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Science and Invention

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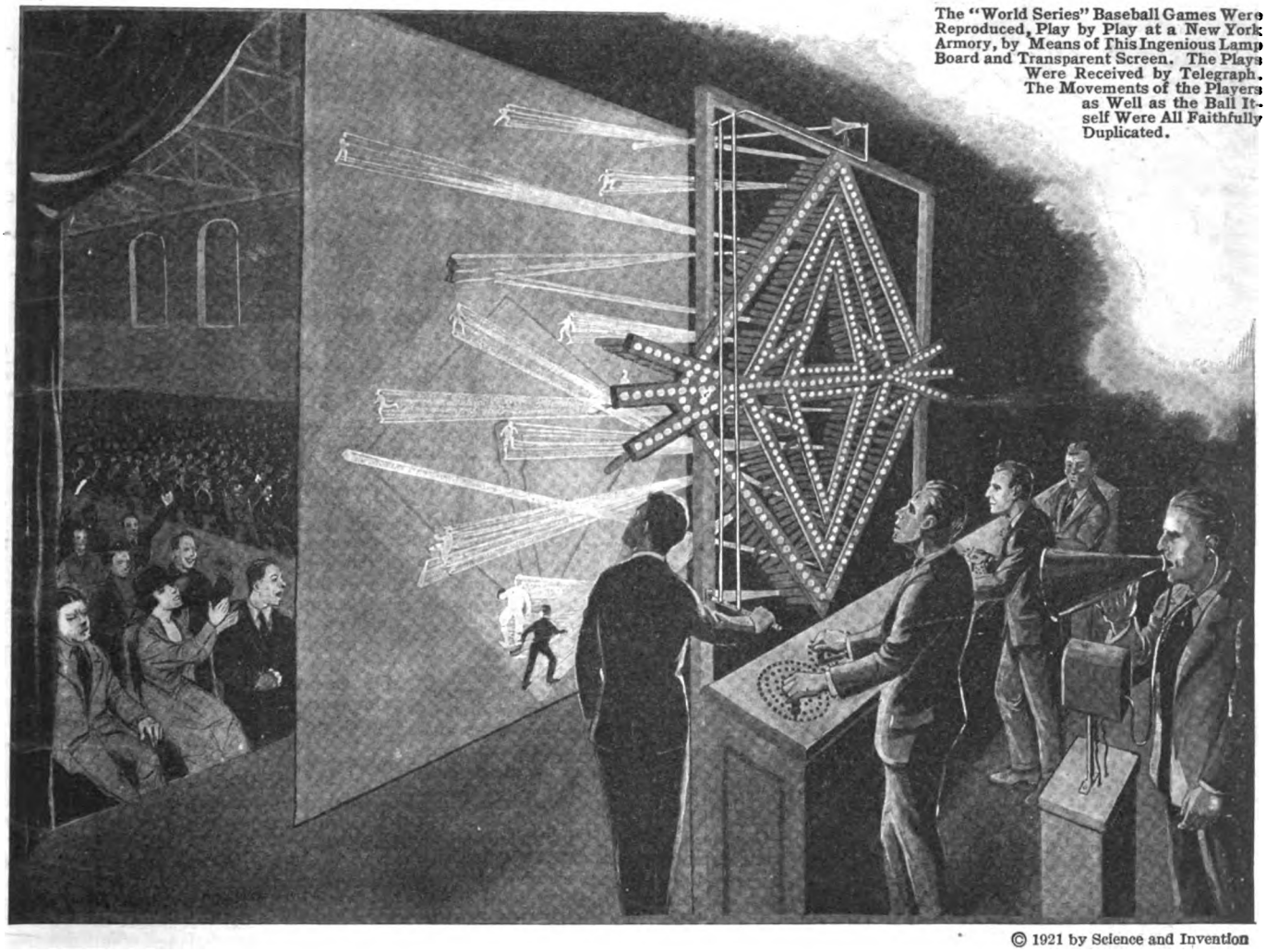
Baseball "Movie" Scoreboard

MOVING pictures flashed upon a screen without a moving picture projector. That would make a strange sub-title. Nevertheless such is the case and in New York thousands of people daily witnest the attempts of Mr. George S. Coleman and his assistants to mystify his audiences with actual motion pictures of the "World Series" baseball games conducted at the Polo Grounds. Each move of the players was telegraphed to the 12th Regiment Armory where this exhibition was conducted, and in turn, the instant it was received, it was flashed upon a screen about 12 ft. high. Viewing the game from the audience's point of view, we see a miniature replica of the baseball diamond. The pitcher is winding up. He makes a vigorous swing and the ball passes to the catcher. The outfielder is jumping up and down. With rapid passes, the ball is sent around to the bases and out to the center field and back again. Now an umpire walks over to take his place alongside of first base. Shortly thereafter the other umpires take their respective positions. The order is given to play ball and a player walks into the scene. He stoops down to pick up the bat and steps to the plate, the pitcher swings and the ball flies to the catcher. The umpire signals ball one. The ball wends its way over the plate again, strike one is signaled. Again the round sphere is tost. The batter makes a vigorous swing, a two base hit is the result. A second player steps to the bat, he is struck out. A third player—the man on second steals to third—this third player is struck out. The fourth one steps forward, he manages to reach first base, but the man on third could not get home, remaining safe on third. Still another player comes up to slug at the ball while word is past thru the audience, "Babe Ruth up." The ball, a beautiful curve, winds its way over the plate. Its gyrations are too wonderful to be true. Babe steps forward; the bat in his hands swings and a moment later the ball again enters the field of vision. Meanwhile Babe has completely circumnavigated the course allotted him and two runs are scored. He comes near home plate and one wonderful slide takes place whence he emerges from a cloud of dust and walks off the diamond.



The "World Series" Baseball Games Were Reproduced, Play by Play at a New York Armory, by Means of This Ingenious Lamp Board and Transparent Screen. The Plays Were Received by Telegraph. The Movements of the Players as Well as the Ball Itself Were All Faithfully Duplicated.

A word or two in regard to how this device functions. In back of the screen on an exceptionally large framework are arranged 600 electric light bulbs of the concentrated filament type. These are mounted in back of a similar number of

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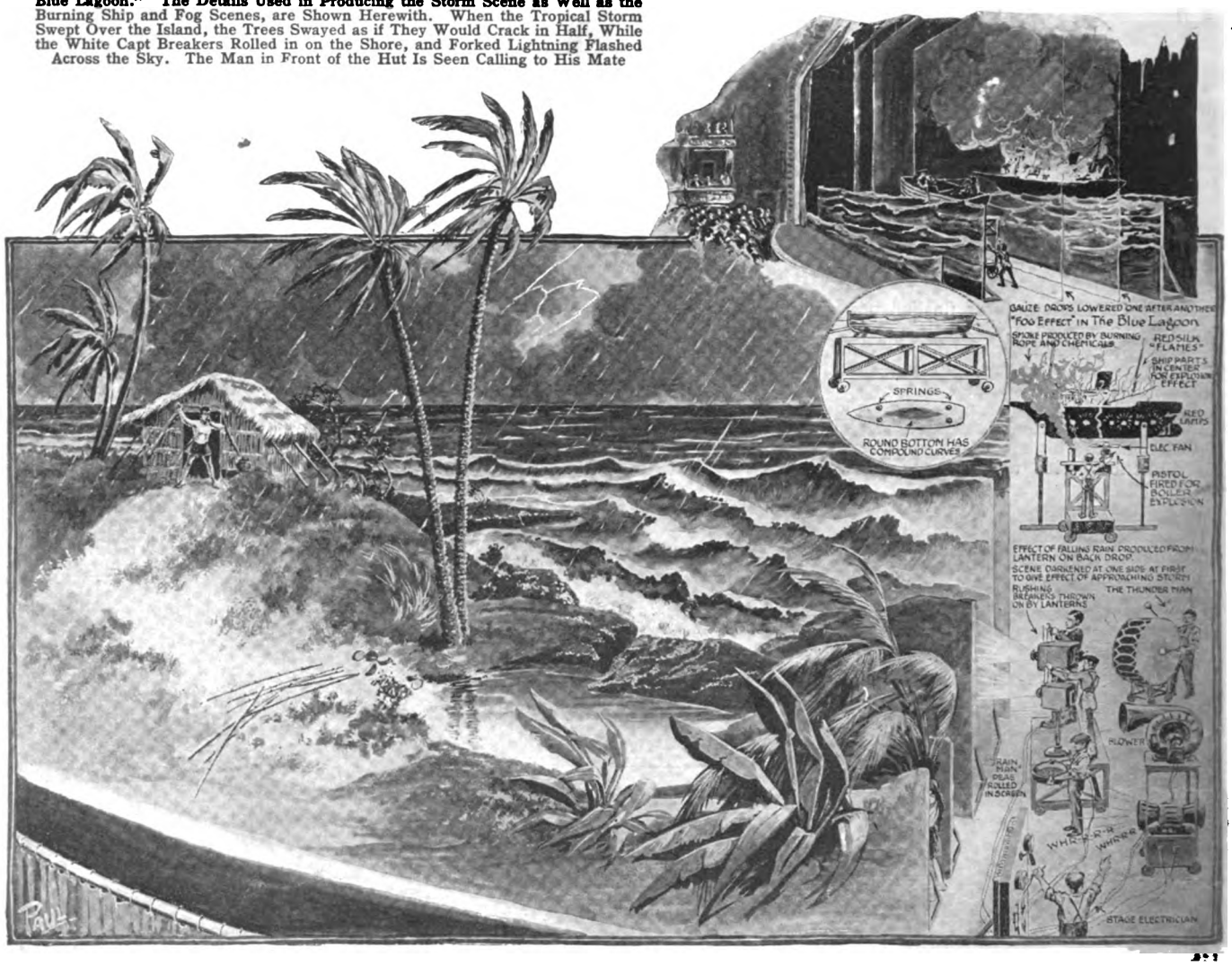
Realistic Storm in Stage Play

The Wonderful Tropical Storm Scene, as Well as the Fire at Sea, Illustrated Below, Were the Features of a Recent New York Stage Production Called "The Blue Lagoon." The Details Used in Producing the Storm Scene as Well as the Burning Ship and Fog Scenes, are Shown Herewith. When the Tropical Storm Swept Over the Island, the Trees Swayed as if They Would Crack in Half, While the White Capt Breakers Rolled in on the Shore, and Forked Lightning Flashed Across the Sky. The Man in Front of the Hut Is Seen Calling to His Mate



HOW would you like to be cast away on a South Sea Island together with a person of the opposite sex at the age of 12 years, and then suppose you both grew to manhood and womanhood without ever associating with other human beings? Romantic, isn't it? Suppose further that the girl, who had blossomed forth into young womanhood, was your cousin; would you marry her by the unwritten law? This and many other interesting situations arose in the recent New York production *The Blue Lagoon*. In the play the two cousins do marry and a child is born to them. Some of the most elaborate stage settings yet disclosed this season accompanied the presentation of the story.

There were many charming scenes on the little island known as the *Blue Lagoon*. In the first part of the story the scenes revolve around life on board an ocean liner. The boat takes fire and one of the very impressive scenes is that, where the ship is seen burning in the distance, while the two children, together with a sailor, one of the principal characters of the play, are adrift in a small boat which pitches and tosses in a most realistic manner. And not a drop of water was used in producing this ocean scene. The accompanying illustration shows how the boat was rocked by stage-hands behind the scenic settings, the bottom of the boat having a compound curve so that it could be rolled either sidewise or longitudinally. Substantial springs, resembling automobile shock absorbers, were mounted on four points about the bottom of the boat in the manner shown, to keep it in equilibrium when not rocked.

The ocean liner finally blows up and sinks and about this time a fog starts to settle on the waters. The fog effect, which proved very mysterious to the audience, was produced by lowering, one after another, curtains of thin gauze, so that eventually, when a number of these had descended, the striking effect of a thickening fog was obtained.

The successive scenes and incidents of the play portrayed the daily life on the island, including the unwelcome visit of a castaway, an English sailor, who, in his attempt to steal the young woman, is killed by her self-asserted husband. The moonlight scene on the island at night was one of the most beautiful imaginable, the water in the Lagoon wavering and flickering very entrancingly. A small pool of real water was arranged at one side of the stage setting, as the accompanying illustration shows. Stars twinkled in the sky—these were miniature electric lights blinked on and off intermittently.

The real big scene of this production was the storm on the island, which is shown in the illustration. The effect of the moaning of the wind was obtained by using large motor-driven sirens. As the sky was gradually darkened from one side of the scene by the electrician, who manipulated the necessary switches, the whirring sound of the wind increased. The speeding up of the sirens took care of this effect. Finally the trees and bushes began to sway, and particularly noticeable was the swaying of the two large palm trees in the central foreground. As the darkness of the storm scene increased, the rain began to fall and lightning and thunder began. The rain-effect was produced by white streaks painted on a revolving glass disk turned slowly in front of a projecting lantern, the moving white splotches giving the effect of falling rain when projected on the back scene drop. The noise of the rain was imitated by a man rolling dried peas in a wire screen sieve. In producing some of these effects several men were stationed about the stage in different positions, so as to distribute the sound and incidentally to give more volume to the total effect, operating the devices more vigorously as the storm increased in fury and reached a maximum of activity. The forked lightning observed in the sky from time to time is usually produced by uncovering a forked shape slit cut in the back scene drop. The palm trees and bushes were caused to sway more and more as the wind and fury

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A Ship That Steers Itself

MANY times this question comes strongly to our minds, "Has Germany been asleep during the period of the great conflict?" To those uninitiated the answer would undoubtedly be, "Of course, we do not see many German products upon American markets at the present time, and the old slogan 'made in Germany' is seldom heard."

Last month, however, the German steamship *Hansa,* of the Hamburg-American Line docked at New York and an investigation of her automatic helmsman disclosed many novel features. The photograph and diagram show the ingenious gyroscopic steering device.

The *Hansa* was formerly the German steamship *Deutschland,* and during the war was converted into a private yacht. It is now operating again in its former capacity, but has been completely remodeled.

At the extreme left in the pilot's cabin, is a gyroscopic compass, which is controlled by a master compass located below decks. Mounted upon this pilot compass and free to rotate by means of a small gear, is a needle-like pointer. This pointer is set to the particular direction which the vessel is to pursue, and remains in that position unless the pilot decides to change the vessel's course. Thus, the pilot may set the needle pointer so as to read due east, and accordingly the rudder of the vessel will be turned to such an angle until the vessel is traveling due east, when it straightens and for each slight variation or change in the direction, it again swerves to rectify the error and keep the vessel along a perfect due east course. In order to determine whether or not there is anything wrong with the apparatus, the pilot looks at the scale marked 1 to 9. This scale, shown at the right of the wheel, indicates that the rudder has been turned. He then glances at the revolution recorder which indicates whether or not the propeller of the vessel is actually turning. He knows definitely that he is safe to proceed on his course, using the gyro-compass as the pilot if both gages give the correct indications.

Encased in the bottom of this compass is an electric motor which communicates by means of a chain and sprocket drive with the pilot wheel. Immediately in front of the pilot wheel is another gyro-compass and back of it is the ordinary

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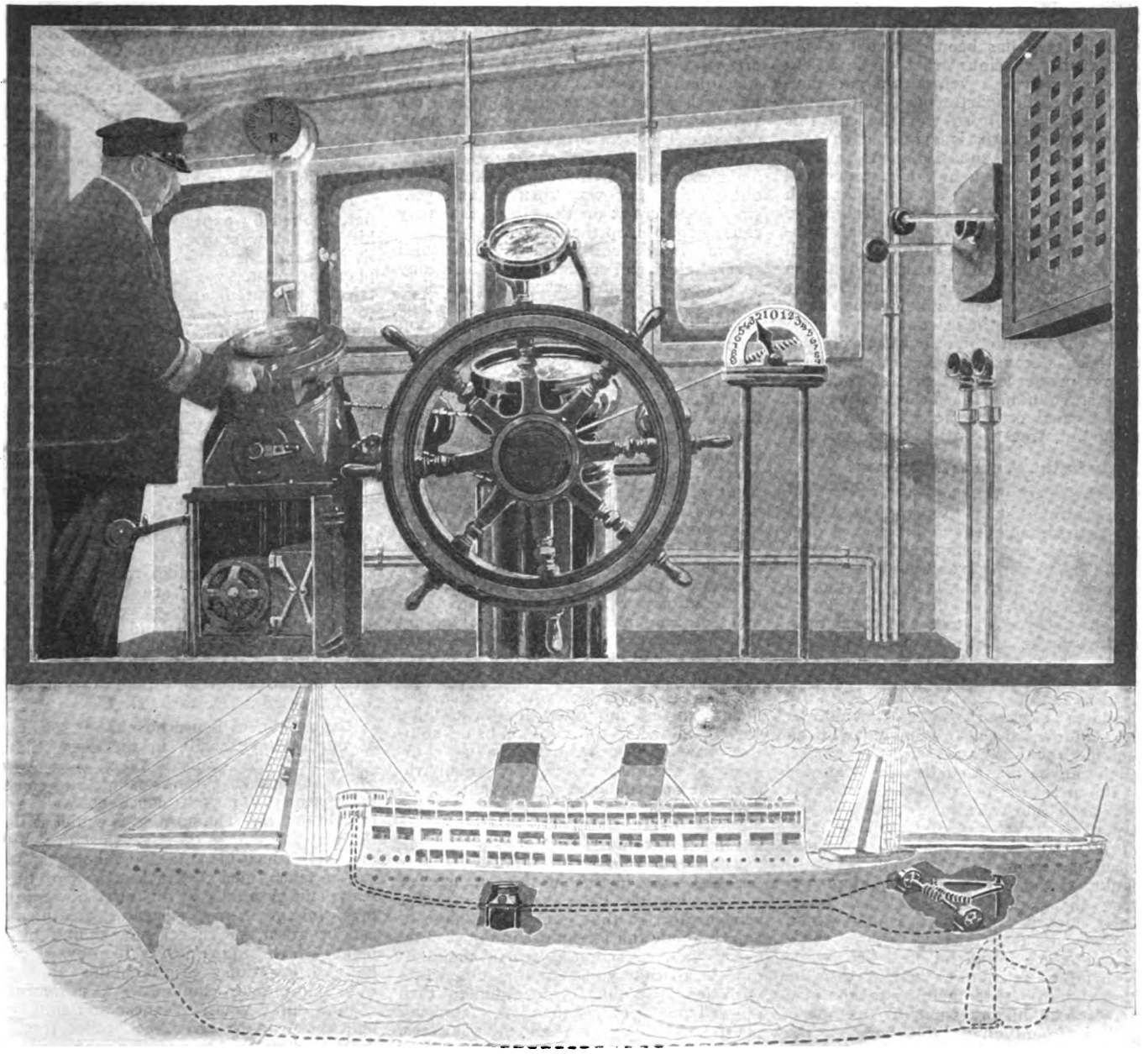


The Interior of the Pilot's Cabin on the German Steamship "Hansa." Note How the Gyroscopic Steering Device Connects to the Steering Wheel by Means of a Chain and Sprocket Drive. The Fire Annunciator Can be Seen in This Photograph as Well as Various Other Necessary Instruments, the Use of Which is Described in the Accompanying Article. The Drawing Below Shows the Location of the Master Compass, the Gyroscopic Compass in the Cabin, and the Steering Motors Connected to the Rudder.

Science in New Apartment House De Luxe

A Wonder Apartment for the City Dweller, with Lakes, Tennis Courts and Sunken Gardens

IN Cleveland, Ohio, there is a remarkable apartment house built somewhat on the style of a modern hotel, which is the envy of all apartment dwellers, who have seen it. The cooking is done in a centralized kitchen for all the apartments, the soiled dishes are washed in one of the kitchen departments, and each apartment has an ice box supplied thru cooling pipes from the basement. The present illustration shows some of the features of this modern apartment house de luxe, and also some of the newest ideas suggested for a gigantic apartment dwelling, which it is proposed to build in New York City. The architects and engineers, who have designed this beautiful city dwelling, have thoroly worked out their plans so as to provide a very spacious court-yard covering several city blocks, while the building itself has been designed to run around this spacious tract of land. In this way excellent ventilation and daylight for all the apartments is obtainable. The court-yard, if so we may call this spacious enclosure, is arranged to contain tennis and squash courts, a lake suitable for boating in the summer and skating in the winter, shady walks with flowers, bushes, and shrubs, leading to a large sunken garden, besides a swimming pool, a baseball diamond, as well as sufficient area for small gardens, so that Mr. and Mrs. Apartment Dweller may have fresh radishes and lettuce right out of the garden in season.

But the architectual features do not stop here, because the present plans include a proposed moat or wall, such as those surrounding the old feudal castles, with a canal or channel of water separating the street from the court-yard.

A Day in the Wonder Apartment of Tomorrow

You awake in the morning and find that considerable snow has fallen over night. Funny, you think, that the room should be so comfortable and not freezing cold, but the automatic thermostat connected to the radiator hidden in the wall, has served to keep the room temperature up to a suitable point thru the night. There is no ice on the outer window or storm sash, due to the fact that air at a suitable temperature constantly circulates between the two windows. The windows are also provided with an electric opening and closing device, which can be operated from the bedside by the pressure of a button. It is as quiet as if one were in a tomb, yes one may sleep very peacefully without hearing any noises thru partitions, floors, or ceilings, from adjacent apartments,—thanks to the cork and felt linings between the floors, partitions, and walls, which absorb any sound which would otherwise be transmitted. Handy reading lamps are found on each bed, while a portable telephone which can be plugged into a receptacle by means of a flexible cord in any room of the apartment, is found on a table between the beds.

Every five-room apartment has one bathroom, while eight- to ten-room apartments have two bathrooms. Hot and cold water is supplied to each bathroom, as well as iced and ozonated drinking water, which is therefore, thoroly germ-proof besides having a sparkle all its own. Of course all the usual electrical conveniences, such as curling irons, et cetera, are provided in the bedroom, or these may be used in the bathroom, when plugged into receptacles provided for the purpose.

When we come to the dining room, we are agreeably surprised at the absence of cooking odors, always so noticeable in the average small size city apartment. An electric ozone generator fitted in the wall and covered by a small grill, has obliterated any odors. You step to the telephone in the hall, or perhaps you have already 'phoned from your bedroom upon arising, and order your breakfast from the central kitchen in the basement. At the appointed time your dumbwaiter alarm sounds and you pass thru the electrically operated swinging door into the kitchenette, shown in the plan view of the apartment herewith. By pressing a button with your foot as you approach the swinging door from either side, the door, operated by electro-magnets under the floor, opens just ahead of you, so that the maid can carry a trayful of dishes without picking her way thru it, and possibly get a crack on the elbow that may cause her to drop the dishes.

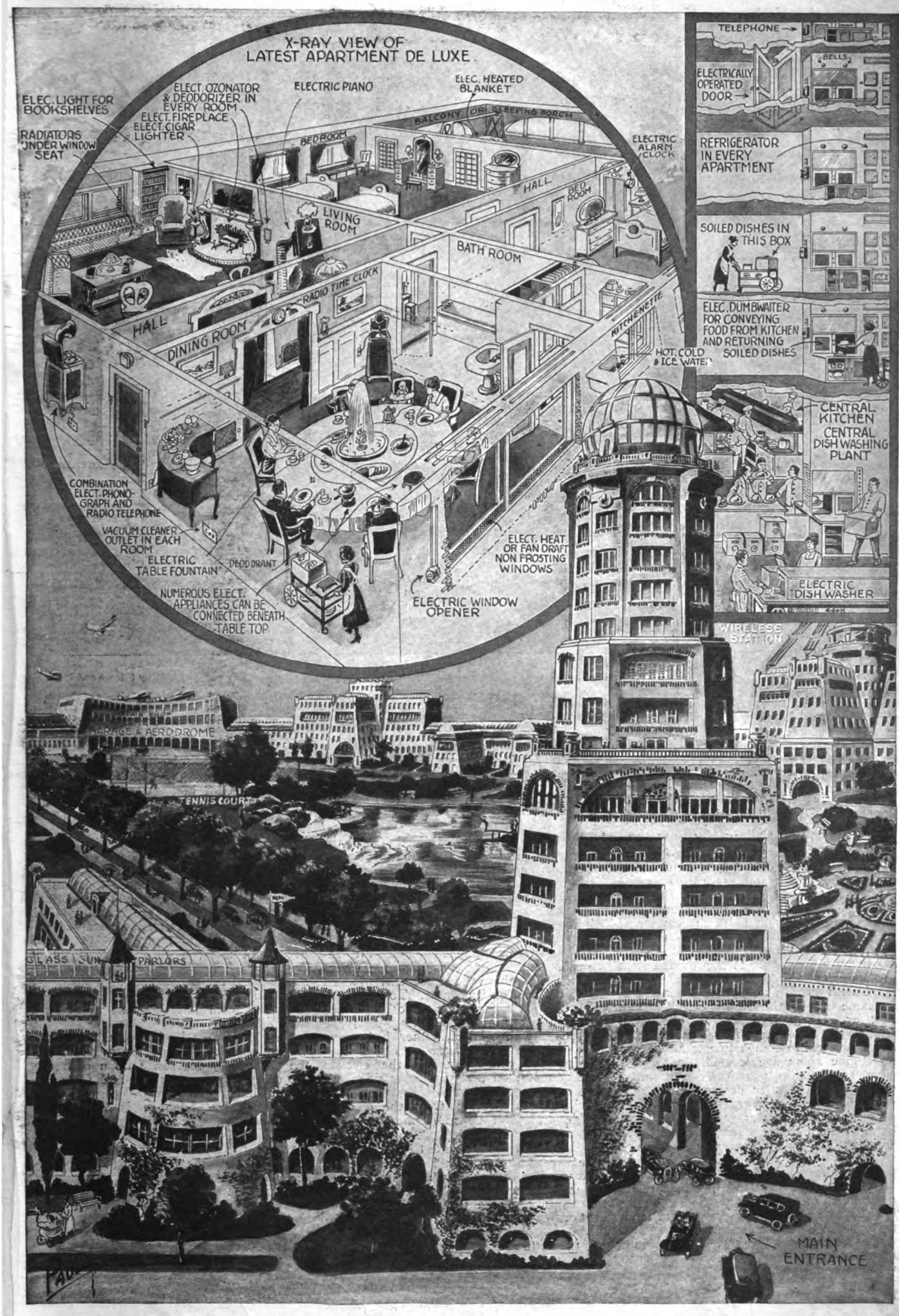
The dining room table is fitted with several electrical sockets into which may be plugged a coffee percolator, an electric hot dish, or waffle iron, etc. The victuals may be carried into the dining room, or else wheeled in on the specially devised tea wagon shown. After the meal, the soiled dishes are placed in a foot-operated metal container containing a deodorant, and these are then placed in the dumbwaiter and dispatched basementward, to be washed in the gigantic kitchen and dishwashing department provided for the several hundred families who make this apartment house their home.

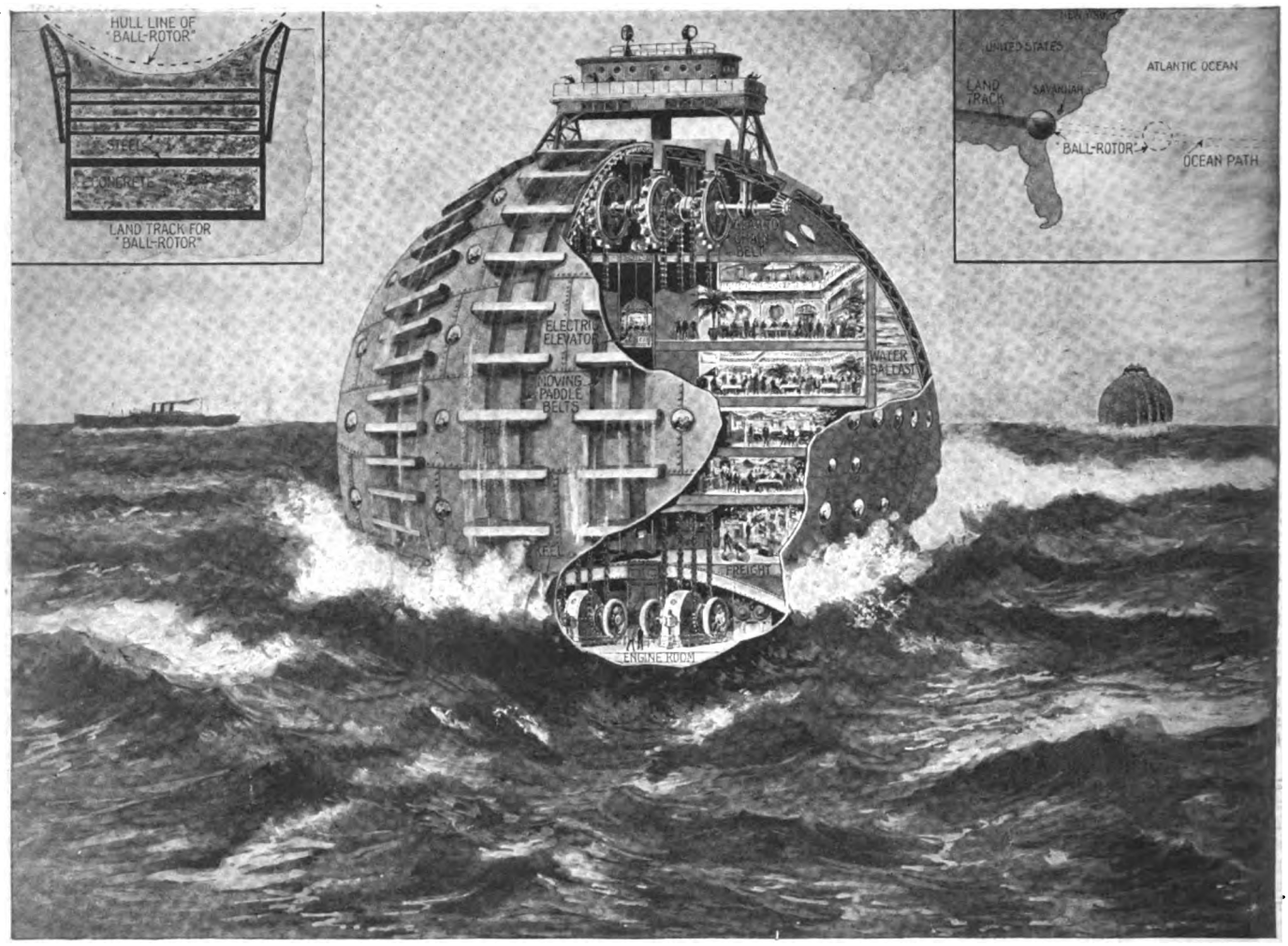
One thing that tickles you all the way thru is the fact that the temperature is so even in all the rooms and halls, thanks to the automatic thermostats, which control the amount of heat distributed by the radiators. Another surprise, that impresses you, is that valves are provided on each radiator so that when the warm weather arrives, you can close the steam valves and open the brine pipe valves, allowing the cooling brine solution to circulate thru the radiator instead of steam or hot water, which will keep the apartment at a prearranged and livable temperature on the hottest days. You also discover that the so-called kitchenette contains a handy sink as well as hot and cold water and ice water besides. Set in the wall alongside of the dumbwaiter door is a nifty iceless refrigerator, so that you do not have to worry about the ice-man coming around every day. A cooling worm made of pipe is all that you see, and it is white with ice. Cooling brine supplied thru pipes from the basement refrigerating plant keep this worm cold at all times, and by placing a pan of water in one of the compartments, you may freeze a small cake of ice so as to provide cracked ice for drinks, table service, etc. Bottles of err—near beer and champagne can be kept cold in this refrigerator as well as fruit that you may want to keep from spoiling. When the maid who has charge of your section and floor of the apartment house arrives to clean the rooms, you expect to see her use an electric vacuum cleaner, but all she carries with her is a piece of rubber tube which she attaches to a pipe opening provided in the base board of each room. You learn later that a large vacuum cleaner plant installed in the engine room in the basement, keeps up a constant suction or vacuum thru pipes running to every room in this huge dwelling, so that rooms can be cleaned at any time and there is no dust or dirt to handle.

