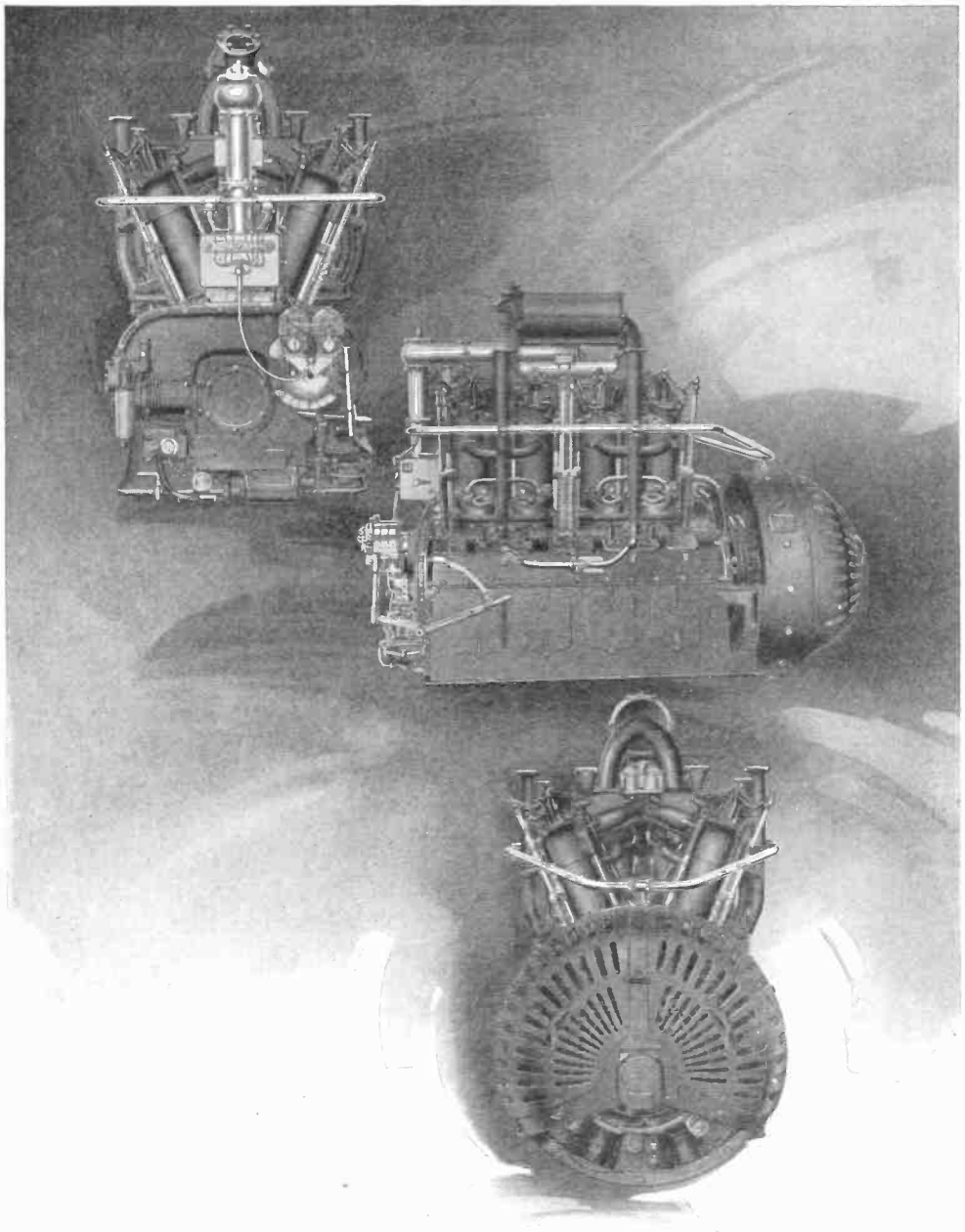
Many of you no doubt, in traveling about the country, particularly in the Western and Southern States, have sometimes seen a strange appearing car drawn up at a wayside station or scudding along over the steam railroad tracks moved by some unseen power. This car looks very much like the usual electric interurban car. Your curiosity is excited, however, from the fact that there is no trolley or third rail visible from which to secure electric power and, moreover, there is no smoke stack or boiler and you rightly judge that it cannot be driven by a steam engine.

Upon inquiry you find that it is simply another of the economic outgrowths of modern railroading. It is a gas-electric motor car that has been developed in the last few years to fulfill a specific need in railroad operation. By gas-electric car is meant one which carries a gas engine to drive an electric dynamo, the latter, in turn, furnishing current to drive the motors which operate the car after the manner of the ordinary electric interurban. "What is the use of having such a car?" you ask, "and, furthermore, if it is necessary, what is the use of going that roundabout way to transmit power to the wheels? Why not have the engine drive the car direct?"

To begin with, the usefulness of the car becomes apparent from the cheapness of its operation as compared with a steam train with its locomotive, tender and additional cars. On branch lines, for instance, where the traffic is so light as to make frequent service with heavy trains unprofitable or even a losing proposition, the gas-electric with its one man operation and economical fuel consumption is used to advantage. Also on through lines, it is frequently used for local passenger traffic between adjoining towns on the line. It has still another advantage, namely, it can jump over from steam lines to electric lines if necessary for any special service.

As to the advantage of using the electric drive, this becomes apparent from a little study. By transmitting the energy of the gas engine to the wheels through the agency of electricity all direct mechanical gearing is done away with, and the electrical transmission is not approached, for reliability, by any mechanical drive known.

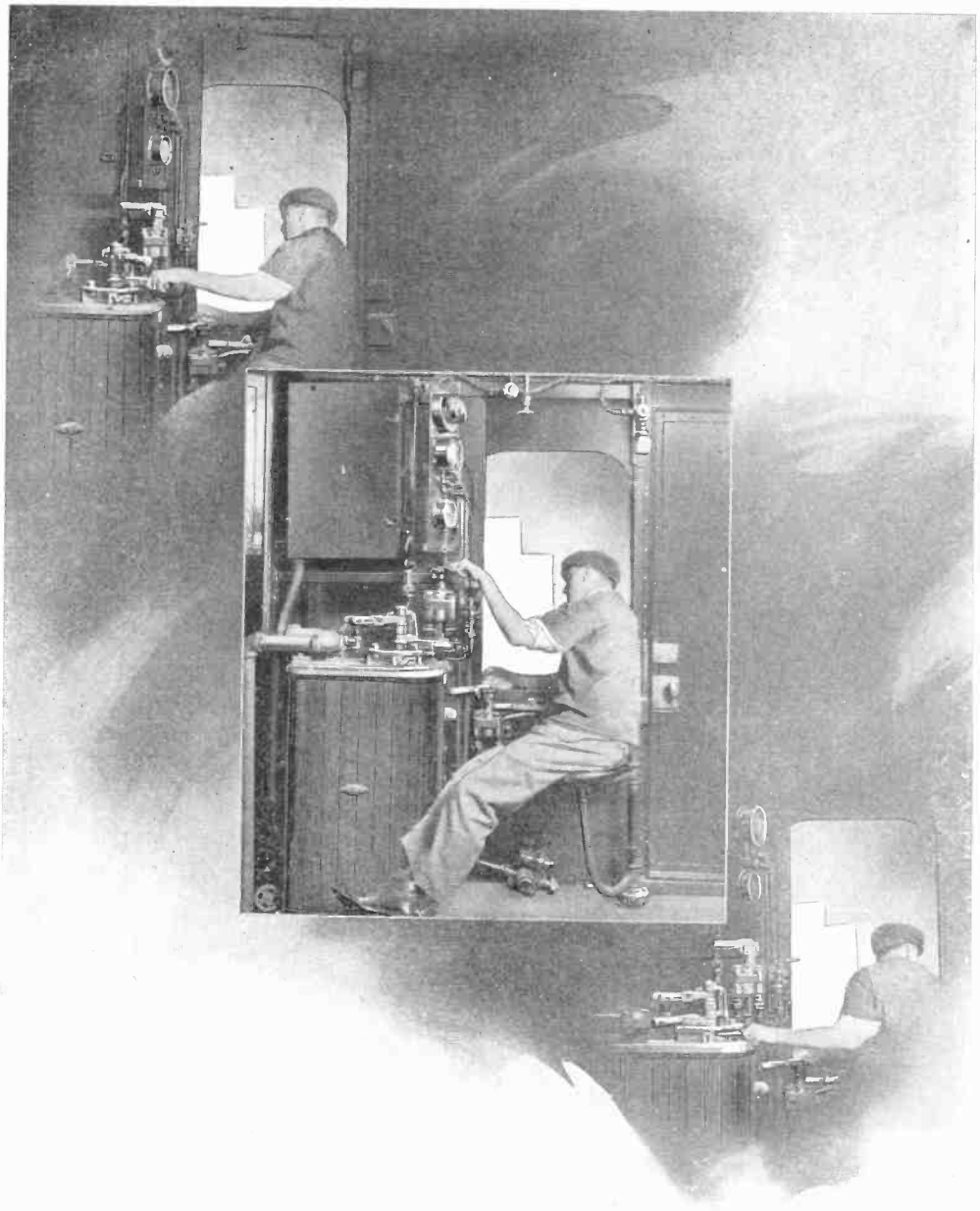
With the electric drive the engine always turns in the same direction and no complicated reversing gear is necessary on the



ENGINE AND DYNAMO WHICH DRIVE THE GAS-ELECTRIC CAR

engine. To reverse the car the engineer simply throws the electric controller handle over and reverses the motors.

The electric drive admits of the engine being entirely above the floor line of the car where it is flexibly supported and free from dust and dirt. All its parts are also under the immediate observation of the operating engineer. The engine also operates always at its normal speed, which is most economical, regardless of the speed of the motors and the car.



OPERATING EQUIPMENT IN THE GAS-ELECTRIC CAR

On accelerating the car, the electrical method of control furnishes what is equivalent to an infinite number of gear ratios, but without changing gears. Moreover, the electric generator furnishes electric lights and pumps air for the air brakes.

The two illustrations herewith give a very good idea of the engine and dynamo arrangement of the General Electric type of car and also show how the operator sits at his ease and by the manipulation of a few simple levers has complete control of his car.

Ditch Digging With Dynamite

Along with other uses which have been found for dynamite, as a creative rather than a destructive force, and probably most surprising of all, is the use of the lower grades of explosive for blasting out ditches and draining swamps and flooded farm lands. Within the last few months a series of interesting experiments in ditching with dynamite were carried on at the Rhode Island State College and proved very successful. It has been found in ditching that it is impracticable to set off the explosive and obtain the desired effect without the use of the electic current so that when the current is turned on all of the cartridges which have been planted along the desired route of the trench are set off at precisely the same instant.

The depth of planting of the cartridges determines the depth of the ditch wanted, and the cartridges are usually planted three or four feet apart, depending somewhat upon the soil conditions encountered. In the electrically controlled blasting fuses there is not the same danger that there is with the ordinary hand lighted time fuse, and in practical experiments it has been shown that the results in ditch digging with the explosive are far superior when the entire charge is exploded at the same instant and the water is released at once with a gush which allows it to wash away the loose dirt and cut the channel of the ditch deeper and deeper.

In setting in the cartridges a hole was made with a crowbar and a wired cartridge inserted with the aid of a broom handle. Each of the holes was similarly filled and the wires connected up in series. When the last cartridge is connected to the final half pound stick, a lead wire from the portable magneto is attached to the first and last cartridges, thus making a complete circuit through all of the charges through which the exploding current from the magneto must travel.

When the charge is exploded the current sets off the cartridges by the melting of an infinitesimal quantity of platinum in the form of a bridge over the fulminate of mercury detonating cap and the entire ditch is opened up in an instant. One of the pictures shows the ditch after the explosion and just as the water is beginning to find its way through the newly opened trench.

DYNAMITE CARTRIDGES READY FOR DITCH DIGGING

PLANTING THE CARTRIDGES

AFTER THE BLAST

Mineral and Buried Treasure; Can They Be Located Electrically?

By ALFRED WILLIAMS

Much, very much, nonsense has been written on this subject. The patent office records disclose a bewildering mass of specifications, some highly scientific, some simply ingenious, others ridiculous to the point of humor, but all interesting in proving the fixed idea in inventors' minds that electrical discovery of hidden wealth is possible. And when one considers the many physical and chemical properties of metal in the earth's crust, it seems as if there must be a means of detecting its presence other than by visual observation or geological inference.

The search for buried wealth and mineral probably exercises a greater fascination over the human mind than most branches of labor; and it is in no way surprising that from early Biblical days the divining rod and other psychological appliances have flourished.

The discovery of electro-magnetism by Faraday in 1820 afforded a basis for rational experimentation, and in 1830 a paper entitled "The Electro-magnetic Properties of Metalliferous Veins in the Mines of Cornwall," was communicated to the Royal Society by Mr. Robert Were Fox of Falmouth, England. Using a crude galvanometer made by a magnetic needle 3.5 inches long, suspended between 25 turns of wire coated with sealing-wax, Fox found that when he earthed one end of his wire to a copper plate buried in the soil, and connected the other wire to the metal in the veins, the galvanometer needle showed a considerable deflection. Further, he found that the deflection was proportional to the mass of metal in the vein. By attaching his electrodes to various points of the mine he was able to tell if any two masses of mineral connected with each other. In other words, he converted the ore bodies into earth batteries, the ore, always highly electro-negative, acting as the positive element of the battery. Summing up his experiments he remarked, "Hence it seems likely that electro-magnetism may become useful to the practical miner in determining with some degree of probability at least, the relative quantity of ore in veins, and the directions in which it most abounds."

Eliminating the many devices based upon the absurd supposition that a mixture of metals, when dissolved in mercury and placed in a dark box suspended from the seeker's hand by a string, will turn around so many times for gold and silver, vibrate vigorously in the presence of lead and copper, and almost shout on approach to diamonds, we have the following theoretically possible methods: (1) resistance measurement; (2) magnetism; (3) electro-magnetic induction, and (4) underground wireless.

Resistance.—Based upon the assumption that a body of metal will cause a drop in resistance of the earth immediately above, many inventors have brought out adaptations of the Wheatstone bridge, the potentiometer and the galvanometer. In this case the operator makes careful measurements of the earth at various places in the geological area under investigation, and finding what he considers to be an average specific resistance, he probes about in the hope of finding a spot of marked diminution. Then, provided that the area of decreased reading extends as a narrow elongation, he assumes that underneath there exists a vein of high conducting power. Under ideal conditions, the soil being absolutely homogeneous, the vein uncapped and the distribution of moisture even, it is, theoretically, possible to locate a mine by this means. I say theoretically, because under mining conditions these ideal conditions seldom, if ever, occur. Moreover, at least 50 per cent. of payable veins possess a resistance, due to the dielectric nature of their matrices, far greater than that of their enclosing rocks. Again, any one familiar with the difficulties of measuring an "earth" will realize the many great obstacles in the way. For instance, a wire connecting the water pipes of Chicago to those of New York would prove the resistance of the intervening earth to be a negligible quantity; but, replace the

enormous pipe-area by small electrodes and the resistance would approximate 100,000 ohms. Now, throw a pail of water over each electrode, and lo! the resistance will fall to 5,000. Move one pole into soil with a content of sand, and up will go the resistance. Under these circumstances it is very doubtful if a fall in resistance has ever been observed over a metallic body other than that caused by moisture and water gathered in the fractures that almost invariably characterize rock in the neighborhood of an ore

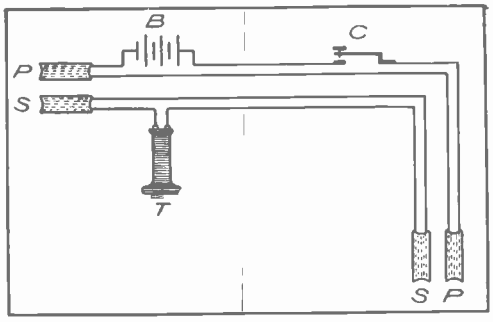


FIG. 1. MAC EVOY'S SUBMARINE SOUNDER

body. This will possibly explain the rare occasions of success reported with systems of this kind.

Magnetism.—Inspired by the work of Lamont, Fteiherr von Wrede, in 1843, found that by measuring the changes in the earth's normal magnetic field, the location and extent of magnetic iron ore deposits could be determined. In Sweden, in the hands of trained experts, remarkable work is being done in this direction. By means of an extremely sensitive magnetometer such deposits are not only discovered, but their size, dip, depth and strike are ascertained. Unfortunately, this method is not suitable for hematite, which constitutes the bulk of the ore of this useful metal. Hence, its scope is restricted to magnetite and the magnetic nickel deposits. In Canada the government has made exhaustive tests with this method.

Electro-magnetic Induction. — Here we enter into a very fairyland. In the realm of electrics nothing is more fascinating and pregnant with potential discovery than in the adaptation of the Hughes induction balance. What is known as MacEvoy's submarine finder has been and is now used for localizing the whereabouts of submerged torpedoes, iron ships, etc. Nor is its use confined to magnetic materials; with less precision it detects the presence of gold, silver, copper, lead and many minerals. It was used in detecting the bullet in Garfield's body; it is used by the steel companies for the purpose of finding blow holes and invisible fractures in armor plate. In fact, its scope is wide. The diagram shows the balance in a practical form.

The letters (PP) Fig. 1, represent the primary coils, through which the break (C) sends an intermittent current from the batteries (B).

The electro-magnetic waves generated in the primary coils set up an induction current in the secondaries, and the telephone (T) is energized.

Now reverse one of the secondary coils so that its winding is opposed to that of its companion coil. What happens? The currents, passing in opposite directions through the secondaries, neutralize each other and the telephone is silent. But interpose a small piece of metal between (S) and (P) and the electric equilibrium is disturbed, eddy currents form in the metal, and the telephone immediately vibrates.

If a silver half dollar be placed between one pair of coils, a counterfeit between the others, the telephone announces the difference; and not only that, but two silver or gold coins of different mintage affect this sensitive instrument. Pieces of ore act similarly, though to a less extent. Next to the spectroscope and the bolometer, no more delicate instrument has ever been devised.

This arrangement, long flexible wires connecting the two pairs of coils, has been used in exploring for pirate hoards, and many unsuccessful attempts have been made

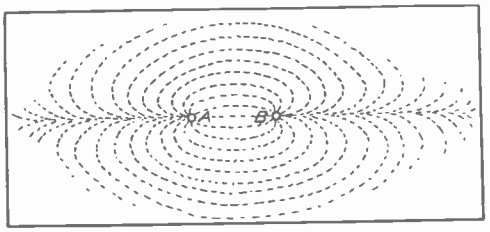


FIG. 2. COURSE FOLLOWED BY WIRELESS EARTH WAVES

to locate veins of mineral in the mining field. Sensitive as it is, especially to magnetic metals, its range is limited to a very few feet. By using very high frequencies, and heavy currents, no doubt the effective range could be increased, and it is quite possible that some adaptation of this method

will solve the problem of electric discovery of mineral. Its simplicity, its portability, lend themselves to the work, and ample reward awaits the electrician who can obtain results on iron and lead sulphides—pyrites and galena—at a distance of 20 feet. The metals themselves should not be experimented on, as Nature distributes free metal very sparingly and in such a way that the balance would be ineffective. Find the sulphides and the accompanying valuable metals will discover themselves.

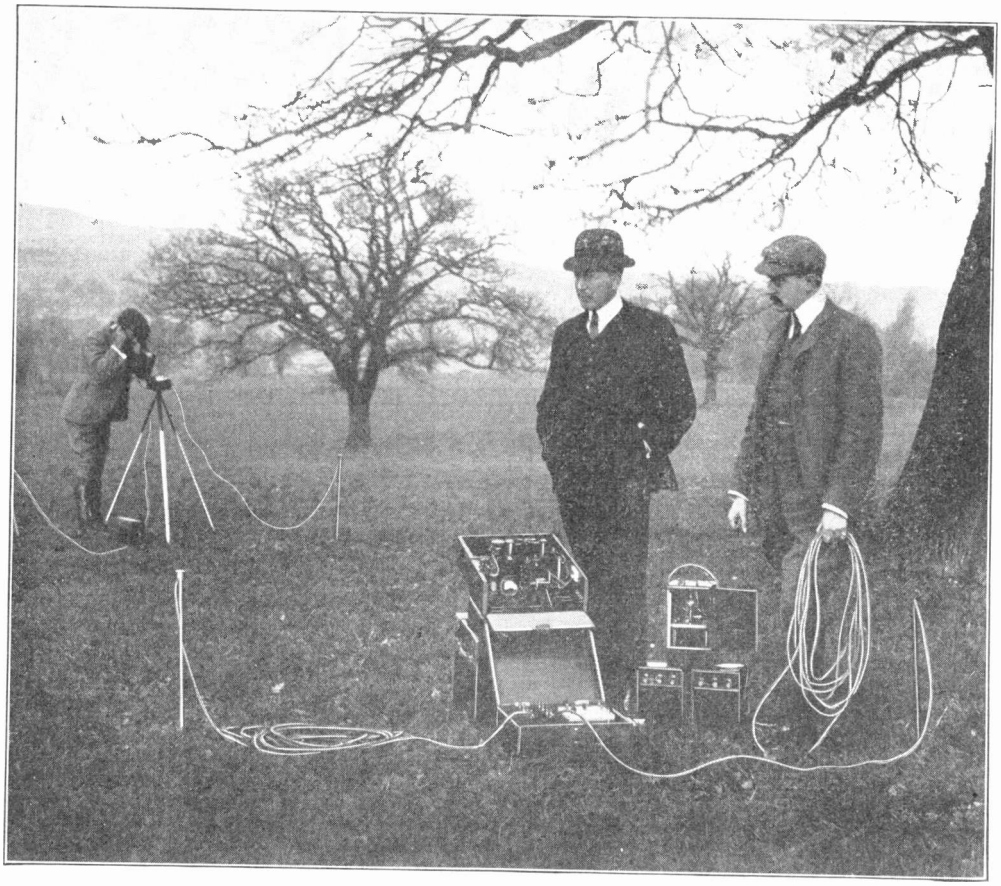


FIG. 3. AN APPARATUS OF AMERICAN DESIGN WHICH IS EXTREMELY SENSITIVE TO UNDERGROUND METALLIC ORES

Underground Wireless.—This is the most scientific and at the moment the most feasible method yet discovered. It is based on the following:

When an intermittent current of electricity is put into the ground at one point, and taken out at another, the energy does not travel in a straight line between the electrodes, but spreads out in the well known geometric curves somewhat like a magnetic field or the ripples caused in water by a falling stone. In addition to the horizontal flow, the waves travel vertically and reach great depths in the crust of the earth. Looking at it from above, the course taken is roughly this: (A B), Fig. 2, may be considered as earth plates, one at each end of a long telegraph line, or they may be mere spikes placed a few feet apart in garden soil. In either case they act as a transmitting circuit and radiate waves or impulses for miles around.

To ascertain the existence of the field of force, take a common telephone receiver connected in series by flexible wires to two portable spikes. Immerse the ends of these spikes in the ground, anywhere in the active field, and a portion of the electricity traveling through the earth is shunted into the telephone which vibrates and emits a sound

the nature of which depends upon the make and break of the transmitting line.

In probing the earth some 30 years ago, Sir William Preece, the eminent British scientist, found earth waves many miles away from the telegraph line, and while continuing the investigation he was surprised to find that the normal field, as shown in Fig. 2, was distorted, twisted and elongated by the veins of mineral in the district. Here, then, was a promising field for experimentation. If ore bodies diverted the flow of intermittent telegraphic currents, it was reasonable to expect that with waves more especially adapted for the purpose some degree of success could be attained. And such has been the case.

The illustration, Fig. 3, shows an outfit of this class, designed by a well known American engineer, which is capable of turning out waves of wide frequencies and potential, and of a kind extremely sensitive to the presence of metallic ores. With 50 to 100 watts, and a transmitting base line of 100 yards, these waves have traveled through mountains, across valleys and over miles of sea, and their sound heard at great distances with receiving telephones of a special type.

It was shown that a highly conducting vein would bring to the surface waves traveling far underground. Also that a non-conducting quartz vein would cause the waves to pile up in the rock or soil between its apex and the surface, the concentrated flux being clearly indicated in the receivers.

In certain cases, and in the hands of an expert, the system is capable of doing remarkable work. Its one serious drawback is the unusual qualifications necessary to operate. Not only must the operator be a skilled electrician, but his knowledge of mining, and especially of prospecting, must be far above the average, as so many factors crop up unexpectedly and the operator must be prepared to know what geological condition is causing the disturbance.

General.—The earth moves through space in two directions. Around the sun, its orbital speed is 19 miles per second, while its diurnal rotation moves its crust, in which are embedded the veins of mineral, a thousand miles per hour. It needs no great stretch of imagination to conceive that electric waves of many kinds reach us from the sun and inter-stellar space—in fact, there is ample evidence that this is so—and they should, on cutting the conducting bodies in the earth, generate waves of radiations of some kind. It reminds one of a huge dynamo, the veins acting as the wires of an armature, celestial forces taking the place of the magnetic field.

Some investigations have been undertaken to prove this point and the fact has been established that veins in contact with the earth *do* throw off radiations of an obscure order. And given a suitable detector, an instrument that would record or manifest these rays, the question of easy and accurate location of mineral and metal would be solved in its simplest manner. And who, in these days of wonderful discovery, can say that such a detector will not be found?

What's in a Name Plate

If a dog wearing a license tag were to stray into your back yard you could take the number of the tag and by going to the city clerk or proper official find out considerable about the animal from the records.

The name plate on a motor is quite as important as the tag on the dog. After a motor is assembled and tested in the factory, information regarding it together with the serial number and type are placed on the name plate. The plate also gives the name of the manufacturer, the frequency (if A. C.), the voltage, and the speed and power the motor will develop. A permanent record of all this is kept at the factory to serve as a reference should it be desired to rewind the motor or put it into other service.

The name plate on either a motor or generator states the kind of current used or generated. While on motors the plate gives the volts and amperes necessary to run the motor at full speed and also states the horsepower, the capacity of an alternating current (A. C.) or a direct current (D. C.) generator is stated in kilowatts (K. W.). A kilowatt is 1000 watts. Thus, a 10 K. W. generator is capable of giving out 10,000 watts. Since a horsepower is expressed electrically as 746 watts it is easy to find the horsepower if you can't think readily in watts. The name plate is usually placed on the field frame of a motor or generator.

We Make a Little Trip Incognito

Old wireless men like to have fun with the younger ones. The stranger also sometimes has one put over on him by some wireless man he doesn't know. We all get more or less experience in telling of the wonders of wireless telegraphy. In other words, as I have said before, the wireless operator frequently lies his way through a bunch of inquisitive passengers. To hear the answers, and the odd reasoning handed out by some operators would make a seasick man laugh. Some are finished liars.

Not so long ago in New York I met a friend, A. W. Dorchester, who had just returned from a trip around the world as wireless man on a private yacht. At the time I had charge of the United station on the roof of the Plaza hotel. Dorchester invited me to go aboard the Lusitania on a tour of inspection. We wished to see the big ship, the wireless, and to hear the wireless man explain wireless.

We found the wireless cabin on the hurricane deck. Outside, seated in a steamer chair was the Marconi man dressed in white duck. He was reading a book and was too busy to notice us. I respectfully walked up and timidly inquired if he could tell us where the wireless room was. Without looking up, he indicated the cabin door with a motion of the book. I then ventured to ask him if he was the wireless operator. I envied him his look of pride when he said he was. Dorchester and I went on in the wireless room. At a glance we recognized the wireless set of Marconi. A neat set, too. The massive magnetic detector lent to the impressiveness of the entire equipment. But we wanted the wireless operator worse than we wanted to look at the Marconi set. He hadn't stirred in his seat outside. In a few minutes I determined to go out and get him, bring him in and start something.

So I boldly stepped out and asked White Duck to kindly come inside and explain the wireless to us. He accepted the bait. He got up and stretched a seventh inning stretch. Then he came in.

The wireless man was an Englishman. He had a real look of intelligence. He assumed a weary busy look of importance, and waited silently for a question. Dorchester put one to him.

"How far can you talk with this machine?"

"Fifteen hundred miles." His voice sounded like a low frequency spark. Such long distance work cannot be done at will. Sometimes it is possible to do such work, but only under the best conditions, with the best atmosphere.

Timidly inquired where the wireless room was

"Can you do this work any time?" I asked. "That is a mighty long distance, isn't it?"

"With our set we can do that distance easily, and at any time," he lied.

"Suppose you had a lightning storm, could you talk through it?" Dorchester asked.

"Certainly," said White Duck, in a frank manner, "that's one of the advantages we have over the ordinary telegraph system. Lightning never affects us." He said it so well that I felt almost ready to believe him But anyone who knows anything about wireless knows better than to accept that dope. Wireless telegraphy is most certainly affected by local lightning to such an extent that it is almost the rule to quit attempting to work until the storm passes.

"Wireless telegraphy must be a fine profession!" I exclaimed. "It must be great to go around the world and see sights, and get paid for going. How long would it take me to learn the business? How long did it take you?"

He blushed a little, and when he spoke this time it sounded as if he had cut some of the resistance out of his field magnets. He spoke clearer.

"I tell you, gentlemen, wireless telegraphy is a good profession. But it is hard to learn, and not many can master it. I have been in the business for about four years and don't consider myself perfect yet. In the wireless operator prospective there is or is not the necessary element which makes him a success or a failure. You may possess this element to a greater extent than I. The pay of wireless operators—I mean the good ones—is excellent." (He didn't tell us how much).

Smoked good cigars and told the truth

That last spiel I considered fairly good. Quite a bit of truth in it, too. I glanced over at Dorchester, and he had his hand on the tuner. He wanted an explanation of the tuner. Such explanations are mostly hard to give, and wireless men as a rule avoid the topic when they can.

"What would you do if there were two messages being sent at the same time?" he asked.

"You see this tuner. Well, by manipulating these keys we are able to get in tune with the station we are working with. No one else can get in on the same tune. If, for instance, the United Wireless and the Navy are working, and we wish to talk to our station at Sea Gate, all we have to do is to put this key here and this one there, and everything else is cut out and we only hear our own station. It's all in the tuner. We consider the Marconi tuner the best."

The talk he let loose that time sounded plausible. But theory and practice are sometimes far far apart.

"Would it make any difference," said I, "if you were 50 miles from the Sea Gate station and the United and the Navy were close in? Could you hear your message all right?"

"No," he said, "the signals would probably be a little fainter and that is all." I knew he was telling me a big old lie.

"This morning I was passing along Fifth Avenue up near Central Park, and noticed some wires stretched along on the roof of the Plaza Hotel. I suppose that is a wireless station?" I asked.

"Yes," he said, "they have a station there belonging to the United Wireless, I believe."

"Did that station ever bother you when you were talking to Sea Gate?" I asked.

"I have heard the station," he said, "but as I just explained about the tuner, it would be impossible for them to bother me when I am working." But I knew better.

"Well, sir, we are much obliged to you for your trouble and little pointers," said Dorchester, moving toward the door.

Then I broke in.

"Such pointers will help me, I am sure—maybe. You said a moment ago that the Plaza spark had never bothered you. You preached the tuner as being the whole works. I can not reconcile your talk now with your conduct a few days ago when you were trying to work the Sea Gate station, and I happened to have some very important rush business to get away from the Plaza Hotel station. You failed to work that tuner. My station broke you all up. I couldn't help it. My business had to go, but you couldn't read through me." The Englishman was as red now as my head.

"You preach 'tuner.' You didn't practice 'tuner'! You couldn't. Now let me cite you a noteworthy case. This past spring I was in Hampton Roads on the S. S. Oceana, tourist ship of the Hamburg-American line. The fleet was returning from around the world, and we had the honor of being able to go into the Roads with them. I had some 400 persons aboard my ship, and plenty of business to get off. There were about 25 warships there equipped with wireless, and several merchant men also. My set was two kilowatt, 125 cycle, and I could *send*. The air was full of live dots and

dashes. They flew overhead and snagged on the antenna to the extent of being felt by the hand when you got near the antenna switch. I had a jimdandy tuner, every bit as good as yours; but it was inadequate and not up to the occasion. There was no tuner on earth that would have been that day. I had to resort to politeness and diplomacy. At the first opportunity I made my bow to the chief operator on the flagship Connecticut, and asked for a five-minute chance to get my business off. That operator was generous and immediately issued a general call and sent this order out: "All hands pipe down for five minutes and give the Oceana a chance." They piped, and giving Coker at Norfolk one call, I shot him five paids and 125 words of press in that time. That was going some. Tuners are O. K. in their place, but a little patience, a little taffy, a little politeness, and an occasional laugh by wireless goes to places where the tuner is no good.

My Englishman was laughing now. He was a 500 cycle set.

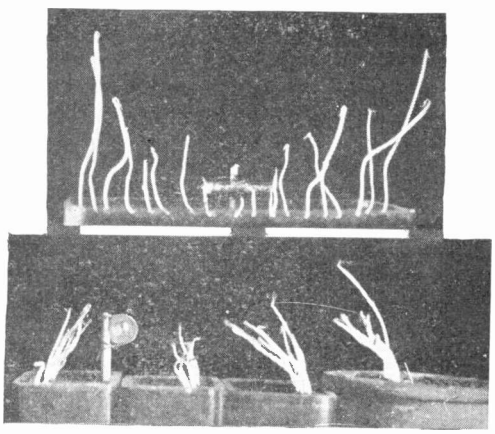
Well, after that we were all alone, we three. We shook hands, the brotherhood of good natured liars, smoked good cigars—and told the truth.

Heliotropism of Plants in Radium Light

Some plants are known to possess the property of turning towards the sunlight. It was interesting to ascertain whether this heliotropism as the phenomenon is called, might also take place in the light of radium. Professor H. Molisch of Vienna University has availed himself of the wonderful resources of the Radium Institute for solving this problem. The supplies of this institute in addition to three grammes of radium comprise some other radio-active substances, such as ionium, actinium and radium-lead.

The experiments alluded to were made in a perfectly light-tight room at a temperature of 16 to 19°C. The light rays given off from strongly luminescent radium products were found to be capable of determining a positive heliotropism. Germs of oats and vetches in fact undergo a striking bending towards these radio-active products. In connection with certain plants such as those of vetches, a considerable delay is at the same time noted in the longitudinal growth. In view of the feeble luminosity of most radio-active products these experiments only succeed with very sensitive heliotropic plants.

The sphere of heliotropic action in radium products is much more limited with seed germs grown under a metal or glass



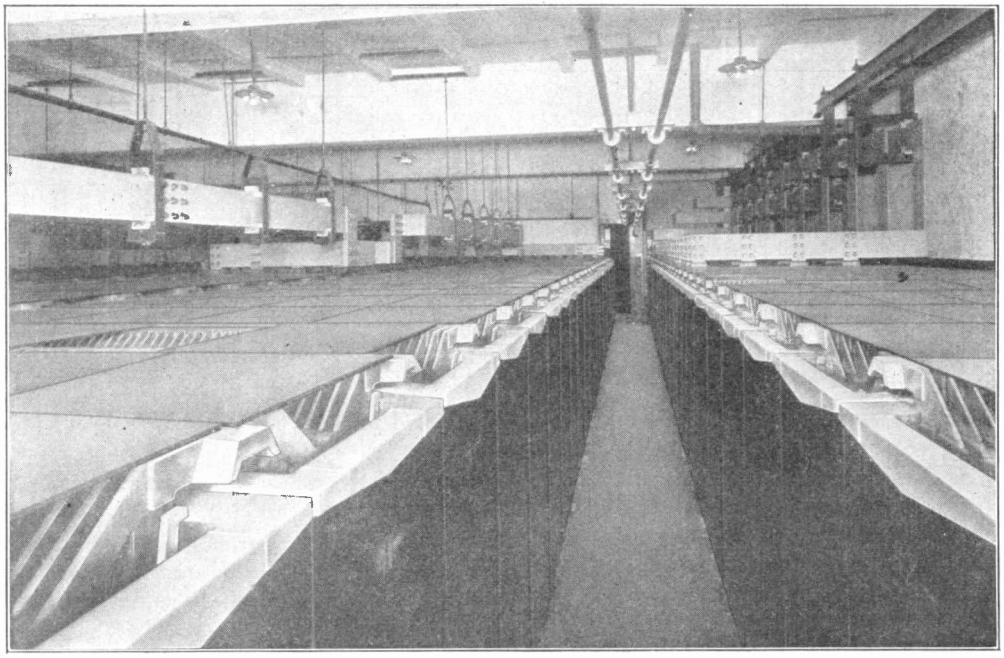
GROWING PLANTS BEND TOWARD THE RADIUM RAYS

cover than with those left without cover in the dark room. In accordance with his work on the light of bacteria, Professor Molisch shows the gaseous impurities of laboratory air to weaken or to eliminate any negative geotropism, while bringing out even more strikingly the heliotropic effects.

Reserve Current for Light and Power Companies

One of the fundamental requisites of a bank is a reserve supply of capital carried as a protection in cases of sudden demands for money. Water companies, gas companies, etc., always have storage basins or tanks where is stored a reserve supply ready at a moment's notice to meet unusual demands.