When noon arrives we hear a chime strike and perhaps wonder how the superintendent manages to keep all the clocks in the hundreds of apartments exactly right. Upon inquiry it devolves that the clocks are electrically wound and corrected from a radio station on the roof of the dwelling. Moreover, we are told that this radio station is equipt for transmitting as well as receiving messages, including the radio time signals sent out from the great Government station at Washington at 12:00 noon, and 10:00 p. m. at night.

In the evening after an excellent dinner, cooked by expert chefs in the great kitchen below stairs, we adjourn to the living room or parlor. If we wish to play the piano, we find that it is electrically operated, and that all we have to do is to manipulate the usual tempo and other control keys. Later we listen to a selection from the opera "Carmen" played on the electrically operated phonograph, and tiring of the records at hand and wishing to learn the latest news of the day (even fresher than that gleaned by reading the 15th edition of the Evening Glibe, while dashing homeward in one of the airplanes belonging to the fleet operated by the apartment house management), we switch on the Magnavox radio loud-talker, which act has caused a signal to drop on the switchboard in the radio room atop the building, and we are immediately switched on to the powerful audion amplifier receiving set, and we hear the latest news, interspersed with snappy jokes and songs, via radio telephone from the powerful radiofone station W. J. Z., located at Newark, N. J.

The apartment house hospital is always at our beck and call, in the event that someone in the family is taken ill or receives an injury. Physicians and surgeons are constantly in attendance as well as trained nurses. The hospital is equipt with the very latest type of X-ray machine, by means of which instantaneous photographs can be taken, thru the thickest part of the body, and by means of this ultra powerful high voltage X-ray apparatus, treatment can be given for cancer and similar ailments which require X-ray therapy. The hospital laboratory also contains among other up-to-date equipment, a powerful radium outfit, whereby cancer and similar afflictions can be given the proper treatment. Convalescents find the roof garden and sun parlor just like heaven with fragrant flowers, and as much fresh air as they may need; the weaker persons taking their sun bath under glass roofs, while the stronger ones may refresh themselves in the open air roof garden.





The Latest Idea in Ocean and Land-going Ships—the "Ball-Rotor." It Spins Along Its Course, or Rather Its Paddle-like Treads Do; the Main Body of the Vessel Remaining Practically Stationary. Special Tracks or Roads are Provided on Land, the "Ball-Rotor" Moving Along Like a Tank, Such as Used in the World War. Internal Combustion Engines Drive the Moving Belts Carrying the Paddles, by Means of Chains and Gears, or Else a Dynamo-motor Electric Drive System Can be Utilized.

The Ball-Rotor—It Travels O'er Land and Sea

THE gigantic rolling ball in the form of a ship capable of speeding along over land and water here illustrated, is called by its inventors, Messrs. Larson & Ross, the Land and Sea Ball-rotor. This monster passenger and freight carrier is designed to be built on a large scale, at least 200 ft. in diameter, which also means 200 ft. or more high. It is provided with four moving belts or treads suitably provided with blades, and these belts act in the same way as those on the well-known tank or caterpillar tractor. The main part of the Ball-rotor, in which the passenger and cargo compartments as well as the engine room are located, do not revolve but remain practically stationary, owing to the peculiar design of the machine. The center of gravity of the Ball-rotor is kept as low as possible, and this factor is favored by placing the cargo as well as the engine room with its heavy engines in the lowermost holds. Water-ballast tanks are provided also on either side of the Ball-rotor, so that in case of an accident or for other purposes, water-ballast may be taken into or released from one or both of these tanks.

The moving belts carrying the blades around the perifery of the ball-shaped vessel, are driven by chain belts directly from the engines, or as shown in another design, the engines may drive dynamos, and electric current obtained from the dynamos operates electric motors secured to the driving gear at the top of the craft, as shown in the illustration.

At this point it is interesting to note how the designers of the Ball-rotor have arranged for turning the craft even at sharp angles. As long as the revolving belts and their attached blades are revolving at the same speed in one direction or the other, the craft will proceed straight ahead on its course. To cause the craft to turn one way or the other, either the right or left hand moving belts are caused to be reversed, either by means of a suitable gear-change or else by reversing the connections to the electric driving motor on that particular side. Of course all such control of the propelling machinery is effected from the officers' bridge and pilot house surmounting the top of the craft.

Wireless telephone and telegraph messages are handled to and from the craft by a wireless station located on one of the upper decks or holds, whichever you want to call it, and the transmission and reception of messages is designed to be taken care of by means of a concentrated self-contained aerial, no wires being necessary on the outside of the craft.

The inventors of the Ball-rotor have designs all worked out for a road to be built over land, this road being about 70 ft. wide and 14 ft. deep. It is designed to be built of reinforced concrete, having a ratio of 1-2-4. This road is calculated to support a load of 100,000 tons with a factor of safety of 20, that is the working load of 100,000 tons represents but 1/20th of the total load which the road-bed will withstand. When preparing to travel over land along a concrete road-bed of the type shown in the illustration, the blades used for propulsion thru the water are feathered or released by suitable gear, so as to form flat feet like those on a caterpillar tractor.

An elevator, or in fact several of them will be required; such are provided for in the designs by Messrs. Larson and Ross for carrying passengers to and from different decks. The freight cargo including passengers' baggage is loaded thru steel doors opening on the outside of the vessel. It is intended by the inventors that the ballast chambers shall serve as safety air chambers ordinarily.

Its design provides for quick maneuvering when in the water, and no doubt it will be favorably considered by naval experts in the event of another war. The Ball-rotor design was suggested and explained to our War Department some time ago, and if they reject it, Great Britain and France are ready to examine it, with a view to its adoption in naval as well as in the Merchant Marine Service.

New Navy Airplane Catapult

By GRASER SCHORNSTHEIMER

NAVAL EXPERT

ACCELERATION! How is from one to sixty miles an hour in as many feet? That is exactly what the Navy catapult does to a plane with a man or men in it. "True, the thing nearly tears you to pieces, but it gets your plane into the air and right smartly."

It's a strange looking affair. It looks something like a railroad turn-table and it can be turned in exactly the same way. It offers no obstructions to the movements of the guns of the warship on which it is mounted and it is therefore a very practical thing for the Navy. When all the ships of the fleet have it—and they all will have it—their scouting facilities will be increased by about seventy per cent, per ship. This is no mean advantage for a warship. And one of the best things about it is, that the usual conservatism, which hinders the adoption of anything new and radical, has not been exercised against it. While I was talking to the chief of our naval air service, the captain of one of our largest dreadnoughts came in and asked that his ship be the first in our fleet to receive it.

On the top of this turn-table affair is a set of tracks and on these tracks is a movable carriage upon which the plane is fastened by locks. When everything is in readiness, a pneumatic "telescope" pushes the plane along to almost the extent of the tracks. The acceleration is exactly from one to sixty miles an hour. Close to the end of the tracks there is a trip, which releases the plane, which shoots skyward, and then the carriage is brought to a stop by automatic brakes and pneumatic buffers.

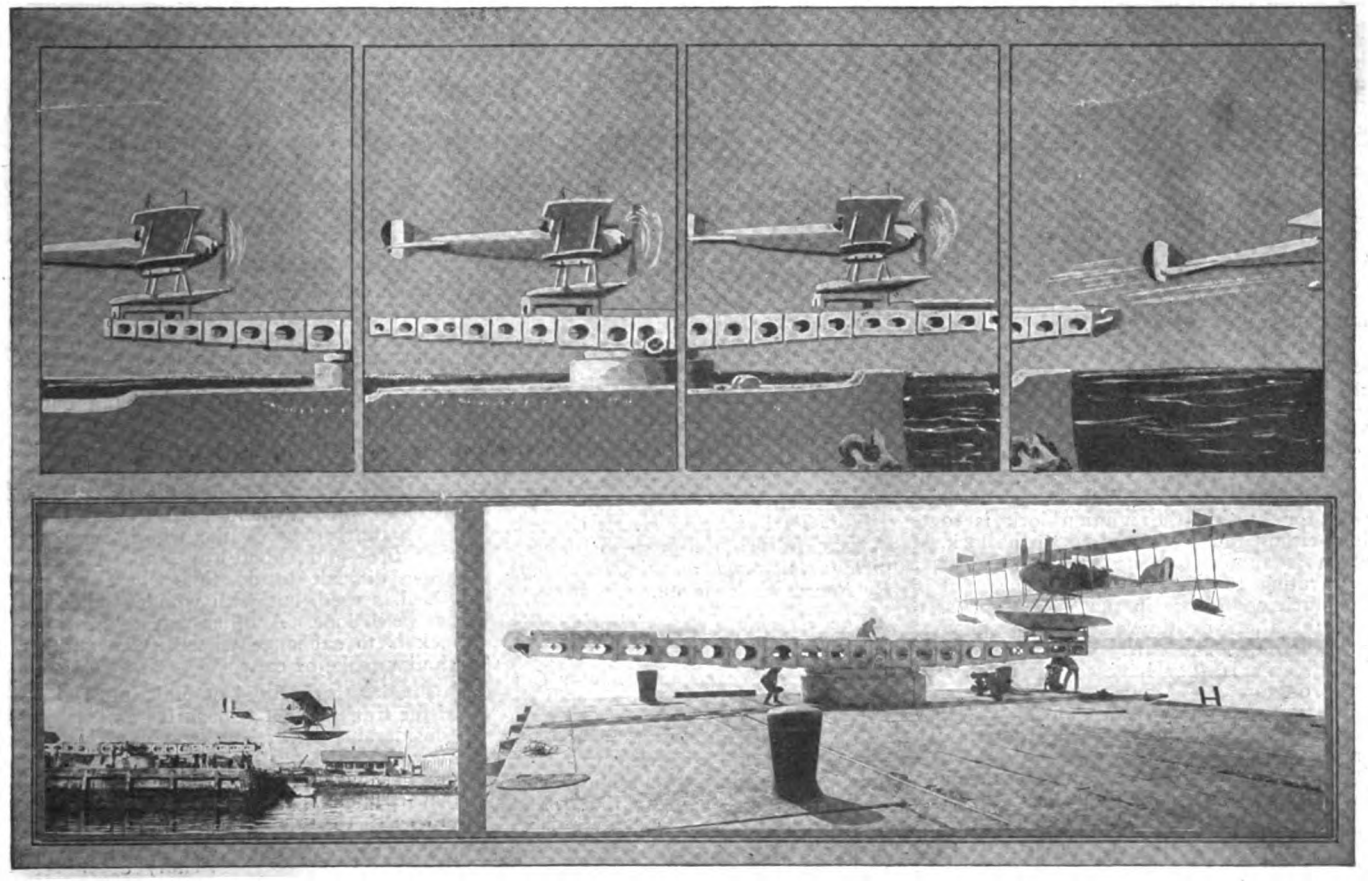
This does not apply only to small planes. Catapults can be built as large as necessary. It may be possible that the very largest bombing planes, which can be stored on an aircraft carrier, can be shot up from the decks of that type of ship. This was impossible formerly, even on the best aircraft carriers, because the larger and consequently heavier planes required too long a run for their take-off.

At present it is impossible for the lighter ships of our Navy to utilize planes, but when the catapults are installed, they will all be able to carry at least one small plane. The reason is that the catapult is small enough to be installed aboard any warship without consequent loss of efficiency to any part of the ship. It may mean that our cruisers and battleships will carry two small planes each, one in its set-up condition, and the other knocked down. The military advantages of this invention can not be over-estimated.

It has its commercial side also if we consider the matter of carrying mail. We have been able to take mail to a ship several hundred miles at sea, but never before have we been able to deliver mail from a ship a hundred miles away from port. Planes can now be carried by small ships on special duties such as ice patrols and derelict patrols, etc. It is expected that a special design of catapult for commercial uses will be developed shortly.

For a year or so, our naval air experts have been trying to adapt the torpedo plane for sea uses. The torpedo plane is very heavy. It usually requires a long take-off and it has therefore been practically unavailable for the Navy up to the present. The catapult will allow the largest Martin torpedo planes, carrying the 21 inch torpedo to be taken to sea with the fleet, aboard aircraft carriers, and to be launched into the air, and we are to have aircraft carriers under the Hughes plan for the reduction of naval armaments. If it ever becomes desirable to use the largest bombers at sea, those capable of carrying 4,000 pound bombs, it can be done because the catapult will permit them to be launched from the deck of an aircraft carrier.

It is rather amusing to watch a catapult in action. One sees a plane mounted on what appears to be a turn-table, large enough to turn a railroad engine. And it turns, bringing the bow of the plane into the wind. Then the plane's motor is started and run up to a high speed. All of a sudden—*Whisssh*—and the plane is in the air. It is all done so quickly that you do not realize what is going on, until it is all over. It seems as tho the plane were shot from a sling-shot.



The Great Handicap Heretofore in Launching Airplanes from War Vessels, Has Been to Start the Plane from the Small Space Available on a Ship's Deck. The U. S. Navy Has Now Perfected the New "Catapult" Here Illustrated, from Which Aircraft of Any Size, Including Bombing Planes, Can be Safely Launched. When the Button is Pushed, the Plane Shoots Along the Steel Beam of the "Catapult" With Terrific Velocity, Sailing Off into the Air at a Speed of 60 Miles an Hour. Even the Smallest Naval Vessels Can Now Successfully Launch Scout Sea Planes.

How the Auto Thief Works

IT is not always the scientific crook who successfully steals a motor car, but in some cases it is the suave master of diplomacy. If we could know of the many different cases where automobiles have been stolen, often with the help of the police themselves, innocently of course, we would find more interesting reading than the most hair raising detective tales ever written by A. Conan Doyle or Arthur B. Reeve.

Before going any further, we want to mention that in general we have very little faith in any sort of lock or horn signal which is supposed to flash or sound when a stranger steps into the car, such signals operating by the aid of automatic contacts placed under the floor or under the seat, etc. These alarms may be efficacious in cities, but they are almost if not entirely worthless in suburban districts or out in the open country, as they will not be seen or heard in most cases. Several cases, which detectives on the New York Police Force have come in contact with, involved the replacement of the usual car battery and ignition system with an auxiliary battery and ignition outfit temporarily installed by the thieves. This happened for instance, in one case where the owner of the car had very cutely opened the primary ignition system with a switch lock. A way of beating the missing distributor arm followed by some thieves, is to supply themselves with several arms of different makes, or else noting the particular make of magneto or ignition system installed on a car, they purchase a distributor arm suitable for the machine and the rest is easy. Against the ravages of the ordinary thief there is perhaps nothing more effective than a well-designed locking device, such as those used on steering wheels, etc., which are locked with a six tumbler Yale or Corbin lock, so long as the would-be thief does not have too much time to fool around with the lock. And providing further, he is not clever enough to pick it with a piece of wire suitably bent; or if not watched such as in public or otherwise, he may attempt to drill the lock or jimmy it.

There have been and there are at present in use several forms of *switch locks* which open the ignition circuit to the engine, but these are only effective in the real sense of the word when the wires are thoroly concealed and preferably run inside metal pipe. If the wires are not concealed and encased, then the usual trick for beating the ignition lock is to short-circuit the wires leading to the lock, which is simple for the thief and most aggravating to the owner, who has put too much confidence in the lock perhaps.

If the thief or thieves really want a car badly, they are fairly certain of getting it, even if they have to put it on a truck or tow it. Many cars have been stolen when suitably protected by secret locks on the ignition and other systems, simply by being towed away, even on city streets. It is claimed, however, for the *steering wheel lock*, that a car cannot be towed with this in place, as no control of the front wheels is possible.

One of the latest motor car protective devices is shown in an accompanying illustration, and is known as the Key-kard. The Key-kard automobile lock was invented by Mr. Joseph Billings, of Brooklyn, N. Y. In the first place it eliminates

Science In a Perverted Role

the usual Yale or other type of key lock which it is always possible to pick when confronted with the right man. In this device a new form of electric lock has been cleverly conceived, which it is practically impossible to pick and most valuable of all, no two key plates are the same in 400,000 locks.

The accompanying photographs and diagram show the features of this lock invention. The Key-kard is made of aluminum and measures about 3"x4". On it is stamped the name of the car owner as well as the car and engine number. When he leaves the car, he lifts the little flap and removes the Key-kard and places it in his pocket. The word WATCHED is exposed thru the window facing forward. The ignition is opened when the Key-kard is removed from its holder and the hood is securely locked. The almost human intelligence possest by this electric auto lock is cared for by a special relay placed in a secret place on the car. The wires connecting the key plate holder, which is fastened to the wind shield on open cars and mounted on the dash inside a closed car, are carried in a flexible steel conduit. Oh, yes, you say, but what if the thief cuts the wires? Let him try it! If the wires are cut the main fuse will be blown and the engine cannot be started until the fuse is renewed; to do this requires the hood to be raised and a substantial automatic magnetic lock prevents this. There are no tumblers used in any of the locking devices or parts of the Key-kard system; everything is simple yet unpickable. Best of all perhaps is the fact that the owner not by choice but by necessity, is obliged to remove the key plate in order to stop the engine from running.

Another new protective device which somewhat resembles the instrument just described, is known as the "Faurot-Scope" named after Inspector Faurot of the New York Police Department, and well-known as a finger print expert. This lock is the joint invention of Inspector Faurot and Lieut. James J. Skehan of the New York Police Training School. When the owner leaves the car in this case, he removes the round disk shown in the accompanying illustration, and substitutes a diamond disk which carries the legend, "Tell A Policeman If This Car Moves Carrying This Diamond Disk." The Faurot-Scope cuts off the ignition circuit to the engine and is arranged to sound a siren if the instrument is tampered with. The instrument contains a burglar-proof (?) lock, it is said, and the upper indicating disk when in place is locked to it. If the thief manages to hammer the instrument off the mudguard of the car, he would find that by so doing he could not start the engine, as the ignition circuit would be opened, and telltale holes would be left in the mudguard, besides the shrieking of the klaxon.

Auto Thief Laughs at Locks.

Locks are not what they seem—at least so we are informed by those, who have been up against the real auto thief who has brains. As one auto thief prevention expert styled it—when you place a key lock on your car you really hang out a sign for the clever thief.

Here is one way in which the well-known tire spike lock has been beaten. The thief simply deflates the tire, forces the lock spike around until it stands between the spokes of the wheel, reinflates the tire—and good-bye car. It may prove difficult to do this where a steel wheel is used, but with wooden wheels it has been done. Another way to beat this lock is to exchange wheels from another similar make of car.

The key lock, fitted or built into the top of the transmission gear shift box, has held considerable favor, but one expert interviewed by us told how he had bet a man that he could steal his car in spite of the transmission lock in short order—and he did, sad to relate. It happened thusly. The gentleman who fooled the owner, bided his time in the vicinity of the car one day, and noting that the policeman nearby was not looking, he dropt under the car and thanks to a wrench carried in his pocket, he loosened the nuts on

(*Continued on page 865*)

Just a Few February Articles

Is the Moon Inhabited? An original and extremely interesting article, especially illustrated. By C. S. Corrigan, C.E.

An Excursion Into the Past—A satire on the Einstein theory and absolutely the most exciting and astounding thing you ever read—imagine being in a flying machine traveling thru space at 186,000 miles per second. By Ernest K. Chapin.

Snow Crystals—Wonder Jewels of Nature. By Dr. Ernest Bade.

Viewing Oil Paintings—In All Their Original Glory of Color—By Means of Polarized Light.

A New Electro-Mechanical Bank Protector to Foil Hold-up Men.

Velocity and Acceleration—Some astonishing and little known facts, popularly explained in picture and story, in an authoritative yet easily understandable style. By Professor James S. Stevens, University of Maine.

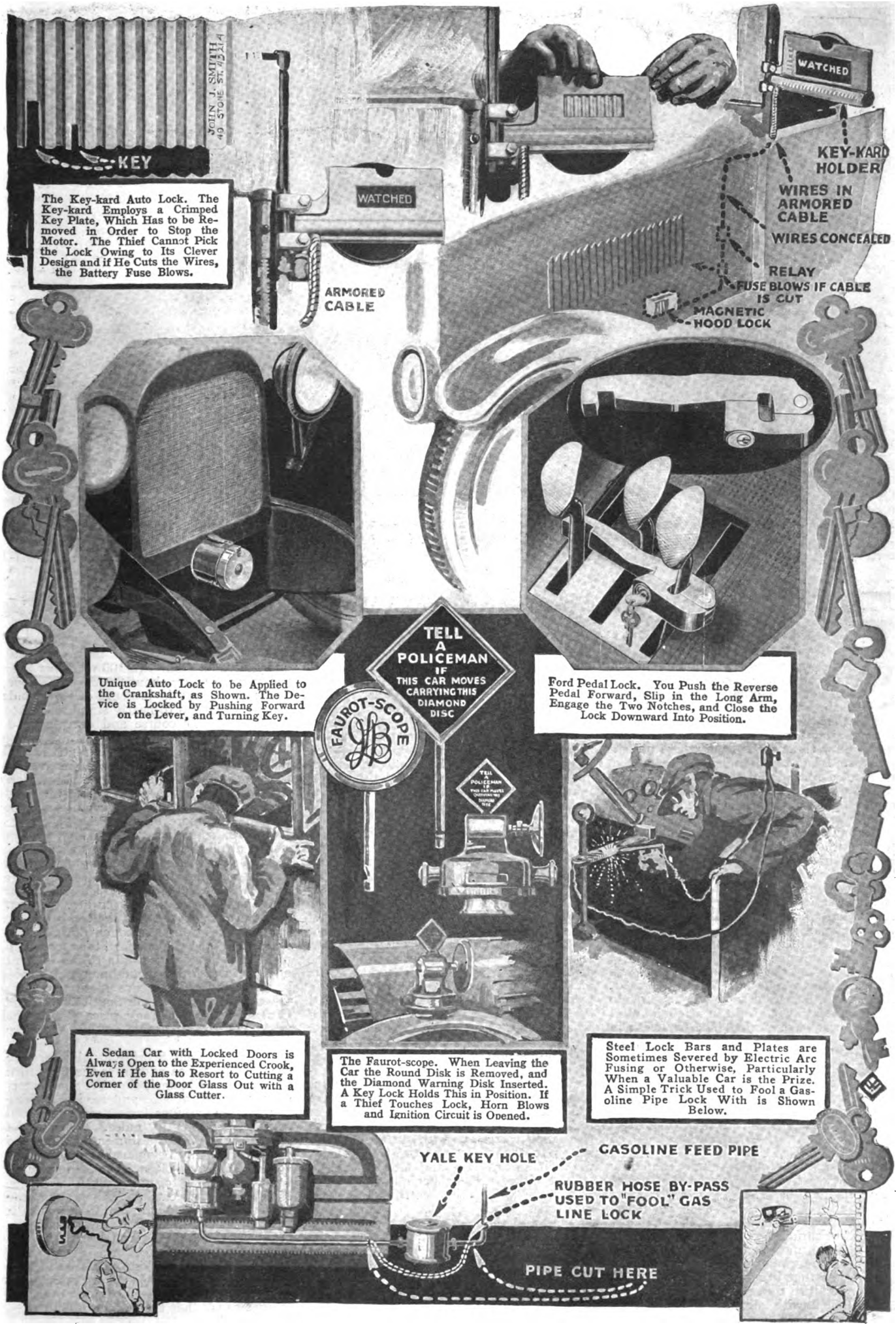
Shall I Take Up Engineering?—The honors and remunerations received by the engineer. Part 2. By H. Winfield Secor.

Popularized Radio—A crackerjack article giving details of how to build simple receiving sets, suitable for listening to the wireless telephone concerts now being given every day and evening.

How To Build a ⅛ H. P., 110 volt, 25 cycle, Induction Motor—With complete details and working drawings. By Robert C. Vondrau.

The Psychic Lens—Scientific Fiction. By Charles S. Wolfe.

Buying a Second-hand Motor Car. By Edna Purdy.



The Key-kard Auto Lock. The Key-kard Employs a Crimped Key Plate, Which Has to be Removed in Order to Stop the Motor. The Thief Cannot Pick the Lock Owing to Its Clever Design and if He Cuts the Wires, the Battery Fuse Blows.

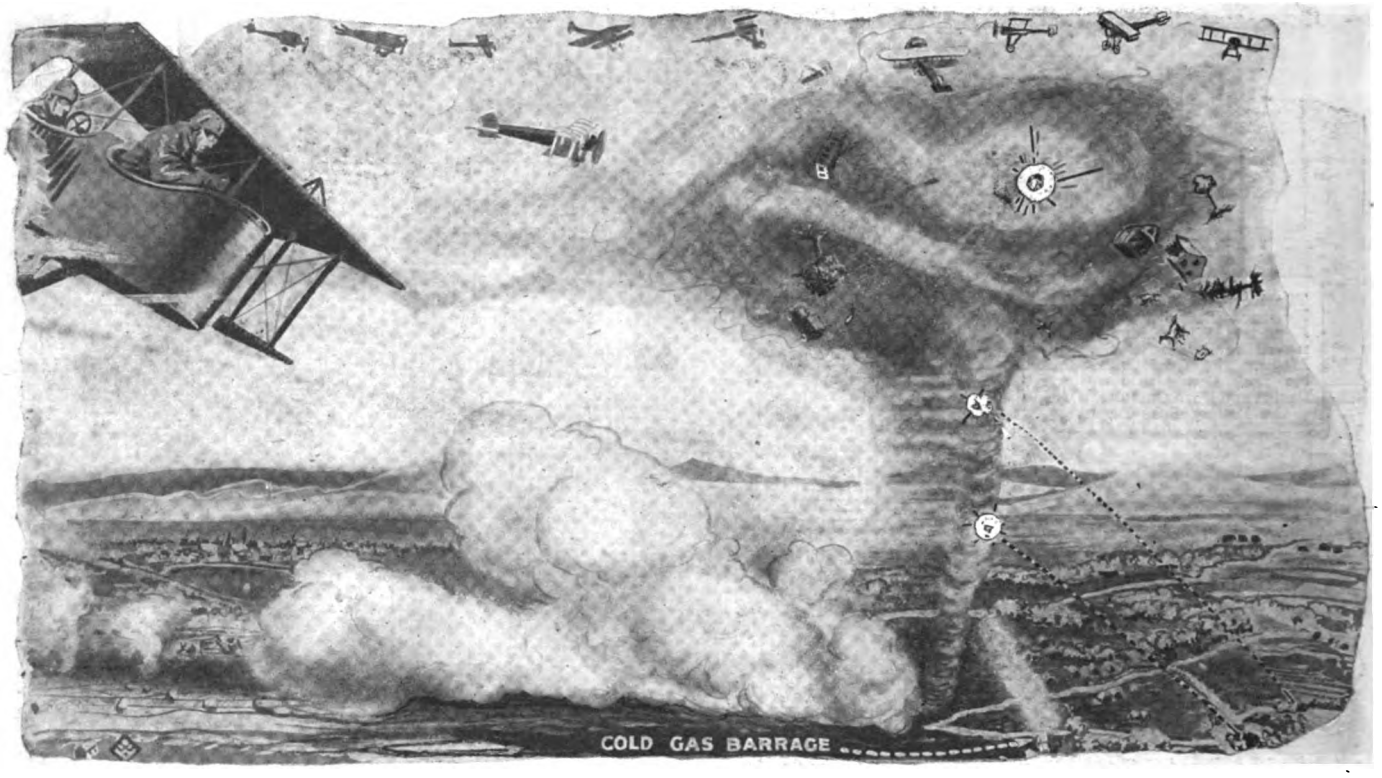
Unique Auto Lock to be Applied to the Crankshaft, as Shown. The Device is Locked by Pushing Forward on the Lever, and Turning Key.

Ford Pedal Lock. You Push the Reverse Pedal Forward, Slip in the Long Arm, Engage the Two Notches, and Close the Lock Downward Into Position.

A Sedan Car with Locked Doors is Always Open to the Experienced Crook, Even if He has to Resort to Cutting a Corner of the Door Glass Out with a Glass Cutter.

The Faurot-scope. When Leaving the Car the Round Disk is Removed, and the Diamond Warning Disk Inserted. A Key Lock Holds This in Position. If a Thief Touches Lock, Horn Blows and Ignition Circuit is Opened.

Steel Lock Bars and Plates are Sometimes Severed by Electric Arc Fusing or Otherwise, Particularly When a Valuable Car is the Prize. A Simple Trick Used to Fool a Gasoline Pipe Lock With is Shown Below.



Must We Go on Forever, Permitting Cyclones or Tornadoes to Proceed on Their Devastating Way Without Attempting to Thwart Them? Mr. Corrigan, the Civi Engineer Who Wrote the Accompanying Article, Has Had Interesting First-Hand Experience in Breaking up a "Twister" in the South-Western Part of the United States, with the Aid of Dynamite, and He Here Presents a Plan for Breaking up the Whirling Column of Air Which is the Source of the Damage Caused by Tornadoes, by Dropping High Explosive Bombs into the Whirling Air Column or Its Vicinity from Airplanes, as Well as Firing Explosive Bombs from Mortars Mounted on Motor Trucks.

How to Prevent Gulf Storms and Tornadoes

By C. S. CORRIGAN, C.E.

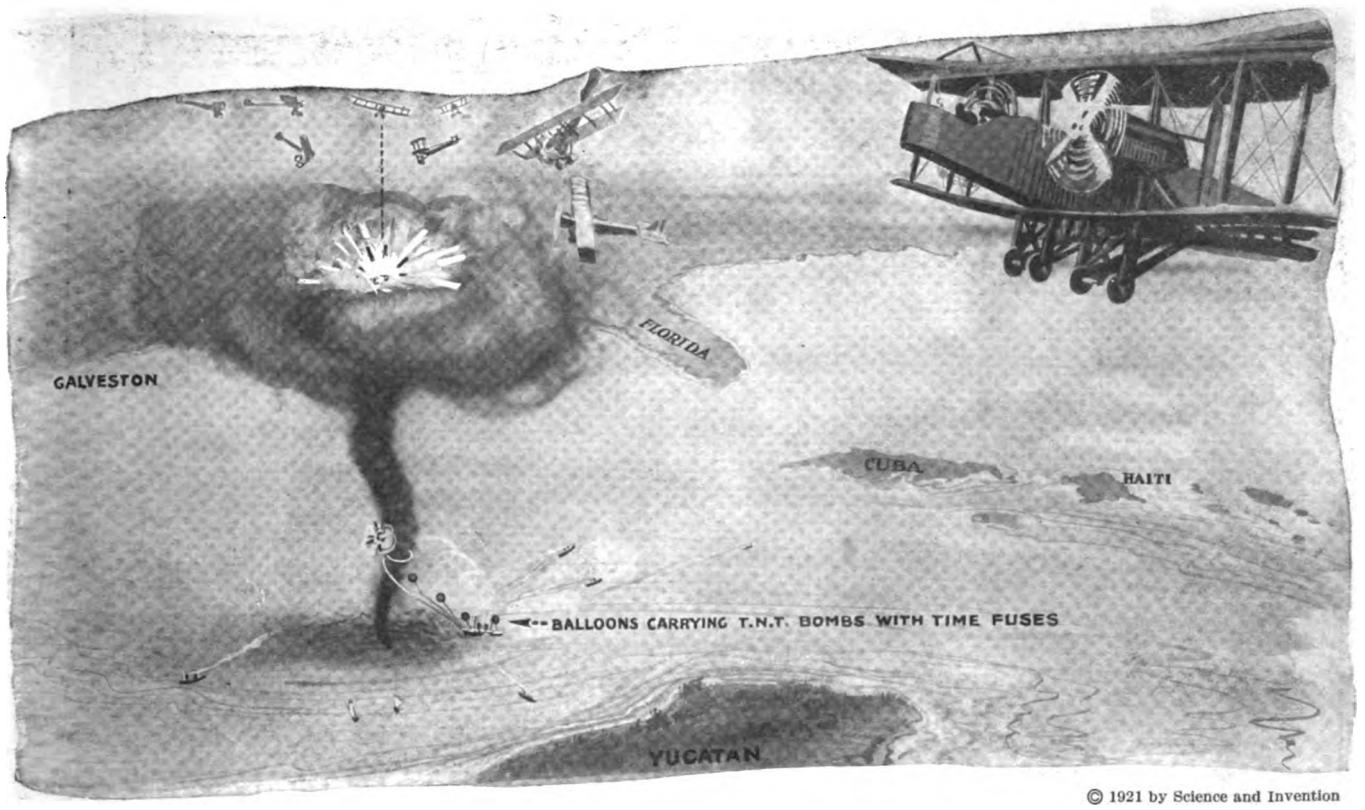
SOME years ago while building a railroad in the Southwest, I stored considerable dynamite in a log corn-crib; next day the rancher told me that the crib had been picked up and thrown around by tornadoes so often, that it was now three miles from where he had built it. I had often thought I would like to shoot a tornado all to smithereens; so I rigged up a trigger that would explode a charge of dynamite when jerked by a long rope, one end of which I tied to a stake in the ground and the other end was fastened to the crib. Two weeks later while at supper in camp half a mile down the valley, we heard an ominous roar, someone hollered "Twister coming," then while the men ran in all directions I stood and watched the dark cloud, with its black arm swaying and writhing, pick up everything as it rapidly advanced, and saw it pick up the corn crib and suck it toward the center of the storm. The rope jerked the stake up and there was a tremendous explosion, the roar ceased, there was a deluge of rain, but no tornado and very little wind, and in a few minutes the sky was clear again. The explosion in the vortex of the tornado had broken and disturbed the suction and centrifugal forces so much that they were unable to keep on lifting the heavy load of rain water which gave the cloud its black appearance, the rain falling cooled the air so the storm could not form again. I concluded then and still believe that all tornadoes can be destroyed like that one was.

I soon found that all storms are caused by areas of excessively hot air at the surface being slightly disturbed by what aviators call, *holes in the atmosphere*, spots where the air is less heavy than at other places, allowing the hot surface air to ascend. On reaching a lighter atmosphere it expands, thereby loosing heat, forming water vapor and contracting, so that it sucks more hot air up, which goes thru the same process, until the hole is filled with air colder and heavier than the surrounding atmosphere. No longer able to ascend the momentum of the ascending air forces it out and over the surrounding air, like an overflow, thereby making it heavier and adding pressure to the air below, so it is more easily sucked toward the center and upward. At first there is no rotary motion and the velocity very small, rotation starts and increases until tremendous centrifugal and suction forces are sometimes developed.

From this you see that it is necessary to have nearly a dead calm, both at the surface and in the upper atmosphere when a storm starts. If on a hot calm day you see clouds called *thundercaps*, forming one after another you know an upper wind is blowing the tops off what might otherwise develop into tornadoes. Altho all storms start at the surface and are constantly fed by hot air from the surface, there is nothing about any of them that you can see until the ascending air expands, cools, condenses its moisture and forms a cloud; once formed a tornado cloud keeps getting lower and darker, then reaches lower and lower with a dark arm that at last reaches the surface; this arm is the vortex of the cloud heavy with drops of rain. It takes that shape because in the vortex the suction and centrifugal force cause the air being sucked up, to expand, cool and condense its moisture while near the ground; the lifting power of the wind prevents this rain from falling there but carries it with dirt and other things to the highest parts of the cloud, where it spreads out and falls as rain or hail at either side or behind the vortex. In a large vortex the centrifugal force is sometimes so strong that it overpowers suction, and throws everything away from the center, making a clear place which the ancients believed was the all-seeing eye of God, as he rode the storm.

Tornadoes vary in size, some having funnels or arms, only a few feet across, others may be a hundred yards in diameter. They advance from 6 to 100 miles per hour the average being about 20 miles per hour, slight differences in pressure of side winds often cause them to nearly stand still, then to change their course and dart forward; their general direction is always S.W. to N.E. They may travel as much as 100 miles or as little as ¼ of a mile, the average distance being 25 miles. Most of them are stopt by changes in atmospheric temperature such as colder air currents on the ground, but more often in the higher atmosphere, sometimes after going up one side of a hill the tornado is prevented from going down the other side by an up-hill wind, sometimes it may be stopt by huge oil tanks or buildings, which the great whirlwind cannot destroy or lift, the part of the arm that goes over the top being too high off the ground to reach down immediately. When the suction stops for a moment or cold air causes rain to fall in front of it, it turns into a cloud-burst which soon is exhausted. There are more tornadoes (about 150 a year) in our Southwestern and Central States than any place else in the world, and many people are afraid to live there.

Our great Gulf Storms usually form in the Caribbean Sea and enter the Gulf thru the Yucatan Channel, they are simply tornadoes formed at sea, and having nothing to stop them assume large proportions and travel thousands of miles. Their chief characteristics are the immense columns of water continually being sucked up, and the great tidal wave, often 10 to 15 feet high, which is drawn together ahead of them. If they hit the coast at high ground, the great column of water is lifted, forms a vacuum at its base which overcomes the lifting suction, it falls and breaks up the vortex, the storm turns into a deluge of salt water rain and soon plays out. But most of the Gulf coast is low, so more often the great tidal wave spreads out over the prairies so far that the water supply to the



Some Years Ago Mr. Corrigan Had Some Interesting Experiences in the Gulf of Mexico, and He Relates How He Has Seen Dozens of Gulf Storms, Which Resemble Tornadoes on Land, Start Up and Develop. Ships Could Approach Quite Close to the Towering Water Spouts Created by These Storms, and Fire Explosive Bombs into the Whirling Water and Air Column, so as to Shatter It, He Says. Bombing Planes, Directed by Radio Either from a Land Radio Compass Station or from Scout Planes Could also be Used, Mr. Corrigan Suggested, in Breaking up These Storms.

central column is slowly diminished and it gradually changes from a water to a land storm and advances until stopt by atmospheric conditions. Most of the damage by Gulf storms is on account of this high tide wave inundating the land, washing away and destroying buildings and helping the waves and wind drive large vessels far up on the shore, as in the recent storm at Tampa.

Long before a large tornado or hurricane can be seen or heard, its suction has reduced the air pressure far in front of it so much that it can be felt, and this accounts for the fact that any barometer will foretell the coming of such a storm. The air pressure sometimes gets as low as 11 lbs. per sq. inch near the center of a storm, normal pressure being 14.7, constituting a difference in pressure of 533 lbs. in each square foot. When people see a storm coming and close the doors and windows, they are only helping to wreck the house as the air inside leaks out as fast as it can. If the storm advances very fast and reaches the house while there is a two pound difference in pressure, the air inside presses 288 lbs. per sq. ft. outward against the walls and roof, the shingles fly off, the walls fall out, the house just flies to pieces, and the tornado only has to pick up the pieces, while if the house had been left open it might not have been damaged. It is this lack of air pressure, that draws the great tidal waves together, miles ahead of the wind of a Gulf storm.

Each hot day in our southwestern states hundreds of small tornadoes or whirlwinds form under favorable local conditions, but general conditions and winds in the higher atmosphere not being favorable they end in a few minutes. The same is true of water spouts on the Gulf and Gulf coast bays. One clear afternoon from the top deck of a dredge boat in Galveston Channel I saw 18 in 4 hours, all that reached land were destroyed when their column of water dropt; none lasted more than half an hour; one of them came in from the Gulf on a direct line towards the dredge, and was closely watched by more than 20 men. When it reached the beach the column of water was lifted about 10 ft. as we saw clear space beneath it, then it all tumbled with great force. Visiting the beach afterward I found that a small bay had been washed out 50 ft. in from the shore. When the cloud which accompanied the spout was over the dredge boat there was a heavy rain, and the water caught in pans was 70% as salty as sea water, showing that that proportion had been sucked up out of the Gulf, the 30% having been condensed from the air sucked in around it. On such an afternoon there are also numbers of little thunder showers; when a spout runs into or crosses just behind one of these, the spout drops and is destroyed by the cooler air.

POSSIBLY you have experienced the terrors of a tornado or hurricane, especially some of those which frequent the southwestern section of the United States in the summer months, and when mere man comes forward with an idea for subjugating the powers of King Storm, you may feel like laughing at him. After reading Mr. Corrigan's article, we feel certain that you will see that he has incorporated some good sound logic in the arguments set forth. Mr. Corrigan is not talking entirely from a theoretical viewpoint in the accompanying article, for he has had a good deal of experience in all parts of the world, particularly sections frequented by tornadoes and gulf storms.

Next month we will have the pleasure of presenting a very original and highly interesting article by Mr. Corrigan,—"Is the Moon Inhabited?"

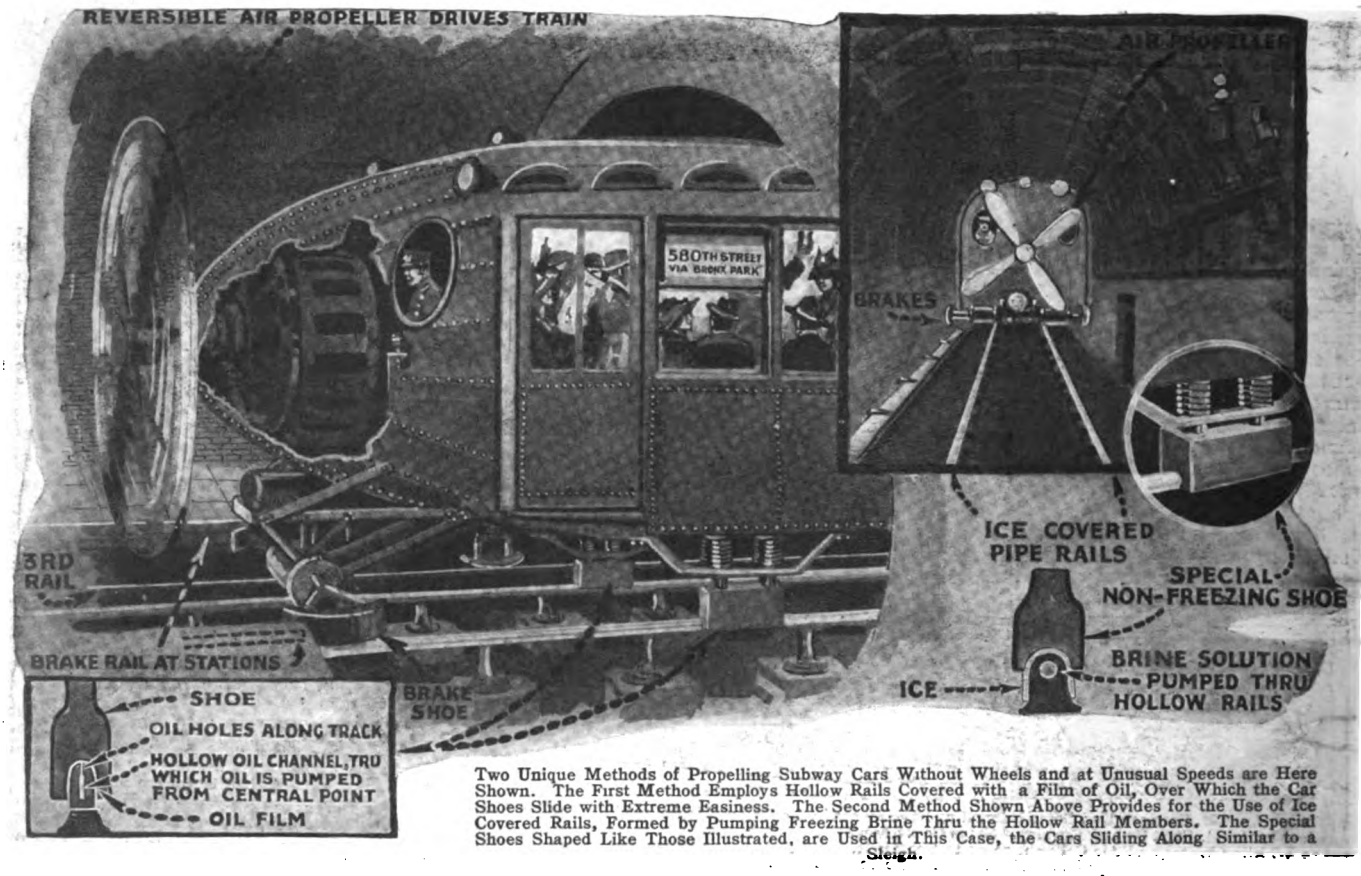
Now from what little I have said about storms it will be seen that of the thousands that form, nearly all are destroyed by Nature before they get large enough to do any real damage, that a disturbance of the vortex or the cooling of the air in front are the weapons she uses to destroy them all. The simplest and cheapest way man can follow Nature's instruction on a large enough scale to destroy large storms would be by disturbing the vortex with explosive bombs.

To do this on land I suggest airplane patrol stations, established where the most tornadoes form, just as we have fire engine houses in cities, I would have automatic wireless tornado alarm boxes similar to fire alarm boxes, scattered every few miles at farm houses. Any person seeing a *twister* would break the glass and the number would ring in by wireless. When received at the station airplanes would start out in its direction. Being a dark cloud in an otherwise clear sky, it could be easily located and time-fuse bombs could be dropt into its vortex. Fast motor cars with high-angle mortar guns to throw time-fuse bombs into the vortex could also be used. The actual vortex not being obscured by a cloud the chauffeur could see at once if the first bomb was ill-timed and the second would be sure to destroy the storm. In a city where bombs might do damage a cold gas-barrage could be spread in front of a tornado by releasing enough of the proper kind of gas; the cold air and gas being sucked up and expanded would condense the moisture and make it hail or rain in front of the vortex and so destroy it.

Ranchers could protect their dwellings by stationing bombs attached to air bags in the direction from which storms usually came, these could be set so that when sucked up into the vortex of a storm they would explode.

Gulf Storms could be entirely eliminated by seaplanes attached to mother ships, cruising in the Caribbean Sea and Yucatan Channel, bombing and destroying all water spouts as old battle-ships were recently destroyed on the Atlantic coast. If a big storm should get into the Gulf, a fast torpedo boat provided with air bags to which bombs were attached, could head right into the storm until the vortex could be seen, say within half a mile of it, then fill and release the bags; when sucked into the vortex the bombs would explode and destroy it.

After a few years' practice and study of storm conditions, storm prevention would be a great deal more efficient than fire prevention, because to destroy storms in certain sections, the conditions would always be the same, while in fighting fires there are many other things, such as falling walls and explosions to be guarded against.



Two Unique Methods of Propelling Subway Cars Without Wheels and at Unusual Speeds are Here Shown. The First Method Employs Hollow Rails Covered with a Film of Oil, Over Which the Car Shoes Slide with Extreme Easiness. The Second Method Shown Above Provides for the Use of Ice Covered Rails, Formed by Pumping Freezing Brine Thru the Hollow Rail Members. The Special Shoes Shaped Like Those Illustrated, are Used in This Case, the Cars Sliding Along Similar to a Sleigh.

Wheel-Less Subways of Tomorrow

WE are so used to seeing and riding in subway and other trains provided with wheels, that it is a little difficult perhaps to imagine a subway train of tomorrow speeding along at a 50 to 60 mile an hour clip on sleigh runners. This idea of providing the cars with runners or shoes designed to rest on oiled or snow covered tracks, as shown in the accompanying illustration, is the more easily reconciled in our minds perhaps, as compared to the old established idea of revolving wheels, when we stop to think of the roller coasters and scenic railways at our pleasure resorts. These cars slide on greased rolls like sleighs and they travel at very high speed and also very economically.

There are several ways in which the cars on such a transportation system could be propelled. One of the methods available is shown in the illustration, and involves the use of an air-screw or propeller like that employed on the modern airplane. This propeller could be placed at the front or rear of the train, pulling it along if in front, and pushing it if mounted in the rear. The propeller could be driven by a powerful electric motor deriving its necessary current from a third rail and contact shoe secured to the side of the car in the usual fashion. Such air propelled railway cars are being used in Germany at the present time, use being made of some of the airplane engines scrapt from the War stock.

By making the propeller reversible with regard to the pitch of the blades, the car or train could be brought to a stop in very quick fashion, the motorman reversing the pitch of the blades, while the propeller was still revolving, resulting in the thrust being reversed, and thus causing the train to come to a stop. At stations it would be desirable undoubtedly to provide a braking rail and suitable brake shoes could be projected from the sides of the cars to make contact with this rail, these shoes being electro-magnetically or electro-pneumatically operated by the motorman.

An English engineer, Capt. H. G. Norrington, is a strong advocate of the "sleigh

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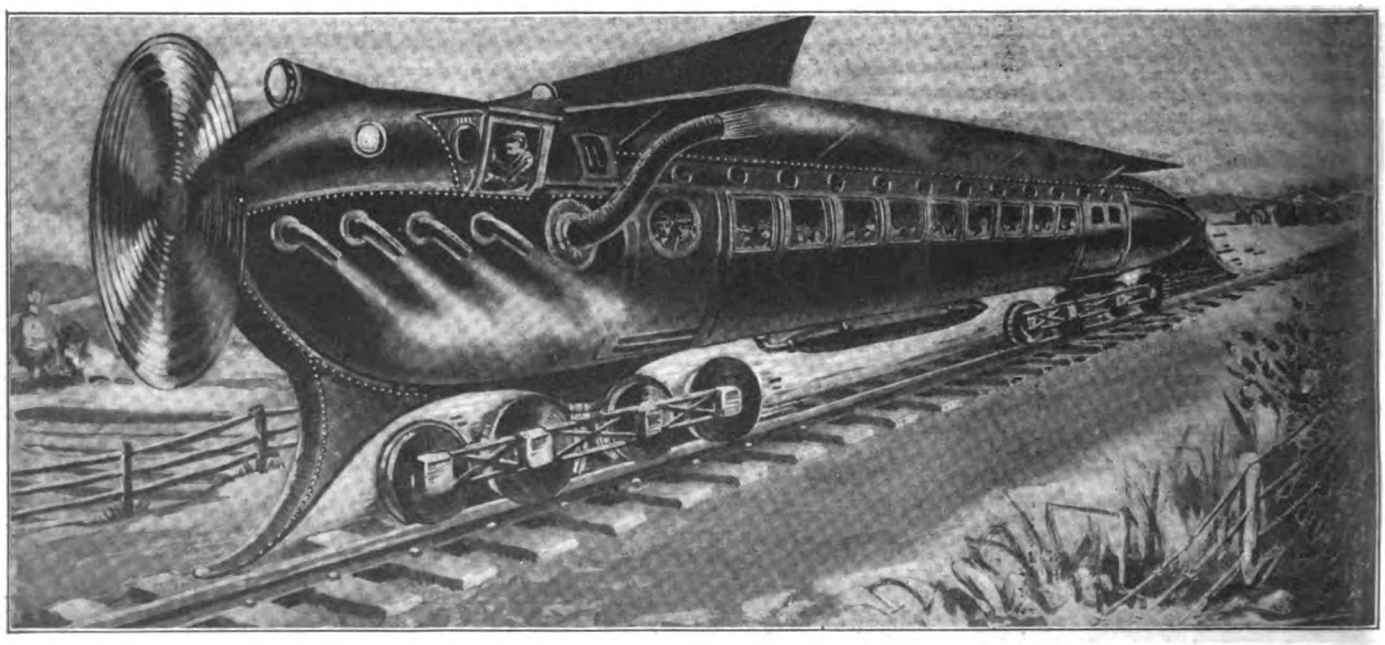
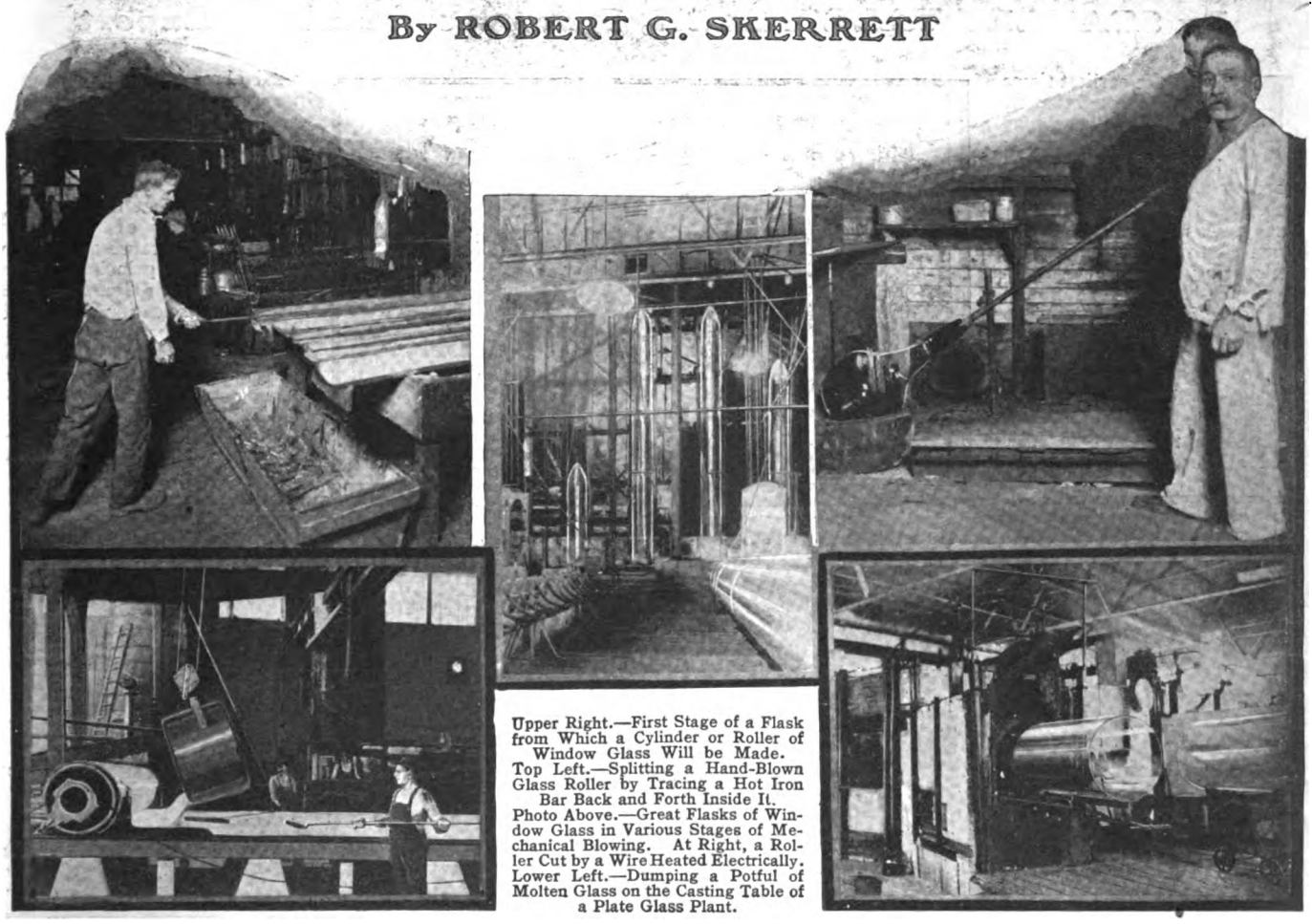


Another Idea in Railway Propulsion is the Air Propelled Monorail System Here Illustrated. The Car Is Maintained in a Vertical Position by Virtue of the Stabilizing Wings and Rudders, as Well as by the Action of Two Powerful Jets of Air Shot Upward Under the Wings on Either Side.

How Window Glass Is Made

By ROBERT G. SKERRETT



Upper Right.—First Stage of a Flask from Which a Cylinder or Roller of Window Glass Will be Made. Top Left.—Splitting a Hand-Blown Glass Roller by Tracing a Hot Iron Bar Back and Forth Inside It. Photo Above.—Great Flasks of Window Glass in Various Stages of Mechanical Blowing. At Right, a Roller Cut by a Wire Heated Electrically. Lower Left.—Dumping a Potful of Molten Glass on the Casting Table of a Plate Glass Plant.

NO country in the world uses building glass to the extent that we do here in America. By building glass is meant window glass, wired glass, opaque glass, and plate glass. In the course of a twelvemonth our plants are capable of producing 630,000,000 square feet of this material in divers thicknesses to suit a multiplicity of demands.

There was a time, and that not so many years ago, when all of this so-called sheet glass was manufactured by hand, i.e., blown by the lungs of skillful craftsmen, but to-day only about 40 per cent of the commodity is so made. Mechanical facilities of one sort or another have been invented and perfected which operate more certainly and faster than the human worker. Indeed, these new facilities enable our factories to fabricate in quantity some special kinds of flat glass which, until recently, we obtained from abroad where cheap labor made its production commercially practicable.

In order that it may be plain to the layman just how far we have progressed by the introduction of mechanical agencies it might be well to describe briefly the manual method which so long dominated the industry. As most of us know, the ingredients for a "batch" of window glass, for instance, are: sand, salt cake, and lime, to which is added a small quantity of charcoal or powdered coal as a decolorant. If soda ash be substituted for salt cake the resultant glass is softer and lends itself better to machine treatment.