Electric lighting and power companies fully appreciate the value of having a reserve supply of electricity so that their customers may always be assured of an uninterrupted service. They realize that to operate their plants without a reserve of current is always to incur the risk of interruptions with consequent trouble to their



VIEW OF AN ENORMOUS STORAGE BATTERY, THE "BANK," IN WHICH A CENTRAL STATION KEEPS ITS RESERVE SUPPLY OF CURRENT

customers; while on the other hand a proper reserve of current forms a highly valuable insurance which is a guarantee to customers of continuous electric service.

For these reasons many of the large electric lighting and power companies have recently installed enormous storage batteries capable of furnishing a large portion, if not the entire amount of current necessary, for short periods of time.

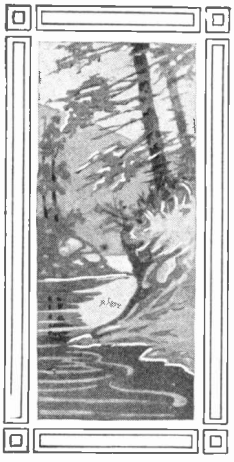
Unusual demands for current are caused sometimes by a temporary accident to electric generating machinery, or by the sudden darkness preceding a thunderstorm, or, as happened last winter in New York City, by a heavy snowfall, which, within ten minutes increased the demand for current on the New York Edison Company's system from 100,000 horsepower to 166,000 horsepower. In this case the rate of increase of current was so rapid that it was impossible to connect additional engines with sufficient rapidity to take care of the load, and the storage batteries were called upon to meet the emergency, and thus saved New York City from partial darkness

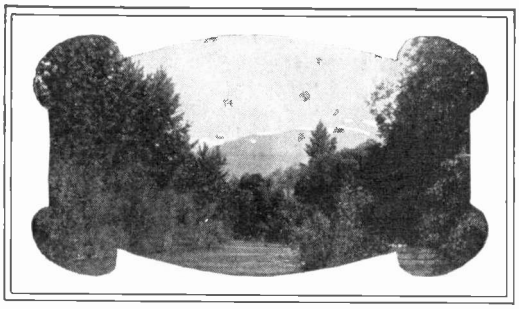
The New York Edison Company alone has 46 emergency storage batteries which aggregate a capacity of 64,583 kilowatts at the emergency rate. In other words these batteries will furnish 86,572 horsepower, which is sufficient electrical current to light 2,583,320 25-watt tungsten lamps for 20 minutes.

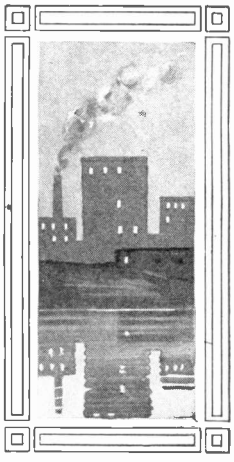
The several storage batteries of the Commonwealth Edison Company in Chicago have a capacity of 59,121 horsepower, in Boston 17,116 horsepower, in Rochester 7,085 horsepower, in Spokane 4,210 horsepower, in Minneapolis 7,049 horsepower and in Kansas City 5,231 horsepower.

An emergency storage battery is now being installed by the Consolidated Gas Electric Light and Power Company of Baltimore, Md., which will be the largest storage battery in the world. The total weight of this battery when equipped with lead plates and battery fluid will be approximately 1,079,200 pounds. The battery will have an output of 7,395 horsepower, sufficient electric current to light 220,680 25-watt tungsten lamps for 20 minutes. Think of storing such an enormous amount of electricity and having it instantly available for use.

In each of the cities mentioned the batteries chosen for this purpose have been the Electric Storage Battery Company's "Chloride Accumulator" and the "Exide" battery.







WHAT A CITY DID WITH A MOUNTAIN STREAM

By P. J. O Gara

If you should ever visit the city of Ashland, which cozily nestles in the foot-hills of the Siskiyou Mountains in Southern Oregon, the first thing to attract your attention would be the beautiful mountain brook of Ashland Park. Its birthplace is some thirteen miles distant in the eternal snows, skirting the summits of Ashland and Wagner Peaks, which raise their heads more than 7,000 feet above sea level.

Falling 6,000 feet in thirteen miles it is a tumultuous stream of laughing, leaping water, flashing and sparkling in the sunlight and darkening in the shade, tossing its mane of snowy, foaming flake over the granite rocks and lichen boulders in resentment of the restraint that impedes its progress and that ofttimes holds it back in bubbling, eddying bays where lurk the speckled trout over the golden gravel.

The people of Ashland delight to explain to the visitor how happily the town is situated, and point with pride to Ashland Creek, the finest stream in the Siskiyou Range; for this little stream not only provides pure, wholesome water to drink, but also furnishes power for street and domestic lighting and such mechanical purposes as may be desired.

There can be no pollution of the water since the timbered canyon through which it flows is included in the Crater National Forest Reserve, as well as in large tracts of land in Ashland Canyon owned by the city itself. There is no city in the west so completely possessed of its water supply and water power as is the city of Ashland. The forest reservation and the lands owned by the city insure the preservation of the sylvan beauty and primitive wildness of the region about the head waters and along the course of Ashland Creek.

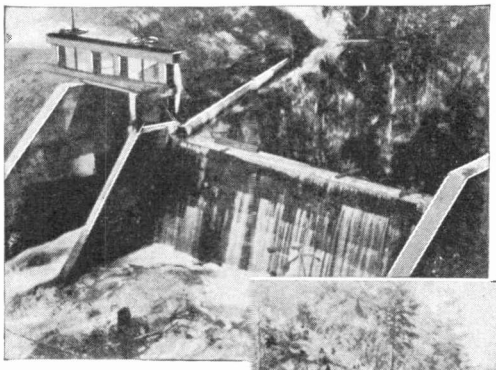
Although the city of Ashland has used the waters of Ashland Creek as a water supply for several years, it has only been three or four years since the city decided to own and operate a hydro-electric plant of its own, using the falling waters of the creek as the source of energy. For many years no one seemed to realize the wonderful power that might be developed from the little stream with a minimum flow of only ten second feet. It was only after some enthusiastic engineer showed the possibilities of the plan of harnessing the stream that the city finally decided upon taking the step.

Following up Ashland Canyon about six miles, along a beautiful road which crosses and recrosses the sparkling stream, one comes to the forks of the creek. A short distance above the forks, two concrete diversion dams are built so as to catch the entire flow.

Twenty-four inch wood-stave pipes pass from the intakes down to the forks and there connect with a "Y" to a single 24-inch wood-stave pipe which leads along the side of the canyon in a trench blasted out of the rock for a distance of about three miles. This pipe has a gradiant of about 30 feet to the mile, so that it is capable of carrying the entire flow of the two branches of the stream. In some places the pipe line is car-

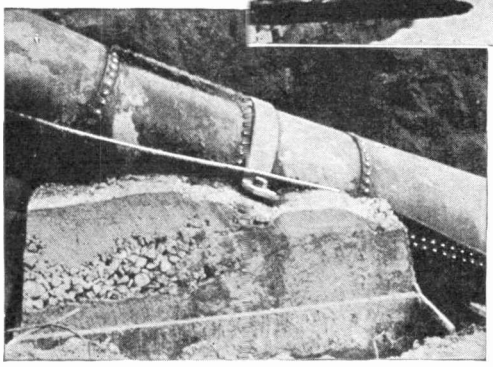
ried as an inverted siphon over deep gulches on beautiful trestles, but for the most part, it is laid in a trench and covered over.

The diversion dams are of the flow type, and are also provided with flushing gates so as to carry away any sediment which would tend to lodge behind the concrete walls. The intake is provided with a screen house. At the point where the wood pipe curves downward, there is a "T" connection and a standpipe is carried from this point up the canyon side to a point whose elevation is that of the breast of the diversion dams. The purpose of this standpipe is to take up any shock which would occur by a too sudden closing of the valve



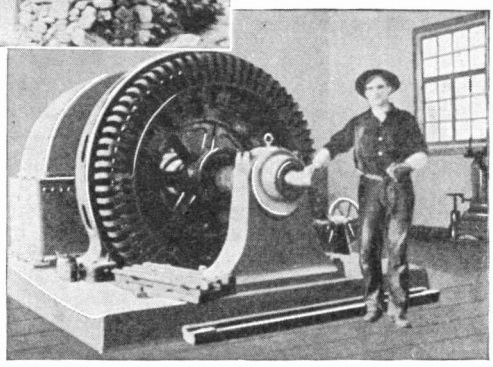
ONE OF THE CONCRETE DIVERSION DAMS

A SECTION OF THE WOODEN PIPE LINE



METHOD OF ANCHORING THE STEEL PIPE

THE POWER HOUSE



THE WATER DRIVEN GENERATOR

and a valve which may be used to cut the water off when necessary to empty the pipe line.

At a distance of about three miles from the intakes, the wooden pipe line turns abruptly down the side of the canyon for about 100 feet, where it connects with a 24-inch riveted steel pipe which continues down the side of the canyon to the power at the power house. As will be seen, there is no reservoir, excepting the very small ones at the intakes, and the operation of the plant, therefore, depends upon direct flow, which, at a minimum, provides about ten second feet—enough to generate nearly 400 horsepower at the power house.

The total head is 415 feet and the effective head is 405 feet. This great head is the

reason so much power is obtained from so small a volume of water, for the impact of the stream, as it comes from the nozzle almost as solid as a bar of iron, against the blades or cups of the Pelton waterwheel, is something terrific.

The power house is a beautiful little structure with concrete and stone base and brick walls. The inside dimensions are 50 feet long and 32 feet wide with a sixteen foot ceiling. It is very well lighted and ventilated, and the construction, as a whole, is of the very best. The power equipment, which is very judiciously placed, is up-to-date in every respect. It consists of a single unit, namely, a dynamo whose revolving field is direct connected to the waterwheel shaft. The waterwheel and therefore the generator field has a speed of 300 revolutions per minute. Both the waterwheel and generator set upon a single bed plate, making the unit absolutely rigid. A belt carried from a pulley on the outer end of the waterwheel shaft connects with a Pelton oil governor which actuates a hood, thus cutting off the water from the nozzle when the wheel tends to revolve too rapidly, bringing the unit down to normal speed. Besides the automatic control, there is a hand control which operates a needle.

There is hardly a home in the city which does not use the energy developed in this little power house. Besides, the city's streets are well lighted at a very small cost. Small factories, dairies, canneries, etc., use a considerable amount of the power as a day load so that there is need for continuous service.

An engineer visiting this very unique, little plant would doubtless find fault with the single unit construction. As a rule, a single unit does not give the guarantee of continuous service which one would like to have.

However, the people of Ashland expect to supplement the present power plant with another of about 200 horsepower, making a total of 600 horsepower snatched from the little stream. This is how they expect to do it.

When the water, which rushes down the steel pipe line, has spent its energy on the waterwheel it drops through a tail race and and a part of it flows into a nearby settling basin whence it flows to the city in a twenty-four-inch steel pipe line furnishing the water supply of the city. As only a small part of the water is actually used for houses, streets, and lawns, the rest of the water flows merrily onward down the canyon. A measuring weir indicates the amount of water which actually goes to waste. It is proposed to carry this excess water through a wood-stave pipe line along the edge of the canyon and drop it through another steel pipe. Here another power house will be built on similar lines as the one already described, and 200 horsepower more will be at the city's command. Besides, increasing the total output of the little stream, there will be a guarantee of continuous service even if one of the units should be compelled to close down. But to be sure that power service will be continuous, the city has arranged with the company which has been supplying the power to give them service in case anything should happen the municipal plant.

It may well be said that Nature has placed within easy reach of the city of Ashland everything that goes to make life worth the living—the wonderful wooded mountains abounding in game, and the streams alive with fish, a perfect climate and a beautiful country.

Transporting Live Fish

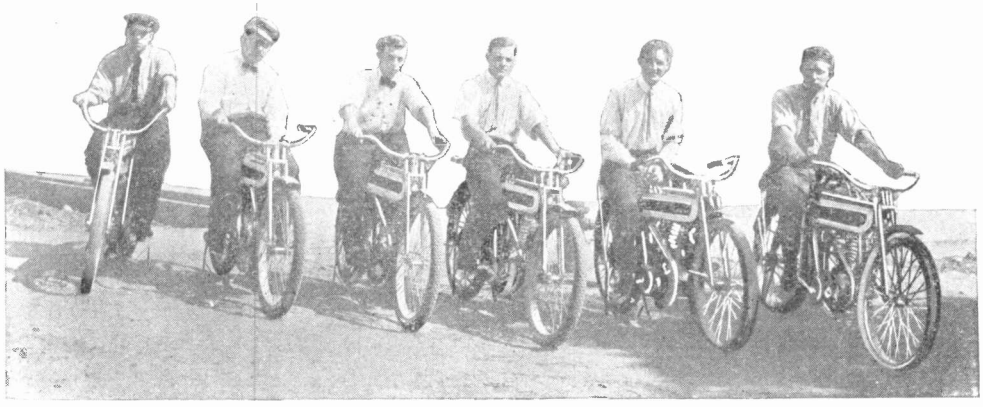
The genuine lover of fish as food knows the finer flavor of the freshly killed fish and if far from the water, he will gladly pay a higher price for the finny dainties if they have been transported alive from the lake or sea where they were caught. Such a transporting of live fish has heretofore been very limited, as large tanks were required, not so much because the finny captives needed room to swim about, as because it took a considerable surplus of water to supply them with the necessary air. Only within the past year or two has it dawned upon fish dealers that the air supply need not be limited to that commonly entrapped with the water; but that by introducing compressed air into a tank the quantity of fish which may be kept alive in the same would be increased several times.

Now special trolley cars are being equipped in Germany with the fish tanks, a motor driven pump being used to force a number

of jets of air continually through the water. Another motor pumps water out of the tank and back through a filter, so as to keep it steadily in motion and fairly fresh. Then electric lights permit of a ready inspection of the tanks during the night.

Motorcycle Squad of a Central Station

The motorcycle squad is an important factor in the affairs of the North Shore Electric Company, which operates in suburban towns of Chicago. The accompanying view was taken at the headquarters in one of the company's rural districts. This district covers a territory 40 miles long and 30 miles wide, including 15 towns and hundreds of farms along the transmission lines.



MOTORCYCLE SQUAD OF THE NORTH SHORE ELECTRIC COMPANY

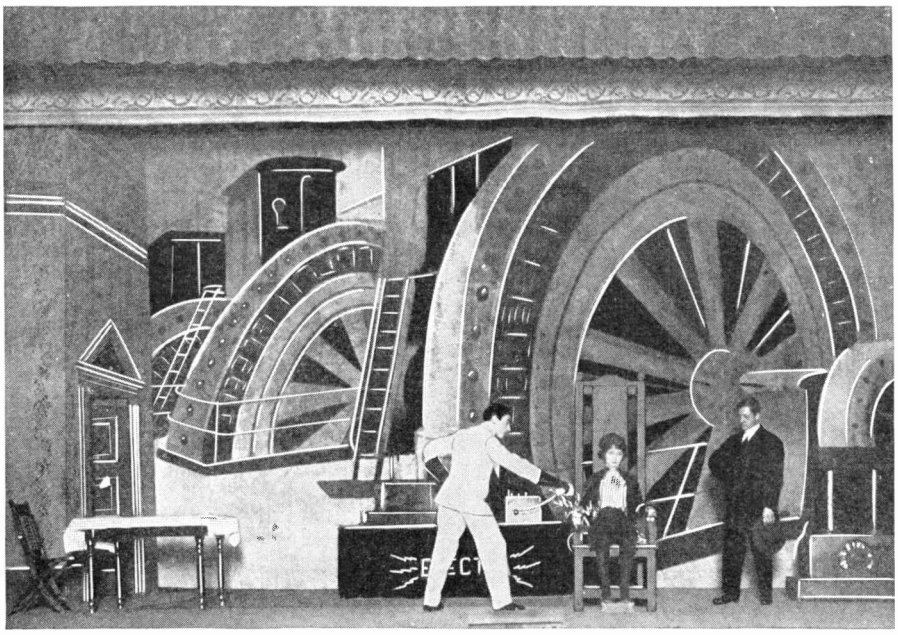
The heads of all the departments are at the district office and handle their men and the work throughout the district from this point. As some of the towns are so small that they do not provide enough work to keep a man permanently, the work is also handled from the district office. The heads of the departments have to make daily trips of inspection of the work in their respective departments in all parts of the district. This requires a large amount of traveling from town to town, and as the train service is such that it would be impossible to make but a couple of towns a day, the motorcycle has proven a great saving both as to time and expense of travel.

The machines are used mostly by the meter and inspection departments and department heads and troublemen. The machines used in the meter department are provided with a carrier placed over the oil tank for carrying meters from town to town when necessary. These carriers are well padded and at speeds of from ten to twenty-five miles an hour take up all the jolts and vibrations of the machine.

The machines used by the troublemen are provided with a standard carrier placed over the rear wheel. This carrier is used for wire, line tools and anything necessary for taking care of line trouble. A gaslight is placed on the machines for "shooting trouble" at night.

These machines are furnished by the company to the employes who are directly responsible for the machine and its upkeep. Each operator is required to turn in a weekly report of miles traveled, amount of oil used, cost of repairs for the week, tire and engine trouble, and the cost of operation per mile for the week. The cost of operation per mile including oil and repairs averages about one-fourth of a cent, which is quite a saving compared with railroad fare of two cents per mile. In this district where the roads are good and the winters not severe the machines can be used nine or ten months out of the year.

In order that the employes may take interest in the upkeep of their machines the company offers a prize of $20 each season for the operator who keeps his machine in the best shape and operates it at the least cost. To decide who is entitled to the prize the machines are inspected at the beginning and closing of the season.



How I Give the Public Electric Thrills

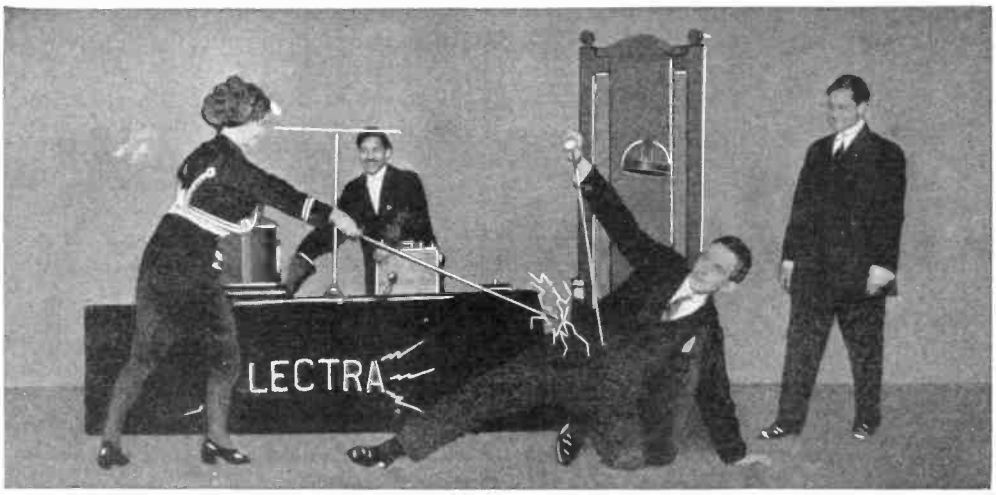
By MLLE. ELECTRA

Why I style myself "The Electrical Queen" is best explained by saying that the great general public, collectively speaking, loves a queen and at the same time is thrilled and profoundly interested by spectacular manifestations of that subtle form of energy which we are pleased to call electricity. By this combination of traits of my audiences—the desire to be thrilled by the roar and crash of electric sparks and the novelty of having a woman take the prominent part—I am enabled to earn my living.

Now, being an electrical queen does not mean sitting around in robes of royal ermine. It rather means a round of duties not altogether pleasant and to some of you seemingly dangerous.

For several years past I have been performing with electricity behind the footlights. In some of my acts I have passed millions of volts of electricity through my body. Here is where I shall get my first contradiction—not from the person well versed in electricity, neither from the one absolutely ignorant of its principles, but more likely from the person with a half-knowledge of the subject, and a little knowledge is dangerous.

"But," you say, "to come in contact with a current under a pressure of millions of volts—a thousand even—would certainly be fatal." That is true if the current were of the ordinary kind used. But in my demonstrations this is not the case, for in many of them I make use of the phenomenal effects of what is known as high frequency alternating current, discovered and demonstrated by no less a man than the great Tesla himself.

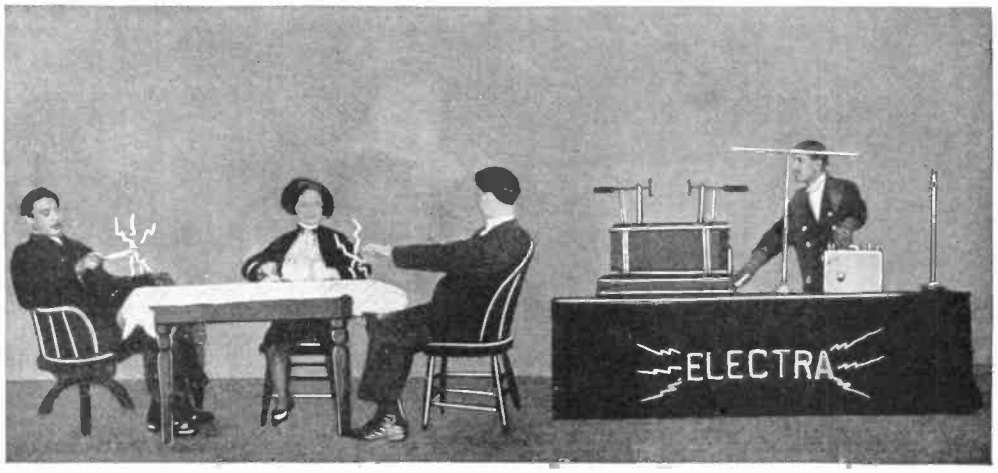


A DUEL WITH ELECTRIFIED SWORDS

You are familiar more or less with the effects of ordinary lighting current at, say, 110 volts pressure and oscillating back and forth in the circuit at, say, 60 cycles or complete oscillations per second. Though not perhaps fatal, such a current is painful to receive in the body. Increase the voltage somewhat, say, to 1,000 volts, and the current is almost certainly fatal. But when the frequency is raised to above 10,000 oscillations per second and the voltage is increased to the hundreds of thousands, we enter a new realm, the realm of high frequency currents, and the effect of such currents on the human body is entirely different—the laws, even, which govern them are no longer the laws which governed ordinary currents. In this new world of high frequency currents some of the most astounding experiments have been performed.

When ordinary current is changed by means of a Tesla coil or resonator into current of extremely high voltage and frequency, with its weird manifestations, we need to make use of some analogy to grasp the explanation of the effects. Dr. Monell has described it thus:

"We fancy a man beneath a falling cliff, crushed by the mass and stunned to instant death. But if by an ingenious device, the mass in falling becomes pulverized and drifts down upon the man in a cloud of dust, we can imagine that he will



AT THE ELECTRIC DINNER TABLE

still stand erect and move in and out of the cloud unharmed."

"Over Niagara pours a mass of water that strikes the rocks below with staggering force, but up from the falls floats an ascending mist of the same water, now transformed so exquisitely that it will not crush a flower."

This, in a way, explains the nature of high frequency currents which I make use of in some of my experiments. Therefore, do not be too sure of yourself when you say that I cannot receive currents at enormous voltages.

It will be interesting to note that since I began my act the only effects noticed have been a reduction in weight, and a slight strain on nerves, and, being a woman, this has been considered a remarkable accomplishment by some of the leading physicians and scientists of the present day who at first predicted serious results, such as paralysis, heart disease and even death, but instead of being detrimental it has been very beneficial in many ways.

Following are some of the mysterious electrical feats performed which mystify our audiences from San Francisco to New York: The lighting of gas from ice held in the hand; candles from bananas, oranges, etc.; cigarettes from the fingers; iron welded in water; candles in the audience lighted by wireless and vacuum tubes. It may be explained that some of these ar performed with ordinary induction coils and condensers which produce effects similar in a way to the Tesla coil.

We finish our act by demonstrating the electric chair, showing the high voltage jumping to the helmet, while pieces of cloth are ignited from all parts of the body, the audiences seeing the sparks jumping fully four inches.

The idea of showing the electric chair was originated and first tried in a vaudeville theatre in Spokane and proved such a big drawing card that we have featured it ever since. It is one of the most painful of my demonstrations, the current being quite jerky, as our frequency is lowered to gain increased amperage. Of course, in principle, it is somewhat different from the real chair, but, at the same time, in apparent effect it is the same.

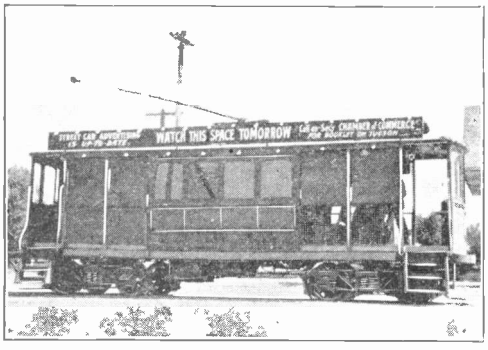
We are carrying 1,000 pounds of electrical apparatus, representing a $2,000 display. It consists of a special drop representing a high tension power plant, one induction coil giving a spark of 15 inches, which is bridged by glass plate condenser for the effect of noise and display, our special high frequency magnifying transformer, resonators, spark gaps, condensers and interrupters, both mechanical and electrolytic.

The magnifying transformer from which we accomplish most of our act is slightly different from most high frequency apparatus on the market, as we use no oil or air as insulators.

We have perfect control of frequency and variations of amperes with voltage. Through this effect we create much comedy with committees who come upon the stage, and especially at the electrical supper table, we have never yet had anyone who was able to take the apples from the plates, while Electra calmly partakes of all, and she is only a woman.

New Advertising Idea

While advertising cards in street cars have proved their value for years, the Tucson Rapid Transit Company has en-



STREET CAR ADVERTISING ON THE OUTSIDE

larged on this idea by running a line of advertisements outside some of its cars which are kept on duty night as well as day by means of a double row of electric lights.

This not only makes very striking advertising, but adds greatly to the appearance of the cars by night, as the bulbs are brightly colored and give a festive appearance to the staid old trolley.

Dodging Electrical Conveniences

By ALBERT SCHEIBLE

In Chicago, as in every other of the actively growing larger cities of the country, new skyscrapers with thoroughly modern equipment have been following each other in rapid succession. Of course these costly and most carefully planned office buildings are all electrically lighted and all aim to give their tenants the benefit of the electrical conveniences. Or, rather, all but one of the new Chicago office buildings have done so, the exception being the new People's Gas Building, opposite the Art Institute. When this fine 21-story building was planned by the gas company, those in charge were in something of a quandary as to the electrical equipment of the building. They knew that unless electric lights were available in every one of their rented offices, it would be difficult to secure tenants, and it might be still harder to hold them. But as their solicitors had right along been urging people to continue their grandfather's practice of using gas, how would it look if the gas company itself set an example to the contrary? And how would the company's own fine offices look if lighted by the homely, suspended gas stoves commonly offered as "gas arcs?" In self-protection the company's natural course was to dodge the use of electricity as far as possible and to try and show that even a highly modern building can be adequately equipped with gas alone.

The results have been highly interesting and reflect great credit on the gas company's illuminating engineer, Mr. C. A. Luther, who had to bear the burden of the planning and experimenting. Now the casual visitor finds the company's own offices on the main floor brightly lighted by gas lamps rivaling electric arcs and controlled from wall cabinets, with equally brilliant lamps lighting up the front of the building. Leaving the offices, he is taken to the cigar booth in the main corridor, an enclosed room which shows remarkably good ventilation, although no electric fan is used. Going upstairs he finds that most of the tenants are using gas, although the fixtures, which are of a novel type, are fitted for both gas and electric lamps. Apparently gas has scored a triumph. But how?

Trace the piping from the impressive gas fixtures in and about the company's own offices and you will find that they do not go direct to the usual mains from which gas is supplied to all of the company's customers. Instead, they lead down to a sub-basement far from the eyes of the general public, where a pair of electric motors raises the pressure of the commercial gas so that it can be used much more effectively in specially designed lamps and burners. The ordinary gas as furnished to consumers throughout the city could not give a modern display effect, so electric motors (supplied with current from the Commonwealth-Edison Company's circuits) have to help it out.

The attendant tells you that these lamps are turned on and off at the wall "just like electric lamps," but he does not offer to let you see it done. Why? Because, instead of turning a switch and having the light flash on or off instantly, he has to use a slow and cumbersome pumping process. He takes a hand pump, inserts its nozzle into one of two openings (an extra one has wisely been provided for use when the first is out of order), pumps away and then waits. In about a minute the light begins to show dimly and in a minute and a half it is burning brightly—that is, if the special burner equipment is carefully adjusted. Fancy waiting a minute and a half for the light after you have turned the knob of an electric switch!

However, the tenants in the building do not have to put up with such delays, for their offices are piped with the ordinary low pressure gas, controlled in the old ways. That most of them have started their tenancy by using gas, speaks well for the persuasive salesmanship of the gas company's commercial department and for the latter's cleverness in providing fixtures in which the electric lamps are placed at a great disadvantage. Besides, many of the tenants when admiring the light given on the main floor by the electrically boosted

gas, may have imagined that the same was available for them.

But how are they to work advantageously on hot days and to entertain their visitors comfortably without the use of electric fans? That the gas company experimented with some gas-driven fans is an open secret, but these fans either have explosion engines which are more noisy than efficient, or else have hot air engines which warm the resulting breeze to an uncomfortable extent. Disgusted with such substitutes for the cool and noiseless electric fans, the gas people decided that their tenants would not need any, since they were in a tall building facing the lake, where cool breezes are the rule rather than the exception. No doubt those occupying offices on the Michigan avenue front may get along fairly well without fans—except on the calm, sultry days when people enjoy them most—and perhaps the others can be persuaded to think that they are not warm even when the mercury says the contrary.

Or, can they enjoy the fanless ventilation which is so noticeable at the cigar booth on the main floor? There the architect solved the problem, as the height of the lower story permitted a sloping sub-ceiling to be placed some feet below it. This extra ceiling was made like an inverted funnel, or pointed tent, so that the top of the booth slopes up from all four sides to an opening in the peak. A gas lamp set in this opening creates a strong upward draft, just as is done by the fire in an Eskimo's hut, and like the latter, it insures good ventilation while the lamp is burning. Unfortunately, the ceilings in the rest of the building are not funnel shaped, nor are they so in other buildings, hence this method of ventilating is not likely to come into general use. Besides, who would want to add the heat of a gas lamp over his head on any day when the thermometer is already above 70 degrees? By so doing, one may dodge the use of an electric fan, but where does the comfort come in?

Lightning Rods

It is the general impression that the chief value of lightning-rods is to shield buildings from harm by conducting electricity from the clouds to the earth. Even intelligent people are often surprised when told that the rods secure safety by allowing the electricity to escape which gathers on the roofs and sides of buildings. But the cases where the electricity goes upward from the earth to the air largely outnumber those in which the current sets in the opposite direction.

The process is a very simple one. The electric equilibrium in the air is disturbed and one kind of electricity gathers in great force on the earthward surface of the clouds. This at once disturbs the equilibrium of the earth and attracts the opposite kind of electricity to the earth's surface. When the tension becomes too great—or the mutual affinity becomes irresistible—electricity leaps either from the clouds to the earth, or reversely, and for the moment the equilibrium of both at that point is restored.

But if conducting points, such as lightning-rods present, are numerous enough to dissipate steadily the force gathered on the earth's surface, there will be no sudden leap and no lightning shock. In the famous experiment of Franklin with his kite, if the lightning from the cloud had run down the string to the key, the bold experimenter would have suffered the penalty of death for his rashness. But it was only the electricity of the kite and the string, decomposed by the attraction of the electricity in the cloud, that escaped by the key, and therefore the shock was a light one.

Heated Towel Racks

Where a large number of persons use the same roller towel, if most of them have washed their hands well before wiping them, the towel may not be badly soiled even after several days. What makes it objectionable in such cases is its getting wet from end to end, there being no ample time for its drying.

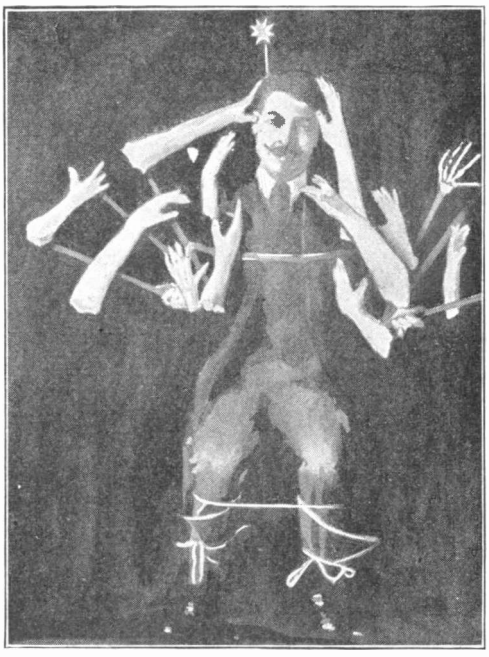
To overcome this objection a London firm is putting out a towel rack having the roller electrically heated so that the wet spots will be drying while the rest of the towel is being used. This requires very little current and the satisfaction of always being able to find at least part of the towel dry and warm appeals to all.

Unmasking an Alleged Medium

Most of us have heard of or been present at seances that flavored of trickery, but accusing the leaders of the same and proving it are two different things. Occasionally we read of a police raid on some flagrantly deceptive performer, without knowing how much credence to give to the usually biased and sensational newspaper reports. The more satisfactory plan, alike for those who believe in spirit manifestations and those who are unconvinced of their possibility, would be to have all mysteriousness removed from the seances so as to show that everything about them is genuine.

But what if the medium and his colleagues decline such an interfering with the silent darkness which they hold to be essential for any exhibition of their powers of bringing the dead back to our midst? Shall we take their undisputed word for it? Or shall we do as one investigator has done, turn the light suddenly on the medium to see if the alleged spirit hands are genuinely so? It was at a seance where the medium (a man in this case) had been tied to a chair and had supposedly been put into a trance before the lights were turned out. Then as the eyes of the audience became accustomed to the darkness, a faintly glowing star ascended over the medium's head, while soft music was heard from somewhere behind him. Then hands appeared close to him and began to stroke his face and shoulders, the hands and forearms being radiant enough to dimly light his figure. There he sat, evidently still bound immovably, with the mysterious hands floating about and caressing him, and with the star slowly waving above him. The audience sat breathless, no one daring to stir except the one skeptic who had come armed with an electric flashlight. Drawing it quietly from under his coat, as he flashed its beams on the man in the chair, a cry of surprise came from a dozen lips. Instead of being in a trance, the alleged medium was sitting there smiling at the credulity of his audience and waving a number of jointed rods to which the gloved arms were fastened. Luminous paint had made them phosphorescent in the dark, just like the star which was supported by a stick slipped under the cords that bound the medium. A slight wriggling of his body made this stick sway to and fro so that the star would move accordingly.