The batch is melted in suitable reverberatory furnaces, at a temperature of about 2,600 degrees Fahrenheit; and a large furnace will hold a number of tons of the syrupy mass. The initial step in the manufacture of hand-blown glass is to form a big cylindrical bottle or "roller." The procedure is as follows: The "gatherer," armed with an iron pipe about 50 inches long, dips this tool into the fluid glass in the furnace—rotating the tube the while to accumulate on its flared end a quantity of the sticky stuff. When the "gather" is large enough, the worker runs with it to a block of cast iron in which there is a half-round recess, and revolves the incandescent glass in this mold to give it a pear-like shape. A momentary exposure to a stream of cooling air serves to "set" the gather. Back to the furnace the craftsman goes, where he builds up more glass upon the original mass; and after five or six trips of this kind, with intermittent manipulation on a wet wooden block with a hemispherical cavity, enough glass is thus obtained from which to blow a roller. The gatherer then passes the laden tube to his more skillful fellow, the blower.

The latter transforms the solid bulb of red-hot plastic glass into a flask which, when the top and bottom are removed, will measure from 44 to 62 inches in length and from 14 to 15 inches in diameter. This big bottle is fashioned by the dual actions of the blower's breath and by the elongating pull of the glass's own weight, as the operative, from time to time, swings the glowing body in a pit. When the glass cools and stiffens during the process he takes it back and reheats it in the furnace. As soon as it is soft enough he blows into the flask and swings it again. By these successive steps the blower produces a cylinder of the desired dimensions. His problem is to make sure that the vitreous walls are of fairly uniform thickness and that his cylinder is straight from shoulder to bottom. A capable blower can turn out in the course of an hour 9 rollers of single-strength glass or from 6 to 8 of double strength. Single-strength glass is thinner than the double strength.

After the top and bottom ends of the flask have been cut off, the cylinder is split once lengthwise by means of a hot rod, and subsequently flattened out in a furnace equipped with a revolving table fitted with slabs of fire clay. When the roller has been softened by heat it is ironed out by the "flattener," who uses a long-handled wooden block for the purpose. The flattener is one of the most expert of the artisans; and the ultimate value of the window glass depends largely upon how well he does his work. The sheets travel mechanically from the flattening furnace into the annealing oven or lehr, and their final move takes them to the cutting department where the glass is cut up into marketable sizes. For shipment it is packed in boxes containing 50 square feet each.

The machine blowing of window glass was essayed in America in the early "nineties," and it took the better part of ten years to perfect apparatus that warranted their adoption by the industry. Since then various improvements have been made of one sort or another, but fundamentally the process is much the same. The melting tank, as might be expected, is a bigger one than that found in a hand-blowing factory; and the furnace may be either directly linked with the cylinder-forming apparatus or separated from these machines. In the former case the furnace is flanked at one end by a series of basins, into which the molten glass flows continually from the tank, while the latter installation requires the ladling-out of the glass and its transfer to red-hot pots set immediately beneath the blowing equipment.

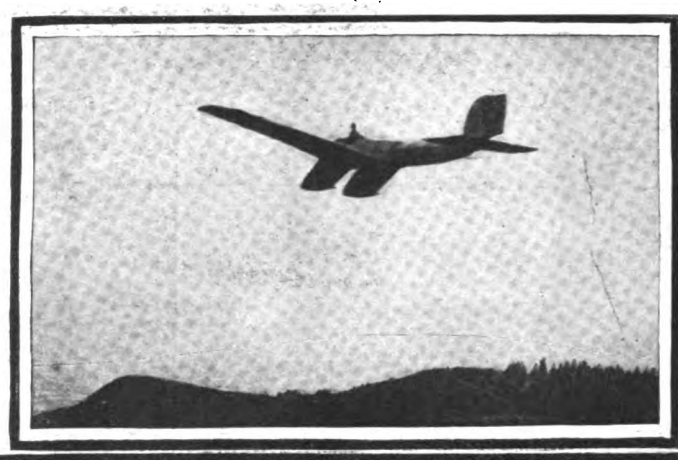
A blowing machine consists of a "cage" or framework which directs the up-and-down movement of an electrically-driven hoist to which is attached, by a pivoted connection,

(*Continued on page* 860)

Motor-less Airplane Flight

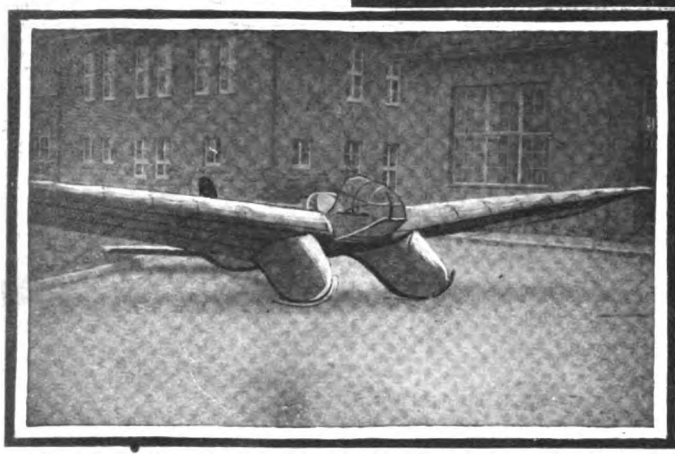
By STANLEY YALE BEACH, Ph.B., Aeronautical Expert

FROM the earliest times man has sought to fit himself with wings and fly as do the birds by flapping them or by soaring off from a mountain top. Otto Lilienthal, of Germany, was the first man of our time to accomplish gliding or soaring flight in this manner. He built a large mound or hill off which he used to jump when running against the wind, and make long glides to the terrain below. Pitcher in England and Capt. Ferber, in France, experimented in the same manner, and all three lost their lives



used abroad by many people in preference to the railroads, and the German insurance companies insure the lives of passengers, the rate being often included in the fare.

The somewhat harsh terms of the Treaty of Versailles are the direct cause of the return to first principles, that has occurred in Germany, and hence of scientific advance. While allowing the Germans to keep 150 airplanes for commercial transport uses, the Treaty required them to destroy all the rest, as well as some 40,000 motors. They are not allowed to build



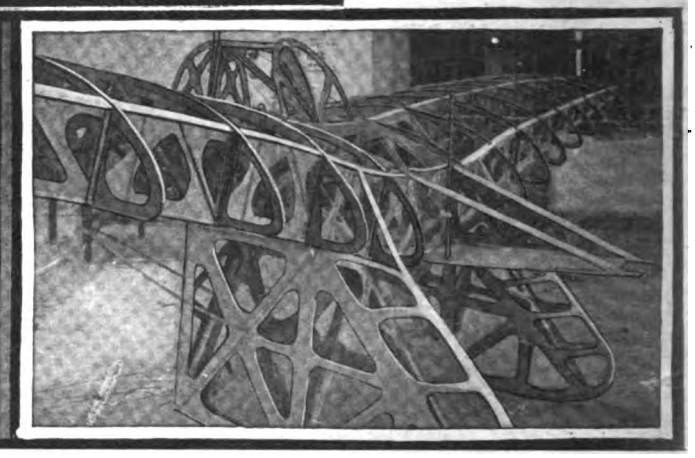


Photo at Right Shows the Carefully Designed Frame-work or Skeleton of the Klemperer Cantilever "Motor-less" Monoplane, Which Has Made the Most Remarkable Flights, Some of Them of Several Miles in Extent. Photo at Left Shows the Klemperer-Aachen Cantilever Monoplane with Wings Covered. The Pilot Sits in the Seat Provided at the Center, the Two Depending Fly-like Members Forming the Landing Shoes. The Top Photo Shows the Klemperer-Aachen "Motor-less" Monoplane in Flight.

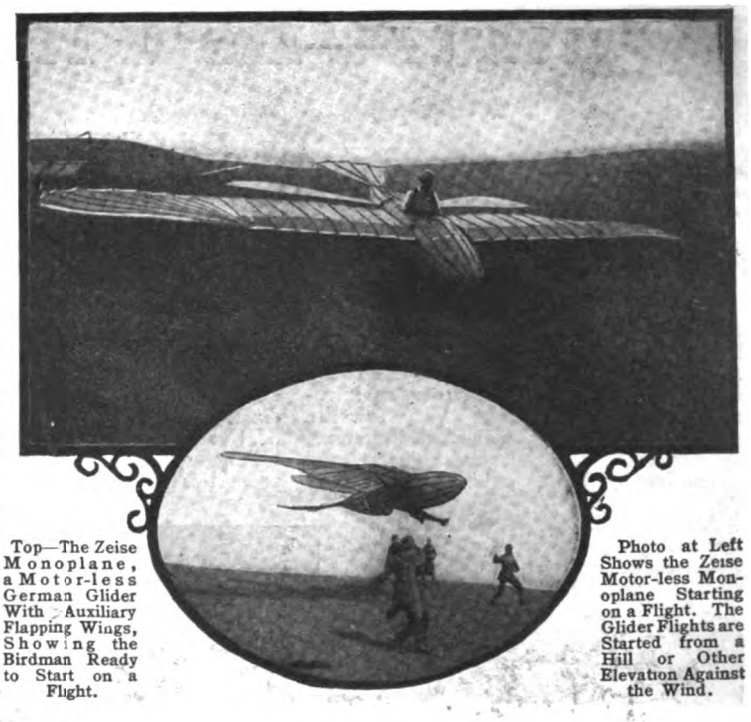
thru falls sustained on account of breakage of their crude wings or on account of their instability. All these early experimenters hung from single, double or triple sets of wings, when in flight and kept their balance by kicking out their legs in one direction or another. Finally, Mr. Octave Chanute, a French scientist who resided in our country, which he had made his by adoption, evolved the biplane type of *glider* after many experiments performed for him by A. M. Herring, and this was the type the Wright Brothers experimented with and finally developed into the first power-driven, man-carrying airplane. Gustave Whitehead, a pupil of Lilienthal, developed in this country a monoplane glider that always flew on a level keel, and which was far more stable in a fore-and-aft direction than the Chanute biplane type. Prof. Langley, too, produced a steam-driven double monoplane (one set of wings behind a first pair, on a long body) which flew about a mile over the Potomac river. His full sized machine fell in the river on account of faulty launching mechanism, and Charles M. Manley, his engineer, was almost drowned before he extricated himself.

As soon as Orville and Wilbur Wright learned of the experiments of Lilienthal, they obtained all his writings and studied them with avidity. Recognizing that the first essential to gliding was a long slope with a wind blowing up it, they selected Kitty Hawk, a spot on the coast of North Carolina, where there are vast sand dunes —veritable mountains of sand. They built their "gliders" in the Winter and tried them out every Summer for a number of years, each time making improvements. Having adopted the Chanute form of biplane, they improved it and its operation in two ways. They lay flat across the center of the lower plane and worked the biplane horizontal rudder, or elevator, with their hands, out in front where they could see it, and they devised a method of warping the wing tips by sliding their shoulders to one side or the other. Thus they made the man a part of the machine, the transverse or lateral equilibrium of which was maintained in a mechanical manner, instead of by kicking the legs to one side or the other as the flyer hung suspended. They eventually became proficient and were able to make long glides off from the inclined surface of the sand dunes. Then it was merely a matter of fitting an engine and propellers to keep pushing the glider into the air, in order to have sustained power flight. They found, however, that the biplane acted very differently when fitted with a motor, than what it did without, and it was not till December 19th, 1903, that they succeeded in making their first power flight. It took them nearly five years to master their machine so that they could fly it with confidence every time. Even then, their first Government airplane fell and killed Lieut. Selfridge and seriously injured Orville Wright, its pilot. With this accident, the toll of the air was transferred from the glider to the motor driven airplane, from which it has chiefly been collected ever since. But so safe have modern airplanes become that they are airplanes or airplane motors. Therefore they have contented themselves with gliders. With ample prize money put up by the German Air Ministry and aircraft constructors, the German Model Aircraft and Gliding Clubs have held meets last year and this year, at which world's records have been made. These meets were held under the supervision of the "Wissenschaftliche Gesellschaft für Luftfahrt" (Scientific Society for Aeronautics), and they have resulted in Germany carrying off all records of motorless flying, just as she was first before the war to keep an airplane aloft for 24 hours in continuous flight. It required the stimulus of war before we developed a motor that would equal this record, and last year the F-5-L flying boat, propelled by two Liberty motors, remained aloft 24 hours and 35 minutes, which is the record.

Characteristic German thoroness was manifested in both competitions, which were open to the world at large, in the hope that scientific knowledge regarding air currents and their mastery would be gained. Engineer Klemperer was the winner of both contests with his cantilever monoplane designed, built and flown by himself, and entered by the Aachen Aeronautical Society.

As can be seen from the illustrations, this monoplane has very thick wings built up of light plywood. The two legs forming the undercarriage, the front end of the body containing the pilot's seat, and the wings form one unit; the body or fuselage behind the wings and carrying the tail form the other. Skids

are placed at the bottom of the legs or streamlined "trousers" for the machine to alight upon and start from, no wheels being necessary. The spread is 9.3 meters (30 feet), the wing area 16 square meters (172 sq. ft.), and the weight empty 57 kilograms (125 pounds). Altho it weighed four times as much as some of the old-fashioned biplane gliders such as were entered by the Nuremburg Pilot Preparatory School, for example, it covered 1,830 meters (6,006 feet) on Sept. 6th, 1920, as against 520 meters of the latter, while it made a duration record of 2 minutes 22 3/5 seconds the next day. These world's records of last year were doubled and trebled on August 30th, 1921, when Herr Klemperer first made a duration record of 5 minutes 32 seconds, and afterward a flight of 6,800 meters (4¼ miles) in *13 minutes time,* during ten of which he maintained the 400-foot altitude which he had gained in the first few minutes. Starting from the slope of the *Wasserkuppe,* a 3,000-foot high mountain in the Rhön district in western Germany, Pilot Klemperer's machine was off the ground as soon as it had been pulled a couple of yards against a 25-mile wind by six men with two ropes. It bounded upward 30 feet the first second—a rate of ascent of 20 miles an hour—and continued to climb in a series of steps for three minutes. It flew toward the village of *Trankhof,* all the while gaining height until, at the end of six minutes it had risen from 325 to 400 feet above the starting point. It rode the air waves perfectly, maintaining its altitude while passing over the villages of Heckenhofen, Brembach, and Schachern, looking for all the world like a regular motor-driven airplane as it flew steadily along. In a long, gradual volplane, it came to earth at Gersfeld. With circles and figures of eight it covered six miles. It had demonstrated the possibility of winning the prize of 100,000 francs for a flight from Paris to Versailles *without a motor,* and which Gabriel Poulain is attempting to win with an *aviette*—an airplane propelled by a man operating a propeller. A foot-operated propeller would undoubtedly be of some assistance in riding the air currents, but future gliders will probably have a small motor that can be started whenever there is need, and it is probable that with the help of such a motor such air sailing or soaring may be eventually kept up for hours at a time and considerable distances covered. Thus the internal work of the wind will be harnest, and it will not be necessary to carry a deadweight load of engine and fuel. Once the atmospheric electricity can be caught and utilized, a small electric motor like the starter motor of one's auto will suffice to keep the airplane flying when the air currents are not buoying it up. Then the dream of Santos Dumont, when he used to fly his little *Demoiselle,* will come true, and everybody will be flying free of charge, just as to-day one can attach a telephone receiver to a tree and hear the radio messages that are flashing past.



Top—The Zeise Monoplane, a Motor-less German Glider With Auxiliary Flapping Wings, Showing the Birdman Ready to Start on a Flight.

Photo at Left Shows the Zeise Motor-less Monoplane Starting on a Flight. The Glider Flights are Started from a Hill or Other Elevation Against the Wind.

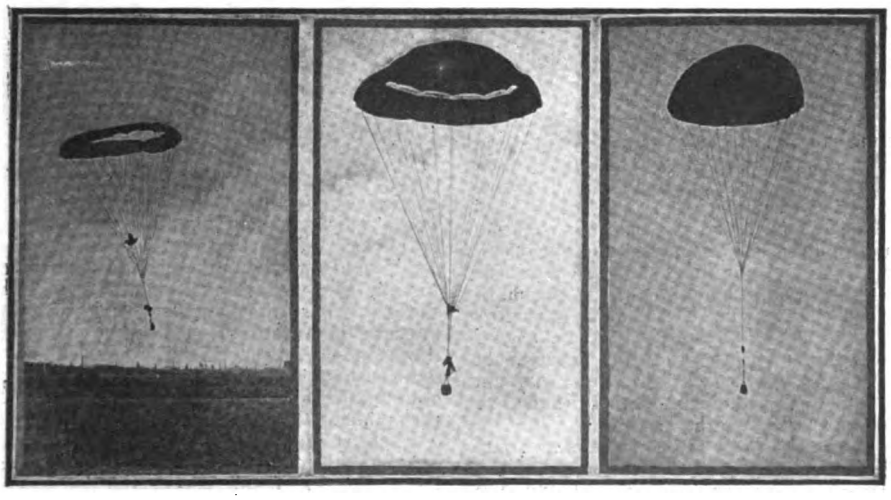
Within a week after Herr Klemperer made his great flight Martens, on a *Hanover* (Pröll) monoplane, raised the record to 15 minutes 40 seconds, in which time he covered 7,200 meters (4½ miles). He kept at or above the level of the start for 11½ minutes, and finally landed after volplaning 1350 ft. in the last 4 minutes. Herr Harth, however, soared for 21 minutes and was only 40 feet below the starting point when he alighted. On September 6th, he remained aloft 22 minutes.

Double Airplane Parachute

THRUOUT the war the Germans made use of parachutes to enable their airmen to escape from disabled or burning aircraft. The aviators of the Allies scorned to use such safety devices and threw their lives away recklessly and needlessly, also incurring a great monetary loss, since it cost from $25,000 to $50,000 to train an aviator.

Before the war was over the Germans had started to develop new types of parachutes suitable for use with the high-speed airplanes that were rapidly coming into use. In jerking a 220-lb. man out of such a machine making over 100 miles an hour, there is a 10-ton pull exerted by the parachute—a force it can never withstand. Consequently the new form of *ring parachute* shown herewith was invented. The big outer ring opens first and takes half the strain, checking somewhat the fall, but not enough to prevent the regular one to moving into its place within the ring, where it forms a single huge parachute that drops very slowly (about 10 miles an hour) to the ground.

This new invention has made it possible to let a complete airplane with its load safely down to terra firma in case anything breaks or goes wrong.



By Means of the New Two-Part or Double Parachute Here Illustrated, Heavy Loads Can be Released Safely from an Airplane in Flight, It is Claimed. The Outer Ring of the Parachute Opens First as Shown at the Left, the Central Cap Rising and Closing the Opening in the Ring at a Later Stage.

Stainless Iron

The discovery of methods of manufacturing iron and steel which will enable those materials to defy rust and stain of all kinds is the latest romance of Sheffield industry. Iron and steel makers are still exploring the possibilities of applying the materials to new purposes.

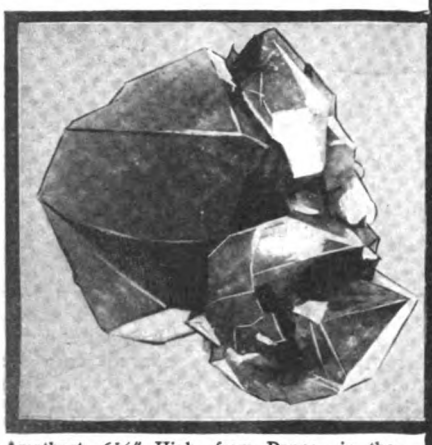
The extent to which the stainless steel has revolutionized the cutlery trade is widely known, but stainless iron is of equal importance. Both materials were discovered some seven or eight years ago. Stainless steel was first devised and soon after it was found that stainless iron could be produced, by much the same process, with the exception that a smaller quantity of carbon-free ferrochrome was required. It is the absence of carbon which eliminates the liability to rust. Stainless iron which is now being made by several Sheffield firms, is made by the addition of from 10 to 12 per cent of carbon-free ferrochrome. Silicon and manganese are present with sulfur and phosphorous as low as possible. In orde rto eradicate impurities and leave the iron practically carbon free it is generally made with a base of Swedish iron, which, is more elastic than other irons. The stainless iron is melted in an electric furnace. Large quantities were made before the war, but during hostilities, when munitions were urgently needed, and ferrochrome was short, its production was stopt. Since the armistice the trade has been resumed and is now carried on on a large scale. Carbon-free ferrochrome is a very expensive ingredient, and it is because less of this is needed in stainless iron than in stainless steel that the former material is the cheaper of the two.

Quartz—Its Place in Nature

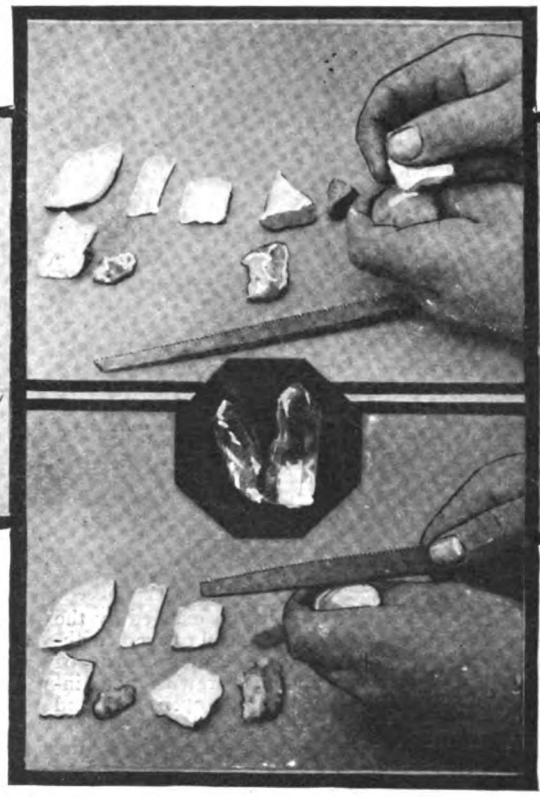
By Dr. ERNEST BADE

MINERALS in the form of stones and rocks form the solid material of the earth's crust. By far the greater part of the rocks like granite are composed of different minerals more or less closely combined forming an aggregate of many smaller pieces. Other minerals are found over a large extent of territory, as intrusions of veins and dikes. Very few are the number of rocks which, as limestone, consist wholly of but one mineral, and cover locally large parts of the earth's crust.

A mineral is not only a naturally occurring substance, but it has a definite and uniform chemical composition with just as definite and uniform physical properties. Very few of natural minerals are elements, by far the greater part are composed of a union of two or more elements. Gold is found as an element but not invariably so. Limestone, which is very abundant, consists of three elements, but *quartz*, which is the most common of all our minerals, consists of but two, silicon and oxygen in the proportion of one atom of silicon to two of oxygen.



Amethyst, 6½" High, from Penna., in the American Museum of Natural History, New York.



Top: Quartz Is Easily Scratched by a Topaz.
Bottom: Quartz Cannot be Scratched by the File.

The Beautiful Onyx—the Straight Banded Chalcedony.

Center Cut: Rock Crystals Showing Typical Hexagonal Prisms with Hexagonal Pyramid Termination.

This *oxide of silicon*, as it is also called, is found everywhere. It makes up the sand of our beaches, it is found in the deserts, it is the principal constituent and sometimes almost the only constituent of sandstone, and sometimes it is even found in the living plant. Here it is part of the fibres in the joints of bamboo, in rushes, and in some weeds. Under these conditions the silicon dioxide is taken up in water solution and deposited in the cell of the plant. Such is the origin of the petrified forests of Arizona.

Quartz is not only found as a soil, but as an important constituent in rocks such as granites, in sedimentary deposits, such as sandstone, and in metamorphic rock such as gneiss. A coarse grained sandstone formed thru the cementing together of larger pebbles is known as a *conglomerate*. At the same time quartz is often found pure as in rock crystal, and it is very common in its massive form.

Rock crystal is widely distributed; the best known localities in the United States are Little Falls, New York, and Hot Springs, Arkansas. They are colorless, glassy, hexagonal prisms, usually surmounted by a hexagonal pyramid, and as such they are placed in the hexagonal system of crystallization. As an additional aid in the identification of rock crystals their prominent horizontal striations on the prism faces may be taken as typically characteristic. Since this mineral is often used as a gem in rings under various names such as Little Falls diamonds, etc., its identification is of practical value.

Among the more important physical properties is its hardness which is 7. As such it easily scratches glass, is not marred by the file, and is scratched by topaz, and comparatively more easily by corundum and diamond. Its luster is like that of glass and its fracture is choncoidal. The color is variable.

It is infusible with the blow pipe. If the powdered material is taken and mixed with an equal quantity of sodium carbonate and placed in a cavity of charcoal, a clear glass, sodium silicate, will result from fusion with the blow pipe flame. Acids, with the exception of hydrofluoric acid, do not attack it.

One of the more important varieties of quartz, used as a semi-precious stone, is the familiar amethyst, which, when cut and polished, has a beautiful purple or violet color. The Greek word "amethystos," "not intoxicated," is very suggestive of its origin, for the ancients believed that, whoever wore an amethyst jewel, would be free from the evil of drunkenness.

The cat's eye and the tiger's eye both silica, are also semi-precious stones. The former, when cut in a round shape, is opalescent while the latter has a peculiar shimmer due to the fibrous structure of the quartz. The value of adventurine, another mineral of this class, lies in the odd luster of this gem which is produced by the inclusions of bright particles of yellow or red mica or brilliant scales of hematite.

Other common crystalline varieties are rose quartz, which is pink in color, milky quartz which is white, and smoky quartz which is black, due to the inclusion of finely divided and uncombined carbon.

The crypto-crystalline varieties of quartz are characterized by crystal structure, when observed under the microscope, and in addition these members have a waxy luster. Chalcedony is a translucent amorphous quartz material which has been deposited from aqueous solution. It is found lining and filling cavities in rocks and stones; it is often mamilary, botryoidal or stalactic in structure. The red or reddish yellow individual is carnelian, the green variety tinted with a trace of nickel oxide is chrysoprase, and if it is speckled with deep blood red or yellow dots, spots, and splashes it is the heliotrope, or bloodstone.

The concentrically banded agate and the parallelly banded onyx, now partially forgotten, were once in great demand. They are now but seldom found, except in the useful arts, where an extraordinarily hard and smooth material is required. Agate is exceptionally well adapted for mortars in which hard substances are to be powdered, also for polishing and finishing stones, and for knife edges in the more expensive chemical balances. The onyx was a much coveted material for cameos in ancient civilization, its variously colored bands lending themselves perfectly for the effective display of the jeweler's skill with his carving tools. And for this purpose they are even used today, some of the stones being artificially colored and the existing colors intensified by simply boiling them for months in honey and then placing them in sulfuric acid.

Flint is a dark colored, often black opaque quartz, only translucent on the edges with a white powdery thin outer shell. The lighter variety with a more

(*Continued on page* 870)

Automatic Phonograph Runs on Dry Cells

UNDOUBTEDLY many of us have rigged up an electrically driven phonograph, but two important factors have invariably interfered with the smooth and satisfactory operation of such electrically driven machines. The first is the fact that battery motors of the usual type are notorious devourers of electrical energy; while in the second place, it has been difficult to develop a satisfactory governor which would maintain a constant speed of the record turn-table.

The accompanying illustration shows one of the most interesting electrical phonographs ever developed and the editors have had the opportunity of hearing it play. They have also seen the reports showing how many records the machine will play on one set of six dry cells. The specially designed electric motor and governor takes only about 1/10th ampere from the battery of six dry cells, and this battery will play upwards of 2,000 standard disk records. This machine is unique in that it will play anywhere and it requires no electric light service for operating the motor, as it has its own battery, thus eliminating the everlasting cranking of the spring motor. In a test conducted at the Stevens Institute of Technology and in the report on these tests by Professor Louis A. Hazeltine, professor of electrical engineering at that institution, it is stated that this electric phonograph, invented and developed by Mr. James T. Sibley, has a more uniform speed and, therefore gives a more uniform tempo, than is obtained with spring driven phonographs. He further states that in his opinion, the unique principle of governing the speed as employed in this electric

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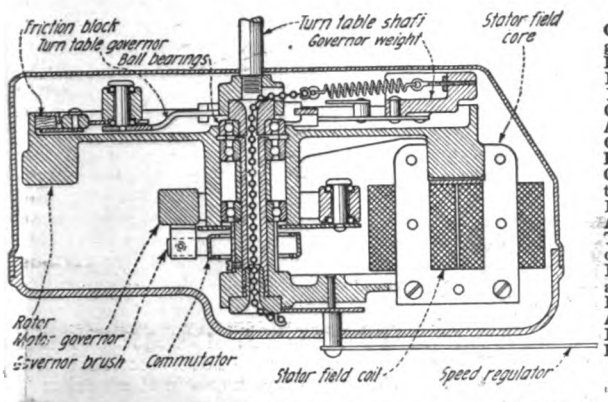
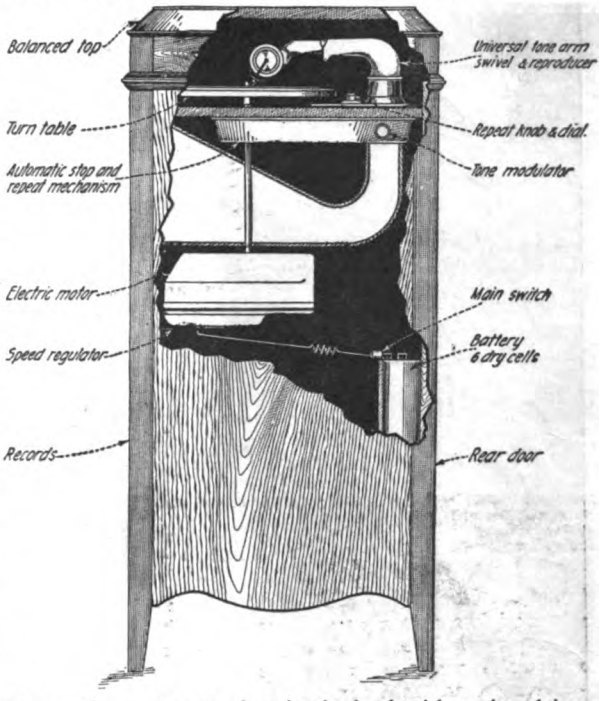




The Electrically Operated Phonograph Derives the Energy for the Motor from Six Dry Cells. These Cells Have Under Actual Test Played Over 2,000 Records. By Means of a Very Clever Governor, the Speed of the Machine is Kept Absolutely Constant The Special Reproducer Plays Every Make of Record and the Machine Repeats a Record Automatically as Many Times as the Repeat Index Dial is Set For.