SPIRIT HANDS AND A SWAYING STAR



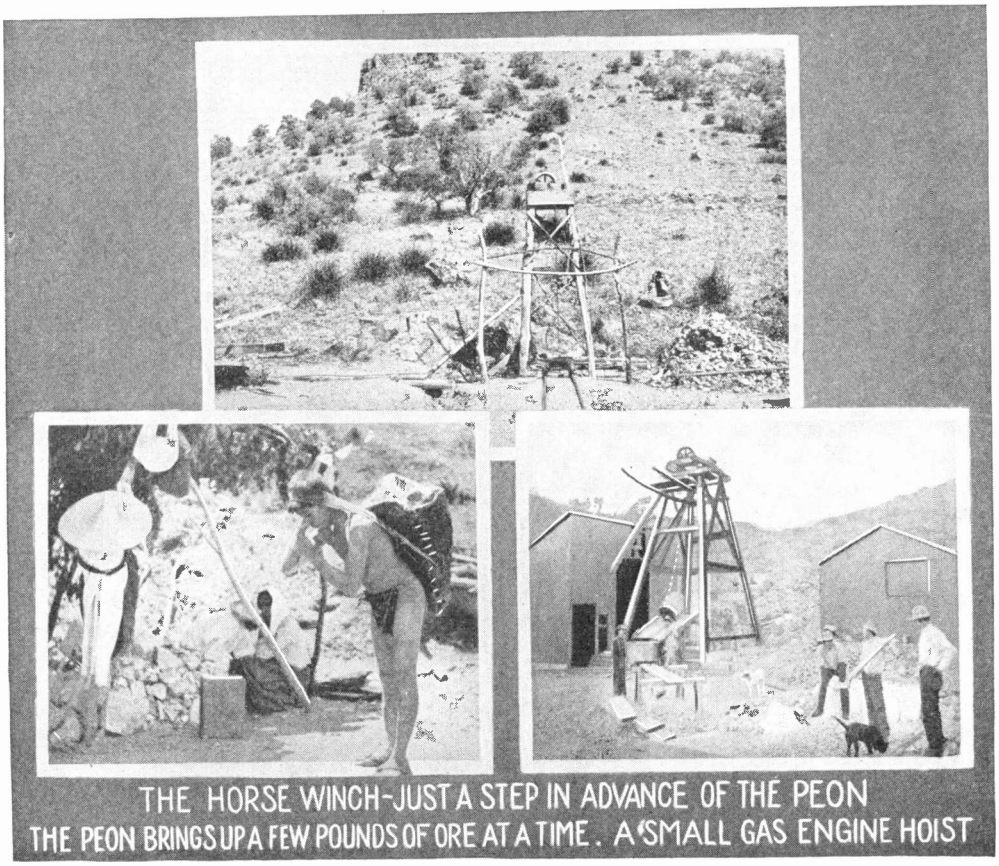
WHAT THE ELECTRIC FLASHLIGHT EXPOSED

Electricity Raises Ore

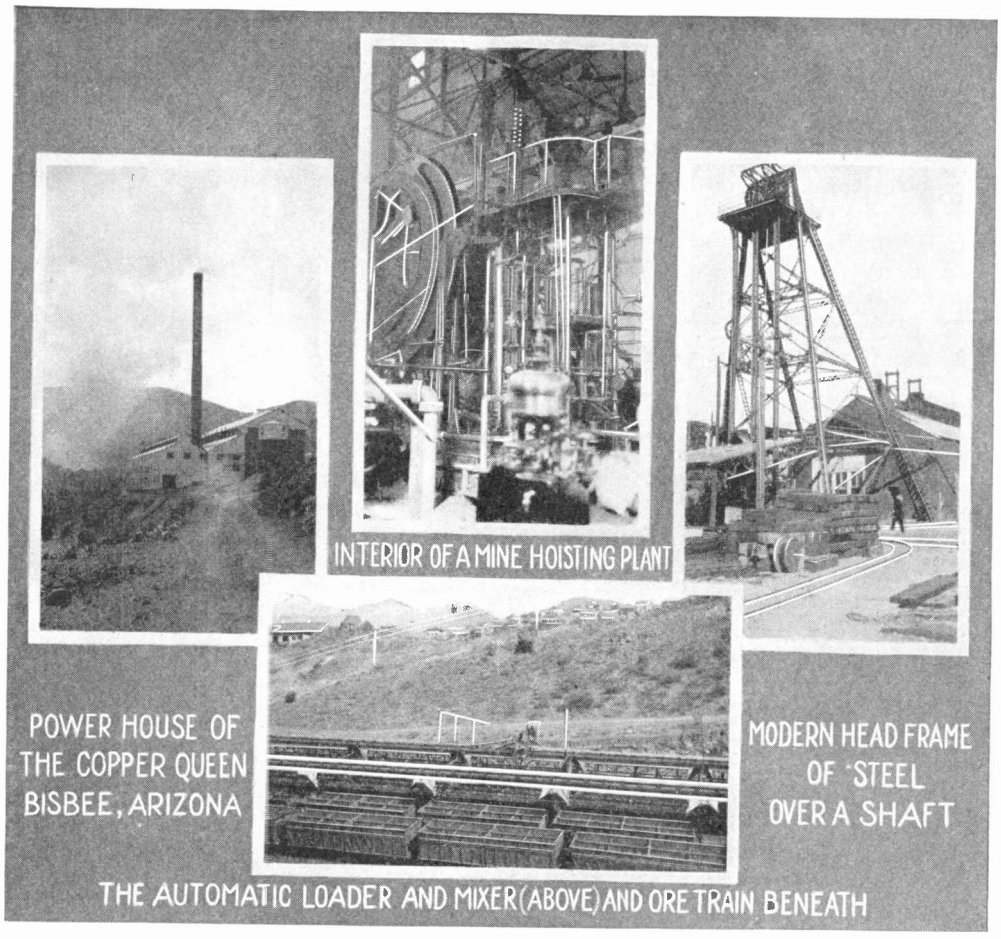
The history of mining is briefly summed up in this series of photographs of various methods for raising ore from the underground workings to the surface. The various systems are all in use in the American Southwest today, yet they represent conditions which are primitive and semi-savage on one hand, and the last word in efficiency and economy on the other.

One view represents the peon as he is found in Mexico and South America, carrying a sack of rawhide upon his back, which contains only a few pounds of ore brought laboriously to the surface. The second shows the old-fashioned horse winch, which is not a very great advance over the first method. A horse draws the ore to the mouth of the shaft, a bucketful at a time, and a small hand car receives the bucket which is wheeled to the dump. Then came the small gas engine hoist, another step forward.

The modern method is shown in the photographs of the electric power plant of one of the mining companies at Bisbee, Arizona. The hoist engineer merely throws a lever and the huge cages carry crews of miners or tons of ore at the rate of 2,000 feet per minute. Reaching the surface, the ore is automatically dumped into an electrically operated belt conveyer, which carries it to the waiting ore trains several hundred feet distant. Here it is automatically loaded and at the same time properly mixed for the smelter. This is done by raising ores from the various levels of the mine (which contains varying elements necessary for an economical fluxing mix-



THE HORSE WINCH-JUST A STEP IN ADVANCE OF THE PEON
THE PEON BRINGS UP A FEW POUNDS OF ORE AT A TIME. A SMALL GAS ENGINE HOIST



ture), and these are delivered in rotation to the belt conveyer. A motor-driven device runs along an elevated track over the ore train and as it travels, dumps the ore from the belt to the cars below in a small but steady stream. It makes a number of trips back and forth before the cars are filled, and as the various grades of ore have been taken by the belt conveyer meanwhile, the desired mixture is obtained. When loaded, the ore trains convey the ore to the smelter, electricity having done practically all of the work up to that point.

Cutting Artificial Diamonds

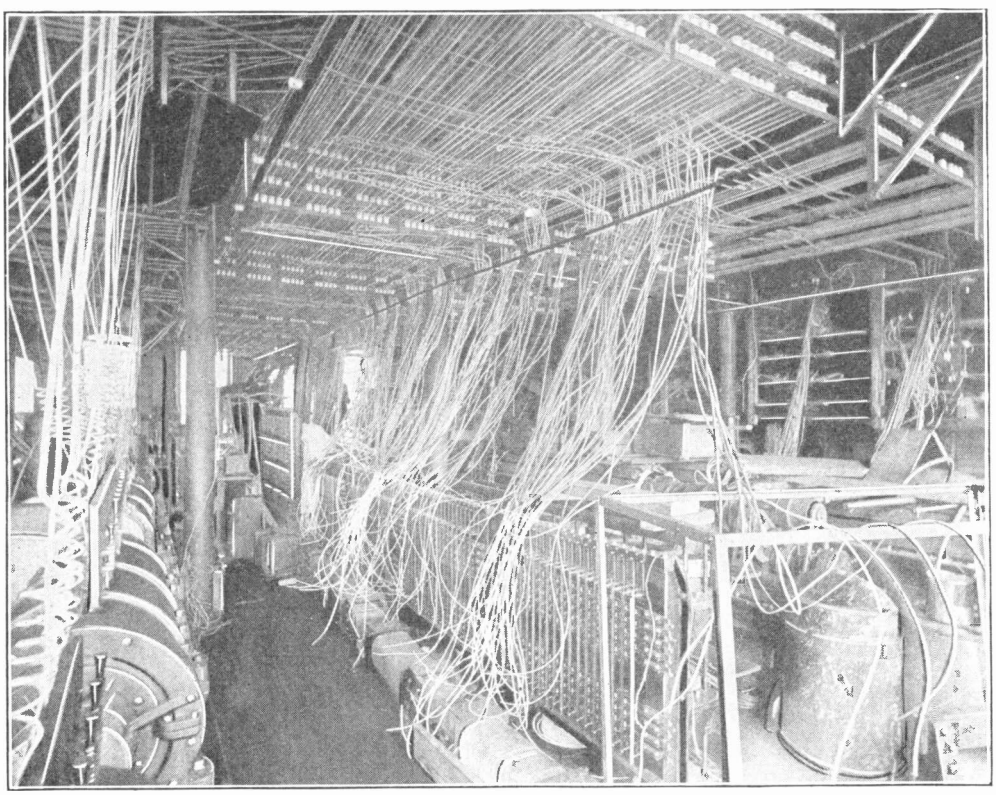
When Acheson in testing some products of his electric furnace found that one of them would grind the edge off the diamond in the ring he was wearing, he knew that he had discovered a material of most unusual hardness. This "carborundum," as he called it, could at first be made only in a dark brown or black form, neither being suitable for jewelry. Only recently have experimenters begun to produce the carborundum in transparent, colorless crystals which are said to have an even greater refractive power for light than the diamond. To obtain these crystals the electric furnace is charged with 30 parts of a pure carbon, 37 parts of quartz, nine parts of sawdust and four parts of salt, besides a small quantity of chromic oxide. The last ingredient seems to have the property of eliminating all color in the resulting product, leaving it clear and colorless.

But even the small crystals as they come from the furnace are not of the right shapes to sparkle, and how are they to be cut? Diamond cannot be used, as it is much softer than this would-be competitor. Nor

can these artificial diamond crystals be used on each other as they are so exceedingly brittle that they will break before they cut. Now the problem remains: will the electric furnace people have to evolve some still harder product with which to cut even the carborundum, or can they soften the colorless forms without marring the wonderful refractive power which makes this material a promising competitor of the gem of gems?

Music from a "Central Station"

To transmit music to a great number of places far or near at the same time has been



SWITCH BOARD OF THE TELEHARMONIUM DURING ERECTION

and still will be considered the dream of a Utopian to those not familiar with the work Dr. Thaddeus Cahill has done in this field at Holyoke, Massachusetts.

Dr. Cahill calls his plant a "dynamophone" or telharmonium. It is a curious system in which a large number of high and low frequency dynamos at a central station are used to furnish current to vibrate a diaphragm in a telephone receiver at the place to which the music is to be delivered. And listeners are agreeably surprised, for instead of faintly expressed harmony such as one would expect to hear from a telephone receiver the diaphragm emits round, powerful tones.

To accomplish this, 144 dynamos are used to furnish alternating currents of frequencies from 40 to 4000, a second, a 185 horsepower motor being the driving power. Switches to the number of 2000 on a special switchboard are controlled from a double keyboard by means of electromagnets. By pressing a key just as on an organ or piano, a circuit is closed and current of a certain frequency from one of the dynamos is sent over the line, causing the diaphragm of a receiver to vibrate at a given rate thus producing a corresponding musical note. Perhaps two or more keys are depressed at a time causing a combination of frequencies. In this case three sets of transformers are

used the better to combine the currents before they leave the station.

So deftly has all this been worked out that tones are produced so much like the clarinet, 'cello or some other instrument as to deceive even trained musicians. Two players at the keyboard have complete control and though a skilled piano or pipe organ player can obtain good results a noted musical critic remarked that it would take even a great musician ten years to master the wonderful instrument.

KEYBOARD OF THE TELEHARMONIUM

It is the inventor's plan to transmit music to hotels, restaurants, halls and residences from a central station. His estimate for a plant for a city of 300,000 people is $125,000 so that it is quite possible that music may be obtained in the future just as easily as electric light—by simply turning it on.

Writing with the Voice

The business phonograph shortened the process of handling correspondence by making notes unnecessary. The sound of the voice is stored on a wax record to be unreeled and transcribed at leisure. This has resulted, in those offices where it is used, in the substitution of typists for stenographers. An American inventor has recently gone a step further. He has devised a machine for printing from sound waves.

This machine is a combination of the telephone and the typewriter. The telephone is a device for picking up the vibrations which we know as sounds and reproducing them in the air at some distant place. An electric impulse traveling through a wire causes a metal diaphragm at the distant place to vibrate exactly as does another diaphragm in the receiving telephone near the original sound. The sounds are transmitted as impulses or waves of various intensities.

The sound writer has a number of electro-magnets, each corresponding to a sound of a certain intensity. Each of these magnets when it is, as we say, energized, that is, when current passes through its coil, attracts one end of a pivoted type bar and thus prints a letter or character.

As the English language is unfortunately not spelled the way it sounds, the Modern and Honorable Order of Lady Stenographers need have no anxiety lest they be driven out of employment by the soulless sound writer. Nevertheless, the machine has a distinct value, and it is not unreasonable to suppose that a later development of it may be used for recording telephone messages when the "party called" is out.

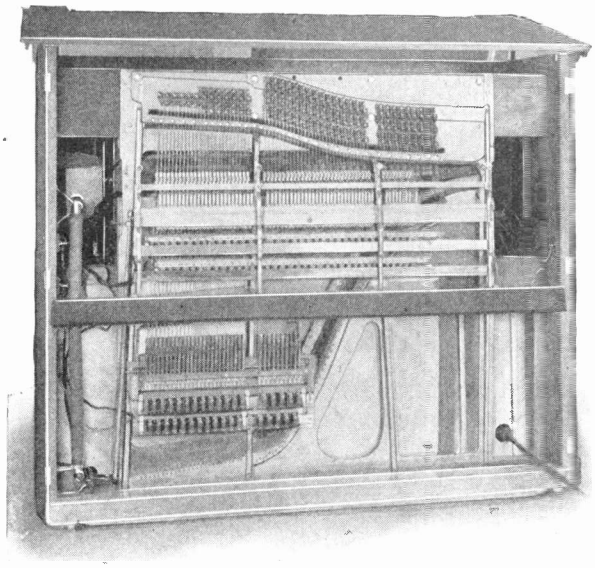
Music from Untouched Strings

An instrument called the choralcelo which may revolutionize the musical world because of the way in which its strings are made to vibrate is described in the June issue of the *Edison Monthly*.

Each string corresponding to a note has behind it a magnet which causes the string to vibrate when a pulsating current is sent through the magnet coil. And it is this free vibration without physical contact that causes the strings to give out tones of far richer quality and effect than it is possible to produce by the hammering of the strings as in the piano.

The instrument is played like the piano or organ, and so long as the player depresses a key the string responds to the magnet with a steady tone. The player's control of the instrument as now constructed is such as to enable him to vary at will the volume of sound from the deepest note to one just dying away. The instrument is arranged to combine the electrical and piano action simultaneously upon the same string, thus giving two tones. The choralcelo may also be arranged to be played by roll music and pneumatic action. Those who have heard the choralcelo render some of the masters' compositions marvel at the harmony and wonderful organ and piano effects produced.

THE CHORALCELO, ELECTRIC PIANO PLAYER



REAR VIEW OF THE CHORALCELO

The inventor, Mr. Melven L. Severy, has given 20 years to perfecting the instrument, during twelve of which he has been aided by Mr. George B. Sinclair.

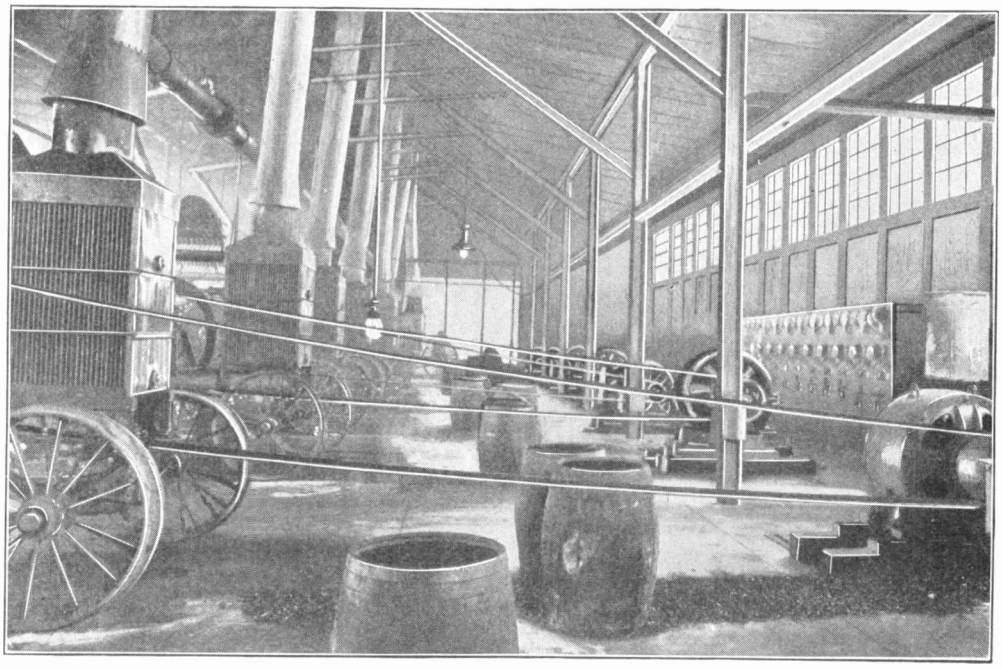
Electric Hoists Build Sky Scrapers

Electric hoists are being used on nearly every one of the big buildings now being erected in the "loop district" or heart of Chicago. On the new Insurance Exchange, which will be the second largest office structure in the world, there are five 50 horse-power electric hoists doing work noiselessly in striking contrast to the smoky, noisy steam hoists.

Engines on Test Supply Factory Power

By C. B. EDWARDS

The "efficiency engineer," a new term in the engineering world which is gradually coming into general recognition, is an individual whose whole time is devoted to studying methods of lowering the cost of output without lowering its quality. While there are today perhaps less than a dozen men whose time is devoted to this work of studying methods and systems in the search of greater efficiency for their employers' establishment, there are indeed few vocations which have been so productive of wealth. And wealth not to the manufacturer alone, but to the consumer of the manufacturer's product as well.



FARM TRACTORS ON TEST DEVELOP ENERGY TO RUN THE FACTORY

There are few examples of what this type of engineers are able to do that are more interesting than a method of testing farm tractors recently put into practice by a western manufacturer. This establishment was devoted entirely to the manufacture of farm tractors, some hundred or more of which were completed and shipped each day. To run the lathes, punches, presses, etc., used in making the tractors, small electric motors were distributed throughout the factory, and power was supplied to them by a steam engine and dynamo of large capacity in a separate building. The sole purpose of maintaining the power plant and burning the many tons of coal consumed was to supply power to the motors used in making the tractors.

As the tractors were completed they were run out and put to various brake tests and tractive tests near the factory, and finally loaded and shipped. A brake test is made by simply running the engine with a friction brake or clamp attached to the flywheel. In other words, the engine is simply loaded down with friction, and aside from its value in the test, power so expended is a dead loss. It finally occurred to the engineer in charge of the entire plant that the tractors might be used to supply the plant with power while undergoing tests.

He instituted experiments that convinced him that the electric power necessary for the entire establishment was no more than the combined horsepower of the tractors built each day. The rest was easy. It was only necessary to purchase many dynamos of sufficient capacity to use up the energy of each tractor and put in switchboards which would admit of using the power generated by the tractors either collectively or individually.

Each one of the tractors furnishes 45 horsepower, and as fourteen tractors are continually on test in the test room, it may be seen that the total output is slightly over 600 electrical horsepower, allowing for various sources of unavoidable loss of electrical energy.

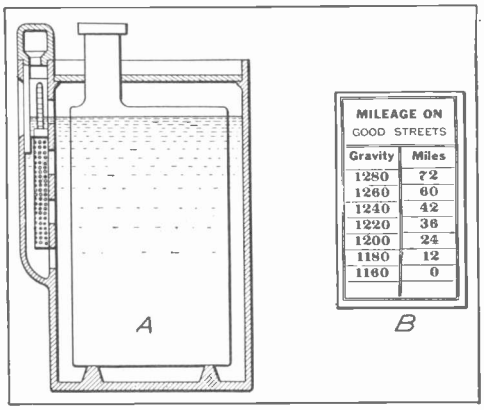
In the testing room it is a strange sight to see fourteen traction engines lined up in a double row and belted to as many dynamos. The engines all run by gasoline and blocked up in front of each generator, are connected by belts to the latter. There they are given a few hours' run on a belt test and finally a wattmeter test card is made, giving the electrical horsepower generated and any peculiarities that the testing engineer cares to note. The generator belted to the engine is cut in on the line during the entire time that the engine is being tested.

Obviously the power developed in this way is used to advantage, and as soon as one test is over another tractor from the assembling department is ready to take up the work of developing power and light in the place of the one just tested. It rarely takes over ten minutes to disconnect one tractor and replace it with another, as the tractors are run in and out of the testing room under their own power.

The manufacturers agree that with this method they have saved many thousands of dollars in not having to maintain and run a generating plant, and also in the fact that the test of running the electrical generators is far more efficient and exact than any previously adopted method could be. Moreover, if there should be any complaint about a tractor the wattmeter reading is at once looked up and noted. By this means the manufacturer has data at hand always to prove that the machines were in perfect condition when they left the establishment.

Tells When to Charge Your Electric

To the man who is running an electric vehicle the all important query is: "How much farther can I go without charging my battery?" and when the battery is being charged the question arises "When has enough electricity been put into the battery?" Of course the voltmeter if accurate will tell something of the condition of the battery, but to answer these questions with certainty, the specific gravity of the liquid in the cells must be measured



MILEAGE ON GOOD STREETS

Gravity	Miles
1280	72
1260	60
1240	42
1220	36
1200	24
1180	12
1160	0

FIG. 1. PILOT CELL AND THE CHART FOR INTERPRETING ITS READINGS

with a hydrometer. The battery of an electric vehicle is often hard to get at and the covers of the rubber jars are sealed down close to the surface of the liquid, making it necessary to draw off some of the solution into a separate vessel for test.

One of the most convenient methods yet found is employed in the Macrea pilot cell which consists of the usual rubber battery jar provided with a hydrometer pocket, the liquid in this pocket communicating with the liquid in the cell through holes in the wall of the cell. Fig. 1 (A) shows a cross-section of the pilot cell with the stem of the hydrometer sticking up out of a perforated metal guide around it, which keeps the hydrometer as it floats in the liquid from sticking to the sides of the pocket. The hydrometer is a glass bulb to which is attached a glass stem. Within the bulb are placed bits of lead to cause it to sink down into water until only a portion of the stem extends above the surface. The point on the stem at the water level is marked

1000. Placed now in other liquids of known specific gravity and heavier than water, enough marks are made to establish a scale. When a storage battery cell is fully charged it has been found that the hydrometer should stand in the liquid at

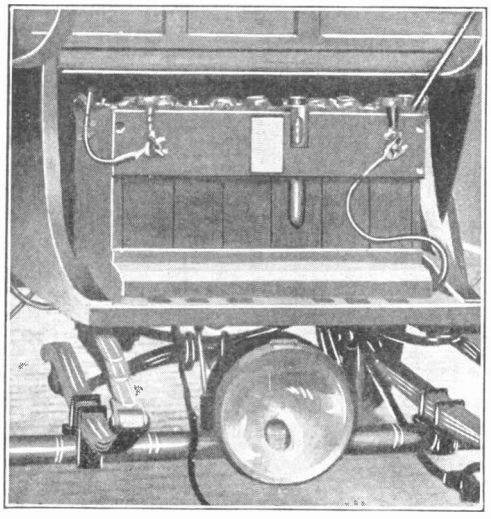


FIG. 2. SHOWING THE PILOT CELL

the mark on the stem corresponding to about the figures 1220. As the battery discharges, the solution grows lighter and the hydrometer settles lower until a point around 1160 is reached which in the case of the hydrometer used in the Macrea pilot cell marks the point where the battery should be no longer taxed. By careful calibration the various specific gravities are used to tell the condition of the cell as to the number of miles the battery is still good for.

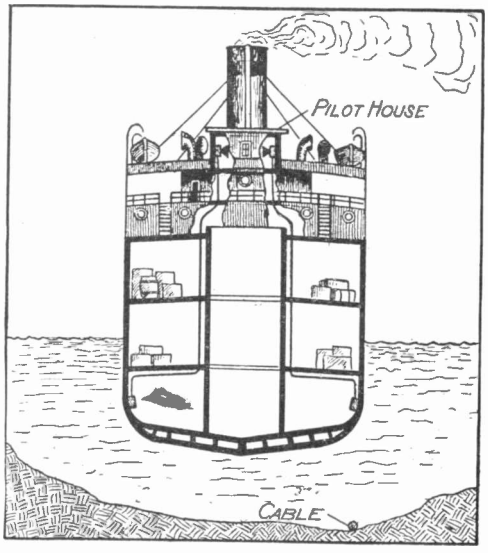
Fig. 2 shows the pilot cell doing service on a vehicle, the hydrometer being easily read through the glass window in the pocket. Reading the hydrometer and referring to the card, Fig. 1 (B), the driver translates his readings directly into miles the battery is still able to propell the car before charging is necessary.

Iron Annoys Paper Makers

When we think of writing papers as made from our old clothes, few of us stop to consider that these discarded garments also have buttons, buckles, hooks and eyes which cannot be made over into paper. The cloth sorters find most of these before the pieces go into the pulp vats, but by no means all. If any are left in the pulp they tear holes in the paper and often damage the rolls also. To avoid this damage, the pulp is passed in a thin layer under a series of magnetized rakes which are moved to and fro so that the magnets will reach every portion of the pulp. The resulting collection on the rakes is said to be as varied and interesting as the proverbial contents of a boy's pockets.

Submarine Signals for Vessels

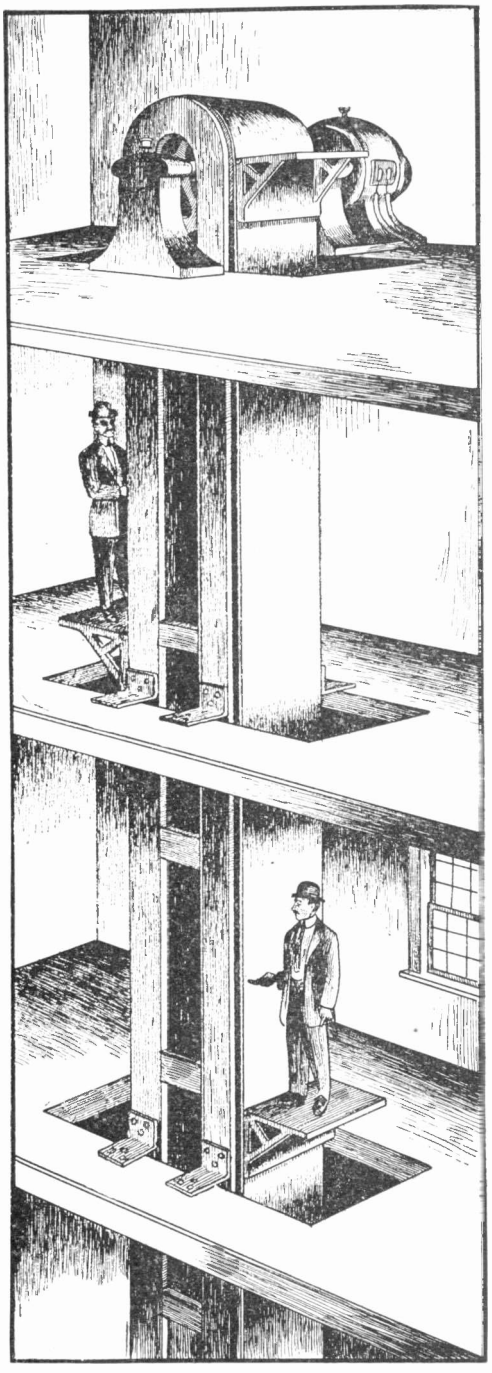
A novel plan for guiding ships at night or during foggy weather has been suggested by Dr. Karl Arnold, who proposes to lay an electric cable along the middle of a river, sound or other passageway for vessels. Electric impulses are to be sent through this cable at regular intervals, or an alternating current might be sent through it while the fog or darkness lasts.



SUBMARINE SIGNALS

Then each vessel is to be equipped with a receiving instrument at each side, both instruments being tuned to respond easily to the impulses in the cable. If the vessel is directly over the cable, the sound of both instruments will be equally loud, but if off to one side (as in the cut) the instrument nearest to the cable will be louder. The pilot can therefore tell whenever the vessel swerves from the intended course and can bring it back to the safe path.

GOING UP AND DOWN ON BELTS



ODD BELT ELEVATOR

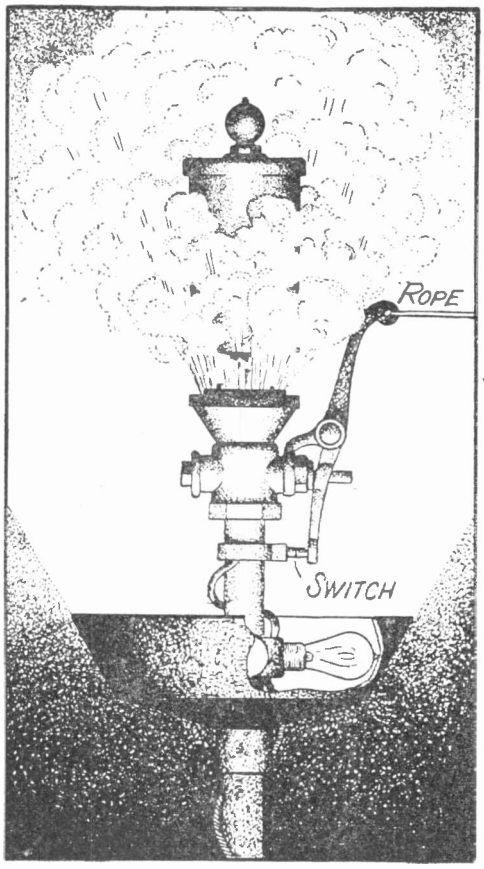
Even the automatic electric elevator, as used in modern apartment houses and in some residences is not convenient enough to suit the employers in buildings where the men have to go from floor to floor quite frequently. However fast such an elevator may be, it is not always at the right floor when wanted, and, at best, it can only go in one direction at a given time. The newspaper publisher who may want to get out "extras" in double-quick time, or the manufacturer who pays a high price for skilled supervision covering a number of floors, cannot afford to have his men use the stairs, nor even wait for an elevator. At rush times he would prefer to have them jump on the conveyors and be taken from floor to floor by them, just as is commonly done with materials in boxes or bags.

And why not. A strong belt passing vertically from the lowest to the highest floor is easily installed, and an opening 30 inches in diameter encircling it will allow the ordinary man to slip through it readily. Then a series of bracketed shelves or platforms fastened to the belt, with a handhold some three feet above and below each, and a motor to drive the belt, complete the equipment. With such an "employes' belt elevator" running at a speed of 50 feet per minute and with the platforms 20 feet apart, the men never have to wait long for their foothold and two can be traveling in opposite directions at one and the same time.

Luminous Boat Whistle

The common practice of having vessels advise each other by whistle signals as to the direction in which they intend to pass one another, is still quite satisfactory as long as the boats are few and far between. But when there are numbers of them flitting about on the same stream, as when crossing the rivers at New York City, the pilots are often puzzled to know which vessel has been whistling. During the day they can tell this from the escaping steam of the whistle, but at night this is rarely visible and any misunderstanding as to the boat which had been signaling might lead to serious results.

To guard against such mishaps a Brooklyn man has built a steam whistle with an electric light attachment. When the whistle rope is pulled it also turns on the current for a group of incandescent lamps



LUMINOUS BOAT WHISTLE

placed above a reflector which projects the light up through the escaping water vapor. Thus each blast after dark is accompanied by a bright flare of luminous mist that instantly shows on which boat the whistle was blown.

"Zone of Quiet" Signs

Hospitals situated in the neighborhood of much street traffic generally have printed signs posted on the thoroughfare a short distance each way from the hospital, warning drivers and others to pass with as little noise as possible. Indianapolis, Indiana, has improved upon this by using electric signs, thus making these warnings conspicuous and more apt not to go unnoticed.

Lighting the Way

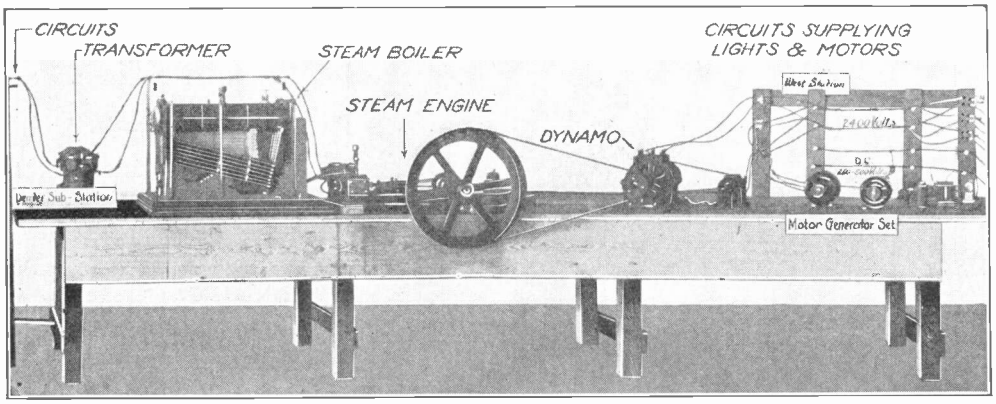
Firemen, policemen, electrical inspectors and others in similar work are often called into buildings where a false step may mean a sprained ankle or a fall down an elevator shaft. In such places a dependable light that will show the way and allow free use of the hands would be most welcome. The fireman in the picture wears on his belt a storage battery to which is attached a plug and cord by which current is supplied to the light in the reflector on the front of his hat. Metal springs grip the hat firmly holding the light in position. The invention is patented by Richard M. Eaton, Niagara Falls, New York.

FIREMAN'S HEADLIGHT

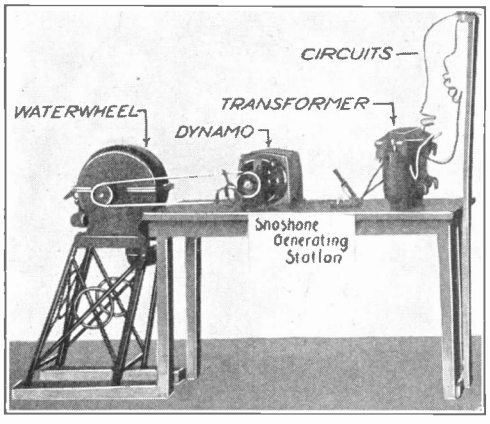
Interesting Models of Electric Plants

One reason why the solicitors and office men as well as the engineers connected with the larger electric light companies of this country are so well informed is that these companies give regular educational courses to their employees at which the important features of all parts of their business are shown by up-to-date methods. Instead of depending on figures, charts or even photographs, working models are often used with good effect.

Thus the Denver Gas & Electric Company has had some interesting models built



MODEL OF STEAM ELECTRIC PLANT



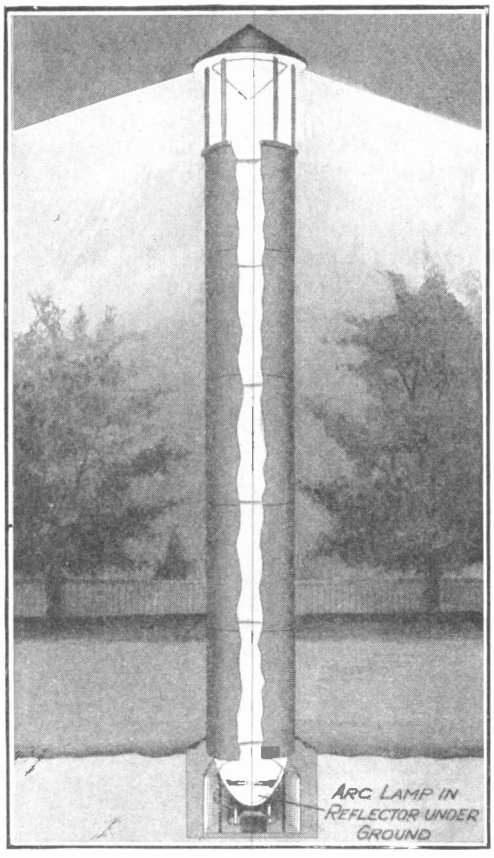
MODEL OF WATERPOWER ELECTRIC PLANT

for showing the combined steam and hydro-electric system by which it supplies current to the people of Denver and vicinity. These models include one showing how the water power of Shoshone falls is used to advantage and another showing the steam generating plant at Denver, the circuits of which are joined to those of the Shoshone plant.

Underground Street Lights

While the use of underground wires for supplying current to street lamps is now too common to attract notice, the idea of putting the lamps themselves underground is much older. When electric street lighting first began to make general headway some 25 years ago, one of the prevailing ideas in many minds as to the function of street lights was tliat they should be imitation suns or moons. In other words, they should be strong lights scattering their rays from points high up in the air. When the arc lamps were so placed on tall masts or towers, it was difficult for the trimmers to get at them for the recarboning and for the adjusting which the early lamps needed much more often than our perfected ones of today.

To obviate this a Frenchman conceived the idea of placing the lamps themselves under the sidewalks and projecting the rays of light from them up a hollow stack and then outward. This merely meant the use of powerful searchlight reflectors at the lamp and of distributing reflectors at the top of the stack. Then the lamps were where the attendant could easily get at them in any kind of wind or weather. What the French inventor forgot and what spoiled the plan in practice was the fact that the intensity of the light given out by



UNDERGROUND STREET LIGHTS

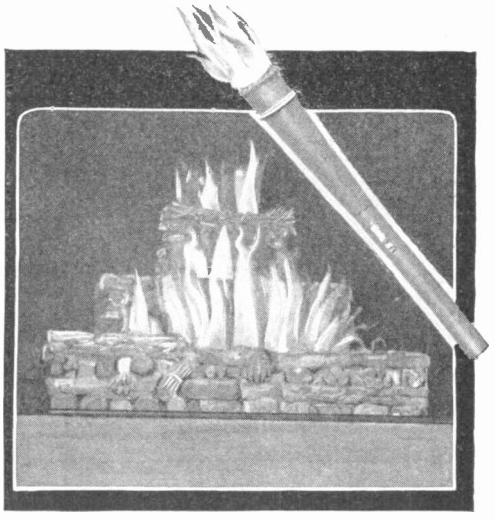
any lamp decreases very rapidly as you increase the distance from the source of the light, so that sending this light up a tall stack greatly lessened the illumination given by it. Besides, the use of mirror reflectors exposed to mist and smoke at the top of the stack was not a success, for this was long before manufacturers had learned how to make the enameled reflectors which are now so commonly used over outdoor lamps.

Stage Fire Illusions

On the stage, as in real life, the sight of fire always sends a thrill through the spectator. To be really effective in this it must not be a lifeless simulation of fire, but must have the snap spontaneity which make the sight of flames so fascinating. Thus the curtain rises on an indoor scene with a slight glow in the fireplace. The glow increases; little reddish flames shoot up here and there between the logs, gradually growing more yellowish in color as they swell in size until they seem to leap high into the chimney. As they do so the faint puffing which was heard when the flames were small, grows into a roar that completes the illusion, for illusion it must be since no wise fire ordinance would permit a real fire among the combustible scenery.

Again the curtain rises. This time it is an outdoor scene at night with the light realistically supplied by torches having tops that blaze high into the air. Again the flames are but an illusion, although an almost perfect one.

And what is the secret? Electric lamps for the lighting, with switches to control the color changes; fine silk ribbons or streamers on which the colored light plays as they wave and toss in the air; fan motors to give



ELECTRIC FIRE AND TORCH

motion to the ribbons and air tubes through which part of the blast can pass so as to produce the roaring noise without which even a rousing fire would seem like a tame counterfeit. Both lamps and motors are controlled from a distance by the stage electrician.

In the case of the torches this is not feasible so these consist of metal shells containing storage batteries for operating both the lamps and a small fan motor, the controlling being done by switches carefully concealed at one side of the torch.

THE GYROSCOPE COMPASS

The gyroscope, which for at least a century was considered a toy, will without a doubt lend itself to the accomplishment of many wonderful things in the future. When in 1851 the great French philosopher, Foucault, drew back and released the immense pendulum by whose swing he proved the rotation of the earth, he placed his name before scientists and students for all time; yet of almost as much importance are his experiments with gyrostats.

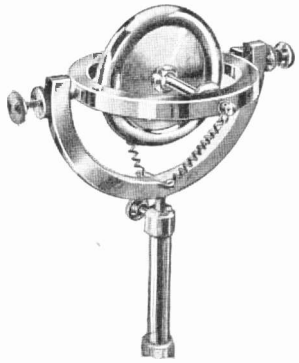


FIG. 1. GYROSCOPE PRINCIPLE APPLIED TO THE COMPASS

After reviewing Foucault's work, Dr. Anschütz (Germany) has perfected a substitute for the magnetic compass. By arranging a gyro in a framework so that it may rotate around its own axis and this axis at the same time be free to rotate on an axis perpendicular to it, the axis of the rotating gyro will set itself in such a position that this axis will point due north and south. This tendency of the gyro compass to turn into a north and south position is due not only to its own rotation but also to the effect of the earth's rotation upon it. The two allowed movements of the gyro are termed "two degrees of freedom" and the arrangement in Fig. 1 shows the mounting.

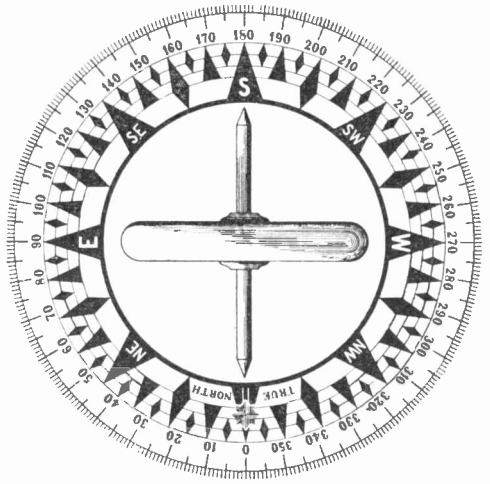


FIG. 2. AS MOUNTED IN THE COMPASS CARD

When serving as a ship's compass the gyrostat is suspended beneath the compass card, the card being attached to it so that the axis of the gyrostat is directly under the north and south line, Fig. 2.

The gyrostat and card float in a bowl of mercury on gimbal rings in the same manner as the ordinary magnetic compass. A small motor running at the high speed of 20,000 revolutions per minute turns the flywheel of the gyrostat. A curious result follows the running of the gyrostat for a few thousand hours. The surface of the flywheel becomes noticeably smoother than when new, due no doubt to air friction.

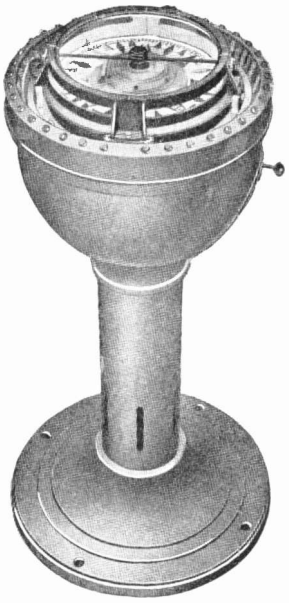


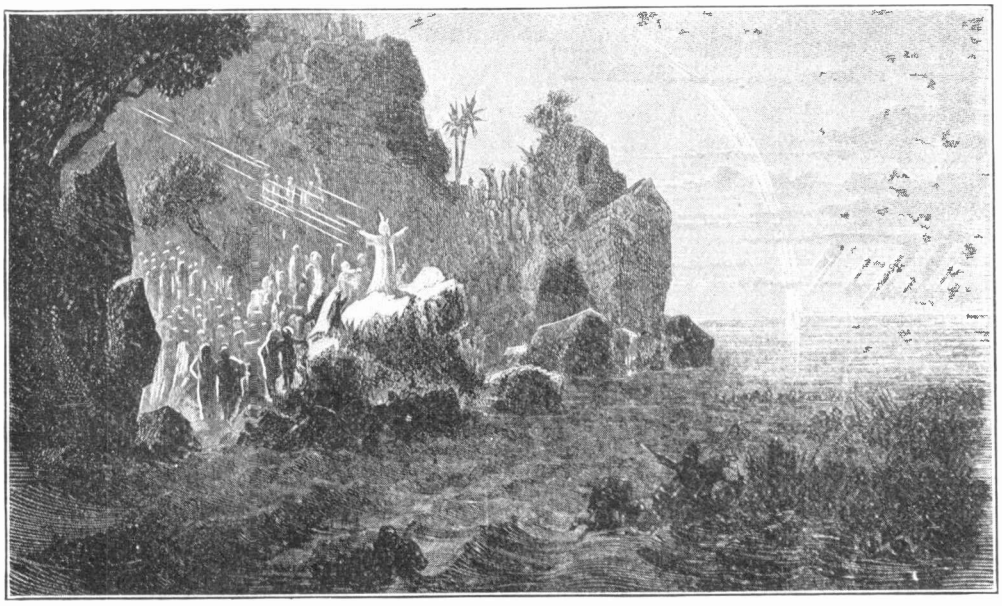
FIG. 3. ORDINARY COMPASS IN MOUNTING

Some two or three hours before a vessel starts on a voyage the gyrostat is set running so that by the time for departure the axis has arranged itself for accurate readings.

In exterior appearance the equipment is very similar to that of the ordinary compass, Fig. 3. Not being affected by surrounding iron it may be placed well down in the ship. Receivers placed at any desired location in the vessel and actuated by electric circuits and contacts read the same as the dial of the gyroscope itself. The first installation in 1908 on the German battleship Deutschland proved successful, since which time the use of the gyrocompass is being extended to other ships of European navies.

Electric Light in Old-Time Theatres

In 1846, when representations of the opera of the Prophet were being given at Paris, it was resolved that the scenery should be unusually splendid—worthy alike of the music and the poem. Two tableaux in particular were objects of special care and anxiety to the manager, namely, the rising of the sun, in the second act, and the conflagration, at the end. The electric arc light was still a novelty and its appearance in the theater had something strange and solemn in it. But it bore its part in accomplishing the immense success of the Prophet.



LAST SCENE—OPERA "LE PROPHETE"

One of the operas in which its aid was found most effective was Rossini's "Moses." Although the scene was constantly illuminated, Moses never moved save in a special ray of light. One scene in particular was then considered very remarkable. The people in the middle of the plain, are sighing regretfully for the fleshpots of Egypt, and they wish to return. At this instant Moses comes forth, his eyes darting light, his whole body throwing out radiance, and his long white robe gleaming like the sun. Even before he has breathed forth his indignation his aspect causes the people to tremble. This scenic effect always gained immense applause.

In the interior of the wings or side scenes were placed three electric arc lamps. From the top of the scenes on each side an electric lamp was directed upon the entrance to Moses's tent, while a third was arranged in front, to strike upon the actor's face. The rays of the lamp were concentrated upon the door. As soon as the tent opened and the actor appeared on the scene, the electric ray was launched upon him. The rays illuminated all this part of the scene, and the actor, previously instructed in what path he was to move, walked continually in the midst of the light.

The light was produced by the aid of batteries of 40 or 50 elements or cells. A space under the roof was specially set apart for these batteries. Each evening an official mounted up to them, arranged them, examined them minutely, and when the performance was over took them apart. The electricity they produced passes into different wires, led everywhere throughout the stage. A little niche was made in the wall, where were to be found the ends of the conducting wires. The chief of the de-

partment attached movable wires to these fixed ones, and thus carried the current up to where the lamp was placed.

Sometimes colored lights were used, either to make conspicuous a special actor, or a particular part of the scene. In "Faust," for example, Mephistopheles was from time to time illuminated by red light. In another piece of less success, an alchymist, reading destiny in a magic vase, was illuminated by a green ray which seemed to come from the vase itself. These lights were tinted by passing through colored glass.

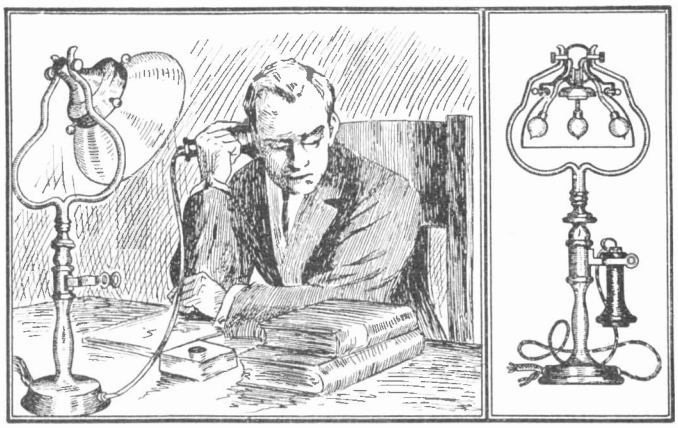
In the final scene of the opera of "Moses" there was a very curious and difficult effect produced by the light. The people of Israel have crossed the Red Sea, and in the front of the scene, in partial darkness, the Egyptians are seen perishing in the waters. At the back of the stage, standing on a high rock, Moses holds the tables of the law. The Hebrews, grouped around him, sing the celebrated prayer (considered one of Rossini's masterpieces), the day is breaking, the electric lamps illuminate the scene, and at this moment, as the symbol of a new covenant, a rainbow appears.

To produce this illusion, two difficulties had to be overcome. It was necessary first to design a rainbow for the electric light; afterwards this bow had to be sufficiently intense to be seen from the auditorium without being extinguished by the other lights. An electric lamp placed about the middle of the scene, but concealed behind a rock, was supplied by a very strong current. Two batteries were used, in order that the intensity of the light should be great. On the other hand, the intensity of the light from behind was diminished without being noticed, because the front of the scene was obscure.

Finally, by means of a specially constructed piece of apparatus, the white light was decomposed into a spectrum, which painted itself as a rainbow upon the scene at the back, and all the rest of the light was lost or concentrated upon the side farthest from the bow.

Combination Lamp and Telephone

A special stand or shelf for the telephone may be unnecessary if a present day invention fulfils expectations. A lamp and telephone combined is rather an odd combination upon which F. J. Kerbel of New York City has obtained a patent. The picture shows the lamp globe tilted towards the



COMBINATION LAMP AND TELEPHONE

speaker so that the shade may gather up the sound and concentrate it upon the transmitter which is located in the top of the shade. Besides having the shade pivoted the general design of the lamp is such as to hide the telephone instrument as much as possible.

Pertinent and True

Robert Frothingham, manager of Advertising, Butterick Building, New York, writes:

"Suppose you knew a man who kept his shades drawn tight all day and burned kerosene instead of letting in the sunlight;

"Suppose you knew a man toiling along a dusty road who would not accept a lift —when there was plenty of room in the wagon;

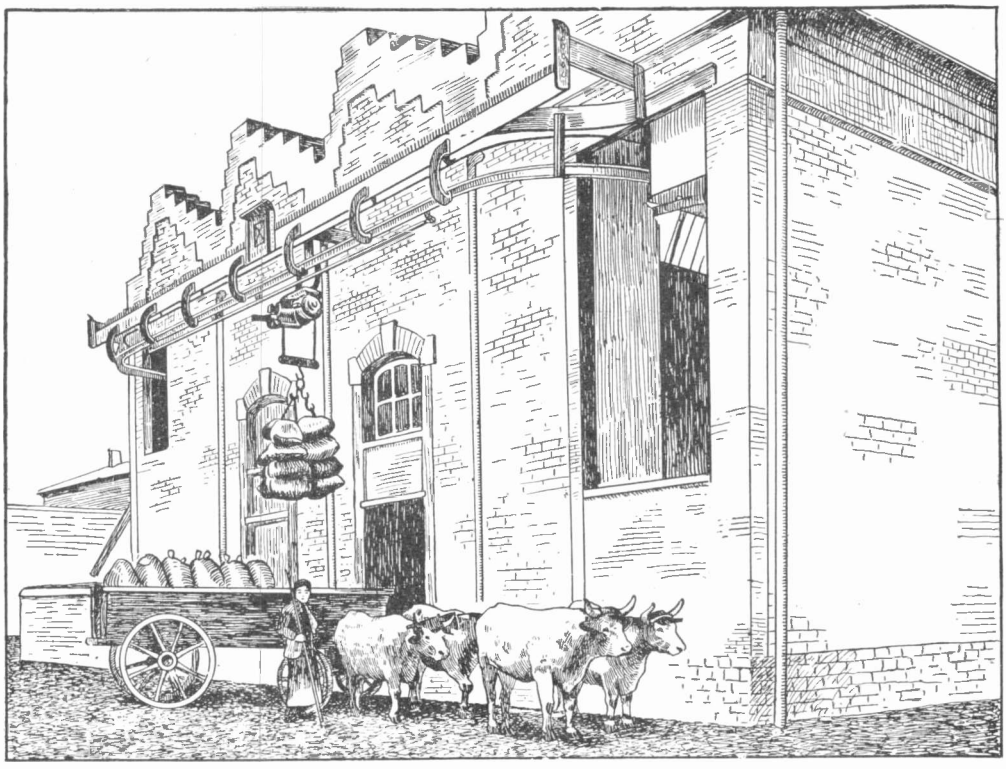
"Suppose you knew a miller—with his mill beside a swift-running stream—who insisted on turning his machinery by hand.

"All foolish, you say? And yet look around you—how few retailers take advantage of the greater uses of electricity.

"Put up your lightning-rod! Let your customers know about your business. Get the habit and you will get the business."

From Ox-teams to Motors

In few localities is the contrast between old and new methods of transportation shown more strikingly than in southern France, where double yokes of oxen are still used for hauling sugar beets to the refineries. The slow clatter of the sixteen hoofs marks the approach of a load of bags filled with beets. But scarcely has the wagon drawn up before the refinery when there is a gentle whirr as a motor-driven hoist comes sailing along an overhead track, picks up six or eight of the heavy bags at a time and spins along with them to the scales inside the building. In a few minutes the whole load has been weighed and dumped in distant parts of the refinery and before another load has time to pull up, the softly purring motor is back already waiting to pick it up.



A STRIKING COMBINATION OF THE NEW AND THE OLD

Electricity has been introduced into thirteen groups of coal mines in India, according to the report of the chief inspector of mines.

Oxidation and Radiation

Inasmuch as burning produces visible radiation, it is reasonable to suppose that the process of oxidation, which is a kind of slow burning, may also give rise to radiation of some kind. Streintz, a German experimenter, has demonstrated the existence of this radiation produced from oxidizing substances.

He has found that magnesium, and to a slighter extent aluminum, zinc, and cadmium, when placed in a gas containing oxygen, give forth radiations which may be of the nature of ultra-violet light, which is invisible to the eye because its wave-lengths are too short to fall within the gamut of vision. This form of radiation ionizes the surrounding gas, and produces chemical effects which can be shown on photographic paper. Streintz has found that the metals may be protected from oxidation by means of a positive charge of electricity, and this fact is regarded by him as suggesting important practical applications.

Electric Vehicle Carries Water to Horses

The use of an electric vehicle to contribute to the comfort of the very creature it is rapidly displacing is the unique condition presented by the electric horse watering wagon, built and operated the past summer by the Society for the Prevention of Cruelty to Animals, of Philadelphia.

HORSE WATERING VEHICLE USED IN PHILADELPHIA

The wagon carries a tank holding 140 buckets of water taken from the city's filtered supply and is on the street ten hours a day covering a route of about fifteen miles.

The crowded teaming localities are visited, especially the shipping and wharf districts. During the month of July 9,876 horses were watered, the highest number being 980, on July 12. The daily average since the wagon was started out is about 460 horses. The wagon cost $2,380 and the expense for wages, garage and charging is around $5.00 a day.

The University of Pennsylvania has been sending challenges to various colleges for games of chess to be carried on by means of their wireless outfits.

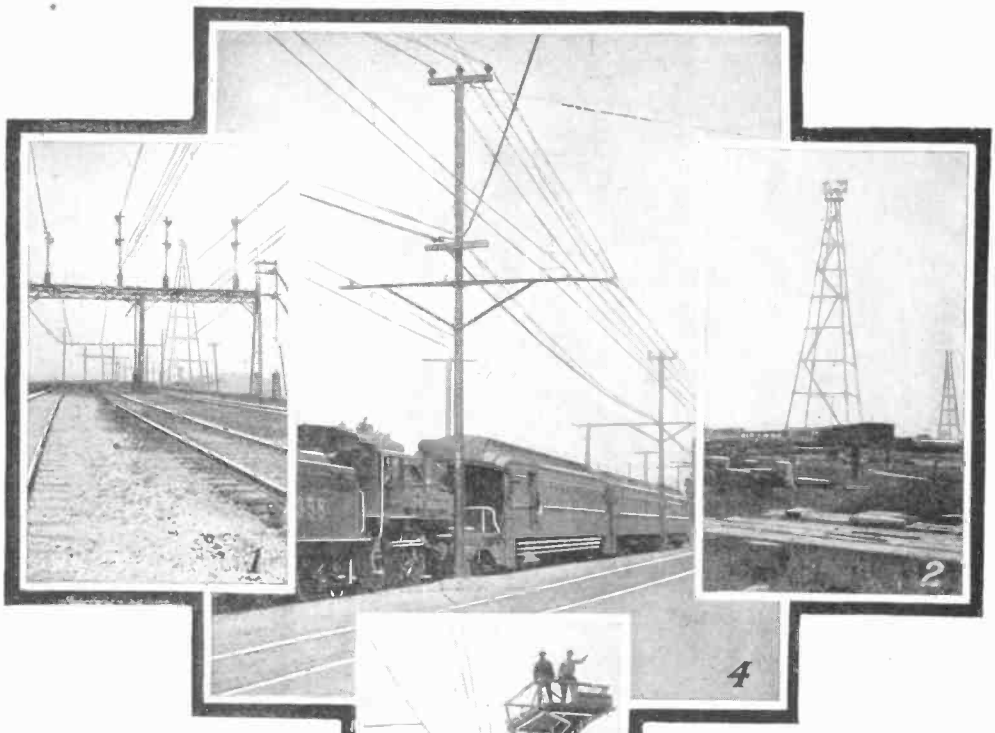
Electrifying a Steam Road

On June 1st the Southern Pacific railroad instituted its new electric car service on the Alameda division of its suburban lines, on the east side of San Francisco Bay. This is but the first step in the work of electrifying the existing steam lines which now serve Oakland, Alameda, Berkeley and other bay cities.

The construction and equipment is considered the most modern in the west. The cars are of steel construction 72 feet in length, 10 feet 6 inches in width, and have a seating capacity of 116 persons. An unusual feature of these cars is the arrangement of the seats, those on one side seating three, and those on the other side two passengers.

There are four motors to a car, each of 140 horsepower and at present are geared to attain a speed of about 45 miles an hour. Every other car during rush hours of travel is a motor car. The overhead line construction is that known to engineers as the single catenary type. The trolley carries current at 1,200 volts pressure, as against 550 volts ordinarily used by city electric railways.

View No. 1 illustrates the method used to support the overhead wires, also one of the elaborate signal bridges. View No. 2 shows prominently one of the two steel towers used to support the distribution wires over the estuary, the span being 1,300 feet.



SOME VIEWS OF THE SOUTHERN PACIFIC ELECTRIFICATION

These towers are 265 feet high and carry ten wires, four of which are aluminum and six copper. The wires are allowed to sag 50 feet, which gives a clearance of 215 feet above the water, which is sufficient for the high masted sailing vessels which frequently pass. The contraction and expansion of the aluminum wires is cared for by means of counter weights.

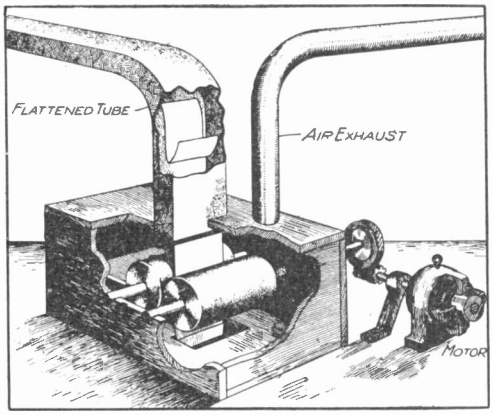
View No. 3 is of a construction tower which was built to be used temporarily while the regular line construction tower was sent to another part of the work. This tower was built on the end of a boom of a wrecking crane. It has the advantages over the ordinary tower that it can be raised or lowered instantly, and also swung to either side a distance of 35 feet, thus giving a radius of 70 feet. It was also found to be invaluable in putting up span wires (supporting wires for trolley). These were secured to the pole on one side of the track, then the boom was swung around to the other side, thus eliminating ladder work heretofore necessary in some places with the ordinary tower.

With everything else in readiness shortly before June 1st, with the exception of the 13,000 volt distribution line, the very ingenious plan shown in view No. 4 was adopted for a temporary pole line, it being found quicker and cheaper than to dig holes and set the high poles, which would be much more difficult to remove, once the permanent line supported on steel towers was built.

The short wood poles (about twelve to fifteen feet) were turned down just to fit in the hollow iron pole a distance of about fifteen inches.

Blowing Reports Through Tubes

In using the pneumatic tube systems, which have been installed in a great many stores and other establishments, it usually takes longer to enclose the transmitted papers in one of the cylindrical carriers than it does to draw this to its destination. If



BLOWING REPORTS THROUGH TUBES

the items are flat and uniform in size, like the record cards used in telephone toll service, the enclosing cylinders might be avoided altogether if these cards themselves could be blown through a flattened tube. By bending up one end of the card like the prong of an arrow, this will catch the air pressure so as to be blown by it. Then at the receiving station, a pair of rollers rotating in opposite directions catches the card and pushes it out of the receiving box into an open basket. A small electric motor at each receiving station turns the rollers, while a single larger one in the basement or attic operates the air blower.

The Use of Selenium

The property that makes selenium interesting and useful is its capability of acting as a fairly good conductor of electricity under the influence of light while in the dark it is practically a non-conductor.

This property has rendered selenium useful for automatically lighting and extinguishing gas buoys, for exploding torpedoes by a ray of light, for telephoning by a ray of light, for transmitting sounds and reproducing pictures at a distance by means of electric wires.

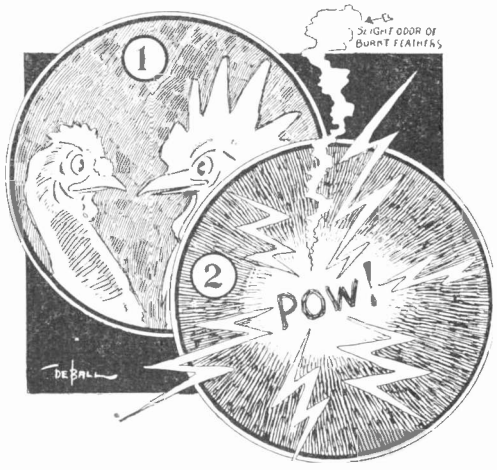
Horse Mortality Argues for Electric Vehicles

During the hot spell last summer 171 horses died each day in New York City—a total of 1,026, all due to the heat. These horses represented over a quarter of a million dollars cash value which was entirely wiped out in a single week. In addition to this, other horses, not affected fatally, were able to work at scarcely half their normal capacity. It is estimated by *Selling Electricity* that the money represented by the horses which died would pay for a sufficient number of electric vehicles to do all of the work done by the horses.

An Electric Kiss

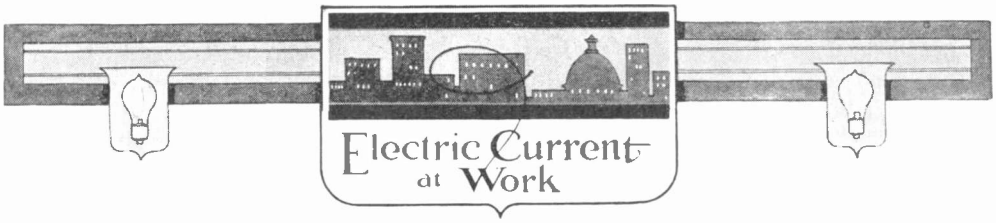
One night not so long ago nearly all the electric lights in an Indiana town suddenly went out and after a minute came on again.

With the going out of the lights an odor like that of an overcooked dinner filled the power house, and upon examination it was discovered that a couple of



chickens had stolen in and gone to roost on the main wires.

All had gone well with them until Chanticleer, who was perched on one wire, had reached across to give a good night kiss to his Biddy, on the other. The moment their bills touched the current of thousands of volts was short circuited through their bodies and the fatal kiss ended in a lightning flash and burnt feathers.



Electric Motors for Farm Work

That the American farmer is keeping pace with his city cousin in the application of electrical service is very readily proven by a trip of inspection though the rural districts where central station service is available.

Fig. 1 shows a portable motor used by an Illinois farmer near Elgin on his 1700 acre farm. The motor is permanently mounted on an ordinary farm truck, and

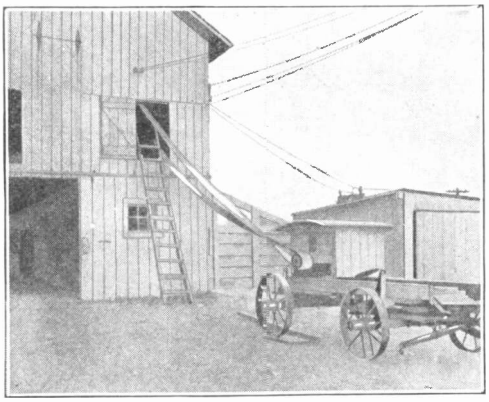


FIG. 1. MOTOR AND WAGON—A CONVENIENT SOURCE OF POWER ABOUT THE FARM

is covered by a wooden housing for protecting it from the weather.

This 1700 acre farm is subdivided into six separate farms, each one having its own residence, barns and storage buildings. The service is supplied by the North Shore Electric Company.

As this section of the state is devoted chiefly to dairying purposes, three of these farms are given to cattle raising. Four of the farm buildings are now equipped with machinery for grinding grain, fodder and preparing all feed used for cattle, horses and hogs, the machines being driven by the portable motor.

The equipment at each place consists of a combined corn and cob crusher and feed grinder, a corn sheller and an ensilage or fodder cutter. These are belted separately to a jack shaft which in turn is run by a motor conveniently located outside, a belt passing through an opening on the second floor.

The motor is used two days at each of the two cattle farms, one day at the horse farm and one day at the hog farm each week. The motor has to grind enough feed for 225 cattle, 50 horses and 200 hogs but does the work very easily.

Fig. 2 illustrates a view in one of the granaries, showing the type of grinder and crusher used. These machines have a capacity for grinding from twelve to twenty-five bushels of ear corn, or twenty to forty

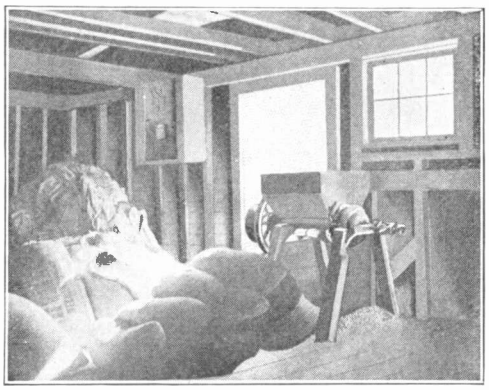


FIG. 2. FEED GRINDER OPERATED BY AN OUTSIDE MOTOR

bushels of shelled corn or grain per hour.

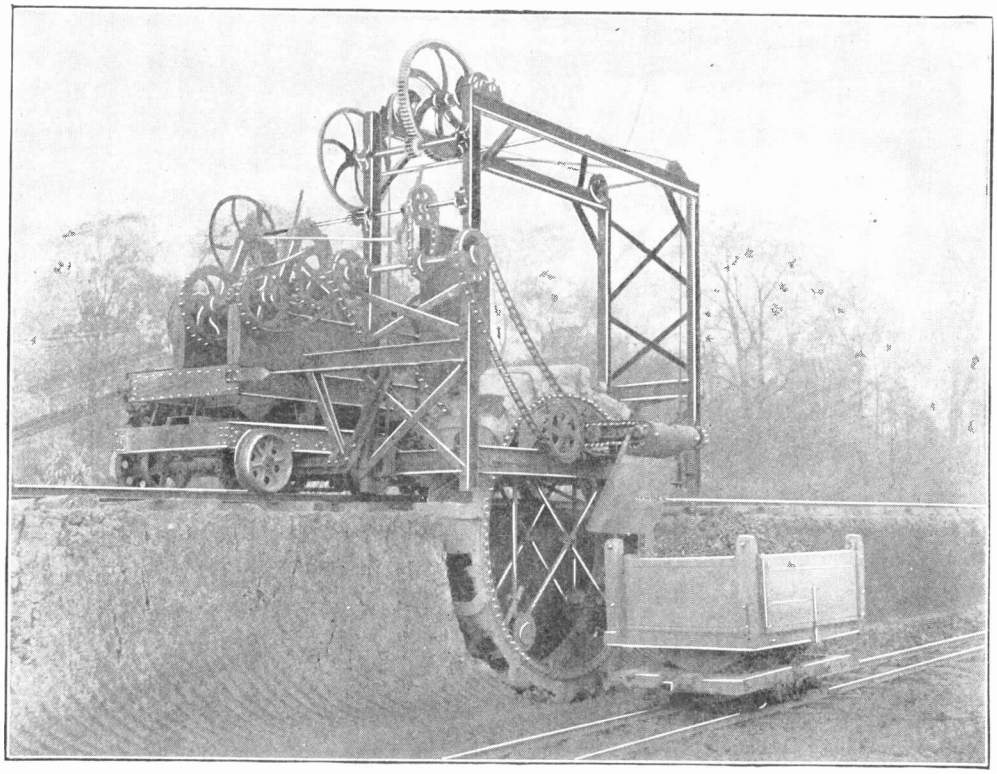
A switch and cut-out is placed in a suitable weather proof box near where the motor is spotted and is tapped on by a flexible cable.

This equipment provides a very convenient way of preparing the food for the stock. The cost of grinding the grain per bushel compares favorably with the prices for grinding at the city mills. It is, however, a saving proposition, as it eliminates the expense of hauling the grain to and from the mills.

An Electrical Clay Digger

Economical as it may be for other purposes, the bucket dredge is too clumsy for use in digging clay and requires additional machinery for grinding up and intermixing the huge chunks which it digs out of the clay beds. Besides, the dredges are constantly needing repairs, owing to the heavy strain which comes on the mechanism when the scoop digs into the clay and again when it suddenly drops its load. The ideal clay digger would scoop out small chunks at a time with very little strain on the machinery and would drop each lump into the car without any further attention on the part of the operator.

That is what the electric clay digger does. Running along on a light track, it turns a bucket wheel which digs out little chunks of the clay and continually drops them into a small car running at a lower level, mixing it in the car so that it is much cheaper to make into tile or bricks than if chopped out in large chunks.



ELECTRIC CLAY DIGGER IN OPERATION

An Electric Motorcycle

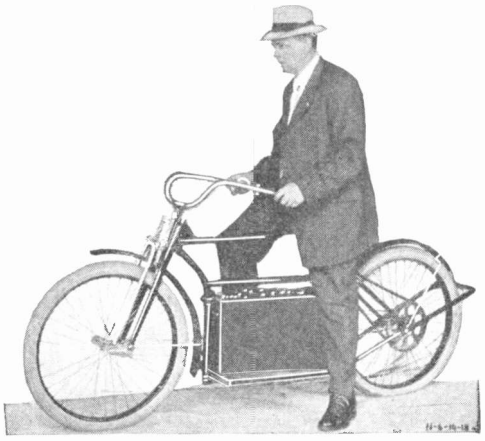
Motorcycle enthusiasts, here is something altogether new—a cycle driven by an electric motor and storage battery. It is not very pleasant on a summer day to sit astride of a hot gas engine. Neither is it pleasant to be obliged to tinker and attend to a complicated engine. The Electra motorcycle, with its clean, noiseless and absolutely dependable source of power, is ready at a moment's notice, and its starting and handling requires no more skill than turning on an electric fan.

The inventor of the machine, Mr. F. E. Hatch, of Chicago, has worked a number of years on the problem of applying electric power to this now extremely popular form of vehicle. Here is what he has done: He has built a machine which is no heavier than the ordinary engine-driven type; he has placed a battery and motor upon it which will carry you a hundred miles on a single charge; he has given it three separate speeds, four, fifteen and thirty-five

miles per hour—suitable for all ordinary requirements; he has fitted it with conveniently arranged means for starting and stopping, and with a simple foot-operated brake like that of an automobile.

In cost of operation, including maintenance, the electric figures out cheaper than the gasoline machine, and in addition is cool, noiseless and safe. What more could be desired?

The batteries supplied are either of the best type lead plate cell or the new Edison battery. The latter has the advantage of being lighter for a given output and more easily cared for by the amateur, as there



THE STORAGE BATTERY MOTORCYCLE

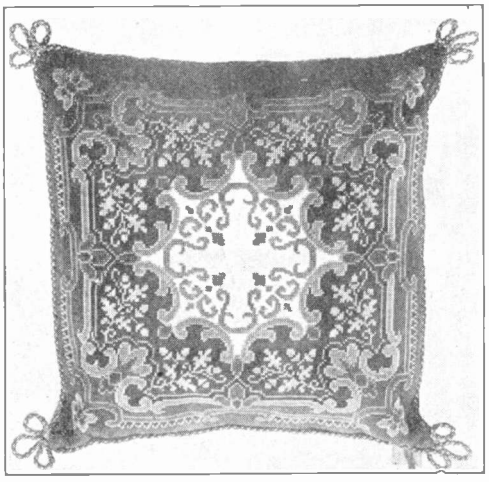
is no possibility of injuring it by over charging or discharging it below the operating limit.

The batteries can be charged anywhere that direct current is available, and in the case of an Edison cell the process requires only a few minutes to put fifteen or twenty additional miles in the cell or about half an hour for a complete charge.

Its many good features make it also available for extended commercial application. There are many reasons why it should be adopted for police and postal requirements in cities. For police use a special machine having very high speed is made. Equipped with a side car attachment it becomes a three-wheeled delivery wagon for the grocer, baker and small merchant or manufacturer, far superior to a horse in speed and mileage, and very much less expensive and troublesome to maintain and care for.

An Electrified Pillow

Many a sufferer from neuralgia or toothache has been kept from the timely use of a hot water bag by the fact that this effective means of relief is too conspicuous

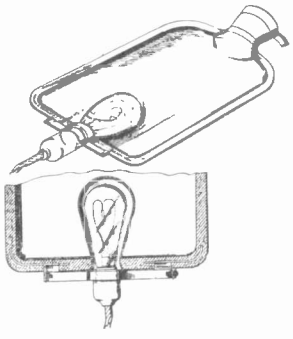


AN ELECTRIFIED PILLOW

when there are others looking on. If such a boon of warmth could be concealed, or better yet if the heat could be transferred to a pleasantly soft pillow, it would be enjoyed all the more frequently. Indeed, as our illustration shows, the cord carrying the current to an electrically heated pillow can be quite inconspicuous and the pillow itself may be handsomely embroidered. All it needs, is a layer of electrically warmed fabric between the casing and the pillow proper.

Keeping the Water Bag Warm

Varying the construction of a hot water bottle so it is possible to heat the water by using an ordinary incandescent lamp is the subject of a patent issued to Dumont P. Lamb, Portland, Ore.