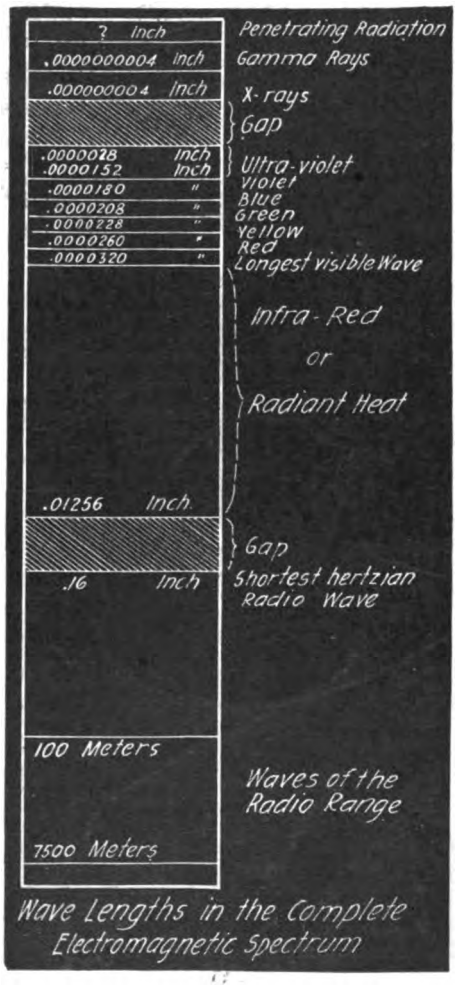
Denizens of the Ether

By HAROLD F. RICHARDS, Ph.D.

ONE of the most amazing developments of modern scientific research is the discovery of the rôle played by the *ether* in the transmission of energy. Ordinarily one thinks of light, X-rays, radiant heat and Hertzian or radio waves as distinct and unrelated physical phenomena. The fact is, however, that if we exclude sound and the corpuscles shot from radioactive bodies, we can say that all radiations consist of electromagnetic pulses in the ether, are of exactly the same nature, travel at the same speed and *differ only in wave-length*.

Everyone is familiar with the colors seen when white light is spread out into the rainbow spectrum by use of a prism or diffraction grating, and knows that these colors are due simply to the sorting out of the different wave-lengths contained in the white beam. We fall into the habit of considering this range of wave-lengths as the complete spectrum, yet the diagram graphically suggests how small a part of the whole electromagnetic spectrum is due to visible rays, and how comprehensive a series of experiments is required for its complete examination. The diagram is not drawn to scale, for the range of wave-lengths is so enormous that a very long sheet of paper would be required to exhibit accurately the proportions of the spectrum embracing the various forms of radiant energy.

An especially interesting fact about the electromagnetic spectrum is that a relatively small difference in wave-length may produce a very pronounced change in the effect of the rays. A wave one-sixteenth as long as the shortest radio or Hertzian wave will affect our instruments as radiant heat, and not as a wireless message. Heat rays occupy a long range of wave-lengths in the spectrum and emerge suddenly into visible light, as the wave-length is gradually diminished. A wave five-sixths as long as the red ray will affect the eye as green, and a further reduction of 25 per cent in the wave-length brings us to the shortest visible violet ray. The ultra-violet rays which follow do not affect the retina but produce an intense chemical action upon a photographic plate. Ultra-violet rays are approximately 700 times as long as X-rays. This comparatively small change in wave-length is accompanied by the appearance of new properties, such as the power of penetrating the human body, of exciting fluorescence and of ionizing a gas so as to make it a conductor of electric currents. Gamma rays from radium are one-tenth as long as X-rays and possess much greater penetrating powers, *being able to pass thru thirty inches of solid iron*. There is still another radiation, of shorter but unknown wave-length, which is termed the penetrating radiation from the sun. To these rays are attributed the peculiar ionization effects observed within a vessel which is adequately protected against the most penetrating known radiations, and the researches of Stormer indicate that they are intimately connected with the aurora borealis.



Besides the fact that all these different forms of radiation consist of electromagnetic vibrations in the ether, we must note that they possess two other points of similarity. One is that they are all transformed into molecular heat when absorbed by matter, and the other is that they travel with the same speed, namely 186,000 miles per second. Comparisons are inadequate to furnish any concrete conception of this velocity, but nevertheless it is interesting to observe that an airplane moving with the speed of light could *encircle the earth 444 times in one minute*. Probably the fleetest quadruped known is the Mongolian

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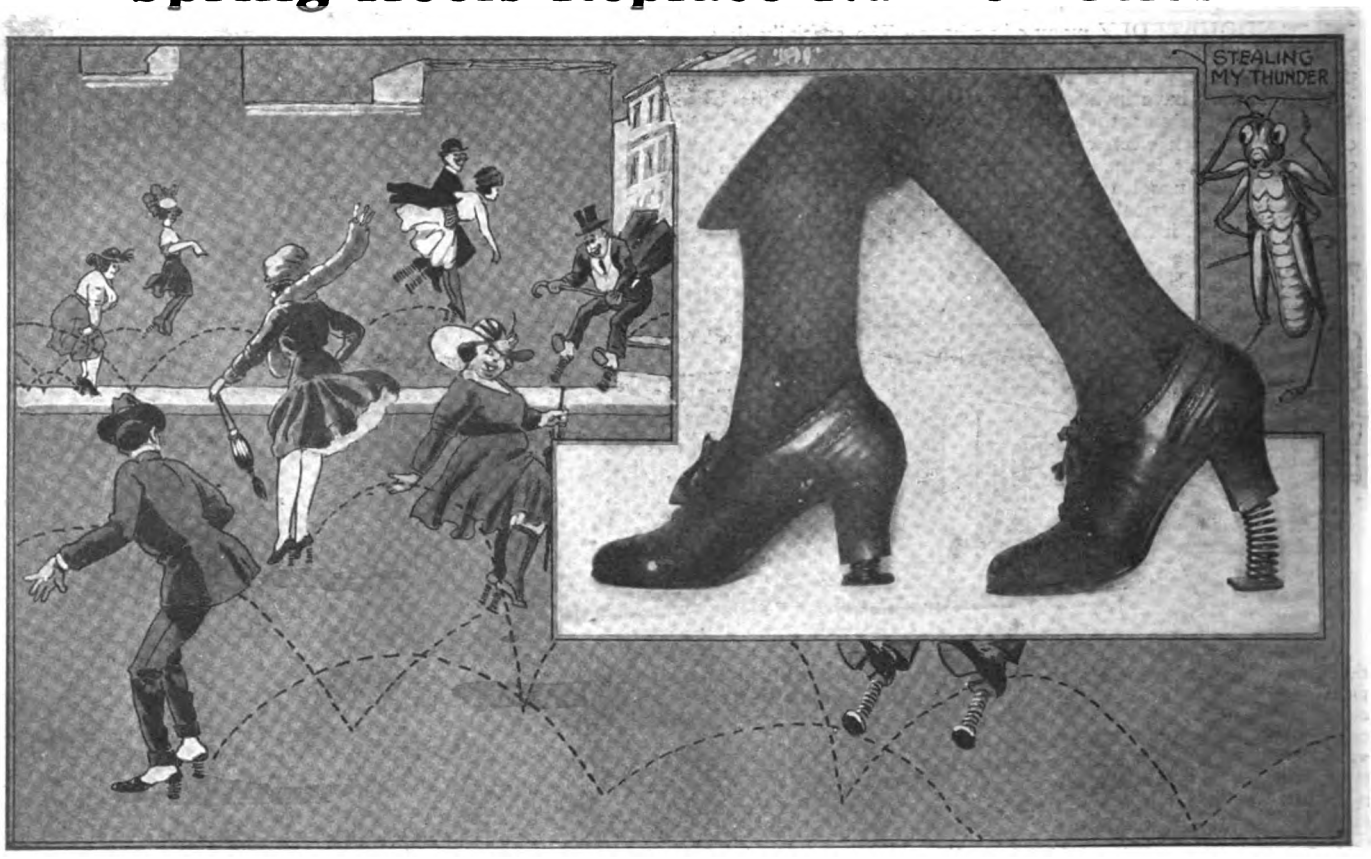
Spring Heels Replace Rubber Ones



Easy Walking with Spring Heels. These Heels are Made of Steel and Fitted Inside is a Spring Attached to a Ground Pad. The Tendency of the Springs is to Raise the Foot After the Completion of Each Step and a Spring-like Walk Can be Attained, it is Said.

The rubber heel industry may possibly get a severe jolt, if the dreams of our friend, the English inventor, who has perfected the spring heel here shown, come true. The actual photograph in the upper right hand corner of the illustration shows just how the new spring heel looks. We have not tried walking on springs since we grew up, but we have a somewhat nervous recollection of having tried to walk about on springs nailed to the heels of our shoes, which springs the gang purloined from a nearby railroad yard. We do not mean to say that spring heels are not all that their inventor claims for them, but as aforesaid, we are just wondering how it feels the first time you leave your doorstep and take a spring walk. Quite possibly the inventor has arranged the moving part of the heel and the spring so that it will not wobble, but, unless this is done, it is a very ticklish job to try and stand up on two springs no matter if they are quite short. And as one walks, the tendency to throw the weight in several different directions is very noticeable ordinarily speaking. Commercially considered, we doubt whether spring heels such as this, would prove any cheaper than rubber heels, and unless the material used in making them was non-rusting, there would be an objection to them on this score. Mr. Paul, one of our able staff of artists, has shown his conception of how we will walk, or rather hop, along the street when the spring heel has taken hold of us. Possibly this may suggest an idea to toy makers for developing a spring heel for the kiddies to amuse themselves with.

Silo

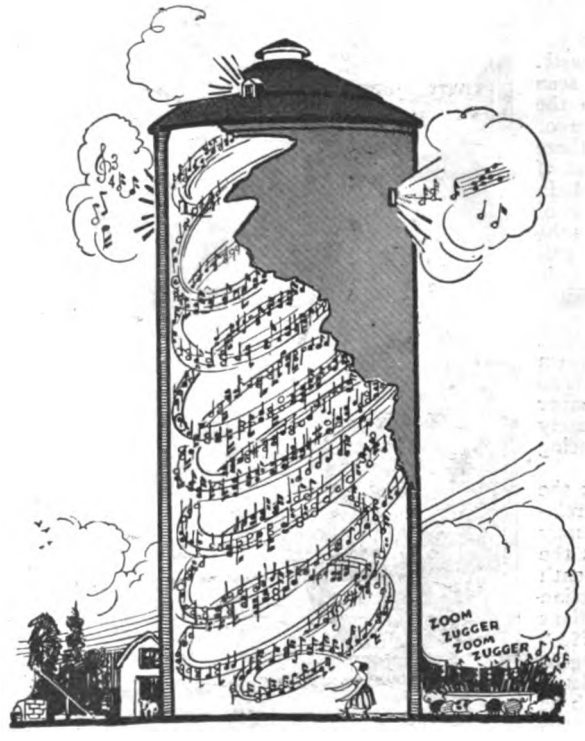
A PIONEER in the field of vocalization appears in the person of Miss Elizabeth Stokes, of Chicago. For the past three summers, during her vacations, she has used the silo of W. J. Probert, near Dousman, Wisconsin, for her private studio. It was discovered but recently by editorial friends, and now they're "telling the world."

She sees nothing startling in this latest innovation for the musical world, and declaims as follows:

"Why all this comment about singing in a silo? Because I spend my summer vacations on a farm, and practice my singing in a silo, my friends tease me and smile indulgently, as if humoring an eccentric.

"A silo is the most honest, unbiased critic I have found. It clarions forth my vocal faults and faithfully echoes my vocal virtues. I use it as a huge resonator, in much the same way a piano sounding board is used.

"Sing I an unsteady tone (perish the thought!) the vibration



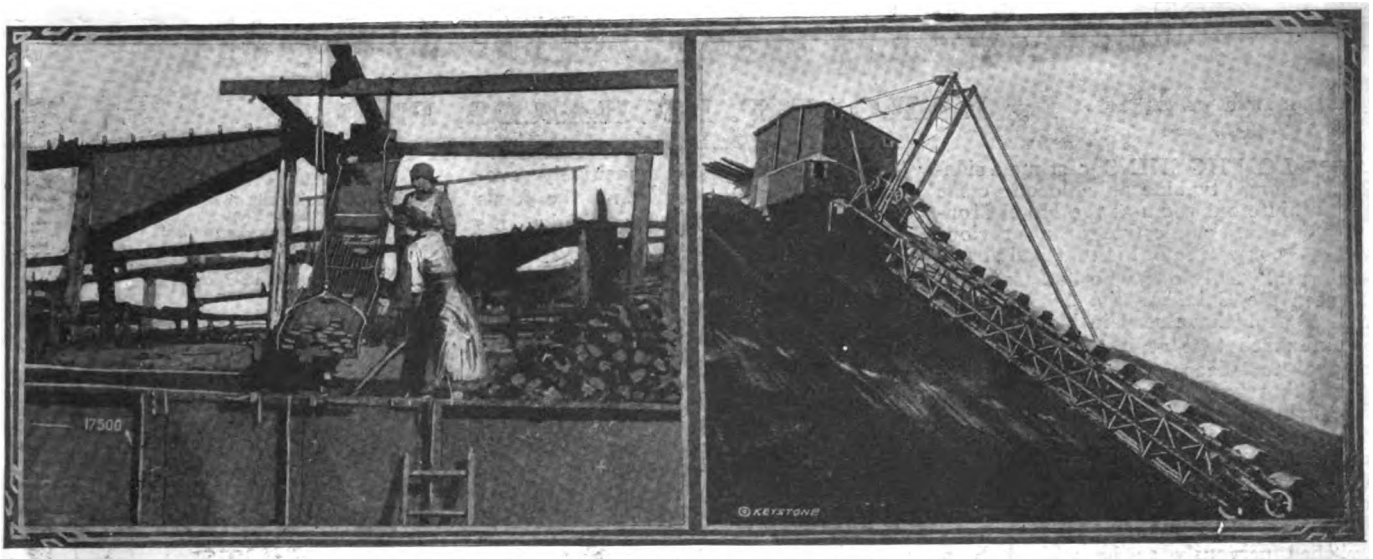
Opera

wavers slowly to the top of the silo, and gives back a weak unsteady reply. Sing I a clear free tone, it vibrates instantly at the top—and continues a few seconds after I have ceased singing. An imperfect tone can hardly be heard outside the silo. My pure tones . . . Well, I have been heard more than half a mile, so the country folk said.

Speaking of Acoustic Amplifiers, What's the Matter with Practising Your Arias in a Concrete Silo, as Did This Soloist, Miss Elizabeth Stokes of Chicago, Ill.? The Notes Swelled and Amplified in Great Fashion, She Says, and Some of Them Were Heard Over One-Half Mile Away.

"The silo I practiced in is made of concrete, thirty-six feet high, with a concrete and iron dome. It faithfully reproduces and magnifies the perfect tones.

"You who are practicing singing would do well to leave your vanity at home, and go to work with the echo in the silo. It will give back exactly what you send it."—Terence Vincent.



Loading Coal Briquettes Into a Car, Showing How Well They Stand the Trials of Transportation.

Open Working of a Coal Mine in Germany, Mechanical Shovels Extracting Coal Adapted for Briquette Making.

Briquette Fuel of Europe

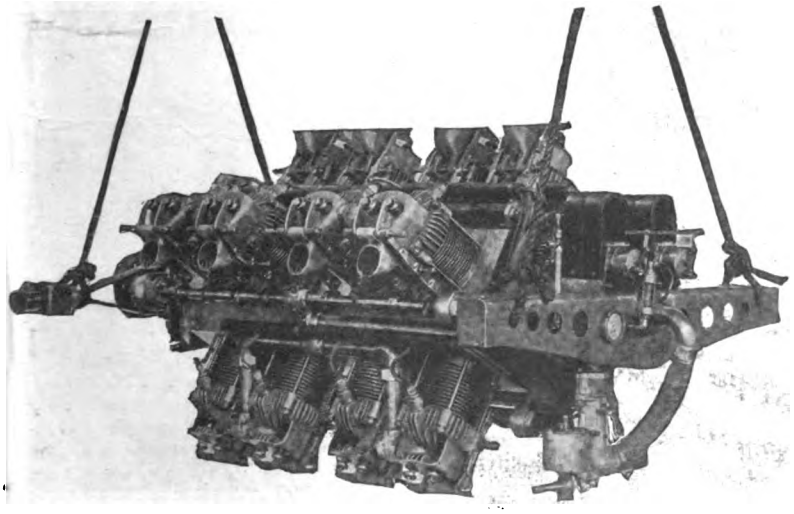
Tourists in Europe, including those of the book variety, are familiar, often unpleasantly so, with the briquette fuel used on the railroads. The systematic economy of Europe does not look with favor on the wasting of any kind of coal, and the idea of throwing coal dust away into the culm heap is not approved there. The briquettes are made by pressure with a cementing material, and the result of the treatment takes the form of little bricks, some four or five inches in diameter, which can be shoveled about, can be loaded, and discharged from cars without going to pieces.

In the briquettes there can be utilized coal of dustlike fineness, nothing need go to waste. One of our cuts shows the open coal mines in Germany, whence some of the briquette coal is taken. In the case illustrated, the coal lies above a hard stratum of rock. Shovels on an endless chain are operated by power, and scrape off and load the pulverulent coal into cars. There are some large pieces mixed with the fine. The cars take it to the shop where the fine stuff is sifted out and made into briquettes, whose appearance can be seen in the cut, showing the loading of the briquettes for transportation.

16-Cylinder Aviation Engine

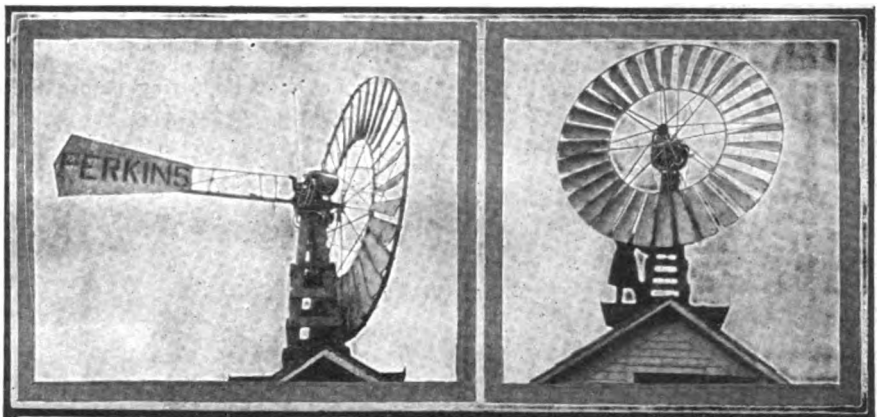
The new aviation engine shown in the accompanying illustration has been developed by an engineering concern of Buffalo, N. Y., and is remarkable in the fact that it comprises four sets of four cylinders placed 90° apart or 16 cylinders in all. It is firmly believed that this engine will surpass the famous Liberty motor in the horse-power developed per pound of engine weight. This engine, altho not developing as much horse-power, in its present design, as the new 1,000 horse-power British airplane engine, marks a new departure in American engine design.

The cylinders are fitted with specially designed exhaust ports to admit of carrying out the burnt gases from the cylinders very rapidly, and overhead valves are employed as can be seen from the photo. A special carburetor system has been developed for use on this engine, so as to supply the four sets of cylinders with an even flow of gas and air at all times.



A Buffalo-New York Concern Recently Completed One of the Most Powerful Aviation Engines Ever Built in America. This Engine Has Sixteen Cylinders, and It Is Firmly Believed That It Will Surpass the Liberty Motor in Horse Power Developed per Pound of Engine Weight.

Electricity from the Wind



A New Design of Windmill Electric Generating Plant Is Shown in the Two Illustrations Above. It Represents a Very Compact and Efficient Unit, and Is Provided With a Clever Speed Governor.

The photographs herewith show a new windmill electric generating plant installed on the roof of a barn. Of course the wind wheel should be erected at a fair altitude, so as to take advantage of all the wind currents possible. This particular generating outfit has been specially developed and perfected so that by means of a clever speed governor which compensates for changes in the pressure of the wind, a constant voltage is obtained at the dynamo. Farmers and suburban dwellers everywhere are interested in any such plant as this, for the reason that there is no tax to be paid on the use of the wind.

The power in a gale of wind even tho blowing at a velocity of but 20 to 30 miles an hour, is quite surprising indeed; a 12 to 15 ft. diameter wind wheel will develop several horse-power when the wheel is properly designed and arranged. Many farmers use electric wind-mill power plants.

The Vibrator of Death

By HAROLD F. RICHARDS, Ph.D.

ELON HOPKINS cast me a sidelong twinkle as Flocon came into our room at the Hotel Mondain, suggestive of a previous conjecture of his that had struck the truth. Only one who had frequently seen the Chief of the *Service de la Sûreté* could have read in his impassive countenance that at last he had found a pool too deep. Once before I had noted that general darkness on his face, like a black veil fitted over the marble features of a bust, so I let fall the lid of my steamer trunk; it was now quite clear that the four-ten would leave without us. Flocon plumped his fat body down upon the trunk, and his moustache twitched nervously as he addrest Elon.

"Hopkins, you've got to help us," he began abruptly. "We can't locate the source of the radical propaganda that is tying up the country, and Camproger said a week ago that I'd have to get either action or help. I guess it's the latter."

Elon's blue eyes twinkled, but his features remained motionless.

"And Marie Denbaule?" he queried, looking up from his pipe.

"I'm coming to that replied Flocon smoothly. "Three weeks ago the shipbuilders struck at Cherbourg, and two days later, the potters at Limoges; then, in rapid succession, the principal industries at Nantes, Bordeaux, and Lille. Rouen, Rennes, Angers and Tours are tied up tighter than a drum. But the strange feature of the situation is that the workers gave no indications of dissatisfaction until this infernally clever propaganda began to flood the country. We have a score of local leaders in jail, for they've been waxing positively revolutionary, but we can't find the focus of infection. Camproger thinks it's a political plot. Gaudet has been absent from the Chamber for days at a time, on and off for the last month. We've tried to trace his movements, but my best men lose him."

"He is the leader of the Left, isn't he?" asked Elon.

"Yes. He expected to be the next minister, but the work of the Conservatives at the peace convention was too good to be overlooked, and Camproger got in. Since then Gaudet has been strangely quiet, and the Conservatives had things all their own way until these strikes began. In the last three weeks the confidence majority has shrunk from 497 to 28, and Camproger told me this morning that his cabinet will fall in two weeks, if we can't stamp out this propaganda."

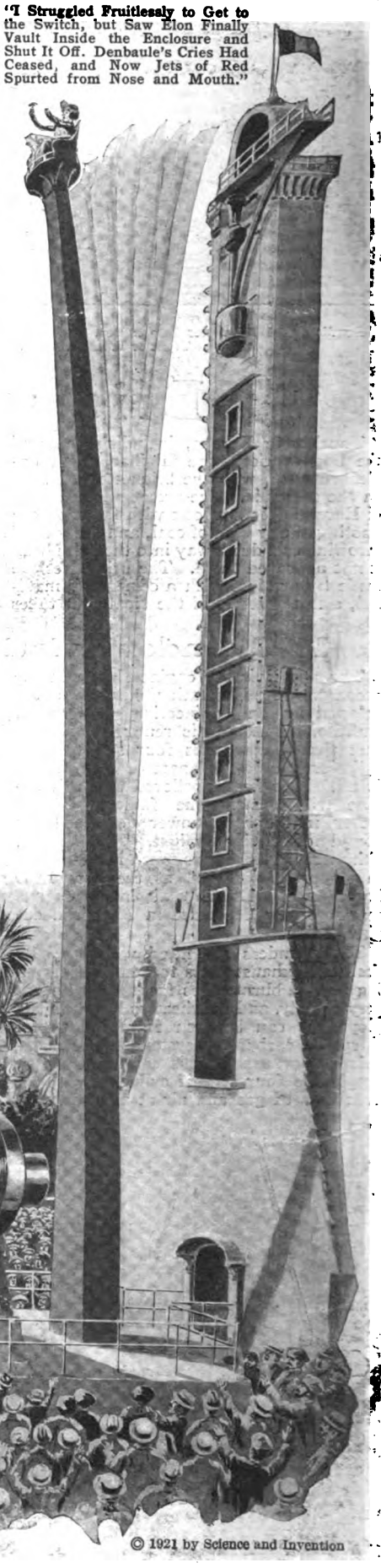
"It appears obvious, Flocon," interpolated Elon, eyeing the tip of the Chief's nose with aggravating calmness, "that Marie Denbaule is doing more good than all the government forces. She seems to exert a tremendous influence upon the people."

"She is known for her personal magnetism," responded Flocon, as if he begrudged the tribute, "and no one can deny the qualities of her mezzo. Yesterday the steel-workers in Nevers went back, to a man, after she had sung and spoken to them. And she will not stop, despite the threats against her."

"You are providing her with ample protection, Flocon?" queried Elon. "Her voice is one in a generation."

"Camproger insists upon it. Since she will not stop appearing before the

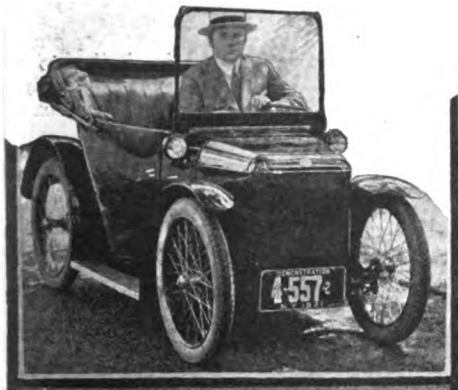
(*Continued on page* 871)

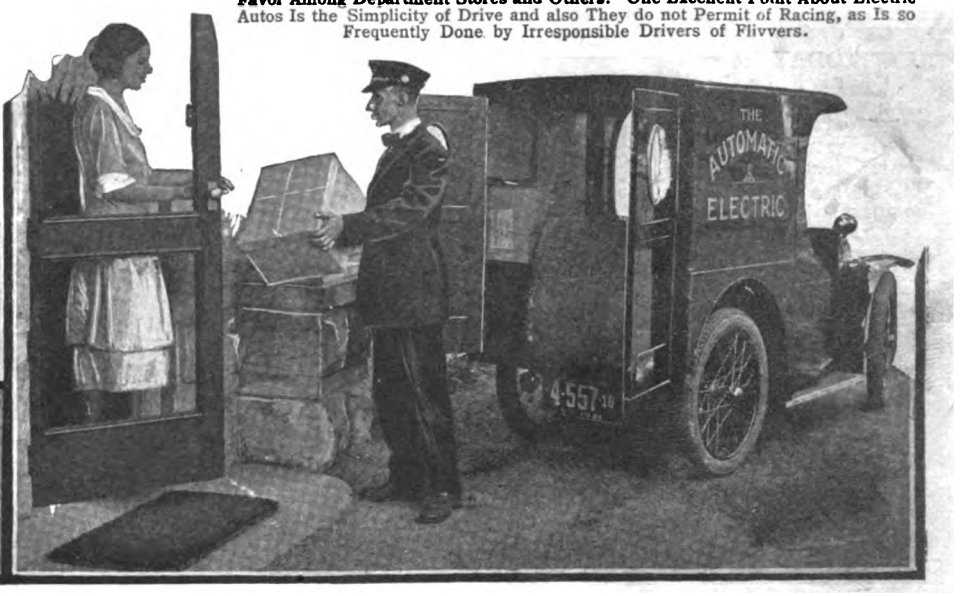


"I Struggled Fruitlessly to Get to the Switch, but Saw Elon Finally Vault Inside the Enclosure and Shut It Off. Denbaule's Cries Had Ceased, and Now Jets of Red Spurted from Nose and Mouth."

Small Electric Auto De Luxe

The Electric Automobile for Commercial Delivery of Packages Holds Considerable Favor Among Department Stores and Others. One Excellent Point About Electric Autos Is the Simplicity of Drive and also They do not Permit of Racing, as Is so Frequently Done by Irresponsible Drivers of Flivvers.





The Photos Show Two Types of a New Electric Automobile Recently Brought Out by an American Manufacturer. It Sells for $1,200 and Is Particularly Well Built. It Has a Radius of 60 Miles at a Speed of 15 Miles an Hour. It May be Housed in a Space Measuring 4 by 8 Feet. The Auto Is Propelled by 14 Storage Battery Cells Operating an Electric Motor of About 1 1/7th Horse-Power.

We illustrate a miniature electric motor car, which is supposed to embody economy and ease of operation to a high degree. It has a very short wheel-base, 65" and its tread is 35", so that it can be used in contracted places, as in factory yards and the like. This wheel-base is over three feet, less than that of the full-sized automobile, and its tread is over a foot less than the same dimension in standard cars.

The automobile operates by means of a storage battery which gives it a radius of action of 60 miles at 15 miles an hour. It weighs only nine hundred pounds. It can be parked in a very small space, one of four by eight feet area is sufficient, as its overall length is 95", and overall width is 42½".

A charging equipment for alternating or direct current is part of the standard equipment, so that the battery can be charged at home. It turns with an extreme radius of 152" to allow for body clearance—the wheels follow a circle of 144" radius. The body is metal panelled with wooden frames. The motor is rated at 24 volts 35 amperes, or about 1 1-7th horsepower and is driven by 14 storage battery cells. The battery is of 123 ampere-hours capacity. A drum-type controller gives 3 speeds forward and reverse. It is good for a load of 500 lbs. dead weight. Two styles of pleasure and one style of delivery cars are being made at present.

$300.00 Prize Contest

The Simplest Radio Outfit

A GREAT change has recently come about in Radio. Due to the activities of the Radio telephone, it is now possible for every layman to hear daily Radio lectures, Radio music, jazz, opera, etc., if he has in his possession even the cheapest Radio receiver. Due to the activities of the Westinghouse Company who have Radio telephone broadcasting stations at Pittsburgh, Pa., Newark, N. J., Springfield, Mass., as well as Chicago, Ill., from which the Company is sending every day from 10 A.M. to 10 P.M. all sorts of entertainment, people in all walks of life have become aroused to the wonders of the Radio phone.

The editor's desk has become flooded with letters from laymen who wish to install a simple radio outfit, and being non-technical, they do not know how to go about it. Of course, they can go in the open market, and buy outfits and apparatus, but many cannot afford the price, or do not wish to invest much money until they have given Radio a thoro try-out, and have become convinced. Once they reach that stage, they are ripe to buy expensive apparatus.

It is like the amateur photography game. A novice does not buy a $75.00 camera as a rule, but starts in with a camera costing a few dollars, often a dollar camera will do.

The editors of *Science and Invention* desire to convert this year thousands of people to the Radio game, and in order to do so they wish to make it easy and painless (to their pocketbook) to them. Hence our big prize offer "*The Simplest Radio Outfit.*"

Naturally, the simplest radio outfit would contain the following: a detector, a telephone receiver, a tuning coil, an aerial, and a ground. As the Westinghouse Co., for instance, is sending on a wave length of 360 meters, it would seem desirable to have a tuning coil, or a tuning appliance to tune in to this wave length. It would also be desirable to bring in the Arlington time signals, ship reports, etc., and therefore, we need some sort of a tuning device.

What we want is a home-made outfit. The prizes will be given to those sending in the best designs of simplified apparatus that can be made by anyone, with tools found at home. Bear in mind that this contest might be called *Home Radio* Contest. It should not be necessary to buy apparatus with the exception, perhaps, of the telephone receiver. All the other apparatus should be made by the average man *knowing nothing whatsoever of Radio*, and little about mechanics. Simplicity must be the keynote, but of course the outfit must work. The outfit may be mounted on a board, encased in a box, or any other way, all at the option of the designer. **In no instance must the total cost of the entire outfit be higher than $3.00.** To win the first prize, we make the condition that *the author must have built the outfit himself*. It must have been tested by him, and must work satisfactorily in all instances, in proof whereof the editors request a photograph of the outfit, and reserve the right to ask for inspection of the outfit, if this should be necessary. The smaller the outfit, the better the editors will like it. Also the cheaper it can be constructed, the better the chance to win the prize. It is immaterial from what the outfit is constructed, and this will be left to the designer.

1st Prize $100.00 in Gold
2 Prizes each of 50.00 " "
4 Prizes each of 25.00 " "
Total, $300.00

While it is not absolutely necessary that a model be submitted with your entry, we venture to say that the judges would rather like to see a model, as it is often much simpler to judge an idea if you have the actual article before you; this is not absolutely necessary, but desirable. In all events a complete sketch must be furnisht by the contestant.

No manuscripts entered in this contest can be returned. We reserve ourselves the right to publish all worthy ideas, which did not win a prize by paying regular space rates. In publishing the various ideas, all the rights revert to the publishers. Use only one side of the paper for writing and keep sketches on a separate sheet. No penciled matter can be considered. More than one idea may be entered by contestants. The contest is open to everyone, radio clubs included, except manufacturers of wireless apparatus. All prizes will be paid upon publication.

This contest closes at noon, February 15th, and all entries must be in at that time in order to be qualified. Should two contestants submit the same idea, the same prize will be paid to both.

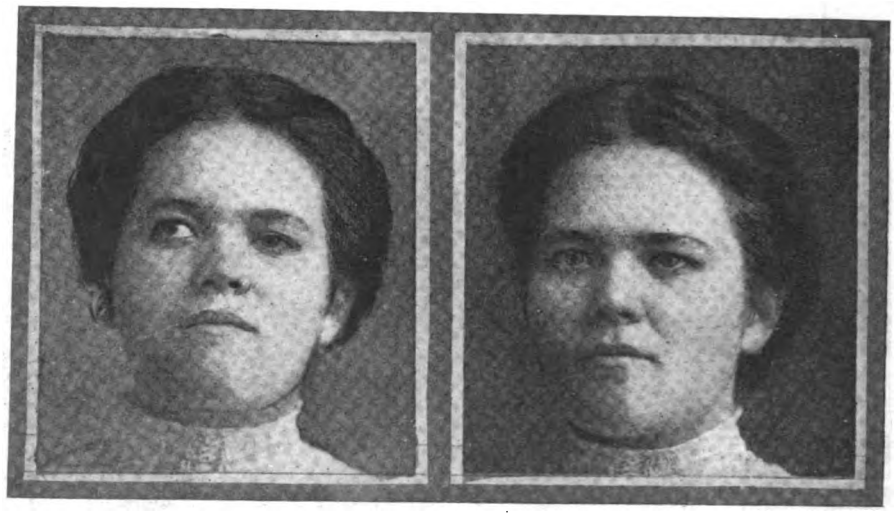
Address all communications to *Editor*, "*Simplest Radio Outfit*," care of this publication.

Do We Need Eye-glasses?

By JOSEPH H. KRAUS, Staff Medical Expert

TODAY may rightly be called the eye-glass age, when the craze for wearing eye-glasses is very similar to the tooth extraction craze of a few years ago. People all around us are heard to exclaim, "I can't see a thing without my glasses," or "My sight has gone back on me."

For quite a number of years Dr. William H. Bates, of New York, has been curing individuals afflicted with all sorts of eye troubles and defects, discarding the prescription of eye-glasses entirely and restoring normal sight without any operative means. This assertion may sound rather surprising, but here are a few facts which will bring the reader to the point of realization of the magnitude of his work, and at the same time make him look into the subject with a little more than passing interest, if he or she is condemned to wear glasses by the oculist's order. At Grand Forks, N. Dak., where Dr. Bates' method is now in vogue, the children in the Public Schools have less than one per cent eye defects. In other words, out of every one hundred children only one, for example, will have any difficulty with his eyes, whereas prior to the introduction of his methods and their general adaptation, eight per cent defects were the usual condition. In 1913, one thousand children with defective eyesight in the Public Schools of New York, regained normal vision by the same system. In one class alone where there were twenty-seven children with defective sight, all improved, and twenty-five out of the twenty-seven were absolutely cured. In addition one incorrigible and one truant became good students.



Actual Photographs of a Case of "Squint Eye" Treated by Manipulatory Exercises. Note the Remarkable Change in the Individual After Such Treatment Had Progressed for a Short Time. Subsequent Photos Show Even More Perfect Alignment of the Eyes.

It is not to be assumed for one moment, that Dr. Bates has a rather far-fetched idea upon which he is basing his work. He has conducted a series of experiments extending over a period of more than 30 years, during which time the Helmholtz theory of visionary accommodation has been absolutely disproven.

Before considering Dr. Bates' exercises, with which he has been able to secure such remarkable results, we will study for a minute the Helmholtz theory and its absolute disproof. Roughly, the eye consists of the eye-ball which may be likened unto a camera. Parallel rays of light entering the eye first strike the cornea which bends the ray, partially focussing it. The cornea is on the outer surface of the eye in front of the lens and is similar to a watch glass. The rays of light then pass thru the lens itself, some of them being cut off by the diafram known as the iris. They then impinge upon the retina if the eye is properly focust where, due to certain changes, we receive our sense of vision by means of the optic nerves connecting with the brain *sight center.*

According to the Helmholtz theory of visionary accommodation, the lens of the eye changes its shape so that it bulges and is considerably thicker when the eye is directed at an object close to it, whereas when the eye is at rest the lens is conceded to be narrower. Helmholtz happened upon this discovery by watching the images reflected in the eye. This result and how it was obtained is shown at the left of our illustration. When the eye is at rest, there are three distinct images which may be seen in it: one on the front of the cornea; the other on the front of the lens; and the third observed by Helmholtz supposedly on the back of the lens. The eye then accommodates itself and the lens thickens or so Helmholtz concluded, and the result is that the distance between the erect image on the front of the lens and the inverted image on the back of the lens, becomes greater. At the same time, the image on the front of the lens decreases in size. Helmholtz then ascribed these findings to a change in the thickness of

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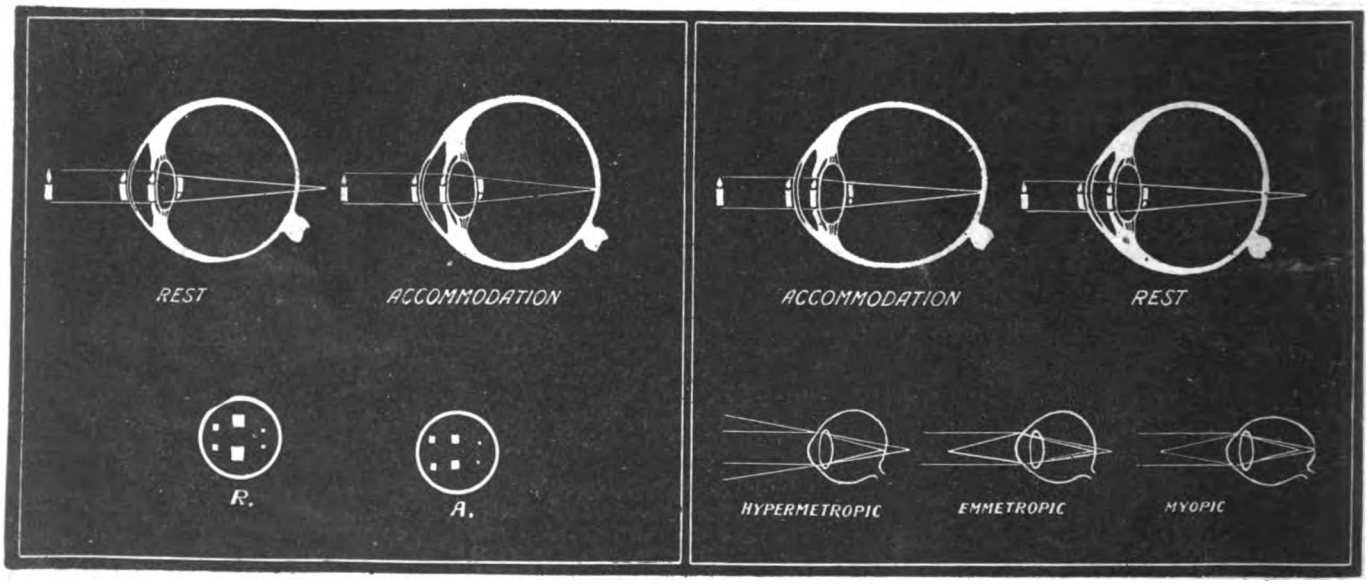


The Images of a Candle Reflected in the Eye. In Any One of These Schematic Diagrams at the Extreme Left We Have the Candle Itself, Then Its Reflection on the Cornea. Further to the Right Another Reflection on the Outer Surface of the Lens and at the Extreme Right a Reflection on the Inner Surface of the Lens. In Accommodation, the Lens, According to Helmholtz, Thickens. Below, We Have Two Circles Showing How the Image of Two Squares Reflected in the Eye Change During Rest and Accommodation. Note the Difference in Distances and Size.

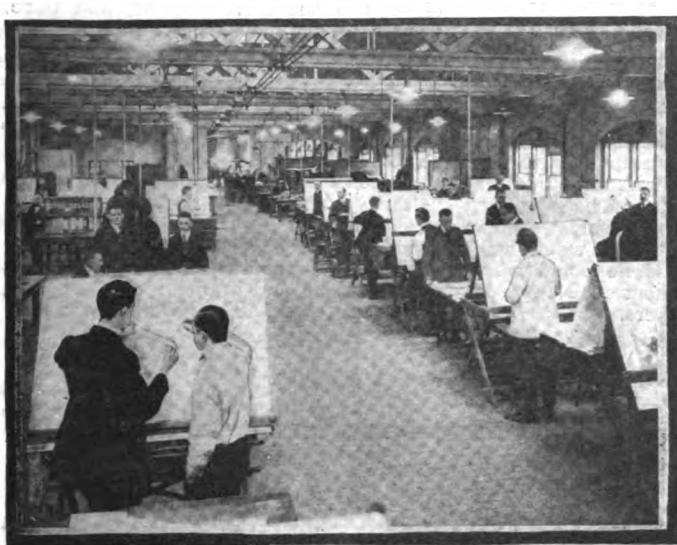
Proof Now Brings to Light the Fact That the Lens of the Eye Does Not Change Its Thickness for Accommodation or Rest, but That the Eyeball Itself Elongates. Normally, or When the Eye is at Rest, the Focussing Point of Nearby Objects is in Back of the Eyeball, but for Accommodation the Eyeball Elongates Sufficiently to Bring the Focus on the Retina. Below is the Far Sighted, the Normal, and the Near Sighted Eye Shown Schematically Together With the Rays of the Point of Formation of Images.

Shall I Take Up Engineering?

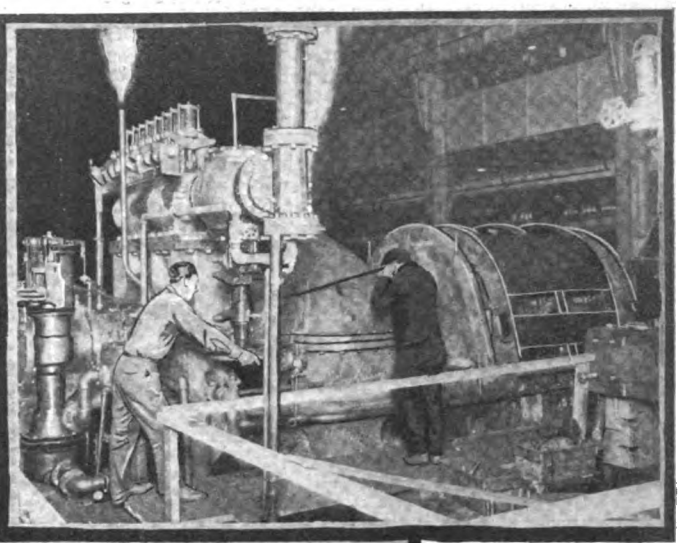
The Duties, Salaries and Opportunities in Engineering Today

By H. WINFIELD SECOR

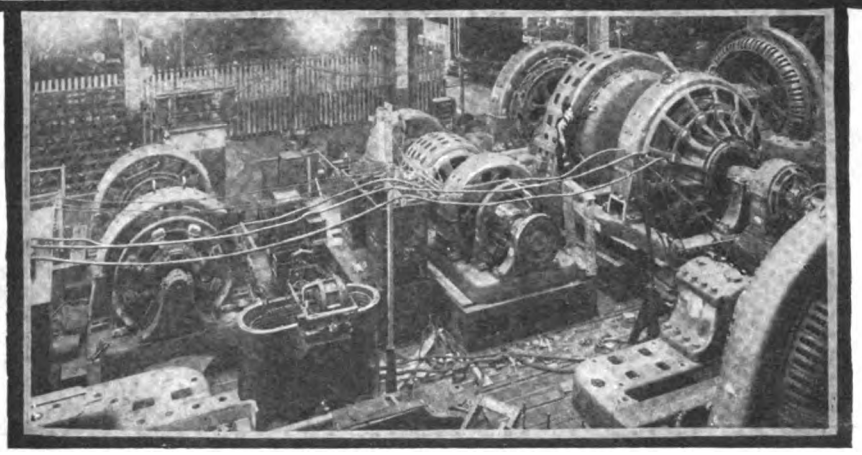
Associate Member of American Institute of Electrical Engineers



The Drafting Room in the Great General Electric Plant at Schenectady, N. Y.

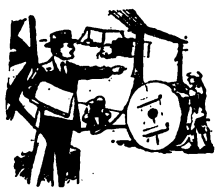


Where Steam and Electrical Engineers Meet—Testing Steam Turbine Driving A. C. Dynamo.



Where Electrical Engineers Apply Their Knowledge—Testing Large Motor-Generator Sets at General Electric Plant, Schenectady, N. Y.

ENGINEERING is claiming more students in our technical schools and colleges each year, as the features and emoluments of the engineering profession are making themselves better known to the public at large. One of the first things you may have to decide is whether or not as a young man or as a father of a precocious child, you really believe that engineering would prove the best vocation. It should be said at the start that the engineer—no matter whether electrical, civil, or mechanical, is always a student. By this is meant the fact that every branch of engineering has changed and is changing constantly, and, therefore, the engineer who graduated ten or twenty years ago, has had to keep abreast of the times, and the change in design; in methods, and in machines, by reading the engineering society proceedings, besides the various journals covering his particular technical field. There have also been a great host of new engineering books brought out in the past ten years, and of course these help to develop the engineer's abilities to a marked extent. You often hear people speak of an engineer in a much lighter vein, than when they speak of a medical doctor, for example, but if they really knew of all the hard work, especially in mathematics and physics, that the engineer has absorbed in his four to six years at college, they would never speak of him in such a fashion.

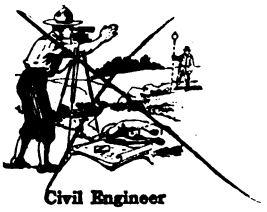


Radio Engineer

Having further made up your mind that to be a successful engineer means good hard study and also a close observation of machinery and plants of interest in your selected branch of engineering, the next important point to give thought to would seem to be as to which class of engineering is the least crowded. Of course if you have made up your mind thru experiment and study perhaps, it would possibly be advisable to follow the branch of engineering which you like best. At the present time, for example, mining and chemical engineering as well as civil engineering, would seem to present unusual opportunities for some years to come, for the very good reason that not everyone thinks that he would like these very promising professions. More in detail will be said anon with regard to the work of each of the different classes of engineering. Some people entertain the idea for instance, that they would not like to become a civil engineer, for the reason that they have frequently seen a hearty-looking young man surveying and of course drest rather roughly with heavy clothes and high leather shoes, finishing off perhaps with a woolen cap such as we used to wear when we were kids. The same holds true of mining engineering, many people thinking that this is a rough and ready sort of job and that it does not pay particularly well, and so it goes.

SALARIES PAID ENGINEERS

Nowadays of course it is not so much the idea that we would like to graduate as a brilliant electrical or mechanical engineer, as it is—"how much salary will I get, and can I support a wife and a motor car?" In one of the large electrical plants in New York City, as well as in several other parts of the country, excellent opportunities are given to student engineers during the summer months and also for young graduate engineers to familiarize themselves with actual commercial engineering work and duties. They are not paid a fabulous salary to start with, but they do obtain a very fine insight into the practical aspects of their chosen profession. The old saying, which has a considerable germ of truth in it, is, that a college graduate is not really valuable until he has learned to apply practically the great wealth of knowledge he has accumulated in the university. Usually the graduate engineer, if he is thoroly observant, will have adapted himself to the work-a-day world in from one to two years, and it may be several years before he can command a salary of more than $3,000 to $4,000 per year. Young engineers receive salaries all the way from $50.00 per week up to $200.00 per week; depending upon their individual abilities, the concern they are connected with, and many other factors. There has been a period of great depression in every line of activity, and the engineering profession was no exception, in the two years following the close of the World War, when thousands of engineers who were in the Army came back home; building operations and work in general took a big slump. This of course meant a reduction in salaries all around, and a man who might in better times have easily commanded a salary of $5,000 to $7,000 per year or more, had to be satisfied with half this amount.



Civil Engineer

It has been recognized for some time by the engineering societies, that their members were not paid their true worth as compared to other professional callings, such as the lawyer or doctor for example. But the public is awakening to this fact.

(To be concluded in next issue)

Fortunes from Little Things

By CHARLES FREDERICK CARTER

No. 7. Big Fortunes from Flashlights

O-O-O-O! Ain't that cute! What's it for?" After the man, who exhibited the first flashlight ever seen in public, had answered this question several thousand times at the New York Electrical Exposition some twenty-odd years ago he got mad, put on his hat and went home. Presumably he stayed there; for nothing further was ever heard about him of sufficient importance to have been preserved in history. Even his name has been forgotten. But his invention lived after him. Rather!

Perhaps a few comparative statistics may help to show how very much alive the electric flashlight is today. Everybody has heard about the much-advertised electric toaster. Well, sales of that handy addition to the breakfast table last year aggregated $2,400,000; the still more advertised electric flatiron, $17,500,000; bells, push buttons, annunciators and such like, $5,000,000; other electric miscellany, such as curling irons and special heaters, $3,000,000. In the same year sales of flashlights and their batteries aggregated $20,000,000! Looks as if people had found out what the cute little things were for, doesn't it?

If you want to know what the flashlight is for, just ask any man who served in the Army or Navy during the war. The flashlight was to be found literally everywhere back of the "first line." Truck drivers used them to avoid shell holes, and in making repairs. At first aid stations they were as important as the surgeon's knife. Around ammunition dumps and elsewhere they were indispensable. All sentries carried them to identify persons passing the lines. Roosevelt carried flashlights into the African jungle and in South America. Peary carried them to the North Pole. The American seaplane N-C 4 carried a flashlight across the Atlantic. A flashlight has been used to lure a bug out of a child's ear, when no other means would serve. There are literally thousands of uses for the flashlight for utility, convenience and protection. In an emergency it has no competitor.

Yet the self-contained, portable electric light had such an exceptionally hard row to hoe at the beginning of its brilliant career, that it came near being abandoned altogether. When asked if they could make a tiny lamp for 3.8 volts, lamp manufacturers not only said it was impossible, but they proved it on paper. And any way, they said, the public didn't want them.

The first man to make flashlights knew nothing about electric lamp manufacture, and not any too much about other features of the business; but he opened a shop in which he was the only workman in Providence, R. I., where he would make up as large a stock as he could carry, then he would take them to New York and deliver them to buyers.

The next step in the process of evolution was when the American Electrical Novelty and Manufacturing Company was formed to make flashlights. In 1909 this developed into the American Eveready Company, which in 1913 became a subsidiary of the National Carbon Company which is now a subsidiary of the Union Carbide and Carbon Co. Now flashlights are made in a seven-story factory in Long Island City with a floor area of 350,000 square feet of the most advanced modern construction. Here two thousand men and women are kept busy turning out flashlights and batteries, or rather they watch automatic machines do the work, while they draw pay for it.

The name "flashlight" has stuck to all forms of self-contained portable electric lights because the first ones could produce nothing more than a flash. Modern ones will give a steady light for hours. The first batteries were of very low current capacity and deteriorated rapidly on open circuit. They had to be used at once. Dealers did not realize this, nor that battery energy could be dissipated in other ways. They threw the batteries into bins with nails and other metal objects so that they were short-circuited and rendered useless.

Then the first lamps had carbon filaments which operated at 3 to 4 watts per horizontal candle-power and were extremely inefficient, even for a flashlight. Altogether, the early flashlights were so inefficient, that it seems a miracle that the idea ever survived. The world must have wanted that form of light to be so patient with its crude beginnings.

Three factors made the flashlight a staple form of light. First was the tungsten filament; second the development of a dry-cell battery 500 per cent. more efficient than the earlier forms, and third, transfer of the management into the hands of a corporation with the enterprise and capital to develop the product on scientific lines.

The flashlight consists of three principal parts: The case which carries the switch and becomes a part of the circuit, the battery and the lamp. The battery is in three parts: A zinc cup, a carbon, and an electrolyte. Service of the battery depends on the depolarizing action of the "bobbin," composed of a mixture of manganese dioxid and grafite formed about a carbon electrode. The bobbin is wrapt in gauze, then put in a cup of metallic zinc. The electrolyte, a paste composed of ammonium chlorid, zinc chlorid, flour and water, is placed in the cups by an automatic machine which fills ten at a time.

Dry cells being perishable they are dated like photograph film and are not warranted after the expiration of the time limit. A few years ago dry batteries could not be sold abroad because they deteriorated so rapidly. Diligent laboratory research has so improved them that they depreciate only 35 per cent. in 12 months. The standard size battery will give approximately 550 minutes continuous service. If then allowed to rest for a few hours it will give about 250 additional minutes service.

Flashlights are made in four principal forms for different services: The tubular, for indoor service, which will illuminate objects at distances of 20 to 30 feet; the lantern type for camp and home, or for general use, where open lights would be dangerous; the vest-pocket light for very short distances. The fourth and newest type is the "spotlight."

The Spotlight is truly a marvel. It has a parabolic reflector and can be focust by screwing the end cap to and fro, so that it can be made to produce a maximum beam candle-power of 3,000 with a spread of beam of but 6 degrees. Such a light enables letters 3½ inches high to be read with ease at a distance of 70 feet. At 300 feet a man can be distinguished against a dark background; at 1,000 feet details of large objects, such as a house can be distinguished.

In the cap is a little compartment for two extra lamps. Batteries are made in units so that single cells instead of an entire battery can be purchased.

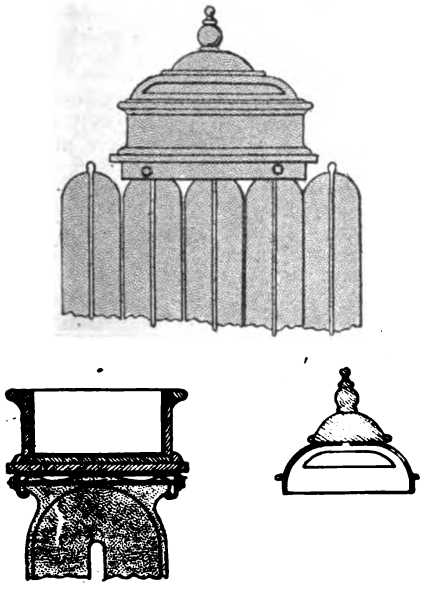
Fortunes Have Been Made from Flashlights—Those Simple Little Battery, Switch and Lamp Combinations That Everyone Uses Today from the Child Down to Granddad. They Have Saved Many Lives and Thousands of Dollars in Preventing Theater Riots, Auto and Train Wrecks, Not to Mention Innumerable Broken Limbs Threatened by Dark Cellar Stairs. Simple, Yes; but It Required Genius and Skill of the Highest Order to Develop the Flashlight to Its Present Efficiency. The "Seven Ages of Flashlight-hood" are Here Illustrated by the Eminent Cartoonist, Frank Paul.

Home Mechanics

Conducted by WILLIAM M. BUTTERFIELD

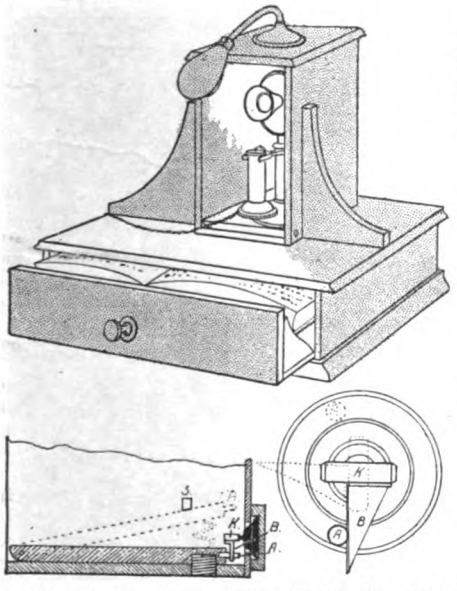
WATER BOX FOR RADIATOR

Here is a metal box constructed on a wooden frame for the purpose of providing an ornamental water container, to be used on steam, electric or hot water radiators thus providing a means of moistening the



An Attractive Water Container for the Home or Office Radiator. This Can be Made of Either Sheet Iron Painted in Any Desired Color, or if Made of Brass Which Is Afterward Hammered and Buffed, a Very Attractive Device Results.

air in heated rooms. This design is an attempt to provide an ornamental container that can be safely attached to a radiator. The wood is used merely as a form to bend the sheet metal over and should be scored deeply with a saw, before it is put together, or else the frame is likely to warp. It cannot do any damage if the wood becomes rotted or charred after the metal covering is put on, and the container attached to the radiator. Sheet metal of any kind maybe cut, bent and soldered in the manner suggested in the illustration.



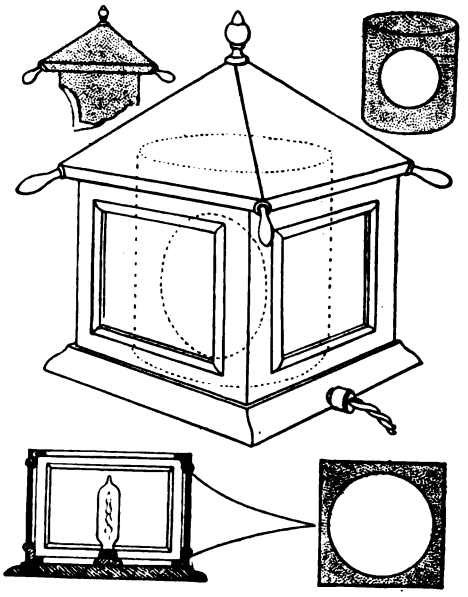
A Nifty Telephone Cabinet Which May be Placed on the Library or Reading Room Table, and Which Incorporates the Advantage of Having an Automatic Light Switch, Which Closes the Lamp Circuit When the Phone Is Lifted Off the Spring Operated Shelf. By Means of the Simple Pin Arrangement, the Rising and Falling of the Shelf is Caused to Rotate an Ordinary Snap Switch, a Triangular Block Being Secured to the Switch Handle.