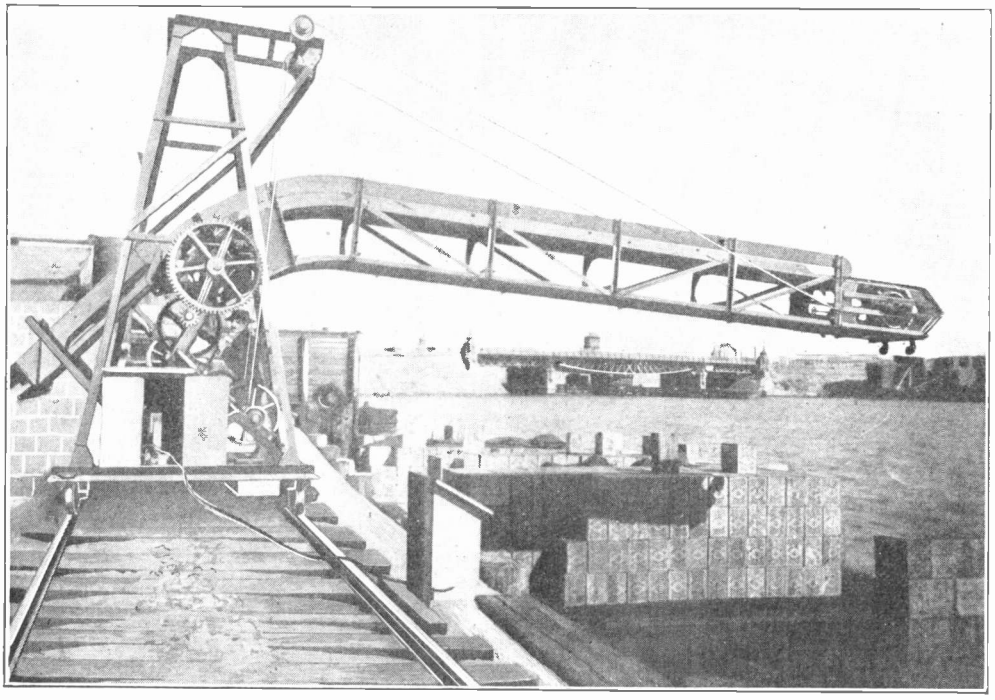
WATER BAG HEATED BY A LAMP

A chamber or pocket large enough to admit an electric lamp from the outside is provided in

the bottom of the bag and a pair of clamps are secured to the bag to hold the lamp in place.

Freight Handling in Sydney, Australia

A unique device for increasing facilities in loading and unloading freight at docks is seen in the accompanying illustration. This portable conveyor of the Jeffrey type may be. This boom is equipped with a continuous moving conveyor belt. The outgoing freight is delivered upon this belt, the cargo, being placed on the belt by hand labor, descends to the barge where it is again handled and piled. When the boom is lowered the boxes travel along on the belt and are delivered automatically to the waiting drays. It is maintained that this method has minimized the human labor and reduced the cost of handling at least 50 per cent.



PORTABLE CONVEYOR AT THE SYDNEY FREIGHT DOCK

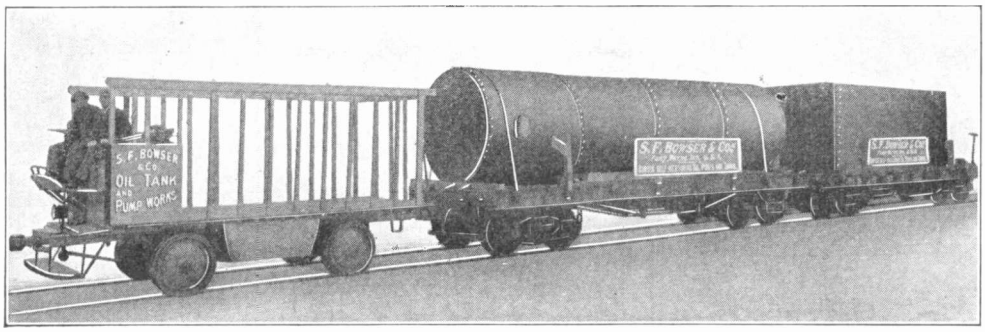
was recently installed for delivering outgoing and receiving incoming light freight at a dock in Sydney, Australia. This machine is in itself a most complete freight handling plant.

It is electrically driven by a small motor and is capable of handling 1000 cases, or light packages per hour. The boom is first raised above the barge, its length being approximately 24 feet and it is so arranged that it can be raised or lowered as may be necessary on account of the tide. It will be seen that the portable truck carrying the boom, travels on a track extending the entire length of the dock, allowing the machine to be placed at the most convenient point for unloading, or loading as the case

Switching Cars with an Electric Truck

In the May issue of POPULAR ELECTRICITY, an electric wagon was shown hoisting a safe to one of the upper floors of a tall building by means of block and tackle.

A still more novel use is made of the electric truck at the factory yards of the S. F. Bowser Company, Fort Wayne, Indiana. The railroad yards are one-third of a mile from the factory. A spur track runs to the factory. Over this track the truck shown, which is one of two in service, draws the cars to the factory for loading and back again to the freight yards when loaded. These two trucks do all the trucking formerly done by two large trucks



ELECTRIC TRUCK PULLING CARS

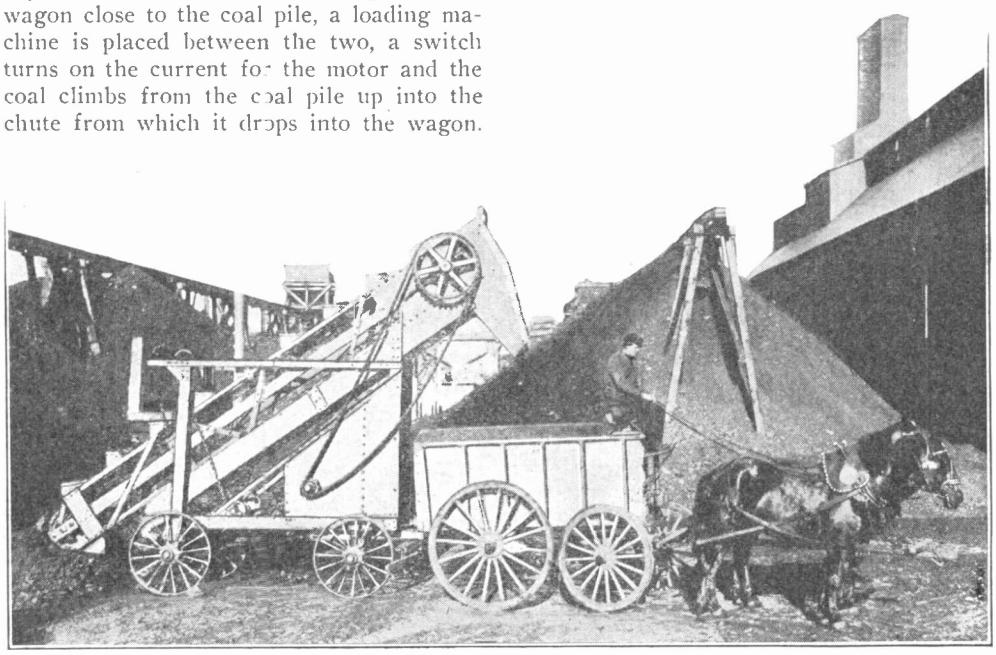
drawn by horses, besides doing the switching work. The battery on each truck is a 48-cell, 25-plate storage battery and will run the truck at six miles an hour when it is carrying a load of 10,000 pounds.

The truck is fitted at each end with a regular railroad drawbar for coupling to cars. The picture shows the truck pulling two flat cars each loaded with a 30,000 gallon tank.

Loading Coal Wagons Electrically

Instead of being extensive users of hand shovels, the retail coal dealers are learning to dodge the use of shovels more and more. Even in yards where the coal is stored on the ground and cannot be fed through chutes, the hand shovel has seen its best days. Now, instead of backing the coal wagon close to the coal pile, a loading machine is placed between the two, a switch turns on the current for the motor and the coal climbs from the coal pile up into the chute from which it drops into the wagon.

Once the wagon is backed into place, the loading takes very little time. Thus, the three-ton wagon shown in the illustration was loaded in 80 seconds. The cable carrying current to the loading machine is quickly shifted about, so that the total time required depends chiefly on getting the wagons into place, for a single loader can take care of a large number of wagons in rapid succession.



ELECTRIC LOADING MACHINE FILLING A COAL WAGON

TRACKLESS TROLLEY IN USE IN BRADFORD, ENGLAND

An English Trackless Trolley

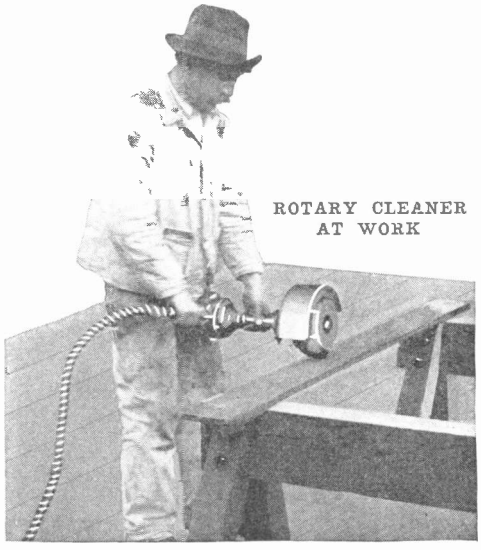
In Bradford, England, extensive use of the trackless trolley idea is being made. In one of these electrically propelled omnibuses, which derive their electric supply from an overhead wire like a street car, there is a seating capacity for twenty eight passengers. The steering gear is arranged so that the vehicle will turn round in a radius of twelve feet, measured on an inner rear wheel. There are two sets of brakes, operated by a foot pedal and a side lever. When it comes to passing by other vehicles on the road, the picture shows how readily this is accomplished.

Cleaning Structural Steel

The old-time method of cleaning rust and scale from structural steel and iron was by scraping and brushing the surfaces by hand with wire brushes, and also by the use of a sand blast. Now this work may be done with a revolving device driven by a small motor as shown in the illustration.

The tool of this rotary cleaner consists of two circular plates on the same hub, supporting at their perimeters a series of pins on which are carried steel blades or cutters which are rectangular in shape.

This tool is used on an electric grinder or a high speed pneumatic machine, and its effectiveness is obtained by the chipping blows of the blades. It is used also for cleaning castings and removing barnacles from boats as well as for surfacing stone and similar service. It is maintained that one man with one of these rotary cleaners operated by electric power, can do the work of eight or ten men with scrapers or brushes, and get better results.



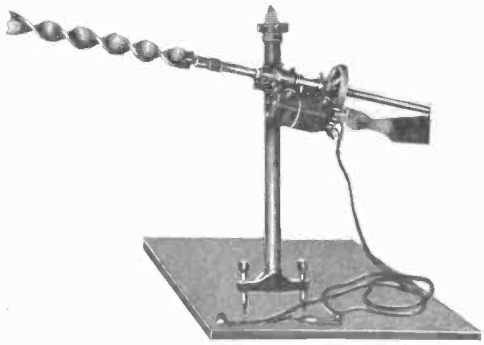
ROTARY CLEANER AT WORK

The Strongest Arm in England

In the fairy tales of our forefathers, a giant's arm, capable of lifting a thousand pounds, was an object of wonder. Then what would our legend makers have said about one that easily handles 300 times as much? Such is the swinging arm of the huge electric crane recently built for shipbuilding purposes by William Arrol & Co., Ltd., of Glasgow. With a reach of 137 feet it was only intended for a maximum load of 150 tons, yet our illustration shows it handling a test load of 187 tons which it can readily raise 143 feet above the ground.

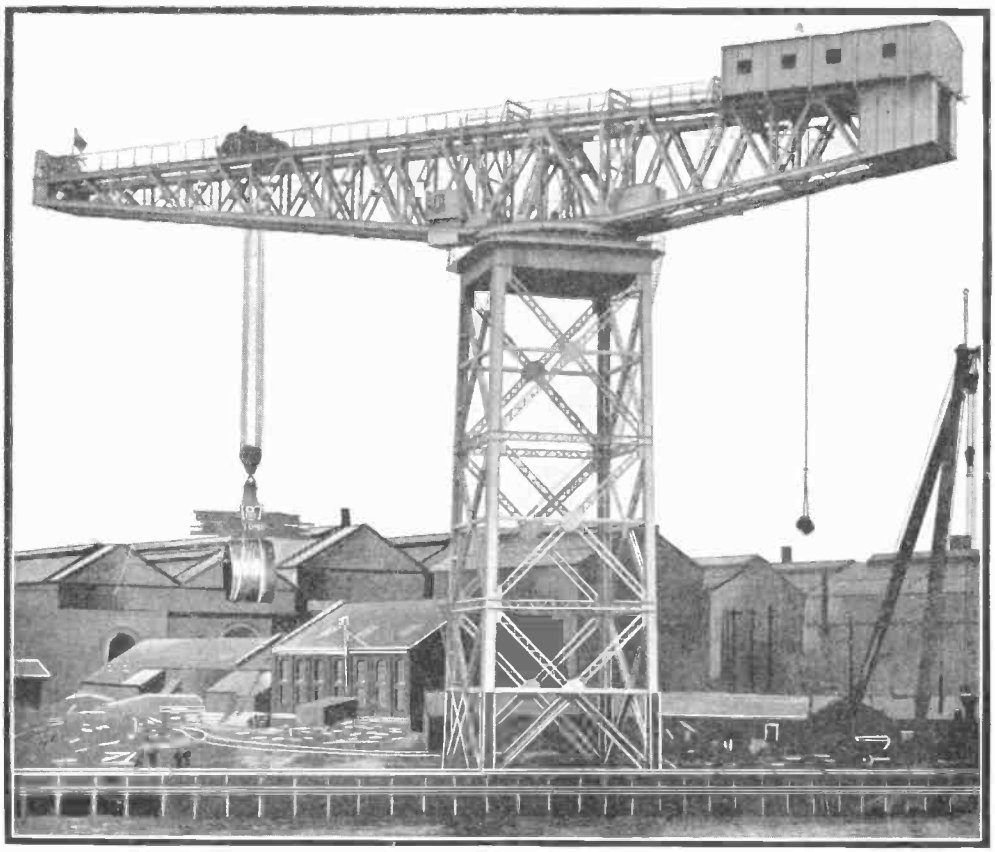
Modern Boring

Have you ever watched a carpenter brace himself with all his weight against his auger when boring an inch and a half, or even an inch hole? That was yesterday. Today a gentle turning of the feed screw with two fingers is ample even when boring a five inch hole, for the up-to-date contractor believes in having the current and not the man do the heavy work. The cut shows



ELECTRIC BORING MACHINE

an auger five inches in diameter as guided with two fingers when drilling coal, which is much harder to bore than wood.



STRONGEST ARM IN ENGLAND WITH A LOAD OF 187 TONS

Electrical Men of the Times

OTTO ERNEST OSTHOFF

To be chosen vice-president and chief engineer of a big engineering concern at the age of 37 means training, push, executive ability, lots of hard work and a capacity for more.

In ten years Mr. Otto Ernest Osthoff has achieved this position with the H. M. Byllesby Company of Chicago and it should be noted that the scope of this Company's operations, covering steam and electric plants, waterpowers, waterworks, gas plants, etc., make the direction of the engineering department a most noteworthy and strenuous undertaking.

Mr. Osthoff was born in Cleveland, Ohio, Oct. 4, 1874. His parents moved to Delphos, Ohio when he was six years old and here he received a common and high school education. When sixteen he entered Adelbert College of the Western Reserve University where he took up classical studies for three years. He then entered the Case School of Applied Science, Cleveland, Ohio, graduating in 1896 with the degree of Bachelor of Science. During his course here he gave evidence of the future trend of his life by incidentally pursuing studies in mechanical, electrical and hydraulic engineering. His thesis on the relative coefficient of expansion of hydrogen as compared with oxygen won for him the Reid prize in physics given annually by Dr. Reid of the Johns Hopkins University to the student passing the best special examination in physics and also obtaining the highest average grade in all studies in the sophomore year. Mr. Osthoff served as editor-in-chief of the college annual, *The Differential*, and taught physics for a year while pursuing his regular studies.

In 1896 he entered the employ of the Willard Storage Battery Company and during the year received from the Case School the degree of E. E., the subject of his post-graduate thesis being "The Design of Central Station Storage Batteries." In 1900 he entered the construction department of the Electric Storage Battery Company of Philadelphia, finally coming to Chicago as their western engineer.

In 1902 Mr. Osthoff became associated with the Byllesby Company and with this connection there opened up a wide field of activity. Under his supervision were designed and constructed electric water-power plants at Big Fork, Mont., Sioux Falls, S. D., Canon Falls, Minn.; steam plants at Mobile, Ala., Oklahoma City, St. Paul, Minn., Oshkosh, Wis., and several coal, water and gas plants controlled by the Northern States Power Company. And these are only a small part of the diversified engineering work he has planned and executed all over the country.

Asked if he had a hobby his reply was that he had no time for a hobby unless his work could be so classed. In his presence one feels impressed by a strong personality but put at ease by a manner altogether frank and approachable. A friend in characterizing him says, "He is a hard worker and thorough, does not jump at a conclusion nor give snap judgments, considers carefully, but sizes up a situation quickly and is in business language a 'safe man.'" And this feeling of confidence in his good judgment has made him much sought after.

Mr. Osthoff is an associate member of the American Institute of Electrical Engineers, and member of the Western Society of En-

gineers, American Water Works Association, American Gas Institute, National District Heating Association, American Academy of Political and Social Science, American Civic Alliance and American Association for the Advancement of Science. He is also a member of the Union League Club of Chicago, University Club of Chicago, Lawyers' Club of New York City, Arlington Club of Portland, Ore., of the Greek letter scientific society, Sigma Xi, Chicago Club of Chicago, Railroad Club of New York City and of the Exmoor Country Club of Chicago.

Ruhmer's Multiplex Telephone

In the March (1911) issue of POPULAR ELECTRICITY an account was given of the invention, by Major Squier, of a system of multiplex telephony, also of a discovery of a similar nature by Frank L. Perry, of Chicago. It appears now that a third inventor was working a ong similar lines at the same time, none other than the famous German inventor, Ernest Ruhmer.

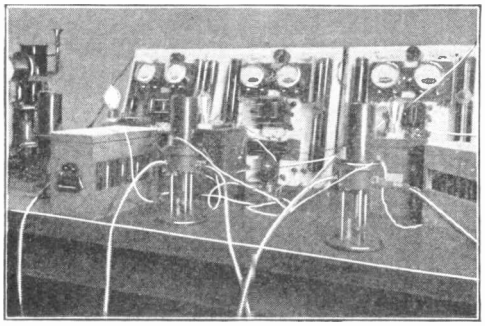


FIG. 1. RUHMER'S SENDING APPARATUS

It is difficult to frame a description of the Ruhmer multiplex telephone in non-technical language, for it is a complicated contrivance, as indicated in the picture of the sending apparatus. It may be said, however, that it partakes of the principles of both wireless and the ordinary telephony. In this respect it resembles the Squier system. Professor Ruhmer uses in the sending equipment the well-known Poulsen arc which is employed in wireless telephony. This arc lamp is connected in the telephone line and burns steadily. Then a transmitter is arranged so that the tiny fluctuations of current caused by the voice are superimposed on the current flowing in the arc lamp circuit, out over the line. These fluctuations effect the resistance of the arc lamp. This in turn cause similar fluctuations in the line current which effect the detector in the receiving instrument.

The frequencies employed in sending are very high, much higher than in ordinary wire telephony. But they are not as high as in wireless telephony. If they were, current waves would be radiated out into space as from a wireless aerial.

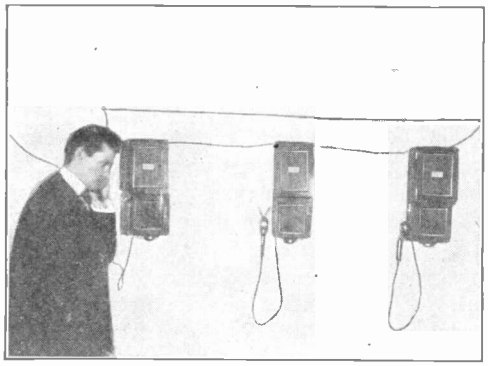


FIG. 2. RUHMER'S RECEIVING APPARATUS

In short, we may assume that in Ruhmer's system, the current carrying the message barely follows the wire as a directing agent, but travels principally in a narrow zone immediately around the wire—almost, in fact, a wireless wave, but traveling always near the wire.

By using dynamos of various frequencies to feed the arc lamps several messages may be directed along the wire at the same time without interfering with each other, in the same manner that messages may be so "tuned" in wireless telegraphy so as not to interfere.

Special receiving instruments are provided at the distant stations, each made to respond to a current of a certain frequency and no other. They are in resonance, as we say, with a certain current frequency. This action is similar to that of a tuning fork which is set in vibration by the vibration of another of the same pitch.

The above is, of course, a bare outline of principles of a laboratory apparatus which has worked in an experimental way, but the practical utility of which has still to be demonstrated.

Electricity in the Household

Where Art and Science Meet

By T. VERNETTE MORSE

The only difference between the modern woman and her illustrious grandmother is the different environments and conditions. The far-famed grandmother was by necessity a manufacturer. The granddaughter must perforce, be a consumer, a selector. She is, in fact, the manufacturer's representative and no one knows this better than the manufacturer himself.

The home magazine is the manufacturer's best solicitor. Its advertising pages are merely so many public letters addressed to the women of the country. From an educational standpoint, the home has no better lexicon of modern equipment than the monthly magazines. Every housekeeper understands this, but, unfortunately, it is only through use and adaptation that the actual labor saving devices may be profitably installed in the home.

The day of invention has arrived. The entire world has caught the microbe; it is a specie of disease. The patent office is overrun with applications. Everything is patented, from a nutmeg grater to a flying machine.

Men are not alone in this arena of brain action. Women are gaining the freedom of interpretation and application, and as a result new labor saving devices (so called) are flooding the market.

To purchase indiscriminately would mean larger houses, more dust and more work. Yes! decidedly more work, for many of the new inventions are so wonderfully invented for a special purpose, that they require more care and labor to keep them clean and in order than is necessary to do the work by hand.

Women are natural economists. Of course they wear bonnets and visit the beauty parlors; we are willing to admit all that. But that does not prevent them from saving the carpet, by sweeping it the right way of the nap, a thing some representatives of the vacuum cleaners might learn with profit. They will serve a dainty luncheon from the left-overs from yesterday's dinner in such a charming, graceful manner, that the guests will really believe that they have attended a banquet.

Give a man $50, and he will spend it in a lump—if his tailor so directs—without giving a thought to the accessories that must be obtained later. Give the same amount to a woman and she will secure a perfectly appointed costume in actual keeping with the money expended.

The foregoing is written in justice to women's natural powers of discrimination and application. For to women has come the necessity of occupying an important place in the affairs of the nation, while she still holds supreme power in the home.

The husband and father, with his many business anxieties, has no choice but to leave the care of the home and family to the wife and mother. Such women cannot afford to be mere automatic nonentities. The husband and children demand something besides love and labor. The modern woman must be very much alive and up-to-date; must have character and discriminating judgment. The times demand this and receive it.

By nature women do not like machinery. They abhor the dust and dirt of the shop. That is one reason why they have so readily adopted electricity. "To press the button, or turn on the switch" is a neat, clean job and women like it.

At first, when pressing the button meant nothing more than a brilliantly lighted room, they were quite content to let men do

all the planning and inventing, accepting, as a matter of course, the great benefits and conveniences accruing therefrom.

As time passed on some one invented the "bread toaster," which was closely followed by the "coffee percolator"—man had invaded the realm of the kitchen with electrical apparatus, which was destined to revolutionize modern housekeeping.

At first women were curious. Few realized that they were facing a new epoch in domestic history. Little by little the inventor and the manufacturers pushed their wares. The retail merchants as a matter of progress, invested a few dollars in some of the most attractive wares and proudly demonstrated to their patrons the wonderful advancement that was being made in labor saving devices. But the housewife walked serenely past, and did her Friday's sweeping in the good old-fashioned way.

But it was no use, the change had come, and could not be ignored. Antiquated ideas must give way to the advancement of art and science in the house, just as the scythe and sickle had previously given way to the mowing machine.

ANTIQUATED IDEAS MUST GIVE WAY TO THE ADVANCEMENT OF SCIENCE

Every considerate man would like to see his wife sufficiently free from the absolute drudgery of housekeeping to have time for a well directed social life. That is the unquestionable right of every normal

family. As a natural result, men were much more ready to install electrical equipment in the home than women were to accept it.

However, in the average home it is the combined good judgment of the husband and wife that eventually decides the question. The new inventions have come to stay, and have gradually been adopted or rejected according to their merits, for the grand test comes through constant use.

Formerly the sewing machine was about the only machine that women came in contact with, but what normal woman could possibly resist the attractions of the automobile. She began by gingerly clutching the steering gear, looking all the while as if she fully intended to scream if anything happened. Today she calmly owns and frequently cares for her own machine, knowing all the parts and their purposes; is her own chauffeur whenever occasion requires, and the public has ceased to comment.

It is said that women are not great in invention. That may or may not be true, they are just entering the field, and as yet we are unable to judge as to the final results.

Twenty years ago it was said that there were no women artists, that only the masculine head and hand were endowed with that wondrous ability known as genius. Today the reputation of our women painters equals that of men, and the discriminating sex line has disappeared.

The question of inventive genius can only be decided by future accomplishments; but the present is in our own hands.

At present it is woman's province to accept or reject what the manufacturer provides. It is the wise manufacturer who employs a woman of experience, with a knowledge of the practical requirements of the home carefully to test and criticise the new inventions before they are put upon the market. Such a course would be economy in the end, and a blessing to the housewife in whose service the article is supposed to be employed.

The wise housekeeper will provide herself with the best, knowing full well that a few extra dollars for permanent equipment will eventually be a great saving in time, money and labor.

With equipment that is really labor saving, and the employment of specialists who will go into the home and work by the day or hour, the servant question and all other complex problems of the home will be overcome. In fact they are already dissolving, for in many homes these plans are now in force and the results are most satisfactory.

Last year it was impossible for the Art-craft Institute to supply the demand for specialists who were capable of doing extra work in the home. Nearly every occupation was represented from the cleaning of silver to the preparing and serving of company dinners; from the darning of socks to planning the furnishings of the rooms.

Women are ready for the new era, and will gladly welcome such devices as really save labor. But they are keen observers; the machine that requires a mechanic to operate and keep in order does not appeal to them. Such a machine if taken care of personally means but a variation of the same old dishwashing grind, with a more disagreeable setting.

Give the housewife good things, give her simple machinery, give her equipment that will accomplish its purpose effectually, and she will be found ready to accept all really advanced ideas.

Model Home Which Travels on Wheels

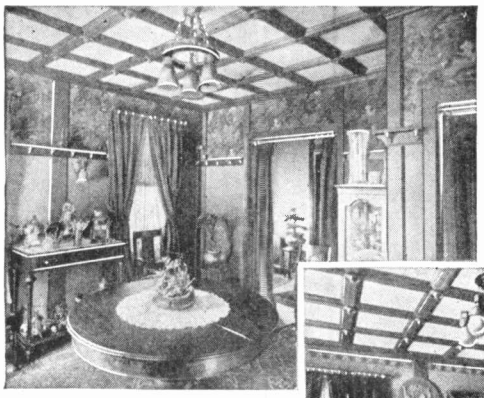
An electric house of Edison light came over night to Newton, Mass. What is more astounding, it came by electric automobile from its previous stopping place at Winchester. Furthermore, this electric house is chimneyless and represents the height of electric development in domestic life.

The idea is that of the Edison Electric Illuminating Company of Boston. The house was originally built at Dover and there began its journey on wheels which will not be complete until it has visited for a time all the outlying suburbs where the Boston Edison supplies its service.

It is said that from the door bell, which rings by current from the electric lighting mains, through the hall with its dim as well as brilliant lighting, and the living room with its comforts for happy evenings after

busy business days, to the dining room with its economical luxuries, electric switches are within the reach of everyone within the home. Every woman who inspects its elaborate arrangements may study at her leisure all the latest conveniences that electricity has to offer.

The sleeping chambers are models of comfort and attractiveness, and the kitchen with its complete electrical equipment, the pantry with its plate warmers and other practical conveniences and the laundry with electric washing machine and facilities for electric ironing, make housekeeping a pleasure. In the garage is an electric vehicle and many electrical conveniences so necessary to the autoist's use, the whole equipment being a marvel of completeness.



DINING ROOM

LIBRARY

At the front of this electric house is a pergola 8 by 10 feet, while the major portion of the house is 34 feet square, providing five spacious rooms within fourteen feet square. In addition to the rooms already mentioned there is a reception room in the center of the cottage which makes a fitting entrance for the many guests who will be welcomed.

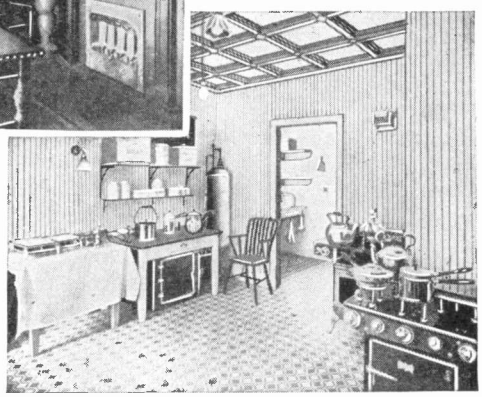
After the house was put together it was completely furnished with handsome and luxurious furniture in keeping with the surroundings. The excellent taste that has been shown in selecting the furnishings would make this residence a most attractive place, even if there were not the additional features of the electric service.

It may be stated that the appliances that have been installed in the electric home and the methods by which electric service is used, are unique and especially novel.

Everyone knows that electric fans are of great value, not only to cool a room in summer, but to distribute the warm air from the radiators in winter, but a great many have never tried these two ways of making an electric fan useful.

Many folks know that toast made on an electric toaster is the best that can be obtained, and is sweeter and crisper than can be made in any other way, but thousands have yet to eat their first piece of electrically made toast. Everyone realizes that vacuum cleaners, vibrators, polishing machines and knife sharpeners can be operated in the home electrically and with great convenience, but many have yet to have practical experience with these things.

An electric curling iron heater may be always available in the dressing room or chamber for the continual comfort and convenience of the hostess or her guests. There is wonderful comfort, safety and convenience in the electric heating pad as it never leaks, will maintain a constant temperature and can be kept at the head of the bed, available for any emergency, for a sudden attack of neuralgia, or any illness, even "cold feet," can be corrected promptly.

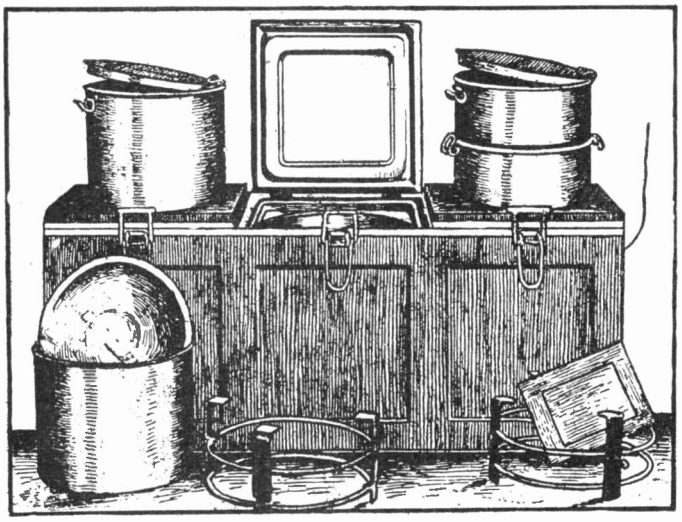


KITCHEN

Fireless Cooking

It is heat that cooks food—not the fire. You can cook anything, with very little expenditure of initial heat, if you can contrive to save all the heat and turn its energy into the cooking process instead of into heating the surrounding atmosphere. This is the principle upon which all fireless cookers are designed.

In the electric kind, the heat is generated inside of the cooker by passing the current for a time through what is known as the heating element, which is nothing more than a small coil of very fine wire. The current in passing through this wire heats it up to a red heat. This coil, being inside of the casing of the cooker, along with the vegetables or whatever is being cooked, does not need to be heated for any great length of time, the sides of the cooker being made up in a manner to prevent heat from escaping, keeping it inside where it performs its work and does not raise the temperature of your kitchen.



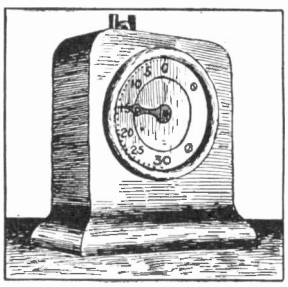
THREE DEPARTMENT ELECTRIC FIRELESS COOKER

The Detroit fireless cooker is one example of the many forms of these utensils now on the market. The large drawing shows a three compartment type with a capacity of 24 quarts. The equipment which goes with this stove consists of two eight-quart and two four-quart aluminum kettles, two baking racks for pies, and, incidentally a cook book. This latter is quite an important adjunct since it tells just how long current should be left on to develop the heat necessary to cook various dishes, also how long the latter should be left in the cooker. This saves quite a little experimenting when one first begins to use such a cooker.

In this cooker the heating element is located below the solid cast iron bottom of the cooking compartment and no water or steam can reach it.

Another convenience is represented by the time clock with automatic switch. When you put in a meal to be cooked you do not care to stand over the stove for the ten or fifteen minutes necessary while the current is doing its work, so you just set the clock to the time when it is desired to switch off the current. Then the clock performs this act for you automatically.

No mistake can be made in operating the fireless cooker. The connecting cord is screwed into any electric lamp socket and the other end connected with the stove. You can't connect it wrongly, because it only fits the right way. You can get a high heat or a low heat in the electric oven, by connecting the cord differently and there is not as much danger as in using an ordinary electric lamp globe to read by.

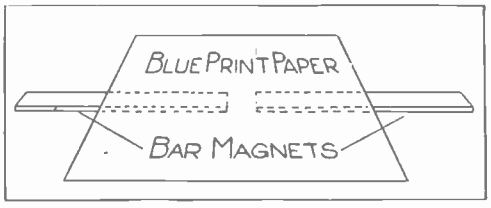


TIME SWITCH FOR FIRELESS COOKER

Without the time switch arrangement should you forget your electric stove and leave the current on, you would overheat the oven, and you might burn anything you had in it, but there would be no danger, as the heavy asbestos insulation is amply sufficient to prevent the heat from affecting anything outside of the cooker.

Blue Prints of Magnet Fields

For the person interested in the study of magnet fields, blue prints offer an easy means of obtaining permanent copies of them. They are very simple to make, requiring little or no experience in photography to get good prints of magnet fields. All that one needs is a package of blue print paper, two or more magnets (bar magnets are best) some iron filings and a large dish of clear water. They are best



made at a south window having a curtain which can be raised and lowered at will.

Arrange the magnets as shown in the illustrations leaving the ends about one inch apart. Lower the curtain and place a piece of blue print paper upon the magnets, close the box containing the rest of the paper, being careful to have the sensitized side up. Then sprinkle iron filings upon the paper which was placed upon the magnet. The filings are best sprinkled by placing them in a coarse cloth sack and sifting evenly over the paper.

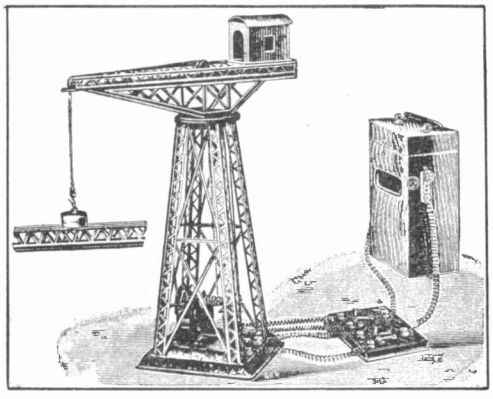
Raise the curtain and expose the paper to bright sun light for about three minutes then shake off the filings and wash the paper in clear water for about half an hour.

At first you may not get the desired results but with a little experience you will be able to judge the exposures and amount of filings so as to get perfect reproductions of the magnet fields. The positions of the magnets may be varied so as to secure an endless variety of fields.

IVAN H. WALBRIDGE.

A Miniature Electric Derrick

Not content with running paper figures with toy motors, our British cousins often build working models of much more complicated devices. Here, for instance, is an electric crane model with a total height of 17 inches and a motor run from two cells of battery. The switches not only control the motor but also supply current to the lit-



A MINIATURE DERRICK

tle lifting magnet at the end of the flexible cord, so that this crane will pick up two pounds of steel or iron and place it anywhere within a seven-inch circle.