VARIEGATED COLORED NIGHT LIGHT

At right is a four-sided table lamp of the electric variety that can be used in the bedroom or nursery. It consists of a movable or revolving top and a stationary base. The base contains the lamp and four openings glazed with colorless, ruby, blue and yellow glass. The top carries a round metal screen with a single circular opening, which may be provided with a projecting lens if so desired, altho this is not particularly necessary. For the purpose of cutting off the light at the top and bottom of the lamp, and also to form bearings for the round screen, two flat screens with round openings are fitted in the base in the manner shown. Each corner and the pyramided apex of the top is provided with handles. It will be seen that if the top is revolved sufficiently to bring the opening of the round screen opposite any of the glazed openings in the base, a colorless, blue, ruby or yellow light will be thrown into the room, thus giving the sleeper a choice of four different colored night lights.

TELEPHONE CASE AND AUTOMATIC LIGHT

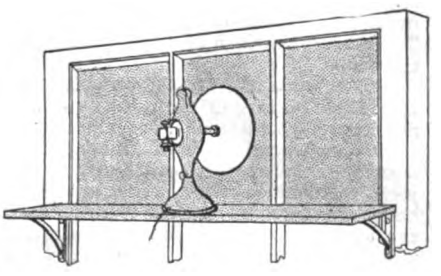
A method of combining the telephone light and apparatus in a single convenient table cabinet is shown below. The drawer-like tray holds the city and suburban books in such a way that each can be turned over and examined without removal. The top holds the telephone and light, and is provided with an automatic device for turning the light on or off, as the telephone is removed for use. A hinged bottom is operated by a coiled spring, and by the weight of the telephone, when placed in the cabinet—the spring raising the bottom when the telephone is removed, and the telephone pressing it down, in the manner shown when in the cabinet. A pin (A), set in the back edge of the bottom is thus made to move up or down in a perpendicular direction. This pin engages the key (K), on an ordinary electric switch in its upward movement and causes it to take the position shown in dotted lines, and the piece of brass (B), fastened to the key (K), in its downward movement, thus causing the key to take the position shown in solid lines. The key thus moved turns the current on or off in the usual way—the switch being placed in a wooden holder at the back of the cabinet, as illustrated. A stop (S) is provided to keep the bottom in working position. The light is an ordinary desk stand and is wired in the usual style with the switch and current supply.

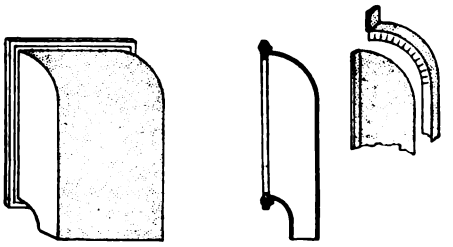


A Four-Sided Table Lamp of the Electric Variety Suitable for Use in the Bedroom or Nursery. The Base Contains the Lamp and Four Openings Glazed with Colorless, Ruby, Blue and Yellow Glass.

VENTILATOR AND AIR CIRCULATOR

A use for the electric fan in cold weather for the purpose of circulating air and heat in one or more rooms is here illustrated. This is a home-made device comprising a shelf attached to any window sash in such a way that the sash can be moved in the ordinary manner; a metal or wooden screen with a hole fitting the fan put in place of the pane of glass in one opening in the sash; and a curved metal screen, for outdoors, fastened to the former screen in the manner shown. It will be seen that if the fan is placed on the shelf as illustrated, a perfect blower is provided that circulates inclosed air, drawing it from the room and blowing it thru the curved screen and out-of-doors. The curved screen prevents cold air, rain or snow from entering the room when the sash is closed. This device is used for ventilating the room or rooms by means of circulation, thus distributing heat to all enclosed areas in equal quantities.



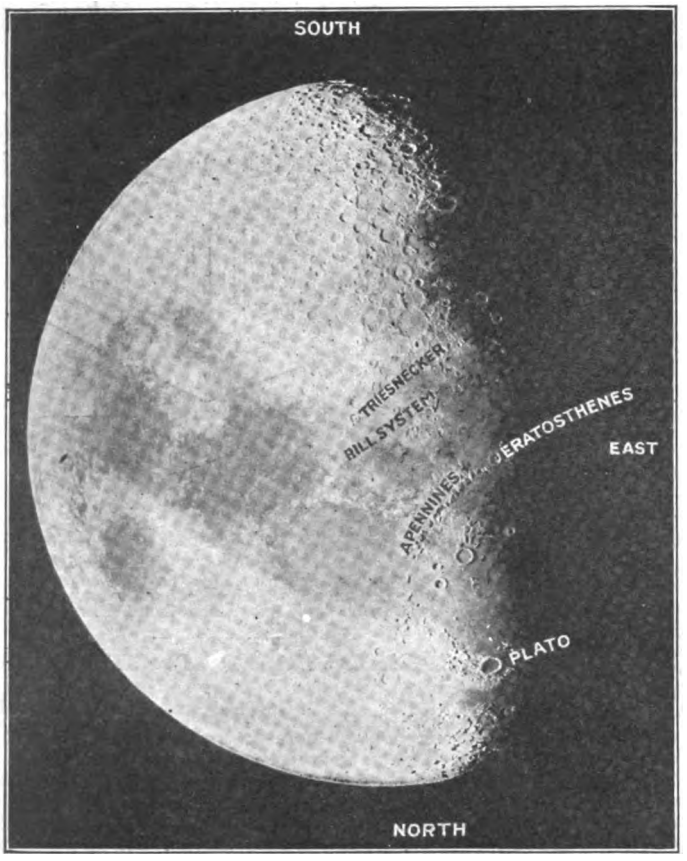


The Accompanying Illustration Shows One Method of Utilizing the Electric Fan in Cold Weather for Circulating Air and Heat Without Creating Undesirable Drafts.

Popular Astronomy

By ISABEL M. LEWIS, M.A.

of U. S. Naval Observatory



The Moon at Eight and One-Half Days: "Plato" Will be Found on the Terminator (Line Between Light and Dark Surface) About an Inch from the Bottom of the Photo (North). Note Smooth Dark Floor. This Floor is Covered with Crater-Cones and Light Streaks Visible in Powerful Telescopes and Darkens Noticeably as the Altitude of the Sun Increases. This Crater Has Probably Been Studied More Carefully Than Any Other Object on the Moon. Changes are Believed to Have Taken Place Here. "Eratosthenes" Lies Some Distance Due South of "Plato" at the End of the Lunar Mountain Chain Known as the "Apennines" and has a Conspicuous Central Peak. This is the Crater in Which More Detail Can be Seen, According to Prof. Pickering, Than on the "Entire Disk of Mars." It is on the Floor of This Crater That Prof. Pickering Believes He Has Found Evidence of the Growth of Vegetation During the Lunar Day. The Intricate "Triesnecker Rill System" Lies a Short Distance to the Southwest of "Eratosthenes" in the Vicinity of the Crater "Triesnecker." There is Considerable Evidence That Changes Sometimes Take Place in the Visibility of Some of These Clefts as if They Were Temporarily Obscured by Mists and Vapors Arising from the Surface.

Is There Evidence of Change on the Moon?

IT has been the orthodox belief among astronomers for years that the moon is a dead world devoid of air and water and so, necessarily, lifeless. It is true that the moon has no extensive atmosphere such as envelops our own planet. There is abundant proof of this fact. The edge of the lunar disk is clear-cut. Whenever, as happens frequently, the moon passes between us and a star the disappearance of the star is instantaneous. There is no gradual dimming or refraction of the star's light by atmospheric vapors. Moreover, lunar shadows are harsh and black. There is no evidence of diffusion of light on the moon by atmospheric gases.

The absence of water or water vapor on the visible surface of the moon, at least to any appreciable amount, is plainly evident to anyone who observes the moon thru the telescope. Even with small telescopes, objects three or four miles in diameter can be readily detected and clouds drifting over the surface could not possibly escape our view if they existed.

Bodies of water, great or small, would be plainly visible and would besides give rise to water vapor and clouds, which we would not fail to detect.

Since the surface of the moon is unscreened by air and water vapor to absorb the incoming radiations from the sun, and the outgoing radiations from the surface, the extremes of temperature between day and night are very great, and are augmented by the fact that the lunar day equals the lunar month in length, so that fourteen days of untempered heat are followed by fourteen days of frigid darkness. Observations of the rate of radiation from the moon's surface during total eclipses of the moon seem to indicate that the moon's radiation is very rapid, and that its temperature during the height of the lunar day probably does not exceed 200 Fah., while at the lunar midnight it may drop to 100 below zero Fah., or even lower.

With air and water both lacking and such extremes of temperature existing why should we seriously consider the question of life on the moon?

This is the point of view of the majority of astronomers and it seems well taken. Yet many astronomers who have made a special study of the lunar surface for years under all conditions of illumination and phase, and have most carefully observed and mapt and photographed its peculiar markings, are agreed that there are evidences that changes are taking place on the moon, and recently Prof. W. H. Pickering has exprest the belief, substantiated by drawings, that there is a progressive change of color or darkening within certain lunar craters with the advance of the lunar day, that indicates, in his opinion, a rapid vegetational growth that springs up in the height of the lunar day and dies out as the lunar night approaches.

Some years ago certain selenographers and others interested in the question of life on the moon exprest the belief that there may exist in the numberless crater-pits and craters, in the deep lying *maria* or "seas," and in the clefts and rills and cracks that form intricate systems all over the lunar surface, certain exhalations from the surface and heavy vapors including possibly carbon dioxide and water vapor that temper the extremes of the long lunar days and nights and furnish the necessary medium for the support of certain forms of animal and vegetable life. Is there any

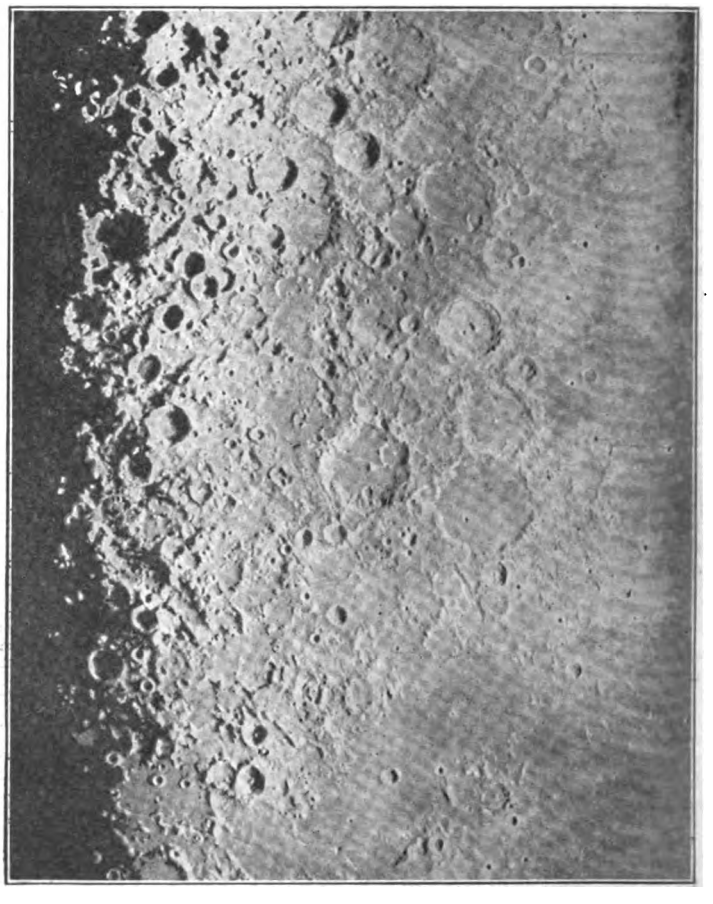
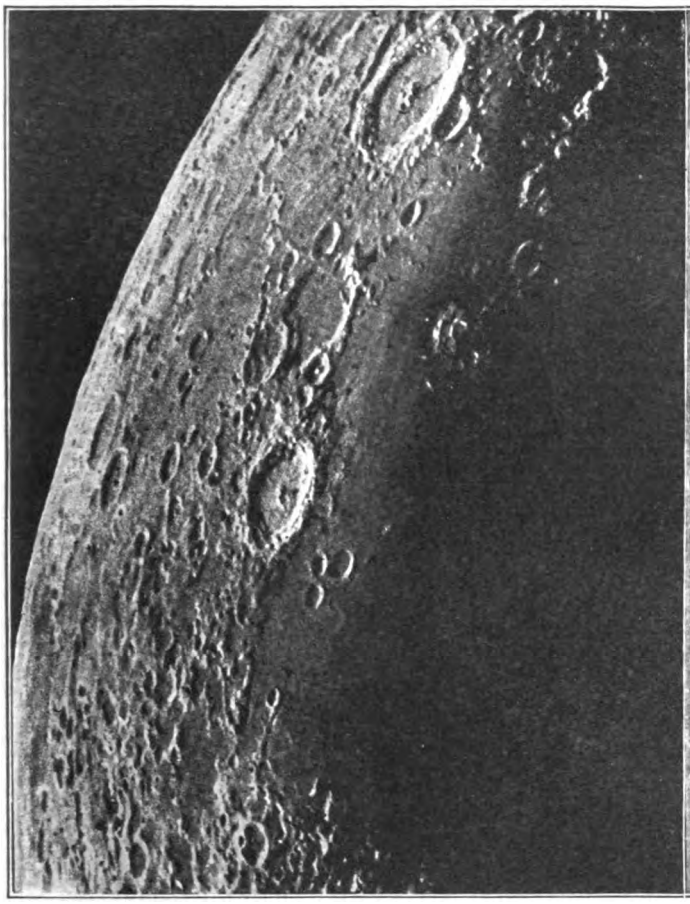
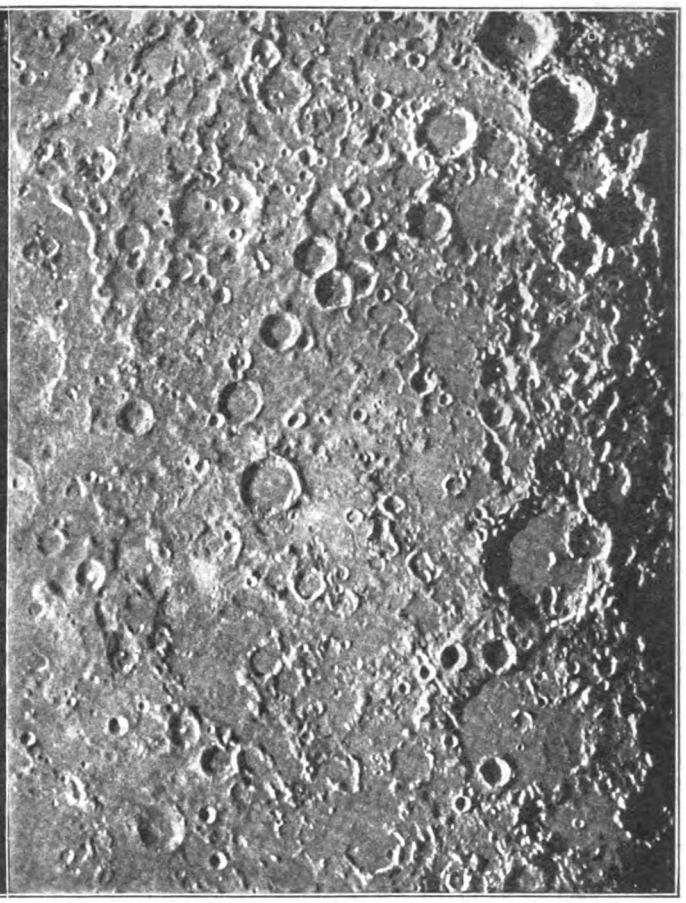


Photo Showing One of the Most Interesting Portions of the Moon's Surface. The "Triesnecker Rill System," One of the Most Intricate of All Lies at the Bottom of the Photograph, which Shows the Moon's Northern Edge. The Entire Region Which is Near the Center of the Moon is Traversed by Numerous Valleys and Gorges and Deep Clefts as is Plainly Evident from a Glance at the Photograph. Many of the Hills Have a Rounded or Weathered Appearance as if They Had Been Subjected to Atmospheric Action. The Crater "Triesnecker," the Center of an Intricate Labyrinth of Rills and Clefts, Lies About an Inch or so Above the Northern Edge or Bottom of the Photo and a Coarse Cleft is Visible Just to the Left of it. There is Considerable Evidence of Change Here, According to Certain Observers. Changes of Tint Have Been Noted on the Inner Slopes of the "Hyginus Cleft" Which Runs to the Bottom of the Photo, and Changes in Visibility of Certain Clefts Have Been Suspected and Attributed to the Presence of Vapors Arising from the Surface.



Lunar View Three Days After the New Moon Seen by West Light.



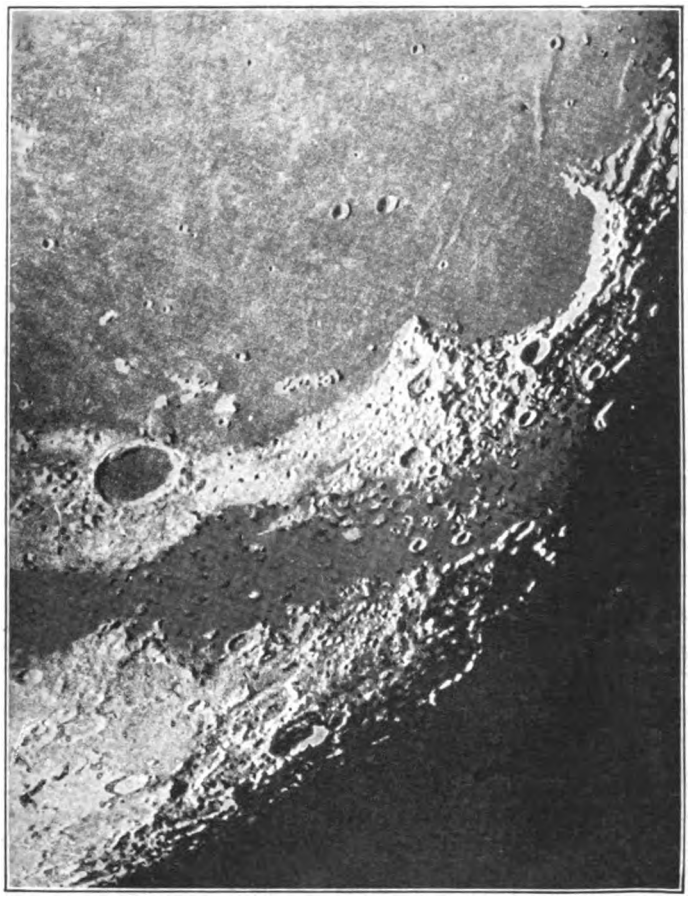
The Lunar Region Comprised Between 0° and 23° of West Longitude and 0° and 31° of North Latitude.

evidence to support this view, we may ask?

Many astronomers, including a number who are not in sympathy with the above view, strongly believe that snow and ice exist on the moon, even tho water in the form of liquid and vapor is not observable. All the extremely brilliant portions of the surface according to some astronomers are covered with snow and ice. Certainly some portions of the moon's surface reflect sunlight as brilliantly as if they were covered with freshly fallen snow, while others are as black as any objects with which we are familiar. There are all gradations of color from pure white to black upon the lunar surface. There also appears to be considerable evidence that certain small markings, described as crater-cones and resembling our terrestrial volcanoes more than any other lunar feature, are at times temporarily obscured from view by a white veil of vapors. Many observers believe that these crater-cones are of the nature of active volcanic vents, and that there is considerable volcanic activity still taking place upon the moon.

These small crater-cones resemble, we are told, parasitic cones found on sides of terrestrial volcanoes, and they are frequently seen on the floors of craters closely associated with light streaks, which is a significant fact in itself. These crater-cones appear under a high sun as minute white spots and can be studied to advantage only with powerful instruments. Maggini, observing the floor of the lunar crater, Plato, in 1916 noted that one of the small crater-cones, that exist there, was temporarily obscured from view by a cloud of reddish vapors, and Prof. Pickering, at Arequipa, Peru, observing the same region some years ago, believed that he saw evidence of change in certain small markings. The crater, Plato, has probably been more carefully studied than any other portion of the lunar surface. It is sixty miles in diameter and may be seen even without a telescope as a dark "eye" not far from the northern edge of the moon. Its floor is one of the darkest objects on the moon—a dark steel-grey in color—and there is no doubt that for some unknown reason its dark hue deepens from the time the sun has an altitude of twenty degrees until after full moon. It has a brilliant white wall rising from 3000 to 4000 ft. above its floor, crowned with several lofty peaks and intersected by a number of valleys and passes. The spots and faint light markings on the floor have been the obje t of much study with small or moderate sized instruments, and at least six of them are known to be crater-cones. Since they can only be studied to advantage with powerful instruments and as such instruments are rarely used for a systematic study of lunar markings, it is difficult to settle the controversy as to whether they have changed in appearance or have been at any

(*Continued on page* 853)



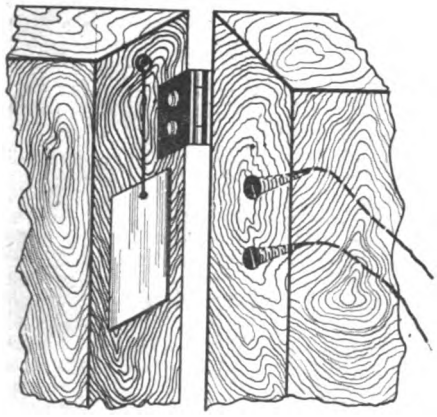
Region of the Moon in the Neighborhood of the Crater of Iris. The Crater Is Towards the Left of the Picture.
Continuing the Publication of Admirable Lunar Photographs Commenced Long Ago but Interrupted by the War, Prof. C. Le Morvan, Astronomer in the Paris Observatory, Has Presented to the Academy of Sciences, Views of the Country on the Surface of Our Satellite in Phases Comprised Between Opposition and the New Moon.

MOTOR HINTS

SECRET IGNITION SWITCH

First Prize, $25.00

Herewith is illustrated a safety device which is suitable to protect any car against burglary. The break in the ignition comes on one of the front doors. Two holes are



Simple, Yet Secret Ignition Switch. The Removable Brass Plate When Replaced Short-Circuits the Two Screws, Closing the Circuit.

bored on the inside of the door hinge, that is, when the door opens a space is left inside the hinges. The two holes are bored on the body where the door closes. The holes are counter sunk so that when the two small screws are screwed in, the heads project just a trifle, in order not to interfere with the closing of the door. Two fine wires are run back of the leather covering and fastened to the screws. A very thin piece of brass is dropt from a thread in between the door connecting the two screws, and the closing of the door holds it tightly in place. When you leave your car take out the strip of brass and your secret switch is undetectable.

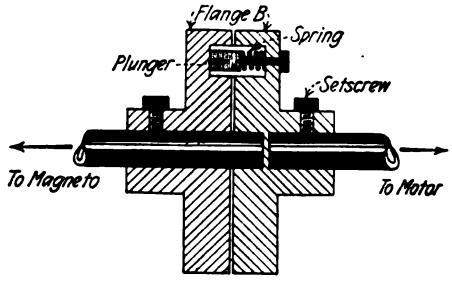
Contributed by GEORGE MALSTROM.

THIEF-PROOF MAGNETO CLUTCH

Second Prize, $15.00

At the present time, all cars have either a high tension magneto or battery-generator ignition system. On the magneto system, the distributor and timer is built into the magneto and is driven from the magneto shaft. In the battery-generator system the timer and distributor are always driven from the generator shaft.

In either case the shaft from the motor to the magneto, or generator, as the case may be, must be in correct relation to the crank and cam shafts. If this relation is changed, he motor is said to be "out of time," and t



Pull Back Spring Pin, Rotate One Flange One Revolution, and Release Pin, Throwing Engine and Magneto "Out of Timing."

NOTICE—CONTRIBUTORS ! ! !

For the next few months we are going to give prizes only to such devices as prevent stealing of cars. It should be remembered always that motorists do no wish complicated and cumbersome devices; something that can be put in place quickly, and that can be removed just as quickly, is what is wanted. The device should, of course, always be secret so that the casual crook will not know how it is used.

FIRST PRIZE.....$25.00
SECOND PRIZE..... 15.00
THIRD PRIZE..... 10.00

All other accepted articles, which win no prizes, will be paid for at the rate of $2.00. Articles submitted should not be long ones. About one hundred to two hundred words will suffice. Address all manuscripts to Editor, "Motor Hints," care of this publication.

every one knows that a car that is out of time will not run, and it is no simple matter to put it in order.

This is the way the device works. Remove the coupling of the magneto-shaft, and put on the end of each part of the shaft a flange like that shown in the figure. These can be made on any lathe with little effort or expense.

The principle of operation can be easily seen from the figure. The small plug or plunger (a) is held out of the flange (b) by the small spring behind it.

When the car is in running order, this plunger fits into the socket in the opposite flange and connects them solidly. When it is desired to lock the car, the bolt like head of the plunger is pulled out and the shaft rotated one revolution; until the plug again springs into place. This turns the shaft out of its relation with the cam shaft and throws the motor completely out of time.

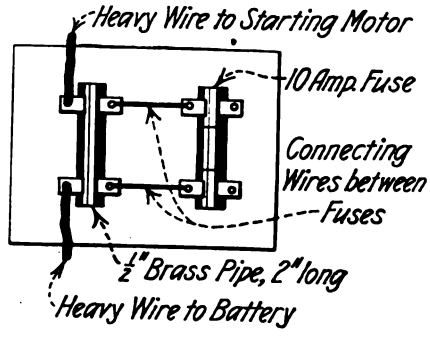
When it is desired to start the car just pull out the plug and turn the shaft back one revolution.

Contributed by O. G. McILVAINE.

A "PHONEY" FUSE BLOCK

Third Prize, $10.00

In order to prevent thieves from stealing an auto equipt with an electric self-starter,



A "Theft" Fooler Made In the Form of a Phoney Fuse Block.

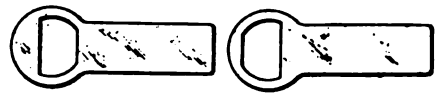
make up a fuse block consisting of an ordinary 10 ampere cartridge fuse and a special set of heavy brass clips to hold a piece of one-eighth inch brass pipe about two inches long, using the brass pipe as a fuse which will easily take the starting current. Connect both the fuse and pipe clips in multiple and put them in the starting circuit at the battery end of the starting switch, using heavy starting cable for all connections to brass pipe fuse.

When leaving the car, take out the brass pipe; then if the starter is operated, the 10 ampere fuse burns out, leaving the battery disconnected from everything, but by inserting the *pipe fuse*, the circuit is closed again, enabling the car to be run.

Contributed by W. RAY MOREHOUSE

A FEW WAYS OF LOCKING CAR.

A quarter inch hole is bored and tapt in the intake manifold on the back so that it will be unnoticed from the front. A standard pipe plug is screwed into this



Mr. Dwiggins Gives Us Several Very Good Suggestions in His Article On How to Foil the Motor Car Thief, One of Them Being Illustrated Herewith. This Takes the Form of An Extra Distributor Arm Shaped So That It Goes On the Opposite Side From the Regular Arm, the Wrong Arm Being Substituted When the Owner Leaves the Car.

hole, which may be easily removed when the owner wishes to lock the car. It is possible to start the motor when this plug is removed but it will not have sufficient power to move the car.

If one provides himself with an extra gas tank cap and has the vent in the top sealed with a drop of solder, then changing the caps will prevent the car being driven far away if a vacuum or gravity feed is used.

A wooden plug fitted to the end of the exhaust pipe will prevent the motor being started.

An extra distributor segment fitted so that it goes on the opposite side from the regular segment, will fool many a thief.

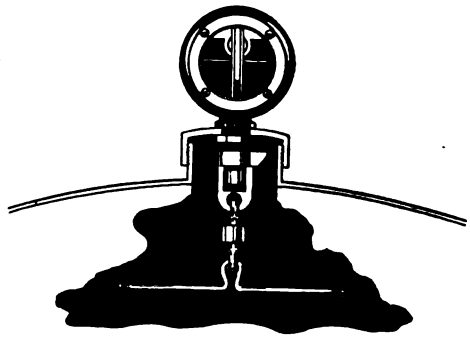
A piece of cotton waste or string stuffed into the little cap on the top of the float chamber of the carbureter will stop the flow of gasoline when the cap is screwed down. Thus the car will soon stop for lack of gas.

Any two of these means used at the same time are enough to discourage the average thief.

Contributed by JOHN F. DWIGGINS.

A MOTORMETER LOCK

It is claimed that these little working thermometers, which form at once a convenient addition to the automobile and in part a finish to the radiator, show the driver when his cooling fluid is getting too hot. They say that more of these are stolen than of all other accessories combined; if they are removed by a thief, the radiator cap goes with them, easily doubling the annoyance. The appliance which we illustrate locks the motormeter fast and definitely does away with the danger of its being stolen. It takes but a few minutes to install it, and the position which it occupies is quite concealed from observation.



The Familiar Motormeter in Place and Securely Locked So That the Thief Cannot Take It.

Editor's Mail Bag

SUGAR COATED SCIENCE

Editor SCIENCE AND INVENTION:

Having read with interest the views of several of your readers as publisht in the August issue of your magazine, I am taking the liberty of writing you my opinion.