Amusing Trick with Static

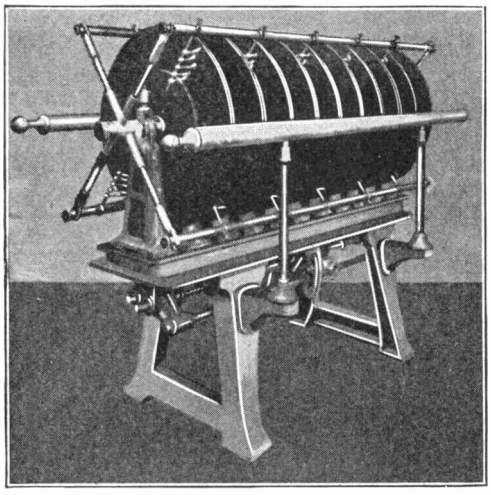
Nearly everyone knows that a rapidly moving belt will collect static charges of electricity. A person can easily draw off these charges to the earth through the hand and body. The writer has at different times presented to a belt like the one mentioned above, a large sized common nail held in the hand. From the end of this nail will appear a small stream of blue sparks. When, however, a finger of the other hand is brought near the fiery end

of the nail the sparks will retreat to the other side of the nail. If pursued farther they will die out altogether. Taking away the finger the sparks appear again.

Apparently the charge is driven away but what really occurs is that a larger conducting surface is presented and the charge is thus not all made to jump the spark gap at one point.

A Powerful Static Machine

In certain experiments with very high voltage currents the alternating current obtained from transformers is not suitable, so recourse is had to static machines. These static machines are of the type frequently seen ten or fifteen years ago in laboratories and doctors' offices and which,



STATIC MACHINE BUILT IN PARIS

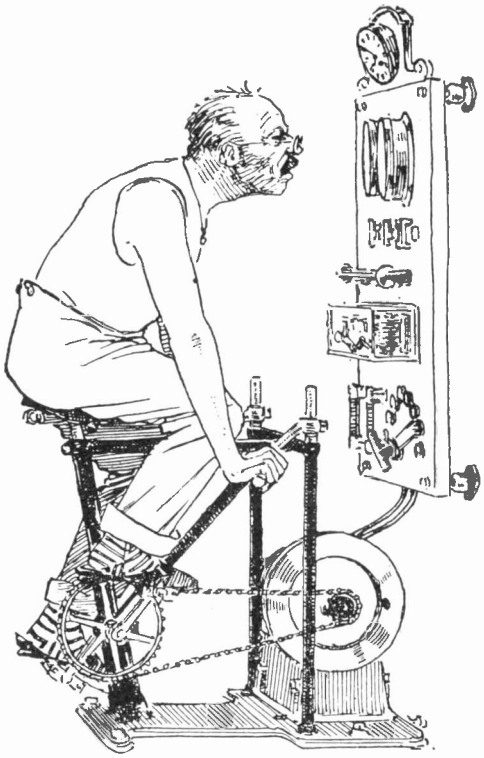
with their swiftly revolving plates and crackling sparks, were quite wonderful sights to the ordinary observer.

In view of the inadequacy of these machines as so far constructed, H. Abraham and P. Villard, in connection with their work on high direct-current potentials, recently entrusted M. Roycourt of Paris with the construction of an extremely powerful static machine destined for their laboratory at the Ecole Normale Supérieure. There are ten pairs of revolving disks in this machine and when first tested out it was able to produce a difference of potential of 320,000 volts between its two terminals. This tremendous electrical pressure may be better comprehended when it is known that in the longest transmission lines of today, extending hundreds of miles a voltage is used not above 125,000 volts.

The Wonderful Alpha Rays

The Alpha rays from radio-active matter consist of veritable atoms of matter projected at a speed, on an average, of 6,000 miles per second.

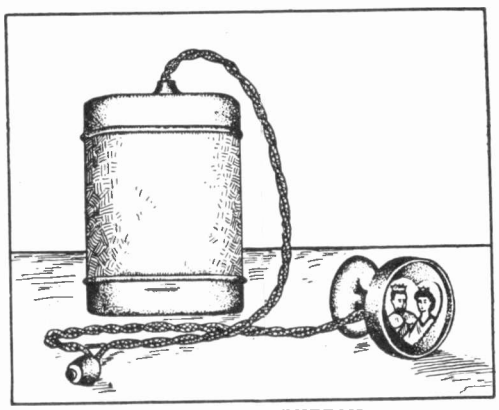
It is the great energy of motion of these swiftly expelled masses that gives rise to the heating effect of radium. Yet they do not appear to go far. The swiftest Alpha particle has been estimated to travel seven centimeters in air, under ordinary conditions, before it is stopped. But on its way it plunges straight through every molecule in its path, producing positively and negatively charged ions in the process. On an average, it is stated, an Alpha particle, before its career of violence is stopped, breaks up about 100,000 molecules.



AN ENGLISH ARTIST'S IDEA FOR TURNING SURPLUS FAT INTO ELECTRICAL ENERGY WHICH CAN BE STORED FOR LATER USE

Illuminated Buttons

Not content with decorating their homes as well as their business buildings with electrically lighted emblems and decorations appropriate to the recent coronation, many loyal Englishmen decorated themselves in similar fashion during the festal week. The favorite in northern England was what we should call an illuminated button, offered by an Oldham firm—"a metal framed coronation transparency for buttonhole use," showing a colored miniature of the King and Queen. This was lighted by a small lamp fed from a pocket battery and its popularity may suggest a new form of campaign novelty for future use in this country.



ILLUMINATED BUTTON

Effects of Electricity

The observations of Müllendorf concerning the effects of electricity on the animal body show some remarkable results. Man has much greater power of resistance, or much less susceptibility, than many other animals. A leach placed across a copper plate so as to touch a larger plate of zinc is unable to crawl off on account of the feeble electric action excited by the contact of the metals. Horses are troubled by slight differences of potential. An ox treated for rheumatism with electricity succumbed to a current absolutely inoffensive to man.

THE YOUNG EDISONS' CLUB

Under this heading will be published letters from readers of the Junior Department. These letters should describe briefly and accurately your experiences in the making and operation of electrical devices and in the performing of electrical experiments. See how good an "engineering report" you can make of your investigations.

The Young Edisons' Club:

Three other boys and I made a telegraph line. It has four stations and over half a mile of wire. Each of us has a standard Morse instrument. We found that it was rather hard to read the messages, so another boy and I resolved to make a recorder rather than buy one.

We got an old clock that would run but did not keep good time. We took it out of the case so as to take it apart, and unscrewed the nuts from the side pillars that support the front and back plates. We filed out all the wheels that interfered with the turning of the wheel that moves the hands.

Next we removed the main-spring and the heavy wide spring. At the jewelers we bought a stronger main-spring and a more powerful heavy spring which cost us 45 cents. We carefully put in these springs and adjusted them.

The clock, when wound up would then run about four times as fast as before. We next got a spool of Christmas ribbon and unwound the narrow paper ribbon shield from it. After removing the silk ribbon we rewound the paper ribbon on the spool.

To hold the paper strip we bored a hole through the cardboard spool and ran a wire axle through it, then bent the ends down and stuck them in a block of wood, so that the spool would revolve when the paper was pulled.

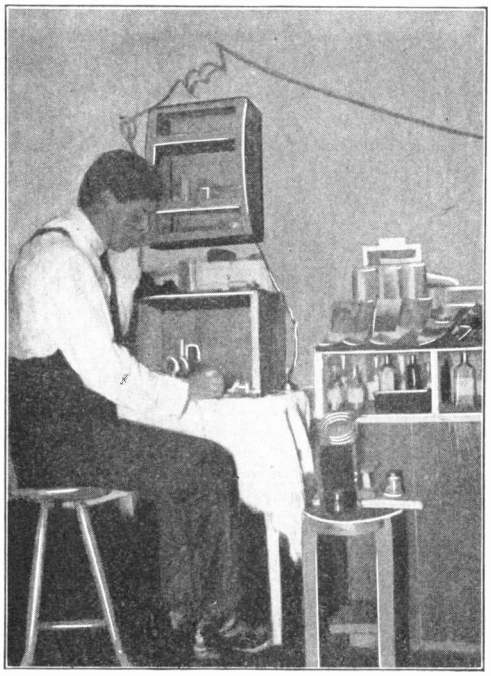
The free end of the paper ribbon was run under the brass rod that is riveted to the armature of the sounder, and which goes up and down when the key is pressed and released. The screw which makes the down click was removed and a piece of soft lead was fitted tightly in its place. This same end of the ribbon was fastened to the rod that turns the clock hands.

When my station was called, I would wind up the clock, which would then draw the paper from the spool slowly. The lead pressing on the paper ribbon would then register the dots and dashes.

Englewood, N. J. D. E. LINDSAY.

The Young Edisons' Club:

The accompanying photograph of myself I took without assistance by pressing a button thus charging an electro-magnet which pulled to it a long iron arm attached to the shutter of a box camera. I am in my wireless, electric and photograph room, where I combine experimental electricity with amateur photography. A miniature electric lamp is attached to the oil burner in the ruby lamp. A battery current is used to increase the temperature of the chemicals. A small motor is useful in stirring powder into solution. Most of my pictures are printed by an electric lamp. My wireless equipment is the first in the community.



HARRY E. WAID IN HIS LABORATORY

Kent, Wash. HARRY E. WAID.

The Young Edisons' Club:

I think that a spark coil is one of the most interesting pieces of apparatus that the experimenter can have. I have a one-half inch coil which I made myself, and get much amusement from it. If one wire is grounded and one hand brought near the other secondary terminal a spark will jump to your finger with a sharp, stinging sensation. If you have a coil try to get a friend to hold his finger to the coil terminal.

Most people think that you have to get hold on two wires to get a shock, and will readily try it. If your friend does try it you will never see a more surprised boy in your life. The reason for this is plain. If you paste a piece of tinfoil on each side of a glass, leaving a small margin around the glass plate, and fasten a wire from one coil terminal to one side of the foil then fasten a well insulated wire to the other coil terminal and bring it near the foil on the other side of the glass, you will see that sparks will jump to the foil. In grounding one wire, the ground is the same as one sheet of foil, the building in which you stand is the glass plate or dielectric, and your body is the other sheet of tinfoil.

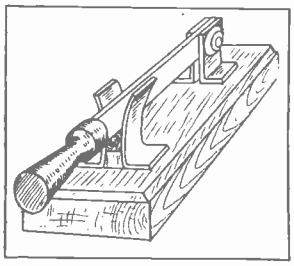
Take two black lead pencils, fasten a wire to one end of each, attach these wires to the coil. Now bring the two sharpened ends close together and you will have an arc lamp. Care must be used in the foregoing experiment or you may get a shock from the pencils.

LEONARD LYNN.

Stockport, Ohio.

The Young Edisons' Club:

An ordinary single pole, single throw switch may be used as a high speed telegraph key as follows: Separate the sides of the groove into which the blade fits when the switch is "on," so that the blade does not quite touch either side. A small chip of wood will prevent it from touching the bottom of the jaws. To operate this switch or key, swing the handle first to one side and then to the other to spell out the dots and dashes. With a little practice this will become easy and natural and much more rapid than with the ordinary key.

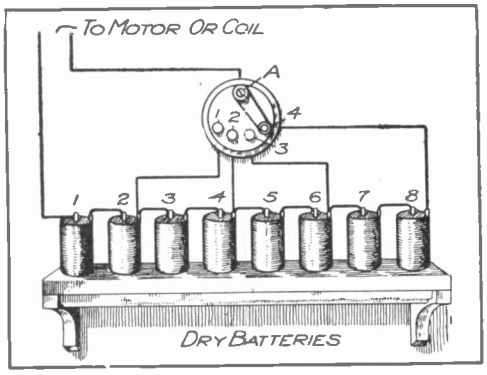


D. CLARKE COX.

123 W. Third St., Madison, Ind.

The Young Edisons' Club:

I use the accompanying plan to connect up dry cells so that two, four or more cells may be handily placed in the circuit. Connect say eight cells in series and run one lead from the carbon of cell No. 1 to one side of the motor. Run the return from the other side of the motor to point (A) on the five-point switch. Now run a wire



METHOD OF CONNECTING DRY BATTERIES

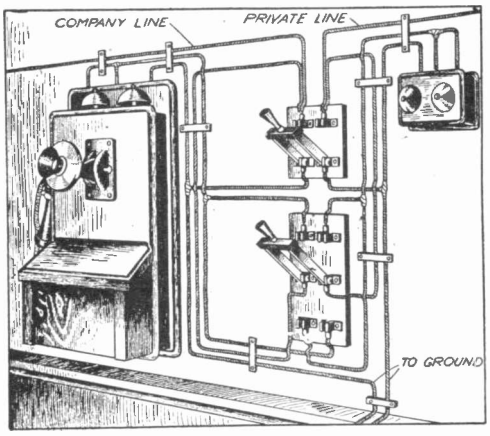
from point No. 1 to the zinc of cell No. 2. Connect it along with the wire which connects cells No. 2 and 3. This makes two connections on the zinc of No. 2. Run a wire from point No. 2 to the zinc of cell No. 4, from point No. 3 to zinc of battery No. 6, and from point No. 4 to zinc of No. 8. Be sure to connect the points of the switch to the zincs of the battery. The points can be connected by the same method so that each one will throw in one cell or any number of cells. I have used this connection to control a motor, a system of bells, and am now using it to raise and lower the voltage in the primary of my wireless coil.

HOWARD E. CRAWFORD.

1319 Lee St., Charleston, W. Va.

The Young Edisons' Club:

Recently a private telephone line was installed in our home and I was called upon to devise a method by which we could receive calls from both lines, by the use of one telephone and extension bells. After a great deal of trouble and experimenting I succeeded. I used a double pole, double throw switch, with connections as shown by the accompaning diagram, also a double-pole, single-throw switch for protection against lightning.



A TELEPHONE PROBLEM SOLVED

With the double-throw switch up, the telephone is connected to the regular company line, and the extension bells are on the private line. With this switch down, these conditions are reversed. With this same switch open and the single-throw switch closed, both lines are grounded, thus providing a reliable lightning arrester.

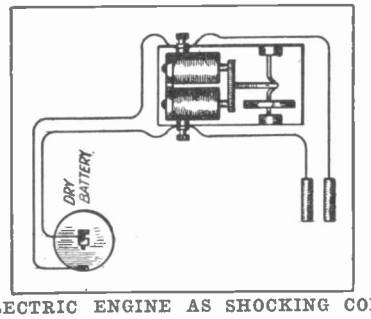
I have found that two separate grounds are absolutely necessary.

EARL HEFFELFINGER.

Williston, N. D.

The Young Edisons' Club:

Almost all the amateurs have a small electric engine which may easily be used as a shocking machine. Simply wire as shown by the accompanying sketch. For a battery you may use four discarded automobile cells

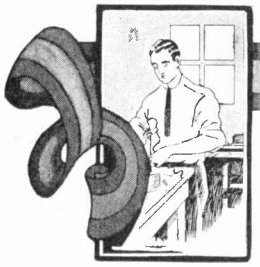


ELECTRIC ENGINE AS SHOCKING COIL

connecting them in pairs, having each pair in series, and the cells of each pair in multiple or parallel. For handles round battery carbons may be used. The shock may be intensified by wetting the hands with salt water.

EARL HEFFELFINGER.

Williston, N. D.



For Practical Electrical Workers

Electrical Analogies

By DALE S. COLE

THE CONDENSER

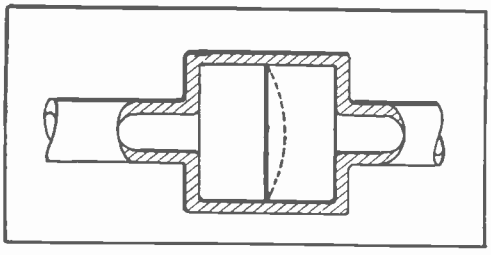
At the present time, when wireless telegraphy is in such great public favor among amateur electricians, the terms "condenser" and "capacity" are almost household words, however vague may be the understanding of them. In trying to explain them we will again use an hydraulic analogy, being careful to remember that in using analogies we must not carry them too far.

A condenser consists primarily of two metallic plates separated by a non-conductor or dielectric as it is called. The shape and material of the plates may vary greatly in different condensers, depending on the work they perform. For instance, two ordinary telegraph wires with air between them form a condenser. Or, one wire and the earth may give the same effect. Some condensers are made of strips of paper and tinfoil in a sort of coil. Perhaps the most common form is the Leyden jar. This is a glass jar with an inside and outside covering of tinfoil.

The dielectric may be air, glass, mica, or any such material that will withstand high voltages. The two plates in all condensers are separated by the dielectric.

When a voltage is applied to the plates the condenser is said to be "charged." By this we mean that energy has been stored in the condenser. If the pressure be removed the charge still remains unless the leakage be great, as is often the case. But, should the plates be connected together and a circuit formed, the "discharge" takes place. This discharge is merely the giving up of the energy stored by impressing a voltage on the plates, and may be accompanied by noise, or not, according to the manner of connection.

Now let us suppose that we have a common water pipe. We cut a section out and insert a rubber diaphragm as shown in the sketch. When water begins to flow through the pipe it cannot pass through the rubber and hence this non-permeable substance is stretched and assumes some position as shown by the dotted line. This sheet acts in this case like the dielectric in a condenser. When a pressure or voltage is applied the dielectric is strained in some such



WATER PRESSURE ANALOGY OF THE CONDENSER

manner as we know the rubber would be. Some water will tend to leak through the rubber sheet and in this we have an analogy to the leakage current of the electric circuit.

Now if the water pressure is removed the diaphragm will spring back to its original position, due to its elasticity, and in so doing will force the water in the opposite direction to the previous flow. This then is similar to the discharge of the condenser, for in each case the stored energy is given back to the circuit. In one case it is a flow of water and in the other of current.

It is only natural that this rubber diaphragm should not come to rest instantly, but will vibrate to and fro for a short space of time. This will impart an alternating

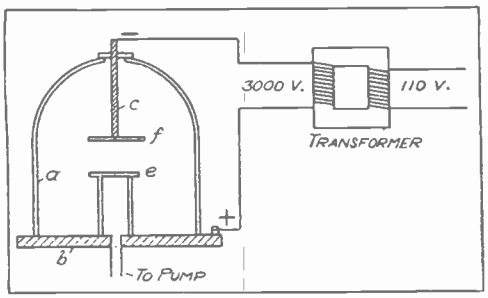
periodic motion to the water. Such is the case in a condenser, for many experiments have borne out the fact that the discharge of a condenser is oscillatory.

Condensers are classed by their "capacity." The capacity of a given circuit is a measure of the quantity of electricity held by the circuit when charged to a given potential. A condenser of unit capacity will hold a unit quantity of electricity when charged to unit potential.

A Special Use of the Vacuum Tube Discharge

There are few persons at the present time who are not more or less familiar with the phenomenon called vacuum tube discharge. However, few are acquainted with the practical uses to which this phenomenon is put in industrial and laboratory processes.

Air is, under ordinary conditions of temperature and pressure, a nearly perfect non-conductor of electricity. But under certain conditions, it can be made to conduct electricity. If we place an electrode in each end of a glass bulb and gradually exhaust the vessel while a proper voltage is applied a glow soon appears. Let us assume the electrodes are six inches apart. At normal air pressure nearly 100,000 volts is required to break down the insulation offered by the column of air between the electrodes, and the discharge would be disruptive as in the case of lightning. However, if the pressure is reduced to a low value, only two or three thousand volts is required to cause a continuous glow which indicates a constant flow of current.



VACUUM TUBE DISCHARGE

By introducing various gases into the vessel, the color of the light can be regulated. This is the phenomenon which takes place in the vacuum tubes which are used for lighting purposes. The most common of these tubes are the Moore tubes, one containing nitrogen, the other containing carbon dioxide.

But an interesting use of vacuum tube discharge is for the deposition of metals. A vessel is constructed as in the accompanying figure. A glass jar (a) rests on an aluminum plate (b) which serves as the anode. The contact is made air-tight by means of wax. The cathode is shown at (c), and at (f) is placed the metal which is to be deposited on the surface (e). The source of high voltage is a transformer though an induction coil can be used. During the process of discharge very minute particles are torn from the negative terminal and shot in straight lines regardless of the position of the anode or positive terminal. If the cathode be covered at (f) with a sheet of platinum this metal will be deposited on any surface placed at (e).

By this means any metal can be deposited in as thin layers as desired. Metals vary in their rapidity of deposition. Cleaner surfaces are obtained if the residual gas in the vessel is hydrogen. In this manner mirrors can be made of any reflecting power by varying the thickness of the coating. This method can be, and is applied to many industrial processes.

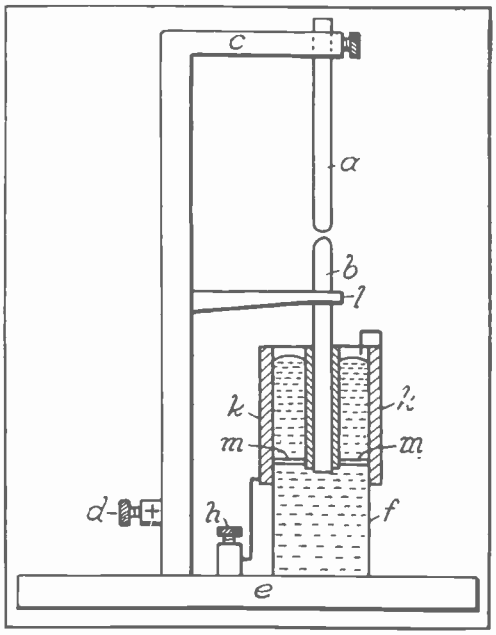
As the metal to be deposited is always the cathode it is obvious that if alternating current is used it should be rectified in some manner. This is not necessary, however, except that it decreases the heating effect. If the cathode is made several times larger in area than the anode the combination offers more resistance to the flow of current in one direction than in the other. If the anode surface be reduced by covering much of it with glass a very nearly complete rectification is obtained.

All metal parts should be made of aluminum owing to the fact that this metal deposits very slowly and with great difficulty. It is obvious that undesirable mixtures would be obtained if other metals were introduced into the vessel. The surface to be coated is placed at such a distance below (f) that it is at the edge of the cathode dark space which can be observed in any vacuum discharge.

A Simple Arc Lamp

It is sometimes desirable to construct quickly and cheaply a small arc lamp which is self regulating and quite steady in its operation. The accompaning sketch shows one which meets the above requirements.

At (a) and (b) are the electrodes; (a) is supported by an iron stand (c) and current enters it at the binding post (d). A piece of well seasoned wood (e) carries a glass vessel (f) containing mercury. This vessel can be of any substance not acted upon by mercury. The electrode (b) fits into an iron sleeve, partly for the purpose of good contact. Around the vessel (f) are



SIMPLE ARC LAMP

wound about 100 turns of No. 14 B & S gauge copper wire, one end of this coil being connected to the binding post (h) while the other end dips into the mercury. The electric circuit is as follows: The current enters at (d) goes through the metal stand (c) to the positive electrode (a), thence through the arc to the negative electrode to the mercury, through the coil (k) and to the binding post (h). A few ohms resistance of several amperes carrying capacity must be connected in series with the arc to serve as ballast. The lamp can then be operated on 110 volts alternating or direct current.

When current is turned on the electrode (b), which is normally in contact with electrode (a), is drawn downward by the solenoid action of the coil (k). With no current flowing the electrode (b), which is floating in mercury, is forced upward by the pressure of the mercury. When burning the arc length tends to increase as the electrodes are consumed thus increasing the resistance of the circuit. This causes a decrease of the current in the coil (k). The soleniod action, which is directly proportioned to the current flowing, is thus decreased and the electrode is permitted to move upward. The lamp is self-regulating and with a little experimenting a very satisfactory arc lamp can be constructed. The electrode (b) should be guided by a guide (l) insulated from (c) and by means of three pins at (m) screwed into the sleeve.

If a light rich in actinic rays is desired, as in the case of photography, the positive electrode should be made of steel. The iron arc, is rich in ultra-violet or actinic rays, which are the rays that effect the photographic plate to the greatest extent. The eyes must be protected by the use of glasses when looking at the iron arc because the ultra-violet radiation causes great inflammation and produces what is termed electro ophthalmia. Clear glasses are sufficient protection because they are opaque to this harmful radiation. If carbon electrodes are used a very steady light is produced.

Making a Waterproof Joint

The installation and maintenance of electric wiring where subject to moisture must be done with extreme care, and probably few places try out electrical work more thoroughly than the Chicago Stockyards where in many buildings the ceilings are constantly dripping water. The places attacked on the wires are where joints are made. According to an electrical inspector of the "Yards," a joint that stands the dampness as long as the insulation on the wire, is made as follows: After scraping clean the two wires and joining them, apply a coating of good waterproof compound to the bare wire. Upon this wind a layer of rubber tape, and over this the friction tape making a smooth joint. Then in finishing, paint the tape-covered joint thoroughly with compound.

Flames as Conductors of Electricity

If a high voltage from an induction coil or transformer be impressed on a spark gap, and the gap is lengthened until no spark passes under normal conditions, when the flame from a lighted match is held between the terminals of the spark gap a discharge immediately takes place. If a glass rod be electrified by rubbing with soft leather then held in the flame, the rod immediately becomes discharged. These two simple experiments show at once that the flame is a conductor of electricity.

According to the electron theory a substance to be conducting must contain free electrified particles. That flames and gases escaping from them contain the requisite

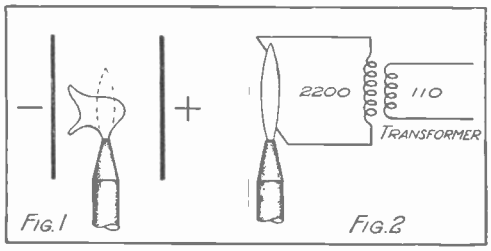


FIG. 1 FIG. 2

electrified particles can be proved in a very simple manner. If a voltage be impressed on a pair of parallel plates which are insulated and separated from each other by a space of about one inch and a positively charged pith ball is hung by a silk thread midway between the plates the ball will tend to move toward the negative plate. If the pith ball is negatively charged it will tend to move toward the positive plate. This of course follows from the elementary principle that like charges repel and unlike charges attract each other. Obviously if the gases from a flame are passed between the plates the negatively charged particles will be attracted to the positive plate and the positively charged particles will be repelled by it and attracted to the negative plate. The gas then becomes robbed of its electrified particles and after passing from between the plates it is no longer a conductor. That this is true can be at once proved by submitting the gases to the tests mentioned at the beginning of this paper. This phenomenon can be seen visually by placing the flame between the plates so that it does not come in contact with them. The shape of the flame will depend on the kind of flame. Fig. 1 illustrates the shape assumed by a certain flame when placed between two plates of opposite potential. The luminous or portion of the flame in contact with the air is attracted to the negative plate, while the non-luminous or central portion which is of lower temperature is attracted toward the positive plate. This at once indicates that the particles in the luminous portion of the flame are positively electrified and those in the non-luminous part are negatively electrified. If salt is vaporized in the flame the phenomenon is much more striking. Coal gas, oxy-hydrogen, alcohol, kerosene and various other flames show these phenomena.

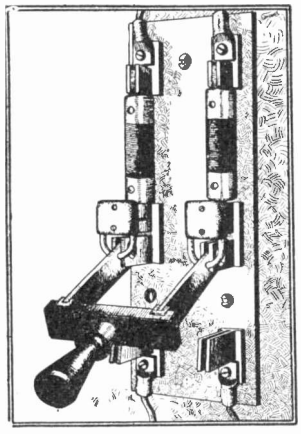
The conductivity of flames is taken advantage of in increasing the luminosity by passing an electric discharge through them. If, as in Fig. 2, two wires are connected to the high voltage terminals of a transformer or to an induction coil and a discharge is passed through the flame the light is considerably increased. In fact with proper adjustment an increase in luminosity as high as seven or eight times can be obtained from a cylindrical flame. The cylindrical flame is more suitable for this purpose and a burner can easily be made by drawing a glass or brass tube so that the opening is about $\frac{1}{8}$ inch in diameter. The discharge is passed through the length of the flame. An acetylene flame is perhaps best adapted to this purpose.

The theory of the phenomenon is complicated, but the higher luminosity when current is passing is no doubt due to the higher temperature attained by the particles which emit the light. Luminosity of flames is due to incandescent carbon particles and these are heated to a higher temperature when a discharge is passed through. When the electrodes are placed in the luminous part of the flame, soot rapidly forms, but with proper adjustment a beautiful white light is obtained. The efficiency of the flame is higher when current is passing, that is, the ratio of the light produced to the energy used is greater when the flame is conducting electricity.

The British postoffice has decided to build a cable from Holyhead to Ireland, 56 miles long. This will be the longest submarine telephone cable in the world.

Workman Locks the Switch

Serious accidents and sometimes fatal ones have followed the closing of a switch on a line being repaired. The *Journal of Industrial Safety* tells how a knife switch



A LOCKED SWITCH

may be so modified that the lineman may protect himself. The blade or blades of the switch are drilled close to the hinge with a hole large enough to receive the hasp of an ordinary padlock. When the switch is open the lock may be attached as shown and the workman keeps the key. If an attempt is made to close the switch the hasp crowds against the hinge and prevents. The switch cannot be closed except by the holder of the key.

How Insulation Is Put on Wires

In examining a piece of rubber-covered wire used in electrical work, did you ever stop to think what a complicated process must be required to prepare the rubber and put it on the wire absolutely even and smooth at every point?

In the last two decades the manufacture of rubber-covered wire has increased by leaps and bounds and manufacturing plants covering acres have been erected and are operating day and night to meet the ever increasing demand for this material.

There are different grades of rubber-covered wire, differing only in the percentage of pure Para rubber they contain.

The crude "up-river" rubber is received at the factory in large solid masses sometimes weighing as much as eight hundred to a thousand pounds. It is placed in a large tank filled with hot water and left there until the rubber becomes soft enough to allow all foreign matter to settle in the bottom of the tank. The pure rubber, after sufficiently heating, is then run through two corrugated iron rolls which form the rubber into a thin sheet, similar to the corrugated pasteboard used for packing.

The rubber sheet is now taken into a drying room and hung on supports from the ceiling. At this point different manufacturers employ different methods for drying the rubber, some use steam coils, which method only takes about two days, while others let it dry naturally, and this requires from ten to fourteen days. It has not been definitely decided which is the better method.

After it has thoroughly dried, the sheet is taken to a set of rollers about fifteen inches in diameter and wide enough to accommodate the width of the sheet. This pure rubber, which is somewhat sticky, adheres to the polished surface of one of the rolls, the sheet being pressed together as an endless belt. The rolls are adjustable and the thickness of the rubber is thus determined.

At this stage the rolls are placed close together and the reclaimed rubber (old rubber shoes, automobile tires, etc.) which have been previously prepared together with a mixture of pitch, sulphur, litharge and other ingredients which each manufacturer keeps a secret), is now run through the rolls with the pure rubber until the whole is thoroughly mixed. The sheet is now removed from the rolls and other sheets similarly prepared are laid on, until the mass becomes about two inches thick. This mass is then placed under a press and firmly pressed together.

The composite sheet formed as above is then cut into strips about two inches wide and fed into a machine which forces it through a copper wire gauze of about one hundred mesh. When the rubber comes from this machine it is entirely free from all foreign matter, such as small sticks, etc. From here it is fed into the insulating machine. The force-feed action of this machine is similar to that in a meat chopper or sausage grinder. At the end of the conveyor or worm is a hollow iron box which

contains the dies, one male and one female. The male die is in the shape of a cone containing a hole through the center exactly the size of the wire to be covered, the female die contains a hole the exact size of the outside dimensions of the finished rubber-covered wire being made.

Where the two dies meet a space of one-quarter of an inch is left and through this space the rubber is forced by enormous pressure by the worm, and is spread evenly over the wire. This process makes a seamless insulation, although there are some methods by which a seam is left in the covering.

When the rubber-covered wire emerges from this machine it is run through powdered soapstone. This prevents the covering on the wire sticking to anything with which it might come in contact.

It is now wound on a large iron drum about five feet in diameter. This drum with the wire is placed in the vulcanizer, which resembles a large iron tank, one end of same being removable to allow the passage of the drum covered with the wire. This head is then put back and the air is exhausted from the interior producing a vacuum. Then heat is applied from steam coils at a high temperature which vulcanizes the rubber, and requires a day more or less for the operation.

After vulcanization, the wire is measured and wound from the drum into a coil and placed in a tank of water where it undergoes a test as specified by the National Board of Fire Underwriters in their code.

The test consists of placing the coil upon a reel. One wire from an 80-volt circuit is attached to the end of the coil and the other end of the 80-volt wire is held by the workman. The wire is made wet and wound upon another reel, the wire passing through workmen's hands. If the covering of the wire contains a puncture the workman through whose hands it is passing feels the electricity, and the puncture is repaired with more rubber.

After the wire has been thoroughly tested it is run through a braiding machine, where a cotton covering is put on. The braiding machine contains spools of cotton string placed vertically on a bed which revolves in a plane at right angles to the wire, the machine plaiting the braid as it is put on. Should two braids be required it must be run through two machines.

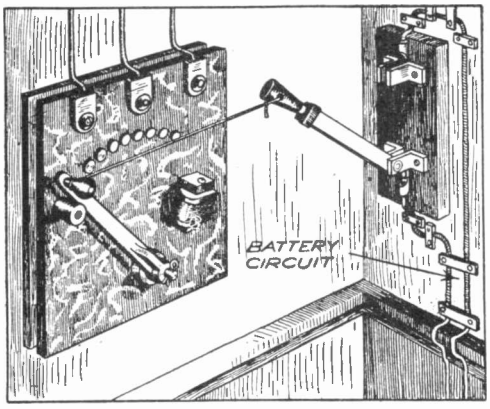
Between the first braid and the rubber is placed the trade mark of the manufacturer. This consists of threads of different colors, each manufacturer of course using his separate and distinct colors. These colored threads are also woven in by the braiding machine.

From the braiding machine the wire is passed through an insulating varnish, and after the varnish is dry it is then run through a wax bath, which gives it a slick polished surface.

The wire is then once more tested for breaks, tagged with the maker's name, size of the wire, number of braids and voltage. Paper or cloth is wrapped around the coil containing from 500 to 600 feet and then sent to the stock room where it is ready for sale.

Automatically Opening Battery Circuit

In charging storage batteries we use an electric motor to drive the charging generator. The simple arrangement shown is



AUTOMATICALLY OPENING BATTERY CIRCUIT

successfully employed to break the battery circuit when the motor circuit is interrupted at the power house or from other causes, thus avoiding a back flow of battery current through the generator.

A stout twine, of properly adjusted length, is used to connect the battery switch to the handle of the automatic-release motor starter. The fall of the handle opens the switch. C. K. THEOBALD.

Engineers' Problems Not All Solved in Books

The engineer in any field is constantly encountering problems that are not solved in books, but require a solution that necessitates head work and often the construction of apparatus quite original. Two such problems are here presented without going into things technical.

The question of wind pressure upon wires strung on poles has always been figured by assuming that the pressure due to wind on cylinders (wires) was one-half that on flat plates of equal area. The equipment shown in Fig. 1 was used by F. C. Platt, H. S. Lane and L. A. Kistler in testing wires of various diameters to find out more about wind pressure on wires. Two arms (AA) were secured to a shaft (B). Wires (WW) exactly alike were strung across and held by fine tie wires (T), then rotated by means of an electric motor. When a speed indicator showed a certain speed the

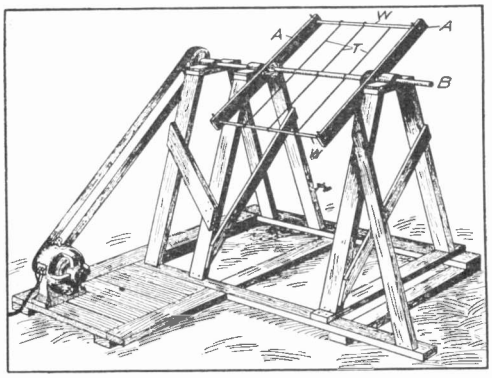


FIG. 1. TESTING WIND PRESSURE ON WIRES

belt of the motor was thrown off and the time taken for wind and friction to stop the apparatus. By applying mathematical formulas to these results and others obtained many important facts were deduced. For example: On No. 000 solid copper wire a wind velocity of 100 miles per hour gave a pressure of 20 pounds per square foot of exposed surface, but as the wires decreased in size the pressure increased, 35 pounds per square foot being the figures for No. 8 wire, which explains the trouble experienced in keeping telephone lines with long spans in condition. Further, cables were found to receive from 15 to 25 per cent more pressure per square foot than solid wires of the same diameter.

Fig. 2 shows a self-explanatory method, described in the *Telephone Engineer,* devised to determine the strength of telephone poles. With the far end of the pole securely

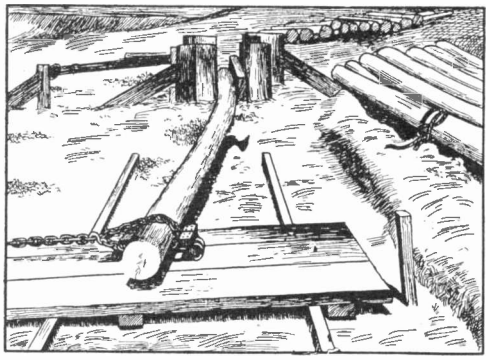
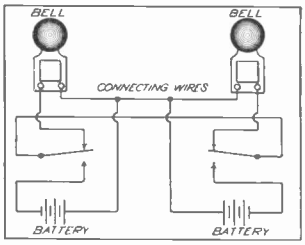


FIG. 2. TESTING STRENGTH OF TELEPHONE POLES

held between large posts set in the ground, and the near end resting on a set of rollers, the pole was bent by means of the chain while an instrument (dynamometer) measures the pull on the chain in pounds. In this way the number of pounds that will break the pole was found. Besides this, the way the pole goes to pieces under the strain tells the engineer a story. On certain poles it was found that the annual rings corresponding to each year's growth were not strongly bonded together, while some of the poles in breaking shattered by the formation of long troughs the whole length of the tree.

Return Call Bell Circuit

Having been often asked how to connect up a two-wire return call bell circuit I have found this diagram which is almost



RETURN CALL BELL CIRCUIT

self-explanatory easy to follow. Two sets of batteries are used and two double contact push buttons.

J. J. CARL.

Growing Use of the New Metals

Not so long ago such metals as tungsten, molybdenum, vanadium and uranium were so rare that the commercial world knew nothing about them, and as a rule only students were aware that they had been discovered. Few people ever saw boron, silicon, titanium, and chromium except in museums.

The cry for "more light" has been echoed around the world until cities now blaze at night with the glory of the noonday sun, and this has been made possible by some of these rare metals. So too automobiles owe their present perfection in part to the once rare metals that temper and toughen steel.

Until a comparatively short time ago these rare metals were left in the dump heap at the mines, being deemed not only valueless, but actually detrimental to the concentration of the ore which was considered of value. In Colorado the miners used to throw away what they called "black jack." Now that they know black jack to be wolframite, an ore of tungsten, they are carefully smelting the dump heaps, and tungsten forms a valuable branch of the mining industry.

In Cornwall, England, the miners found tungsten ore, but called it mock lead because of its high specific gravity, and they too left it in the dump. Upon learning the value of the stuff they are working over the refuse heaps to recover the valuable tungsten.

In 1842 this ore was found in Lane's mine at Trumbull, Connecticut, and, Eben Smith discovered it in 1876 in Colorado, but it is only within the decade that it has become of value commercially. In the summer of 1904 some prospectors working their way along through Okanogan County, Washington, with pick, shovel, drill and powder, staked a claim which abounded in a new ore that they believed to be filled with gold and silver. Much excited, they filled their pockets and hastened to an assayer in Loomis to secure an analysis.

When neither gold nor silver was found they gave up their claim. But the assayer noticed unfamiliar crystals in the ore and proceeded to investigate and found it impregnated with tungsten acid. When this fact became known there was soon a new industry for the region.

Tungsten is now in demand for incandescent lamp filaments. In the form of sodium tungstate a fireproofing of value is produced. Tungsten brought joy to the heart of the housewife in that it fixes dyes so that wash goods will wash. Silk merchants rejoiced for other tungsten salts added weight to silk.

Tungsten steel is extremely tough. Projectiles made from it have penetrated through fourteen inches of the best armor plate. Tungsten compass needles are the best on the market.

Tungsten ores have been melted in electric furnaces, but the problem now is to produce it by direct pig iron blast furnace smelting.

Tungsten is now mined in Arizona, California, Nevada, Montana, Idaho and Colorado, which produces 60 per cent of the output. The tungsten belt in Colorado is three miles long and eight miles wide. The market for tungsten has become almost as staple as that for copper, zinc and lead.

A possible rival of tungsten is molybdenum, a metal discovered in 1778, but as yet found in such scant quantities that the uncertainty of the supply makes it commercially second to tungsten.

Though tantalum has been known for a century, it was not commercially useful until Moissan in 1903 brought it into the limelight through the electric furnace. It is found in the Black Hills of Dakota, and its most important minerals are columbite and tanalite. A small quantity has been kept in this country for experimental work, but the yearly output, amounting to several tons, has been shipped to Germany.

The most important use to which tantalum is put is in the manufacture of filaments for incandescent lamps. They were put on the market in Germany in 1905 and in the United States in 1906. The tantalum lamp scores on these three points—high efficiency, ability to withstand high currents and whiteness of light.

Vanadium in small quantities is distributed in sandstones, limestones and igneous rocks. Its greatest value, when alloyed with iron as ferrovanadium, is in the making of steel. The automobile business has greatly increased the market for vanadium. The spars used in Sir Thomas

Lipton's racing yacht Shamrock III. were of vanadium steel and so were those on Emperor William's yacht Meteor.

Uranium, in many respects the most interesting of all the rare metals, was recognized as an element in 1782 by the chemist Klaproth, who named it after the planet Uranus. The chief ore of uranium is uraninite, commonly called pitchblende, and from pitchblende comes radium.

Uranium is found in Joachimsthal, Bohemia; in Saxony, Germany; in Cornwall, England, and in Gilpin County, Colorado, where it is said to have been discovered in 1878. Its uses are not many. Two of its oxides produce pure black glaze for porcelain and some of its salts are used in photography. It is a steel hardener, but is in no way superior to vanadium, chromium, nickel or tungsten. In the manufacture of incandescent gas mantles its presence is said to improve the properties of thorium, cerium and zirconium salts, applied for the same. The entire production of the world at the present time amounts to only about 300 tons of ore, yielding from three to thirteen per cent of the metal.

To Detect Changes of Speed

Engines used in electric lighting are required to run with great regularity. An interesting device for detecting, with extreme accuracy, any change of speed in such an engine has been employed in a New Jersey factory.

Two metal plates are pierced with corresponding slits and placed one in front of the other so that, when the slits are in line, the spokes of the fly-wheel of the engine can be seen passing them. One of the plates is caused to oscillate, by means of an electro-magnet, at such a rate that the two slits are in line every time a spoke is passing.

If there are six spokes in the wheel, and the wheel turns at the rate of 400 times a minute, the movable slit must oscillate 2400 times in a minute. If the speed of the engines is perfectly regular, a spoke will always be seen directly in line with the slits; if the speed varies the spoke will appear ahead or behind its proper place, according as the rate of the wheel's revolution is increased or diminished.

Combined Call Bell and Burglar Alarm

The device here described proved its efficiency by making it necessary for one party to think it over and tell the judge why he disturbed this alarm in attempting to enter a store protected by it.

The owner of the store lives next door, a fifteen foot alley between the store and

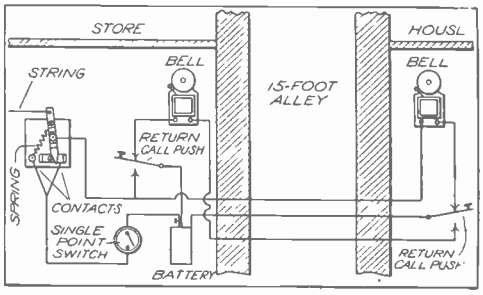


FIG. 1. CALL BELL AND BURGLAR ALARM

house making this part of the wiring for the alarm device simple. The diagram, Fig. 1, is almost self-explanatory. By opening the single-point switch the burglar alarm cir-

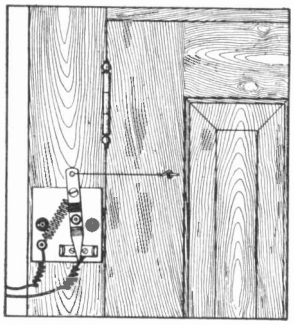


FIG. 2. ATTACHMENT OF SWITCH TO DOOR

cuit is cut out but the bells are still operative between the store and house as a call and return bell system from the same bat-

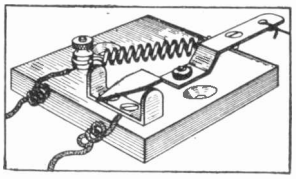


FIG. 3. SWITCH

tery. At night the single-point switch is closed and the "trap" set. A string from the spring-controlled arm holds the arm midway between the two contact points. If

the string is fastened to the door as in Fig. 2 and the door be opened or the string pulled or broken the pointer closes the circuit and rings the bells. The string may be run across the inside of doorways or across a stairway with the same result that if pulled or cut the bell will ring until the pointer is restored to a middle position or the switch opened.

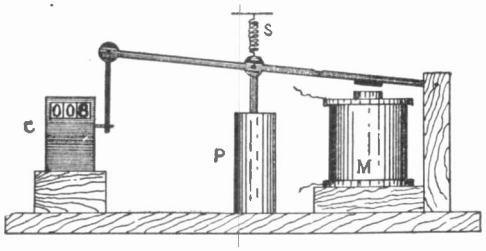
Fig. 3 shows a closer view of the "trap." This system has been installed for more than a year and operates most satisfactorily as previously explained. J. M. B.

Telephone Bell or Door Bell—Which?

If your door bell has a tone like that of the telephone bell, you have no doubt resorted to the common practice of stuffing one or the other with paper. A much more satisfactory way of causing them to have a different tone is to saw into one side of one of them with a hacksaw. This bell will then sound loud and clear as before and at the same time different from the other, and mistakes as to which is ringing will not occur. J. R. STIMSON.

An Electric Counting Machine

An eight-station electric counting device was recently made at home and installed in the office of a box factory. This apparatus, one station of which is shown and described, is operated from push buttons located at various machines throughout the mill. This enables the office force to keep track of the



ELECTRIC COUNTING MACHINE

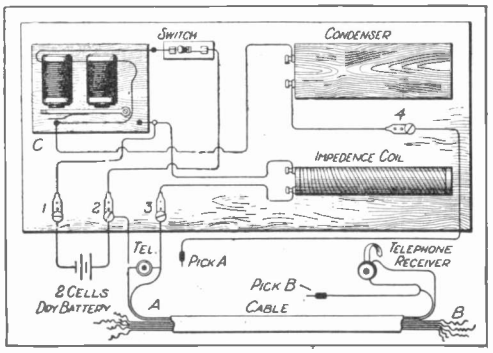
daily output, for when a completed article or a certain part of an article is finished at a machine the operator pushes a button and causes the counter in the office to register.

Current from a battery of six dry cells magnetizes the electro-magnet (M) when the machinist pushes the button. This lowers the lever through a distance necessary to operate the mechanical counter (C). These counters are to be had at small cost from dealers in printing machinery. A bicycle pump (P) cut in two and re-bottomed, serves as a cushion for the fall of the lever, while a spring of suitable tension lifts the lever to its raised position.

CHAS. K. THEOBALD.

Tone Test for Telephone Cables

The following is a description of a tone test equipment for service in testing out telephone cables. The material for it can



TONE TEST FOR TELEPHONE CABLE

be obtained at almost any electric shop. There is necessary: One five-ohm buzzer, one one-half microfarad condenser, one 100-ohm impedance coil, one small single pole switch, and four small binding posts.

Mount these on a board as in the illustration, and connect the condenser to the insulated contact (C) on the buzzer. The other side of the condenser goes to binding post (4). When the cable tester at (A) places his "pick" on a wire, the tester at (B) then proceeds to find that wire by running his pick over the bare ends. When he hits the right wire both testers hear a buzz in their receivers, caused by static, picked up from the buzzer by the condenser. A then tells B to tag this wire No. 1. A is in constant communication with B, as the impedance coil prevents the buzzer from interfering with the talking circuit. A single pole switch is cut in on the buzzer circuit in order to stop the buzzer when not in use. Two dry cells will last a very long time on a set of this kind. Be sure and have pick at (B) connected to that side of telephone circuit connected to post (3). PARNELL SCANLAN.

Popular Electricity Wireless Club

The Wireless Telegraph Automobile

By WALDON FAWCETT

Probably the most spectacular electrical novelty of the year is a new type of military motor known as a wireless telegraph automobile. This may be described as a wireless telegraph station on wheels with all the facilities for establishing communication at any time of the day or night, almost literally at a moment's notice. The military signal corps officers of the United States have within the past few years experimented in the use of motor cars as portable telegraph and telephone stations (making use of wires laid on the ground or erected on trees or poles). But in this instance the motor vehicle has been designed primarily as a movable base of wireless communication in the field during military operations. The new wireless telegraph auto is the invention of Major R. P. Davidson of the Northwestern Military Academy who has had the coöperation of Lieut. F. L. Beals of the United States Army but no patents have been taken out and the first act of the inventors after the initial car was completed was to demonstrate it before high officials of the U. S. War Department and offer Uncle Sam the benefit of any of the ideas embodied.

In the wireless telegraph car, as in the case of so many automobiles for special service, the basis of the design is a stock or standard pattern of high-grade touring car. In this case there has been employed a 30-horsepower motor car with detachable tonneau which has made it easy to fit the special body, leaving seats at the front of the car as usual and which in this car are assigned to the driver and the officer in command of the squad operating the car. The special tonneau fitted has long seats on either side, the six occupants of which face one another and these seats are elevated, affording storage space below for the entire wireless equipment and a truly astonishing amount of miscellaneous supplies, as will be explained later.

However, the really notable feature which renders the exterior appearance of the car distinctive is the telescopic wireless mast which is of light but staunch steel construction in eight sections nesting into one another with admirable economy of space. With the new telegraph car in touring rig only the basic or socket section of the collapsible mast appears, standing upright in the center of the tonneau, but upon command only a very few minutes is required for two men to elevate the telescopic mast to a height of about 50 feet, carrying the antennae of the wireless, while other cadets or enlisted men secure in position in the field the guy wires which brace the mast. A peep into the capacious locker or compartment of the car discloses an ingenious substitute for the telescopic mast as a means of carrying the antennae aloft. This alternative is a balloon of a size that can be quickly inflated and may prove serviceable when, for any reason the mast cannot be used or when it is desired to secure greater height for the antennae in order to telegraph a longer distance. That this latter is not likely to be a contingency of frequent occurrence, however, may be surmised from the fact that during the tests that have been carried on within the past few weeks wireless communication has repeatedly been carried on over distances ranging from 35 to 50 miles, using the regular "knock down" mast.

Purely from an electrical standpoint perhaps the most interesting feature of the new wireless car is the installation whereby the gasoline motor of the automobile is

employed to generate electricity for the wireless, for illuminating purposes, etc. The auto carries a Delco motor generator, —a combined lighting, ignition and starting set, weighing 67 pounds and of the differential wound constant voltage type. It is direct connected to the pump shaft for illumination, ignition, and the wireless, and when used for starting is disconnected and geared to the fly wheel. There is a special magneto and a twelve-cell Exide battery connected up in four sets of three cells for lighting and twelve cells in series for starting.

The electrical illuminating feature of the wireless telegraph car is not the least of its novel attributes and renders it a sort of nomadic power house that supplies light-

SIGNALING WITH A SEARCHLIGHT

WIRELESS FIELD SET READY FOR ACTION

ing current not only for touring at night but also for camp routine and for wireless work after nightfall, when conditions are notoriously most auspicious for this form of communication. The car carries three six candlepower lamps for use as side and rear lights and in addition there are two twenty candlepower tungsten headlights and a powerful electric searchlight. On one of the two wireless cars thus far constructed the searchlight is equipped with shutters for heliograph signaling thus giving this versatile type of car yet another communicative asset.

It is the expectation of the inventors that one of the principal uses for such a car in military operations would be as a mobile station for receiving wireless reports from aeroplanists scouting high in the air. At the same time it might be possible, under such circumstances that the wireless squad would want to resent interference close at hand by a hostile aircraft. To meet this contingency each of the new wireless cars mounts, forward, close beside the searchlight, a Colt "needle gun" or rapid-fire gun capable of firing 480 shots per second and so pivoted as to permit it to be trained at any angle. It might appear as though all this was considerable to carry on a motor car of 116 inches wheel base and yet that does not tell the full story. In addition the auto has snugly stowed away a Marconi portable wireless set of the latest approved pattern; a complement of shelter tents; cooking outfit; a set of emergency tools and utensils such as axe, shovel, etc.; blankets and bedding; and three days' rations for the members of the squad that man the car.

A significant circumstance is that this new wireless auto is not an invention on paper. Not only have the two cars of the type thus far built been demonstrated at Uncle Sam's new Army Aviation Field at College Park, Md., but they have been subjected to all the varied exactions embraced in a tour of upward of 3,000 miles in the course of which the autos were experimentally operated on a number of the battlefields of the Civil War. The wireless equipment "stood up" admirably under all sorts of weather and road conditions and communication was repeatedly established between the two cars when separated by distances of 30 to 40 miles.

Legal Rights of Wireless Companies

The legal rights of wireless companies are soon to be tested in California to decide whether aerograms may be made public by amateurs or other unauthorized persons, or whether they are entitled to the same protection that the law gives to messages transmitted by telegraph or telephone wires. The circumstances which brought about this test case are unusual and interesting, involving the publishers of the leading newspapers of Los Angeles, the Commercial Wireless Company operating between that city and Catalina Island and a couple of schoolboys who own a private equipment which intercepted a certain business communication.

The newspaper situation in Los Angeles is rather strained just at present, in fact there is a very lively newspaper war going on between Mr. E. T. Earl, proprietor of the Express and the Tribune, on one side and the publishers of the Examiner, Times and Herald on the other. The Times is owned by General Harrison G. Otis and according to Mr. Earl, the Herald is not only owned but controlled by that same individual, although it advocates policies diametrically opposed to General Otis's attitude. The message which caused the impending legal battle was sent through the Examiner's wireless office and addressed to the manager of the Herald, who was on a pleasure trip to Avalon, Santa Catalina Island. It read as follows:

"Note—To F. S. Peard, Avalon:

"General suggests that we make reproduction of Examiner Earl expose in Herald in morning. Suggestion sounds good to me, and will follow it unless you wire to the contrary. Both phone ordinances passed by Council and signed by Mayor this afternoon. Now is the opportune time for reprint. (Signed) WEBB."

This aerogram, signed by the managing editor of the Herald, was received by a schoolboy, who caught the significance of it and its value to Mr. Earl. After consulting with a couple of other wireless amateurs, he took it to the Tribune office and the following morning the message was printed in that paper with editorial comment to the effect that the aerogram conclusively proved that General Otis not only owned the Herald but dictated its editorial policy.

Steps were immediately taken to prosecute Mr. Earl for making public a message transmitted by a commercial wireless company, and on August 4th he was indicted by the grand jury under the following section of the code:

"Sec. 619. DISCLOSING CONTENTS OF TELEGRAPHIC OR TELEPHONIC MESSAGES. Every person who wilfully discloses the contents of a telegraphic or telephonic message, or any part thereof, addressed to another person, without the permission of such person, unless directed so to do by the lawful order of a court, is punishable by imprisonment in the state prison not exceeding five years, or in the county jail not exceeding one year, or by fine not exceeding five thousand dollars, or by both fine and imprisonment."

The schoolboys who received the message were not indicted, as Mr. Earl assumed the full responsibility for the act. The defense made by his papers is indicated in this extract from an Express editorial following the indictment of its publisher. It reads:

"Does the United Wireless Company own the air? When did it acquire that monopoly? When the operator at the Examiner station flung his message into the air, he then and there disclosed its contents to all who chose to read it and had the facilities."

The papers which are opposing him claim, on the other hand, that the business of the wireless companies is jeopardized by the unauthorized disclosure of its aerograms, and state that the case will be vigorously prosecuted. It will be followed with interest by all who are interested in wireless, either professionally or as amateurs.

C. L. EDHOLM.

Wireless Transformer Data

These data on transformers were compiled with the assumption that the builder would use average care in making his transformer. If the winding is not carefully done, more wire may be required than specified in the table. The transformers are designed to operate on 100 to 120 volts, 60 cycle alternating current.

In these transformers the secondary is on one leg and the primary on the other. The legs on which the windings are to be placed are those denoted by (B) in the tables. The letter (C) in the table denotes one side of the core. All cores are square. For example, in the 100-watt transformer the core is 1 1-2 inches square. Fibre separators are used between the secondary sections of the thickness specified in (N).

Before attempting to build a transformer we suggest that the amateur read carefully descriptions of such apparatus by Mr. Morgan in the September, 1909, December, 1910, and January, 1911, issues.

TABLE OF TRANSFORMER DATA

WATTS	100	250	500	750	1000	1500	2000
A	9	9½	9½	9½	11	12	11
B	6½	7	7	7½	10	10	15
C	1½	1¾	1¾	1¾	2	2½	2½
D	16	12	14	13	6	5	4
E	5	5½	5½	5½	6½	8¼	8½
F	a 1/8	¼	¼	¼	¼	¼	¼
G	Empire Cloth						
H	16 D.C.C.	16 D.C.C.	14 D.C.C.	14 D.C.C.	12 D.C.C.	10 D.C.C.	8 D.C.C.
J	3½	4	5½	6	7	10	14
K	8	9	9	10	18	22	23
L	34 Enamel				32 Enamel		30 En'l
M	2½	2½	2½	2¾	5	5	9
N	⅛	⅛	⅛	⅛	¼	¼	¼
O	¼	¼	¼	¼	¼	¼	¼
P	7	7	7	8	10	10	16
Q	¼	¼	¼	¼	¼	¼	¼
R	Empire Cloth						

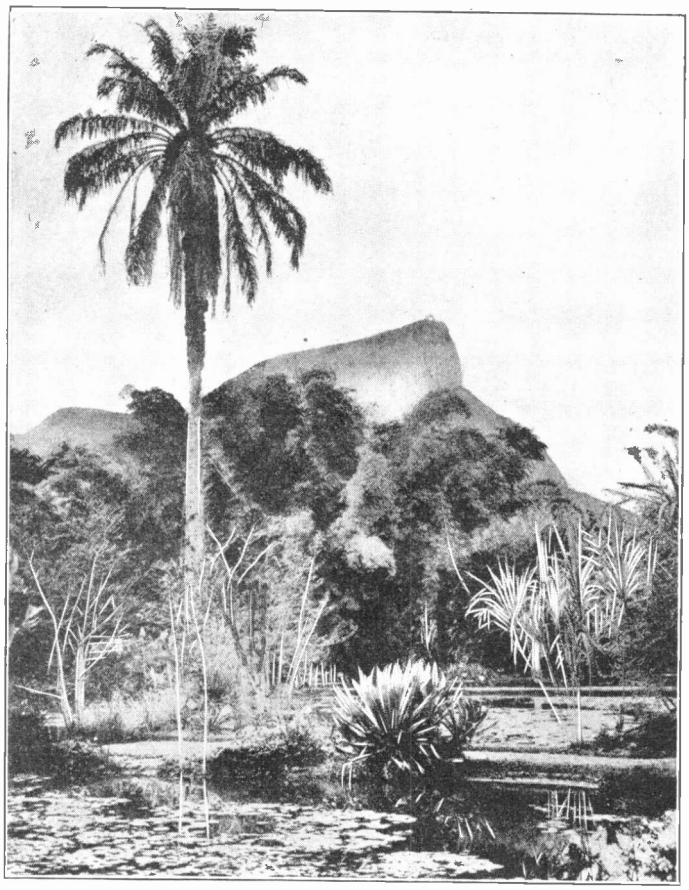
Key to Table

A—Length of Core (outside measurement).
B—Width of Core (outside measurement).
C—Thickness of Core.
D—Number of primary layers.
E—Width of secondary sections (each side).
F—Thickness of insulation between core and primary.
G—Kind of insulation between core and primary.
H—Size (B and S) primary wire.
J—Weight of primary wire.
K—Approximate number of pounds secondary wire.
L—Size (B and S) secondary wire.
M—Length of windings.
N—Thickness of separators for secondary sections.
O—Thickness of secondary sections.
P—Number of sections in secondary.
Q—Thickness of insulation between core and secondary.
R—Kind of insulation between core and secondary.

A. B. COLE.

Wireless in the Amazon Country

By J. M. MERCER



By far the most interesting phase of wireless work in South America is found in the Amazon Valley. Over this mighty stream, from the upper reaches of the Rio Negro and Rio Madeira, through the Tunguragua and Ucayli to the city of Para, at the mouth of the Tocantins, extends a complete wireless system.

River travelers have grown accustomed to seeing the cable ship Viking scooting up and down the river or at work repairing the submarine cable and making tests at anchor. Owing to the river changing its course from time to time, and also to the immense amount of sediment carried by it, communication by means of this cable has been hindered and at times completely interrupted for months. This district is the source of the rubber supply of the world, and therefore the necessity of reliable telegraphic communication from the up-river districts to Para as a shipping center is readily apparent. The general dissatisfaction expressed over the cable service led to the inception of the wireless idea, which has today developed into one of the most successful installations in the world.

Concessions for commercial work were granted to the Amazon Wireless Telephone and Telegraph Company over six years ago.

Contracts were drawn with the old International Wireless Instrument Company for radio-telegraphic communication between Para and Manaos, a distance of 740 miles. Of course, at that time wireless equipment was nowhere near its present stage of development, but allowance being made for the cruder forms of apparatus, some good work was done, though finally given up.

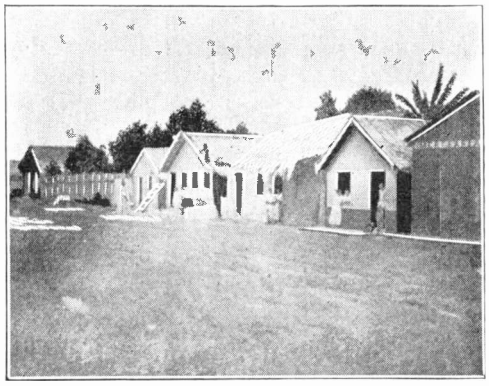
The Fessenden system was next tried, and engineers of that company succeeded in obtaining signals over dense forests and jungles at a distance of 150 miles with a one-kilowatt set. However, it has remained for the Telefunken Company, taking advantage of earlier investigation, to install the successful system. This company now has three stations on the Amazon, at Para, Santerem and Manaos. Construction work is also being extended into the rubber estates of Itatuba, Itacotiara and Ananaz. As these stations represent the most advanced ideas in design of wireless work, a glance inside one of them may prove interesting. Starting from the market place in Para we take a car and pay 200 reis (six and two-thirds cents). We accept our receipt for same with the gravity of demeanor necessary in all dealings with the people of this race. After having receipts punched by another official and waiting several times for power to return to our vehicle, we reach our destination. Several corrugated iron buildings and two tall masts with their intervening antenna wires meet the eye, and the chug-chug of the 40-horsepower engine is heard. Upon entering the operating room an amazing array of switchboards, transformers, condensers and induction coils is presented. This is a station of the high-frequency or "skeeter-spark" type, and uses a quenched gap. Over in one corner is the operating table, and there we see a slim, brown-skinned native operator. These operators were secured from the government land lines and as all land wire-work in Brazil is done by Morse recorder and tape, it was necessary to teach them the wireless system of sound reading by rigging up a buzzer, battery and key on a table and sending newspaper articles to them several hours per day. All telegraph work in South America is operated in Continental code, and the American Morse code is to them a marvel of speed, as they only work a maximum of fourteen or fifteen words per minute. Twenty-four hour service will very likely be maintained, using three operators. Messages are accepted in Para at the present rate of 2,400 reis per word (80 cents) and are sent to the station by land wire and thence to Manaos, relayed through Santarem.

The farther up the river one goes the higher up the scale goes the thermometer, until 130 to 140 degrees is not uncommon. The average wireless man in the United States can conceive the difficulties of working in this torrid climate and over swamp land, by trying to work, for instance, on the Great Lakes in August, when the "static" rolls in continually and messages must be repeated over and over. Make a comparison of temperature, take away the clarifying effects of water, substitute dense jungle for flat prairie, add an electrical storm or two per day, and you have a fair idea of the obstacles to overcome when working in the tropics. However, all this has been met and conquered after many instances like the following: One day in May notice was received at Para that Santerem would be ready to test at 8 a. m. the following day and to alternate transmitting and tuning at five-minute intervals. The station crew was there early and waiting, and promptly at 8 o'clock the following was sent from Para:

Hr. Pa oc gm ga tst, which translated means, "Here is Para," "oc," etc., being code for 8 a. m., good morning, go ahead, test. No answer. And for two long days and part of the night we disturbed the atmosphere with wailing calls for SA to get on the job. SA, SA, SA, PA, Ans, pls ga. After 30 hours of this a little weak string of dots and dashes came ticking in our phones, but too faint to be readable through the heavy static.

We answered at once and told them to put on more power and decrease their wave lengths. We were then using 4,000 meters. More turning of condensers and tuning of variometers; no answer. Next day, however, they were good and strong, and through communication was once more established.

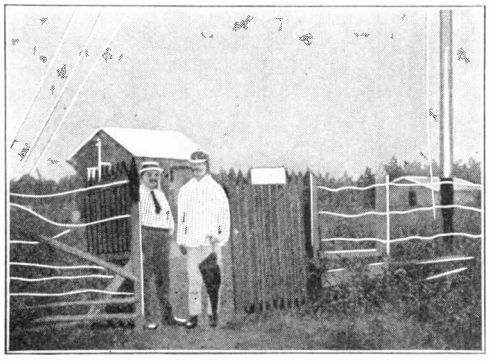
The native people regard the "Telegrapho sem fio" as the most wonderful and fearful thing on earth, and it is more awe-inspiring to them than the Pororoca, the tidal wave which rushes up the river with every



STREET IN THE NATIVE QUARTER OF PARA

full moon with such force as to raise the water level almost 30 feet.

One evening about 9 o'clock one of the antenna leads became loose and "sparked off" onto the iron roof, a distance of about six or seven inches, and really did make a fearful racket, which could be heard for some distance into the surrounding jungle. Everybody from the nearest native quarter immediately took to the tallest of the tall timbers, banana trees in this case, together



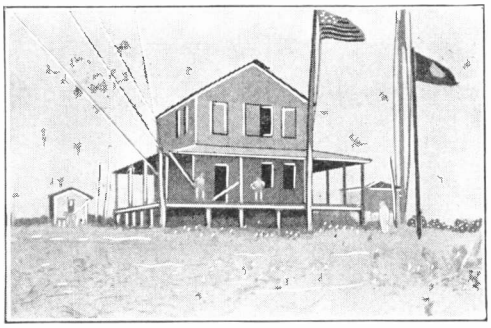
THE WIRELESS STATION AT PARA

with monkeys, parrots and hogs, all in one wild scramble for safety. The operator on duty at the time showed unusual self-possession for one of his race, merely muttering "O Diable," and cutting out the key circuit.

They are becoming accustomed to it, however, and the business element is now realizing the utility of a prompt, reliable wireless service, and that it is a commercial asset.

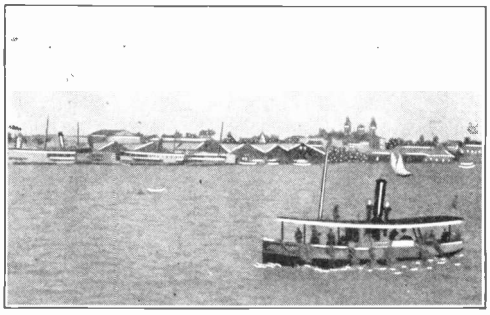
The Brazilian and Peruvian governments have combined to form a coast-to-coast wireless transmission, using Para, Santerem and Manaos stations of the Amazon Company, and from Manaos to Porto Velho the Marconi stations owned by the Maderia-Mamoré Railroad. From there to the present station at Lima by government-owned stations of the Telefunken system. At this writing construction engineers of that company are at work in the State of Iquitos installing several high-power sets for this service, and in a short time through communication will be a reality.

Two years ago the Marconi Company erected two 75-kilowatt stations for the M. M. R. R. Co. Using a high power, they are enabled to work direct from Manaos to



SANTEREM STATION IN PROCESS OF CONSTRUCTION

San Antonio or Porto Velho, and handle about 500 words daily. Recently this service was made commercial, and now private messages can be sent far up the Madeira River. The railroad company publishes a weekly paper in Porto Velho, called the "Porto Velho Marconigram," containing various bits of news that have drifted in from the outside world via wireless. This is sent out along the river to the different camps and distributed among the American railway engineers and construction men em-



LOOKING AT PARA FROM A BOAT ON THE AMAZON

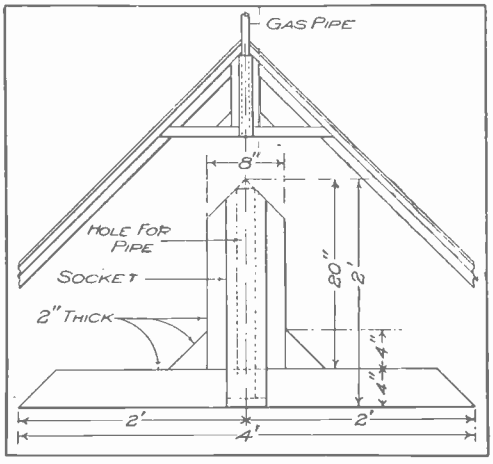
ployed by the company. It is highly valued and is read and re-read many times. A tale runs that once as mail was being unloaded from a boat to a camp the allotment of Marconigrams fell overboard and was snapped up by a ten-foot alligator. Everyone acting on a common impulse immediately started on a still hunt for 'gator meat. Consequently there was an abundance of hide on the market for some months, but they recovered the papers in good condition.

On returning to the United States on any steamer from South America the spirit of gaiety increases as the distance from New York decreases, and usually the wireless man has his hands full and working overtime to handle the messages that the boys are sending home while at sea.

The operator himself can well share in this, as it is a great big burden lifted when he can throw his Portuguese-English dictionary into the bunk, and to hear some friendly operator along the coast say, "73 om. Bring along any cigarettes?"

Pipe Support on a House

The amateur of today when searching for a suitable place for this aerial pole realizes



SUPPORT FOR PIPE AERIAL

the advantage of putting it on a housetop. When the roof is flat it is comparatively easy but with a peaked roof the problem is more difficult. The writer solved the problem in the following way:

A frame as shown in the drawing was made of two-inch material. The angles are given for a roof which is half pitch. If the roof is a different pitch, the angles will be greater or smaller as the case may be.

The writer has a soft pine frame of the dimensions given supporting an eighteen foot length of ¾-inch gas pipe and it would support even more. However if the size of the pipe is greatly increased the dimensions of the frame will have to be increased accordingly. The socket should be attached with screws.

To prevent the pipe from rusting it should be thoroughly cleaned and enameled. After being painted this makes a strong but not unsightly support. MARK A. FRANKLIN.

Queries Department to be Discontinued

After this issue the Wireless Queries Department will be discontinued. The reasons for taking this step are fully set forth in a statement made in the Questions and Answers Department of this issue.

Free Messages on the High Seas

On June 14th last the steamer Lake Champlain of the Canadian Pacific lines had a new demonstration presented to it of a way wireless might be put to use out on the high seas at no expense to the user.

Away out off Cape Race a little schooner, the Neptune, from Scandinavia, bound for St. John's with a cargo of salt, was encountered flying signals of distress. Of course the law of the seas provides that the next approaching vessel shall stop and render assistance in such cases, and so the proud Champlain, already sadly behind her schedule, halted to aid the skipper. Coming within hailing distance, however, and asking what was desired the distressed ones really had no answer to make. One fisherman sat on deck calmly smoking his pipe, without apparent concern. In fact, it soon proved there was really nothing amiss.

Here, however, is the crux in the matter. The Champlain must report the delay to her owners by wireless. It would at once appear in the naval or marine intelligence that the ship Neptune had been encountered in such and such latitude and longitude on the sea. The friends of the Neptune's skipper had been advised to watch for such reports and so, at no cost to either skipper or themselves would find out just where, on the seas, their friends were.

Questions and Answers

Questions and Answers Department to Be Discontinued

After this issue the Questions and Answers Department will be discontinued. There are several reasons why this step has been taken. In the first place, the service which we have heretofore been giving absolutely free to our readers has become so burdensome and costly that we cannot continue it longer without slighting some other part of the magazine. Letters come into this office literally by the hundreds every month. Only a few get into print, the rest we have answered by mail or else turned over to experts outside of the office, to be answered, all at a great deal of expense. We believe that this time and money can be more advantageously expended in making a better magazine.

We may say also that this step has been made necessary largely by a number of thoughtless ones who have used the department beyond all reason.

Of course it is our desire to make friends for the magazine, and we have always looked upon the Questions and Answers Department as working toward that end, but there is a limit to all things, and too many of our readers have not recognized that limit.

In the future we will answer questions that are sent in, but a charge must be made for the service, which will be quoted to the questioner upon receipt of his letter.

Chatterton's Compound

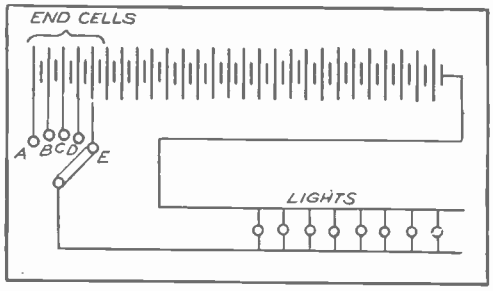
Question.—What is Chatterton's compound?—P. F., San Francisco, Calif.

Answer.—This compound is a cement used for cementing together layers or sheets of gutta percha, and for like purposes in splicing telegraph cables. The formula is: Stockholm tar, one part; resin, one part; gutta percha, three parts. Measure parts by weight.

End Cells

Question.—Referring to a storage battery, what is meant by "end cells?"—C. J., Tipton, Ind.

Answer.—The diagram gives the location of the end cells and end cell switch of a storage battery. When a battery is fully charged its voltage per cell is around 2.05. A 110-volt circuit would then require 53 cells in series and fully charged to give the proper pressure. As the battery discharges the voltage per cell when the battery is nearly exhausted is about 1.8. To



BATTERY END CELLS

provide 110 volts from the battery now would require 61 cells. Consequently, by installing 61 cells of which eight are arranged so that one cell after another may be added as the battery discharges the voltage on the mains is kept constant. Devices called end cell switches, which operate either automatically or manually, are provided to move over contacts E, D, C, B, A.

Strength of Solenoid

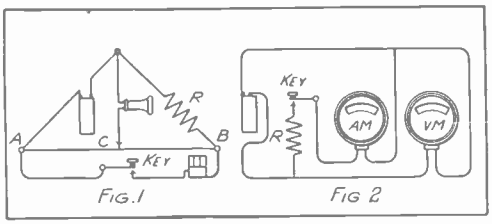
Question.—Upon what does the strength of a solenoid depend?—J. H., Hazelton, Pa.

Answer.—In general the strength of a solenoid depends upon the number of turns of wire, upon the closeness of this wire to the plunger, upon the number of amperes sent through the coil, and upon the position and length of the plunger in the coil.

Measuring the Internal Resistance of a Battery Cell

Question.—Will you please tell me how to find the internal resistance of a battery cell.—H. S. M., Astoria, N. Y.

Answer.—One method of doing this is to arrange the cell, a telephone receiver, a hand generator, key, a known resistance, (R) and a 30-inch length of German silver wire, as shown in the diagram, Fig. 1. The



MEASURING RESISTANCE OF BATTERY CELL

whole forms a sort of Wheatstone bridge with a telephone receiver in place of the galvanometer, and the generator for testing current. Slide contact (C) along the wire until a point is reached where no sound is heard in the receiver. Then if the German silver wire has been set off into resistance divisions on a scale under it the resistance of the cell may be found, as with a Wheatstone bridge. That is:

$$\frac{CA}{CB} = \frac{X}{R} \text{ or}$$

$$X = \frac{CA \times R}{CB}$$

where all resistances are known except X, the resistance of the cell.

A second method, Fig. 2, requires a voltmeter and ammeter. Connect up as shown and read the voltage, calling this V. Now close the key and read both the ammeter and voltmeter, calling the ammeter reading A, and the voltmeter reading V_1. The resistance, X, of the battery, is:

$$X = \frac{V - V_1}{A}$$

Rolling Transpositions

Questions.—(A) In cutting rolling transpositions into a telephone circuit, is it essential that they be turned or rolled in one direction? (B) If two or more circuits are on the same pole must they be turned the same way?—J. A. H., Salem, W. Va.

Answers.—(A) No. (B) No.

Rectified Voltage; Transposition on Telephone Lines

Questions.—(A) What is the highest voltage advisable to put on the rectifier described in the July, 1911, issue? (B) Why do the wires of a telephone line have the relative positions of the wires changed (on some lines) about every half mile?—J. B., Selma, Calif.

Answers.—(A) 220 volts. (B) Fig. 1 shows the effect of a nearby telephone or electric light wire upon a grounded tele-

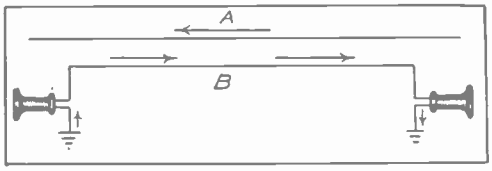


FIG. 1. UNTRANSPOSED LINE

phone circuit. Wire (A) induces in circuit (B) a current in the opposite direction, as indicated by the arrows. If (A) is an electric light wire a noisy telephone circuit results. If (A) is a telephone wire cross-talk is heard on the telephone circuit (B).

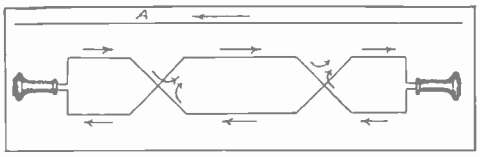


FIG. 2. TRANSPOSED LINE

To rid the telephone circuit of these troubles a metallic line may be used and at intervals transposed, Fig. 2. The induced currents will then neutralize each other.

Transformer Voltages

Question.—In transformers for wireless purposes, what are the most generally used secondary voltages?—R. I. C., Holyoke, Mass.

Answer.—One-quarter K. W., 6,000; one-half K. W., 10,000; one K. W., 20,000; two K. W., 30,000.

Science for Its Own Sake

Sir James Dewar recently pointed out that the whole cost of a century's research of experiments at the Royal Institution, London, has been only about $600,000. What an insignificant sum to pay for the benefits mankind has received from the splendid investigations of Young, Davy, Faraday, Tyndall, Dewar himself, and others, comments the *London Times*.

Royalties and License Fees—(Concluded)

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

TERMINATION OF LICENSE.—*By Expiration of Patent or Express Limitation.*—A license under a patent expires with the patent, or by its own limitation where its duration is expressly limited.

REVOCATION, RESCISSION, OR FORFEITURE. —*In General.*—A license under a patent which has been acted on by both parties cannot be rescinded or revoked by either party of his own volition, in the absence of express provision to that effect, but only by mutual agreement or by court decree.

EXPRESS PROVISION AS TO TERMINATION. —The right to terminate the license may be determined or affected by express stipulations in the contract. Thus, where the contract so provides, the licensee may terminate the license, and upon his giving notice to that effect to the licensor all his rights and obligations under the contract are at an end. But such notice must be clear and unequivocal. So also the licensor may reserve the right to cancel the license for breach of its conditions by the licensee.

BREACH OF COVENANT BY LICENSEE.—A mere failure of the licensee to pay the stipulated royalty or license fees, or to perform the other conditions of the contract, does not *ipso facto* work a forfeiture of the license. And in such case, in absence of special provisions on the subject in the contract, the licensor cannot maintain a bill in equity to annul the license, but must bring an action at law upon the contract. The parties may agree that in the case of default by the licensee in making payment, the licensor may terminate the license by giving notice to the licensee to that effect, and such agreement will be enforced. But the licensor cannot annul the license for such default without giving the notice provided for. And such notice must be a clear and unequivocal revocation. Nor will the breach of covenant and notice of forfeiture *ipso facto* terminate the license. There must be a suit in equity for a rescission. If the licensee continues after default and notice to exercise the license, the licensor cannot sue him as an infringer, but must either bring an action at law on the contract for royalty, or sue in equity to have the license annulled. The reservation by the licensor of the right to revoke the license for nonpayment of royalties confers no rights upon the licensee, nor does it take away the licensor's common-law right to enforce the contract.

INFRINGEMENT BY LICENSEE.—An infringement by the licensee does not necessarily work a forfeiture of the license. But where the licensee at the same time assumes such a position of hostility to the patent as to amount to a repudiation of the license, he loses his rights under it. And an express condition that infringements shall terminate the license will be enforced, subject to any circumstances calling for equitable relief against forfeiture.

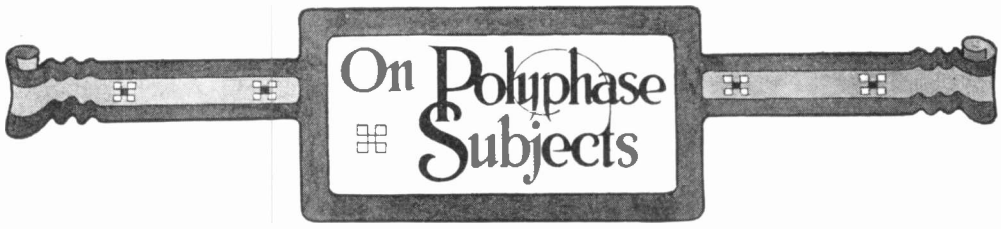
REPUDIATION BY LICENSEE.—The licensee may forfeit his rights under the license by an abandonment or renunciation of his contract. And where the licensee fails to pay the royalty provided for and repudiates the license, but continues to use the invention the licensor may sue either for the royalty or for infringement.

ASSIGNMENT BY LICENSEE.—An unauthorized assignment of a license by the licensee is a nullity, and will not work a forfeiture, unless the contract so provides.

WAIVER OF FORFEITURE.—The forfeiture of a license for breach of its conditions may be waived by the licensor, and such waiver constitutes a sufficient consideration for a promise to pay the royalties due.

DEATH OF LICENSEE.—A personal license expires with the death of the licensee, and does not pass to his representatives.

EFFECT OF TERMINATION.—Upon the termination of the license the rights and obligations of the licensee are, of course, at an end. Thus, he no longer has a right to use the licensor's name in connection with articles subsequently manufactured by him so as to lead the public to understand that they were made under the licensor's patent, and such use may be enjoined. And he is no longer estopped to deny the validity of the patent or the title of the licensor. If the licensee continues to use the patent after the termination of the license, he cannot be held liable for the royalties stipulated.



The Smallest of Projectiles

By the aid of an ingenious photographic device, the velocity with which molecules are shot off from metal electrodes when a spark from a Leyden jar is discharged through them has been very accurately measured.

The result of the French experiments along these lines shows that the average velocity, within one millimeter from the pole of the electrode, is at the rate of nearly one mile and a quarter per second, which is about three times the velocity of the modern rifled cannon projectile. Yet this immense velocity, in the case of the French experiments, fell off so rapidly that at a distance of four millimeters it was only one quarter of a mile per second. The velocity varies with different metals, and it is thought that further experiments in this regard may lead to important discoveries in spectrum analysis.

A Thin Walled Safety Vault

Are thick walls of extra hard steel really needed for the safety vaults of banks and other institutions? Many banks and safety deposit companies pride themselves on the enormous thickness of the walls in their vaults, a feature obtained only at great expense and one which still requires some signaling arrangement to insure real safety. For, no matter how thick and how difficult of penetration the walls may be, they will yield to the persistent attack of the burglar equipped with highly modern tools.

It is evident that the protection therefore lies partly in making the wall so difficult of penetration as to foil an amateur or a poorly equipped safe blower, but more so in having an electric signal system which will sound an alarm before the inner portion of the vault lining has been punctured by the burglar's tools.

Then if such an alarm system is needed anyhow, why spend a small fortune in adding layer after layer to the walls? Two Parisians, Branley & Laurent, believe that they have a much cheaper solution. They provide air spaces between the outer and inner layers of the vault and connect all of these air chambers to an air compressor and a sensitive pressure gauge. The air is pumped up to a pressure which will instantly force some of it out through even a small hole made in the outer casing of the vault.

As soon as this occurs, the needle of the pressure gauge moves back and closes an electric contact, setting off a series of alarm bells and signals. Of course the connections to the air pump are carefully concealed and protected by an additional electric alarm system which will scare and announce any one trying to tamper with the compressed air mechanism.

Newspapers Left on "L" Trains

An employe of the South Side elevated railroad, of Chicago, made the following statement recently: "Few people realize it, but the newspapers left on our elevated trains in one week will make a bundle weighing several hundred pounds. The papers are picked after each trip and deposited at one of the barns, and when several bales of paper are gathered they are sold and each man who assisted in gathering is given a proportion. During the early morning and evening rush hours is the time when we find the most papers, of course, but scarcely a male passenger gets on to ride any distance at any time in the day without a paper, and ordinarily he leaves it on the train. On the Englewood branch of this line my 'bit' for one month was over $8. A couple of crews usually get together after we sell the paper and we have a paper banquet."

A well-known ship owner tells the following story:

"Whenever I see a toothpick I think of a dinner that was given in Rome in honor of two Turkish noblemen.

"I sat beside the younger of the noblemen. He glittered with gold embroidery and great diamonds, but nevertheless I pitied him sincerely, for he was strange to our table manners, and some of his errors were both ludicrous and painful.

"Toward the dinner's end a servant extended to the young man a plate of toothpicks. He waved the plate away, saying in a low and bitter voice:

"'No, thank you; I have already eaten two of the accursed things, and I want no more.'"

* * *

Butcher—Twenty-eight cents a pound.

Mrs. Murphy—That's awful high. I guess that's the aviation meat Oi've been reading so mooch about.

* * *

Mrs. Cobb—Was the grocer's boy impudent to you again when you telephoned your order this morning?

Maid—Yas, Mrs. Cobb, he was that; but I fixed him this time. I sez, "Who the hell do you think you're talkin' to? This is Mrs. Cobb."

* * *

"I want a pair of button shoes for my wife."

"This way, sir. What kind do you wish, sir?"

"Doesn't matter—just so they don't button in the back."

* * *

A little city girl was visiting a friend in the suburbs, and was much impressed by the morning rush of her hostess's father for a certain train.

"Why does your papa go to town every day?" she at last inquired.

"So's to make enough money to sleep out here at night," was the unwittingly shrewd reply.

* * *

Mrs. Fly (buzzing angrily)—What do you mean by coming home in this condition?

Mr. Fly—Couldn't help it, m' dear. I shlipped and fell into a ghlass of beer.

* * *

Mrs. Hardapple—Zeke writes from college that since you called him down for spending so much money he is coming home in trepidation.

Mr. Hardapple (suspiciously) — Trepidation? What is that—one of these here new-fangled gasoline cars? Ain't the trains good enough for that boy?

* * *

An inquisitive purchaser in a Chicago candy store saw a sign on the telephone, "You may talk for five minutes."

"Why not three minutes?" he asked the clerk as she removed one chocolate drop permanently from the possibility of a sale.

"We let them talk five minutes," she replied, "because the longer they talk the more candy they see and the more candy they see the more they buy. It always works."

A drummer approached a girl in charge of a soda fountain and before giving his order asked: "How is the milkmaid tonight?"

"Milk isn't made; it comes from cows, you fool," was the retort. He was glad to close his mouth with some of it.

* * *

"Let me see some ladies' hosiery."

"For your wife or do you want something more expensive?"

* * *

The other-people's-business man persisted in trying to extract information from a prosperous looking elderly man next him in the Pullman smoker.

"How many people work in your office?" he asked.

"Oh," said the elderly man, getting up and throwing away his cigar. "I should say, at a rough guess, about two-thirds of them."

* * *

A man arrested for murder bribed an Irishman on the jury with a hundred dollars to hang out for a verdict of manslaughter. The jury were out a long time and finally came in with a verdict of manslaughter. The man rushed up to the Irish juror and said: "I'm obliged to you, my friend. Did you have a hard time?" "Yes," said the Irishman, "a h—ll of a time. The other eleven wanted to acquit yer."

* * *

"Will you please drive off the track?" asked the motorman. The truck driver promptly reined to one side.

"Thank you ever so much," added the motorman, with a smile.

"You're very welcome," responded the truck driver, "but you must pardon my seeming carelessness. I had no idea your car was so near."

* * *

Mrs. Newlywed (to clerk)—Have you any wax for polished floors?

Clerk—No, we have only sealing-wax.

Mrs. Newlywed—Well, that will do. If it's for the ceiling I suppose it will do for the floor just as well.

* * *

Physician—I shall have to forbid you smoking, drinking, playing billiards and keeping late hours.

Patient—Ah! I see my wife has been consulting you.

* * *

A woman rushed into a grocery store recently and demanded of the first clerk who greeted her:

"Please give me a mouse trap; I want to catch a car."

* * *

Teacher—Charles, tell what you know of the Mongolian race.

Charles—I wasn't there; I went to the ball game.

* * *

The Kansas editors are asking if to turn and stare at a harem skirt is one of the "breeches" of etiquette. Answer: It is, I "trow, sirs."


SOME MORE ODD USES FOR AN ELECTRIC FAN
TO KILL BUGS CATCH THEM AND POKE THEIR HEADS IN WHIRLIGIG
TO SLICE CUCUMBERS SEE SKETCH-
TO BEAT EGGS- WHIP CREAM ETC- PUT SAME IN TUB INSERT FAN - BLOOEY!
TO MAKE A FUNNY NOISE - POKE A LITTLE STICK IN THE FAN
TO RUN A BOAT- SEE DIAGRAM
ON HOT NIGHTS START FAN NEAR BED- TO GET RID OF LANGUID FEELING IN MORNING STICK TOE IN SAME -
CLARK DE BAL

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.

EQUALIZER.—A term applied to the wire connecting usually the positive brush of one compound wound generator to the positive brush of the next when these machines are operated in parallel. Should the voltage of one machine be lowered, current from the other machine will begin to flow through its fields, thereby raising the voltage and at the same time reducing its own until the voltage of both machines are again equal.

EQUIVALENT CONDUCTORS.—Conductors having the same resistance per unit of length.

ETHER.—A perfectly elastic medium which is said to fill all space, even a vacuum, and by which the theory of light is explained. Light is according to theory due to vibrations of the ether.

EXCHANGE.—A central office of a telephone system in which are installed switchboards, cords, plugs, etc., by means of which operators connect one subscriber with another. In an automatic telephone exchange cords, plugs, operators, etc., are dispensed with and connections are made by automatic devices operated by electromagnets.

EXCITER.—A direct current generator used to excite the field magnets of alternating current dynamos.

EXPLODER.—A small magneto used to generate a high electromotive force, employed in setting off charges of powder in blasting.

EXPLORING COIL.—A small flat coil used in connection with a telephone receiver to determine where lines of force are going astray and to carry on other investigations of the same nature.

EXTERNAL RESISTANCE.—The resistance of an electric circuit outside of the battery or generator.

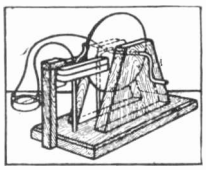
EXTRA CURRENT.—The rush of current due to induction following the sudden opening or closing of an electric circuit. This is marked at the contacts of the vibrator of an induction coil across which is usually bridged a condenser to take up this extra current.

F.—Abbreviation for Fahrenheit. For example: 20° F., means 20 degrees Fahrenheit.

FARAD.—The name applied to the unit of electric capacity. A condenser of one farad would be raised to a potential of one volt by a charge of one coulomb of electricity. As a farad condenser would be very large, the unit used in practice is one-millionth of a farad (micro-farad), and such a condenser contains about 3,600 square inches of tinfoil.

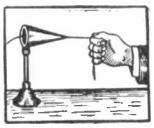
FARADAY'S DARK SPACE.—The space without glow between the electrodes in an exhausted tube.

FARADAY'S DISK.—Faraday placed a copper disk between the poles of a magnet and attached wires to a galvanometer. One of the galvanometer wires was connected to the shaft of the disk, the other being held against it. When the disk was revolved the galvanometer showed a current flowing. This was the first step to the building of the electric generator.



Faraday's Disk

FARADAY'S NET.—A conical linen gauze bag supported upon an insulated stand. The apex of the net has two silk threads attached to turn the bag inside out. Faraday used the bag to prove that electricity resides only upon the outside of a body, by charging the bag and testing with a proof-plane and electroscope inside the bag, then turning the bag inside out and testing the inside again. No electricity was found on the inside, while the outside in each case was charged. (See cut.)



Faraday's Net

FEEDER.—One of the conductors of a circuit running to a center of distribution where branch circuits are taken off. The term is sometimes applied to several parallel wires in a group running to the same point.

FIBRE.—An insulating material made of cellulose treated with a metallic chloride and possessing qualities making it suitable for use where the highest insulation is not necessary.

FIELD DENSITY.—The number of lines of force per square inch or square centimeter given out by a magnet.

FIELD MAGNET.—One of the magnets or poles of a dynamo or motor used to produce the field of lines in which the armature revolves.

FIELD OF FORCE.—The region in which lines of force from a magnet exert their influence. Also applied to the field of a statically charged body which attracts or repels other bodies. The pith ball experiment is a good example of the action of an electrostatic field of force.

FILAMENT.—The term applied to the thread-like material in the incandescent electric lamp. In the carbon lamp the basis of this filament is cotton fiber treated to remove the silicon and then carbonized. In the tungsten lamp finely powdered tungsten metal is mixed with a binding material, placed in a steel cylinder and with a pressure of 32,000 pounds per square inch the paste is squirted through a diamond die.

Pay 17 Cents a Day

and Own The Printype Oliver Typewriter

IMPORTANT: The introduction of the Printype Model came as the climax to our great advertising campaign in which we offered The Oliver Typewriter No. 5 on the 17-Cents-a-Day Purchase Plan. For months past we have devoted all our advertising announcements to the new Printype Oliver Typewriter, with its revolutionary improvement in typewriting type.

The impression has gained ground that the 17-Cents-a-Day Purchase Plan does not apply to the Printype Model. In some instances the idea prevails that we can even charge extra for The Oliver Typewriter equipped with Printype.

We desire to state with all possible emphasis that The Printype Oliver Typewriter can be purchased on the "17-Cents-a-Day" Plan at the regular price of $100.

The Machine That "Typewrites Print!"

America rings with praise for The Printype Oliver Typewriter—*the first writing machine that successfully TYPEWRITES PRINT!*

This remarkable machine combines all the operative conveniences, all the practical improvements of the most highly perfected typewriter, *with the type that from time immemorial has been used in magazines and books!*

It is infinitely superior to the old style, thin outline Pica typewriter type—a fact which none will deny. It ranks in importance with *visible writing*, which the Oliver introduced.

The preference of typewriter buyers is so overwhelmingly in favor of Printype that *already over 70 per cent of our total output are "Printypes."*

The advantages of Printype are *self-evident.* The story is told at a *glance.*

Its beauty, its symmetry, its clearness and *character* lend a new distinction to typewritten correspondence.

Printype Increases Speed

Not only does Printype enhance the artistic appearance of type written matter, but it enables the operator to attain greater *speed*, as the type is so easy on the eyes. It relieves the tension on the *nerves* and thus gives wings to the *fingers.*

Printype — OLIVER Typewriter

The Standard Visible Writer

With all its commanding advantages from a purely mechanical standpoint, and its new *artistic* triumph, its supremacy is unquestioned. Its simplicity, versatility and extreme durability all revolve around the great basic feature —*the Oliver Double Type-Bar.*

Without this Double Type-Bar the successful use of Printype would be absolutely impossible.

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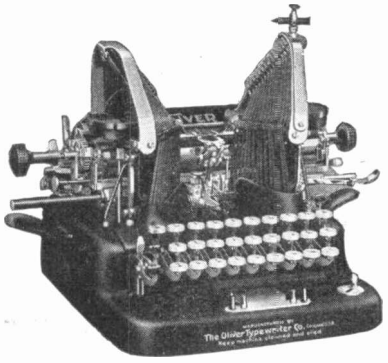
This machine—*The Printype Oliver Typewriter*—offered on the famous *"17-Cents-a-Day" Plan*—has all the improvements, all the exclusive features which our experts have developed. It has the Vertical and Horizontal Line-Ruling Device, the Disappearing Indicator, the Back-Spacer, the Tabulator, the Adjustable Paper Feed, the Double Release, the Automatic Spacer, the Locomotive Base and many other innovations which contribute to *high efficiency.* It operates with the lightest touch and, of course, *writes in sight.*



Why Don't You Write Us Today?

How can you resist the attractions of "Printype" and the appeal of the "Penny Plan?"

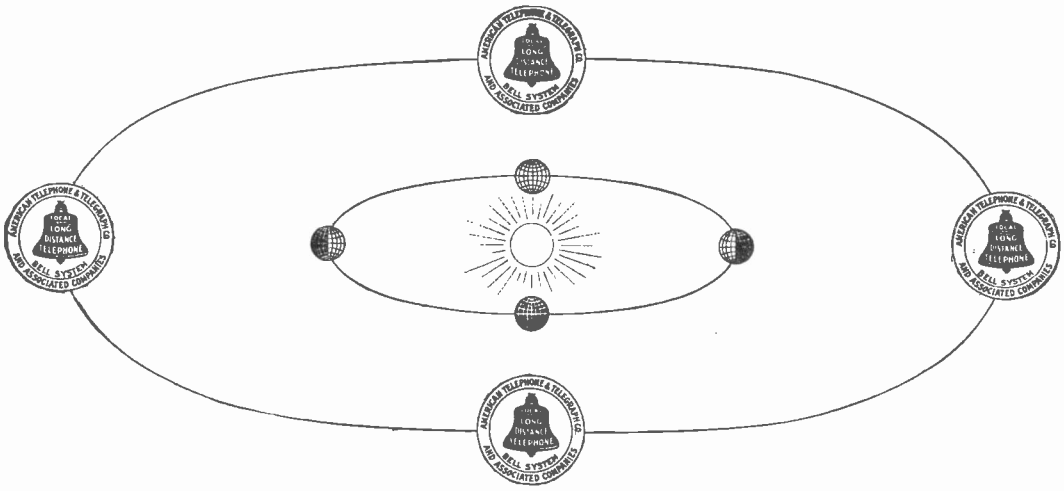
Here is the world's greatest writing machine—*The Printype Oliver Typewriter*—the standard visible writer—the regular $100 machine—*actually offered for pennies!*

A small first payment brings The Printype Oliver Typewriter. Then you save 17 cents a day and pay monthly.

Your request will bring the special Printype Catalog, the details of the Penny Plan and a letter *written in Printype.* Whether you are "Commander-in-Chief" of a business or a private in the ranks, you will be greatly interested in the literature we will send you. (128)

The Oliver Typewriter Company

798 Oliver Typewriter Bldg., Chicago Agencies Everywhere



Comparison of the Distance Traveled by Earth and Bell Telephone Messages

The Orbit of Universal Service

In one year the earth on its orbit around the sun travels 584,000,000 miles; in the same time telephone messages travel 23,600,000,000 miles over the pathways provided by the Bell system. That means that the 7,175,000,000 Bell conversations cover a distance forty times that traveled by the earth.

When it is considered that each telephone connection includes replies as well as messages, the mileage of talk becomes even greater.

These aggregate distances, which exceed in their total the limits of the Solar system, are actually confined within the boundaries of the United States. They show the progress that has been made towards universal service and the intensive intercommunication between 90,000,000 people.

No such mileage of talk could be possible in such a limited area were it not that each telephone is the center of one universal system.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY
AND ASSOCIATED COMPANIES

One Policy ***One System*** ***Universal Service***

"Driven by a Westinghouse Motor"—Be sure of that!

EVERY good vacuum cleaner—and there are many good ones—and sixty per cent. of *all* vacuum cleaners made in this country use Westinghouse Motors.

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The Westinghouse engineering reputation is known the world over. It is the brain back of the motor that makes it almost human in its ability to do the particular thing for which it was designed—and without using a cent's worth more power than is necessary to do it efficiently.

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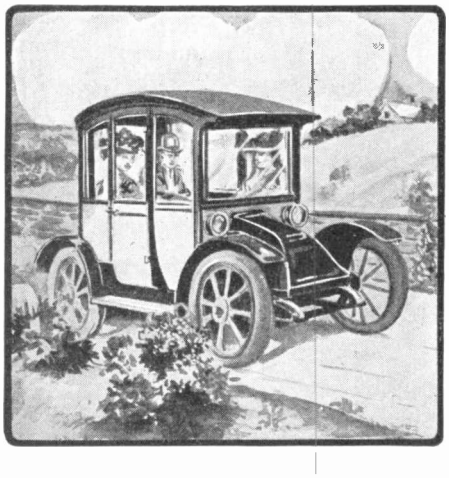

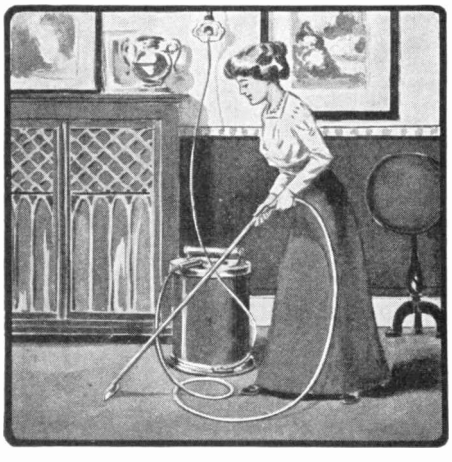

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$10.00 EACH FOR NAMES OF PERSONS interested in patents. For conditions, address P. O. Box 2343, Washington, D. C.

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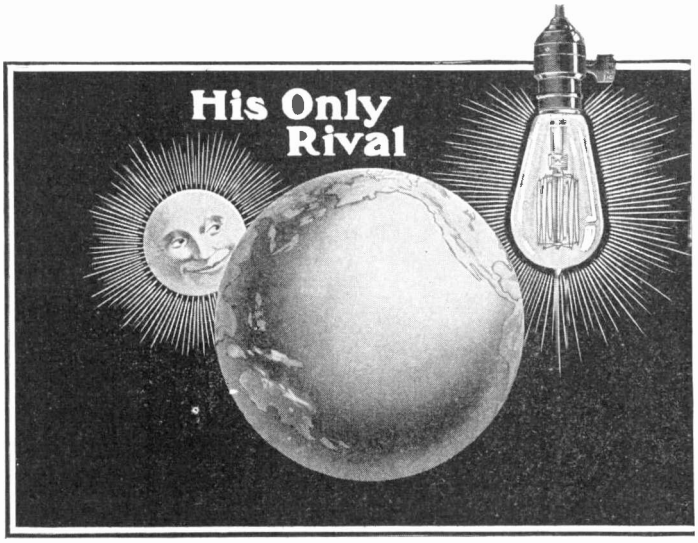

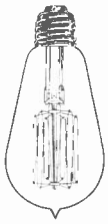

Latest Edison Mazda Lamp with Non-Fragile Filament

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When Edison invented the Electric incandescent lamp thousands journeyed to Menlo Park to see "the light that burned without air."

Edison put a little paper horseshoe filament, that he had carbonized, into a glass bulb and pumped out the air. Next he passed a current of electricity through this horseshoe.

The Dream

As it glowed white hot, lighting up the darkened room, another light glowed in his face, for he saw the revolution that tiny bulb would bring about in the world's sunless hours.

But the first lamps of 16 candlepower used up 100 watts of electricity.

Slowly, as improvements came, the amount of light was increased. Six years ago, people thought the limit was reached, for the close of the first quarter-century of Electric lighting was celebrated by the advent of the Edison Gem lamp. Using the same amount of electricity, it gave more than twice the light of that first wonderful lamp.

The Revolution

Suddenly another invention in electric lamps revealed the dawn of a new era in electric lighting—unseen in the dreams of anyone—except Edison.

This was the Tungsten filament lamp which—instead of the original 16 candlepower—or the fancied limit of 40 candlepower—gave actually 80 candles of light from the same 100 watts.

General Elec

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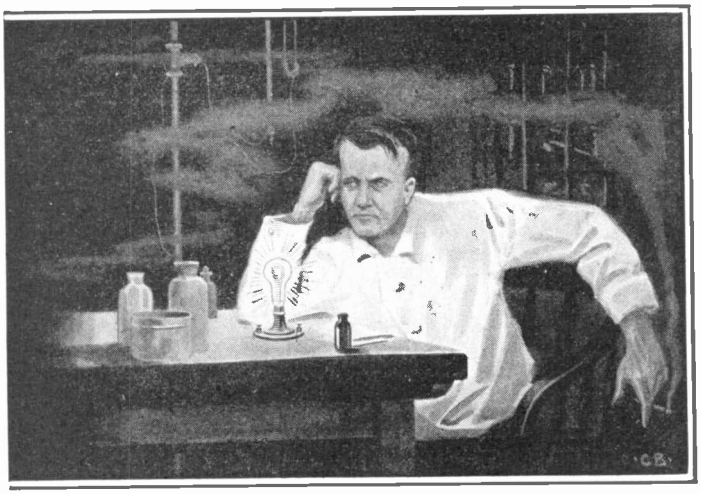

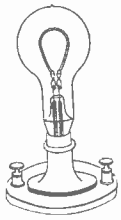

Edison's Original Lamp Invented 32 Years Ago

Comes True

This lamp almost materialized the Dream—but the filament was brittle—and the cost was high. Both these obstacles are now cleared away. First, a brilliant invention has resulted in the production of a drawn wire stronger than steel. This wire is used to make the filaments in Edison Mazda lamps.

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The Dream Comes True

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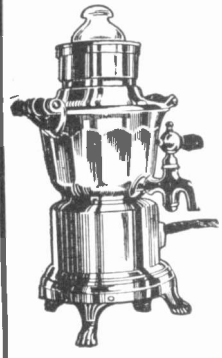

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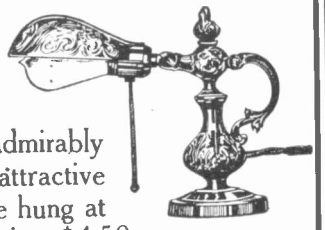
The Electric Coffee Percolator makes a pleasing addition to the table service because of its handsome appearance. There is no denying that the best means of cooking coffee to retain all its delicious taste and fragrant aroma, as well as to eliminate the unhealthful bitter essence, is with a percolator. And the Electric Percolator is the most convenient and desirable of any. We carry various makes and sizes at $12.50 and up.



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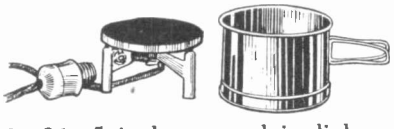

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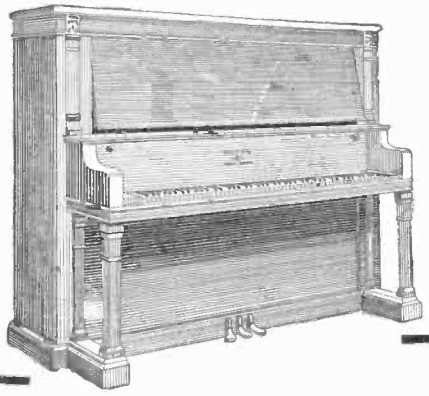

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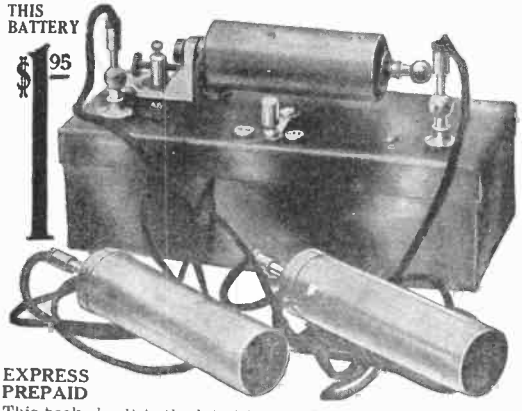

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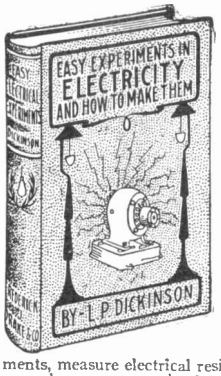

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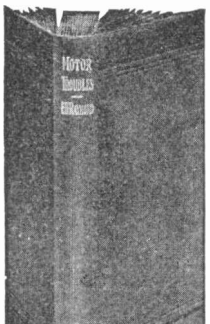

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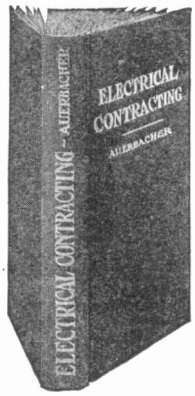

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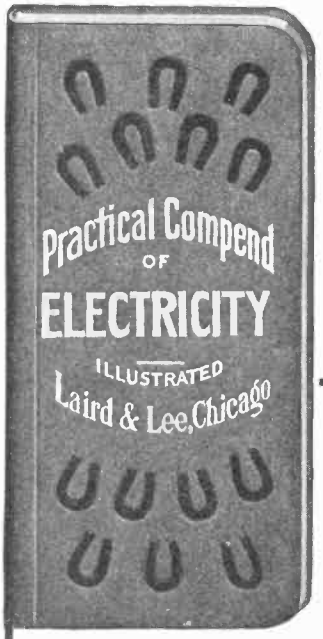

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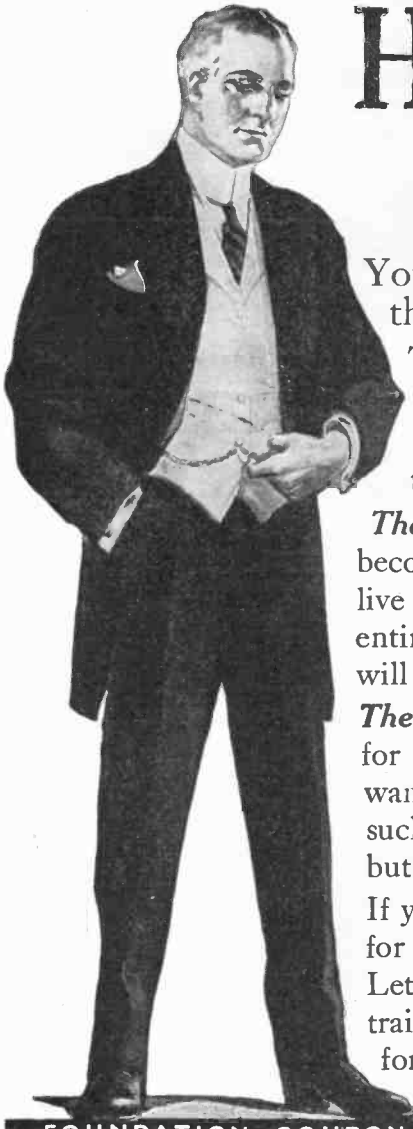

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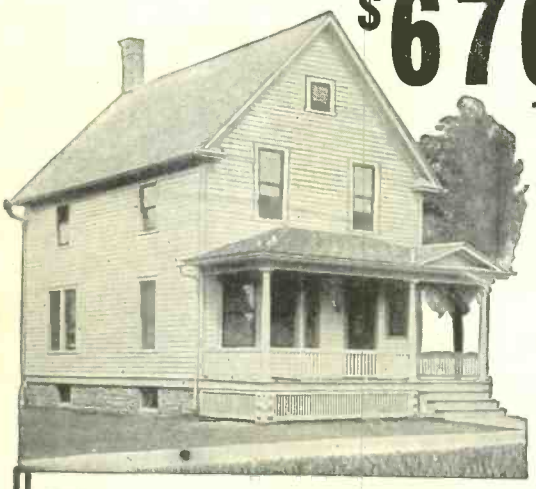

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