I think the magazine is very good as it is now, altho you will doubtless find a way to make it even better than it now is. I enjoy your "sugar-coated science" articles as I am not a college graduate, and believe others in the same class with me prefer the easily understood explanations rather than technical ones.

Your ideas may seem very far-fetched, but in my opinion, if they were perfected, they would bring a fortune to someone. I am not inclined to scoff at any unsuual ideas after seeing what has been accomplished in the last few years.

The "How-To-Make-It-Department" is good, and I would like to see it enlarged. The articles relating to electric traction problems are always enjoyed by me, as are the scientific stories and even the "Ads," so you see I haven't any kick against SCIENCE AND INVENTION.

There are two subjects I would like to have you secure articles on, if you think they are of general interest, and these are: The extraction of aluminum, and the induction furnace. I would like to see directions for making the induction furnace, and also a workable arc furnace. I close with best wishes for SCIENCE AND INVENTION.

KNOX L. ALEXANDER.

1637 Kimball Ave.,
Chicago, Ill.

ONE WHO WAS YOUNG TOO

Editor SCIENCE AND INVENTION:

Your valued publication received today, and as usual it has been read from cover to cover. I note in the "Editor's Mail Bag" that a number of "high brow" readers object to what they designate the "juvenile tendency of the magazine." It's odd how quickly we forget the beginnings of our scientific education. Every month there are thousands of young fellows, just getting on their feet, so to speak, as regards this all interesting subject of "Science and Invention," and these are the boys that must be boosted along. This is the material that will develop in the future the wonderful advance which we know is in store. By all means keep the boys interested. I have been a subscriber to SCIENCE AND INVENTION or the ELECTRICAL EXPERIMENTER for the past few years, and congratulate you on the steady progress which your publication has made. Keep up the good work.

R. C. MCNAUGHTON.

155 48th Ave., West,
Vancouver, Canada.

WE STAND CORRECTED

Editor SCIENCE AND INVENTION:

I have been a constant reader of your paper for several years and have always been a believer of the saying that "There is nothing new under the sun."

Referring to the September issue of your magazine and to page 423 to an article on "Magnets Hold Ferry Boats In Slips," and referring to Prof. T. O'Conor Sloane's suggestion regarding the same, beg to advise that *the writer secured a fundamental patent on this on August 12th, 1889.*

I enclose a copy of the patent (which of course has expired some time ago), for your attention and perusal. In same you will find exactly the conditions and requirements as outlined by Professor Sloane, so much so that it seems that it is possible *he had access* to a copy of my patent when making *his statements in your paper.*

The only trouble with my patent was that it was ahead of the art as practised. I would be pleased to have you correct the article, as I patented the device over 32 years ago.

HARLAN P. WELLMAN.

315 Broadway,
Ashland, Ky.

(Your most interesting letter has been received, and your patent with its very clear drawing, shows that you certainly were ahead of the times; and the mystery is that it has not been adopted by the ferry boat companies. It deserved appreciation.

Professor Sloane never saw your patent or a copy of it, and was most interested in finding that you preceded him with what he considers your really meritorious invention.

—EDITOR.)

"WHY SHOULD JULES VERNE BE THE LIMIT?"

Editor SCIENCE AND INVENTION:

I am always ready and waiting for your magazine to appear on the newsstand each month. I like it very much, just as it is gotten up by you, and I like to read scientific articles ably written on every subject. They constitute my "novel reading." And while I am only a carpenter, I read every scientific magazine that finds its way to the newsstand of the ordinary city. Would read others if I could get them, even if published by Prof. Einstein.

WE invite our readers to use these columns for discussion on all subjects of interest to them. We aim to make this page an exchange place for ideas and invite discussion. As hundreds of letters are received weekly, it is manifestly impossible to publish all of them, and we aim to publish only the more interesting ones. Try to keep your communication within two hundred words, and use only one side of the paper when writing. It is not possible to answer communications addrest to this department by mail due to the great influx of communications received.

—EDITOR.

I would like very much to have a magazine entirely on Chemistry, but of course, few people would like the plan, so we are glad that there are enough interested in such articles as to cause you to devote a fair portion of space to the subject.

I note that some of your readers think that some of your articles are too fantastic. That they even surpass the imagination of Jules Verne, and the 1,000 leagues under the sea? Well! Why should Jules Verne be the limit? We know more now, and have a decidedly larger sphere of concept before us. If we can't surpass Jules, then we are his inferior. I sometimes think that the human mind is not capable of conceiving of anything which cannot be, in the future.

E. A. GAWTHROP.

Baton Rouge, La.

FROM SOUTH AMERICA

Editor SCIENCE AND INVENTION:

Reading through your August number I found some extra entertainment in perusing letters from correspondents. Sympathizing with readers crying for more matter on subjects of their particular interests I yet fell to speculating as to how far you would get as publishers of a popular magazine if you catered too much to any one class of readers—it occurred to me that my own case was typical and I recite it, thinking it may be of interest to you.

At the time wireless possessing a fascination for me I bought your first magazine "MODERN ELECTRICS" from April, 1908, to some time in 1911. By that time the development of wireless was becoming too technical for me who never really came in touch with it actually working, so I left off taking the magazine.

Last September at a newsstand I picked up the first copy of "SCIENCE AND INVENTION" I had seen, and glancing over the pages I saw a name that caused me to exclaim, "Why here's Mr. Gernsback in print again," so I bought the magazine to see what the stunt was now and as it proved interesting I have, as you know, since become a subscriber.

With some amusement I have observed that your newer adventure interests a decidedly wider public than did the one devoted entirely to wireless in which case I was the only one to look at it.

The literary interests of the rest of the household may be gauged by the fact that there comes into the house every month, the COSMOPOLITAN, MCCLURE'S, HEARST'S, MUNSEY'S, NATIONAL GEOGRAPHIC, LADIES' HOME COMPANION, besides the more or less scientific magazines that I take for myself. The only one of the latter that seems to have a real interest for the whole crowd is "SCIENCE AND INVENTION." After it has passed the fourteen year old Italian servant girl who can only look at the pictures I send it on to a member of the Government Meteorological Service, a man of real scientific attainments who nevertheless seems to find entertainment in your "sugar coated small dose" way of presenting science and speculation to the public.

Personally I enjoy the whole magazine and would not ask for less of anything—what commands my greatest sympathy perhaps is your evident idea of inciting your readers to invent, develop and perfect and it seems to me that you could hang your whole enterprise on this idea with reasonable hopes of financial success.

I take this opportunity to observe that I have often thought that if I was editor of a magazine that printed instructions as to how to make things, to the instructions of an author I would continually apply the test as to whether or not he was making it clear to his reader pupil WHY he was to do this or that. It is a good test and when met will eliminate complaints regarding vagueness of details applying to some printed instructions. I will however admit the conviction from reading instructions in your paper that this observation does not apply so much to "SCIENCE AND INVENTION."

GEORGE EARL FULLER.

Belgrano 553,
Beunos Aires.

OUR FANTASTIC COVERS

Editor SCIENCE AND INVENTION:

Just a few words to let you know how I like your wonderful magazine, SCIENCE AND INVENTION. I like your Radio Department best of all and I always turn to it first of all. I am always interested in *The Oracle*, and on the whole, like your magazine fine.

Now. about those "fantastic covers." I have been a newsstand reader for about two years and have just lately become a subscriber and I'm glad to say that it was one of those "fantastic covers" that attracted me. So I'll tell 'em that I'm for those covers thru thick and thin.

Just keep on like you have been doing and SCIENCE AND INVENTION will stay O.K.

REGINALD L. DOWNEY

Princeton, W. Va.

Ultra High Speed Atoms—and Their Effects

By ROGERS D. RUSK, M.A.

IN a second of time a particle of ordinary hydrogen gas moves an average distance of one mile, while in the same length of time, a high speed hydrogen atom could move completely around the earth. Such high speed

A High Speed Hydrogen Atom Travels at a Speed That Would Carry It Around the World in One Second.

atoms are only generated under certain conditions and can only be detected by careful experiments, but they are of unusual scientific interest.

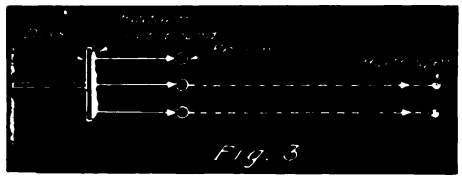
Alpha particles shot off from radium are nothing more than high speed atoms of helium carrying a minute positive charge of electricity. Sir Ernest Rutherford, who has been recently studying the effects produced when ordinary gas molecules are bombarded with these high speed atoms, has achieved some surprising results. In one out of every billion collisions with ordinary hydrogen gas particles, a high speed hydrogen atom is produced. In every other collision the atoms pass thru one another without effect, other than a possible slight deviation in direction. When nitrogen gas was bombarded with high speed helium atoms, additional high speed atoms were detected which appeared to be hydrogen, altho no hydrogen was present before. The obvious conclusion was that the nitrogen atoms had been disintegrated by the tremendous force of the collision and that a hydrogen atom was one of the component parts of the heavier nitrogen atom. The experiments, tho not to be considered final, are of startling interest and significance.

The particles of any gas are constantly moving about with very great velocities. If this were not the case, a gas could not exert a pressure when it is confined. In the atmosphere, oxygen molecules move with a velocity of about one-fourth of a mile per second. Hydrogen molecules, because they are lighter in weight, must travel at four times that velocity in order to exert the same pressure. Multiply this velocity by fifteen thousand and you have the velocity of an alpha particle. The velocity of an ultra high speed hydrogen atom is six tentns greater yet.

It is evident that these high speed particles represent an enormous amount of energy compared with that of the ordinary gas molecules. Sir Ernest Rutherford states that an alpha particle may strike a thirteen pound blow, tho its size is far below the range of any microscope. As is well known, the energy of a moving body is given by the product of one-half the mass by the square of the velocity ($\frac{1}{2}mv^2$). From this it may be easily calculated that such an alpha particle represents about two hundred and forty million times as much energy as an ordinary atom of helium gas. Indeed these alpha particles represent a much greater amount of energy than any other known atomic unit. Electrons from radium, or vacuum tubes, may have a ten times greater speed, but their energy is less, because their mass is only one seven-thousandth part as great.

Alpha particles from radium have been studied for a number of years, but the study of high speed atoms produced by collision, and the study of the changes produced in the atoms by such collisions has only just begun. Ordinarily when the atoms of a gas collide with one another, nothing happens more than that they bounce back, as if they were perfectly elastic solid balls. That atoms are not solid particles, but consist of electrified particles rotating about each other at comparatively great distances, is shown by the fact that when traveling at extremely high speeds they may pass thru each other without their centers of electrification coming near enough to produce a deflection of either atom.

Many investigators have studied the effects of the collision of charged particles with ordinary atoms at low speeds. A charged particle in a gas will assume



When Helium Atoms from Radium Collide With Hydrogen Atoms, High Speed Hydrogen Atoms Are Produced, That Travel With a Speed of Nearly Twenty-five Thousand Miles Per Second, and Travel Four Times as Far as the Helium Atoms on Account of Their Smaller Size and Greater Speed.

the motion of the gas particles, unless it is acted upon by some outside influence. If an electric field is applied to the gas, the uncharged particles of the gas are unaffected, but the charged particle will move in the direction of the field with a velocity determined by the strength of the field. When the pressure of the gas is quite low, it has been noted that the charged particle gains in velocity, until its energy is such, that, upon striking an uncharged particle, it is able to break it up into charged particles or ions. As part of the energy of motion is used up in producing this ionization, the collision is said to be partially or wholly inelastic, depending upon whether the first particle loses a part or all of its motion.

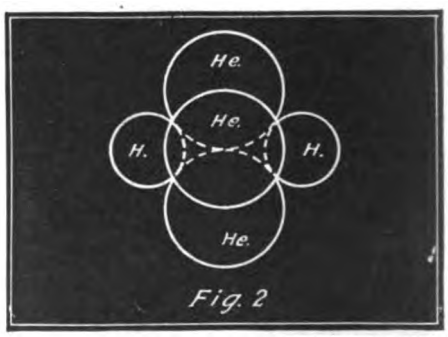
The above situation is somewhat analogous to the case of ships colliding at sea. At very low speeds the vessels might bump away from each other without suffering injury. At higher speeds one or both of the ships would suffer a more or less serious change. Now consider one of the vessels picked up and hurled with the speed of a rifle bullet at the other. The result would be disastrous to the ships, but of unusual scientific interest. The same is true of atoms, and the effects produced by high speed atoms may be of untold scientific importance when they are better understood.

High speed atoms may be detected by the scintillations they produce upon a fluorescent screen such as one coated with zinc sulfid. Alpha particles have been detected in that way for some time, and Marsden has shown that other high speed atoms produce the same effect. When an alpha particle strikes a hydrogen atom in the proper position, the hydrogen atom, because of its lesser weight, is shot forward and becomes a high speed hydrogen atom. The different atoms may be distinguished by their difference in range. In traveling thru ordinary air, alpha particles from radium will travel seven centimeters before being completely slowed down by collisions with air particles. The lighter in weight an atom is, the greater its range will be, so that high speed atoms should travel four times as far as alpha particles and be distinguished from other atoms by that property.

Making use of the above knowledge Rutherford studied the effect of alpha particles colliding with nitrogen gas molecules. The interesting thing that occurred was, that some long range particles appeared, which seemed to be high speed hydrogen atoms. The only conclusion to draw was that the nitrogen molecules had in some way been broken down by the force of the collision, and that hydrogen was one of the disintegration products. This is a result of tremendous scientific importance. If substantiated, it goes far toward proving the hypothesis that all atoms of all substances are made up of one or more fundamental units. The facts of radioactivity seem to show that these units are hydrogen and helium atoms.

What occurs when an alpha particle strikes another atom, is similar to what occurs when the alpha particle is first liberated from the radium. Under such a bombardment the atoms of a gas are literally torn to pieces. Radioactivity itself is nothing more than a series of atomic explosions in which, at times, alpha particles are thrown off as disintegration products.

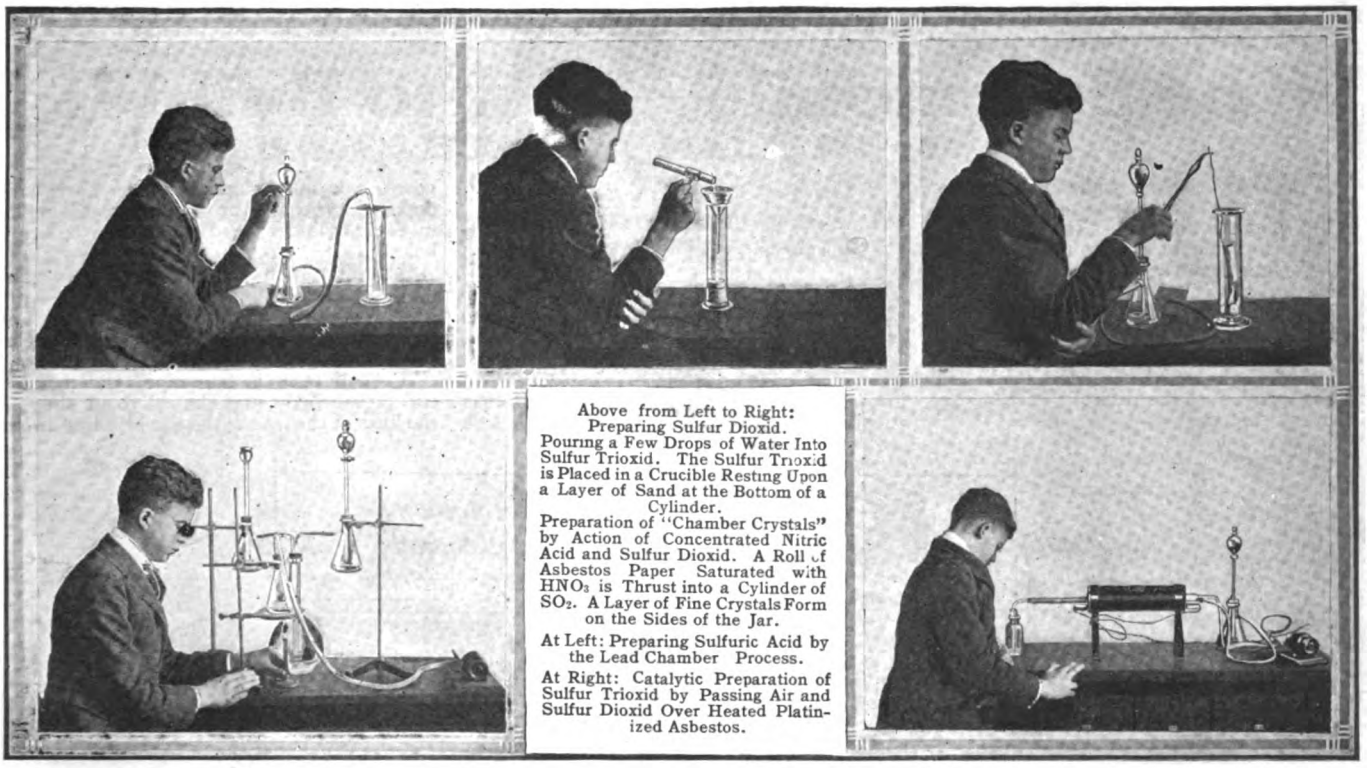
(*Continued on page* 866)



Rutherford's Experiment Indicates That a Nitrogen Atom May be Composed of Three Helium (He) Atoms and Two Hydrogen (H) Atoms.

Sulfur and Sulfuric Acid

By PROF. FLOYD L. DARROW



Above from Left to Right: Preparing Sulfur Dioxid. Pouring a Few Drops of Water Into Sulfur Trioxid. The Sulfur Trioxid is Placed in a Crucible Resting Upon a Layer of Sand at the Bottom of a Cylinder.

Preparation of "Chamber Crystals" by Action of Concentrated Nitric Acid and Sulfur Dioxid. A Roll of Asbestos Paper Saturated with HNO_3 is Thrust into a Cylinder of SO_2. A Layer of Fine Crystals Form on the Sides of the Jar.

At Left: Preparing Sulfuric Acid by the Lead Chamber Process.

At Right: Catalytic Preparation of Sulfur Trioxid by Passing Air and Sulfur Dioxid Over Heated Platinized Asbestos.

COKE, lime and sulfuric acid are the three most important raw materials of chemical manufacture. In one way or another they enter into the manufacture of practically all chemical products. You cannot name a single article from a pin to a locomotive that does not use directly or indirectly sulfuric acid in its manufacture. A substance so important in the chemical world is worthy of the attention and study of even the amateur chemist. Already in carrying out the experiments described in this series of articles you have had occasion to use this acid in many ways.

Before we proceed to the actual experimentation with this acid, perhaps a few words as to its history will be in order. Tradition says that sulfuric acid was first made by an old alchemist, Basil Valentine of Bohemia. He found by accident that if he heated in a retort a certain green shale, which he found on his native hillsides, there would distil over a heavy oily liquid. This green shale was green vitriol or, what we now call ferrous sulfate, with seven molecules of water of crystallization. Upon heating, the water and the sulfate group of atoms rearranged themselves to form water and this oily liquid which was called, *oil of vitriol*, and is so called even down to the present day. The chemical name is of course *sulfuric acid*. The names blue vitriol, green vitriol and white vitriol, names of several salts of the acid, still preserve the historic name of the substance. As first obtained sulfuric acid was a curiosity and, aside from being a solvent for the alchemists in their fruitless efforts to change the baser metals into gold, it found very little use. The first deliberate attempt to make the acid for commercial purposes came in England toward the close of the eighteenth century. A man by the name of Ward set up a huge glass sphere about three feet in diameter. In the bottom he placed a pedestal with a basin of water and thru an opening in the side he thrust alternately ladles of burning sulfur and heated saltpeter. The atoms of the two substances united to form sulfur trioxide, the anhydrid of sulfuric acid, which dissolving in the water formed the acid. In 1789 the discovery of the bleaching action of chlorin gave a great impetus to the manufacture of sulfuric acid, for sulfuric acid was essential to the production of chlorin, and it is from this date that the modern development of the sulfuric acid industry began.

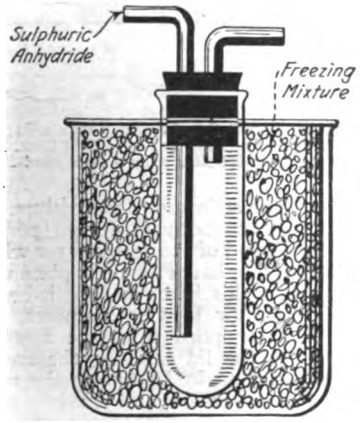


Fig. 2—Apparatus to be Used With That in Figure 1 for Preparing Crystals of Sulfur Trioxid.

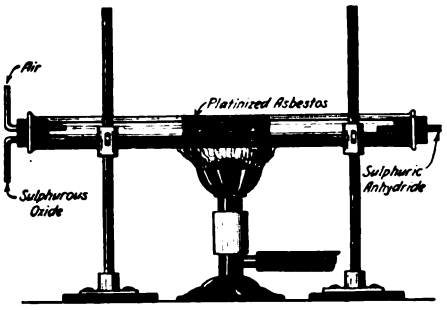


Fig. 1—The Preparation of Sulfur Trioxid.

Properties and Forms of Sulfur: Sulfur itself is a most interesting and useful substance. Its color and very faint odor are at once apparent. By shaking a little powdered sulfur in a test tube with water and allowing it to settle you will discover that it is insoluble in water. Its solubility in carbon disulfid, however, is very great. Place a small crystal in the bottom of a test tube and cover it with a few cubic centimeters of this liquid. Upon shaking, the sulfur will quickly disappear. If you will pour the resulting solution into a watch glass, and allow it to stand for a few minutes, until the liquid has evaporated, you will have left *rhombic crystals* of sulfur, one of the two forms in which sulfur crystallizes. Their rhombic shape will at once appear if they are looked at with a hand magnifier.

(*To be Concluded in the February issue.*)

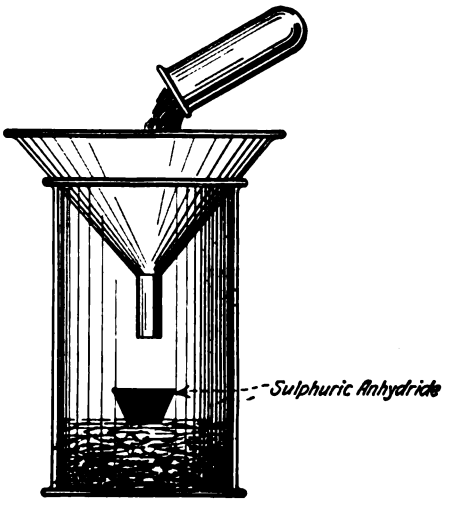
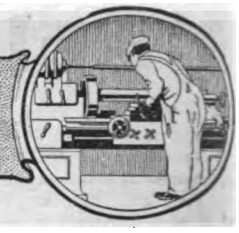


Fig. 3—Action of Water on Sulfur Trioxid.

THE CONSTRUCTOR



The Solomobile—How to Build It

By WILLIAM J. BEACH

THE *Solomobile*, while being an extremely novel type of conveyance, has additional advantages, the principle of which resides in the fact that the motor is entirely enclosed and protected from rain and mud; it is simplicity itself and can be made by anybody having a home work-shop and a half way decent kit of tools; nor is it not an experiment, as a model has been made and it has proved to be thoroly satisfactory in every respect.

A Low-priced Motor Driven Pleasure Vehicle

as per the side view in the drawing. The insides of each body-plank are provided with hard wood stringers 1" square; the left hand body side-piece is cut away to allow the flywheel-magneto and spark plugs to protrude thru to the outside; both side pieces have *louvres* or ventilating slots cut in them at the front and rear as is shown in the side view.

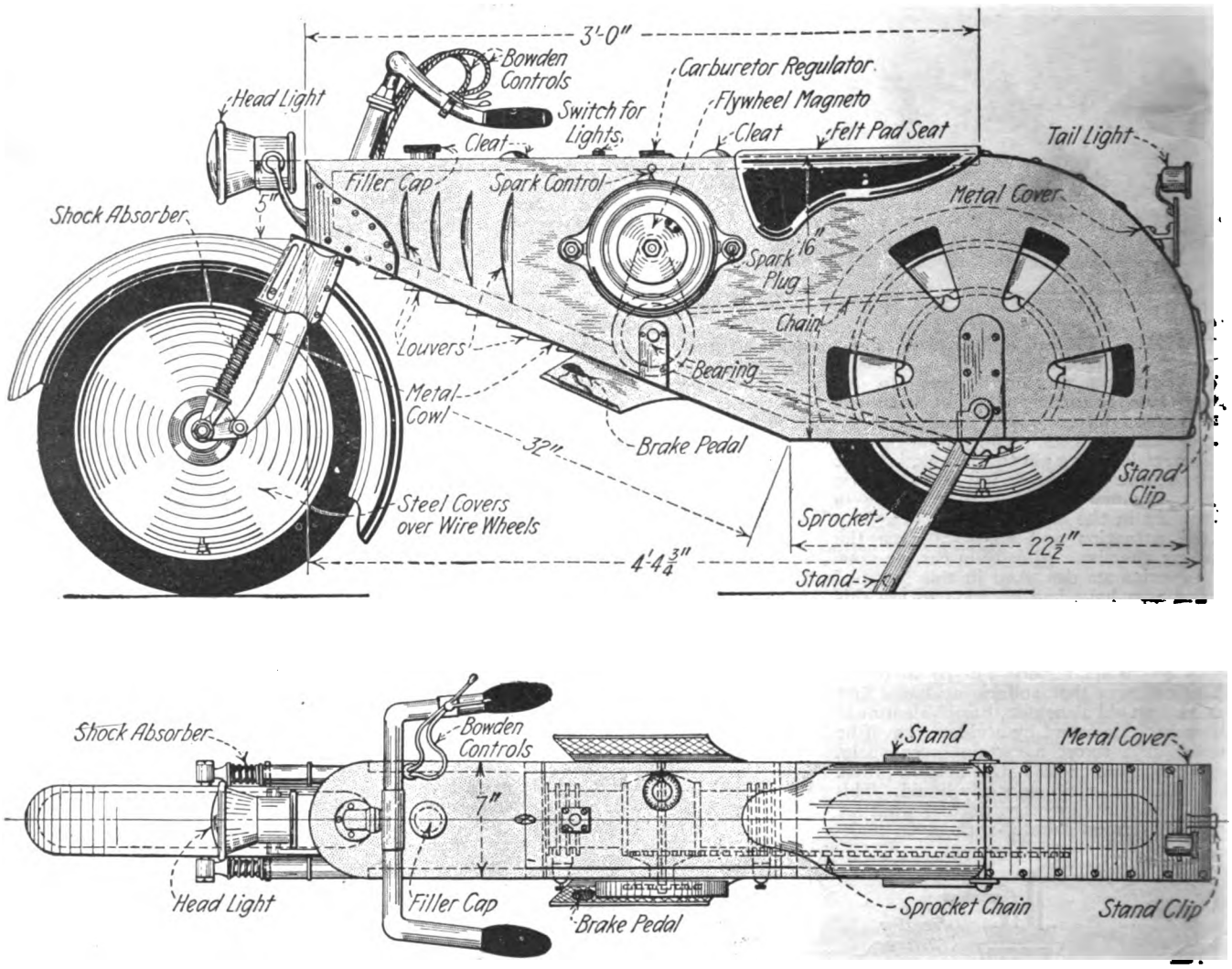
The two side members are secured side by side with cross-pieces of the same size as the stringers, each cross-piece is provided with small metal angle brackets which are fastened with round head stove bolts, allowing all heads to be on the outside. Two of the cross members are so located that the motor may be suspended from them in a very simple manner, as the motor used in the model, which was made for test purposes, was of a standard make horizontal opposed type and provision already made in each cylinder head to receive securing bolts.

Immediately under the motor and running in suitable bearings is a jack-shaft, which carries two sprockets, the smaller of which lines up with the drive sprocket on the rear road wheel.

A small tank is housed in the forward end of the body and shaped to fit snug to the lines of the frame; the gas pipe line is led along one of the stringers to the carburetor.

The top of the body is decked permanently at each end of the motor, over which a detachable lid or hatch is held in place with clips or cleats; this hatch is supplied with a push switch for lighting purposes, the current being supplied from the flywheel magneto. As the lid carrying the switch is detachable, the wire leading to the magneto is purposely broken and provided with a spring friction contact, that will complete the circuit when the lid is in position.

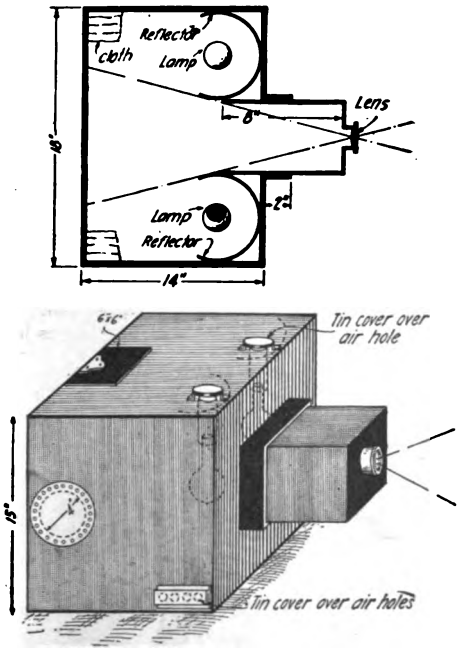
(*Continued on page* 852)



Everybody Likes to Ride Instead of Walk Whenever They Can, but There are Many People Who for One Reason or Another, Do not Care to Bother with a Regular Motorcycle or Automobile. The "Solomobile" Here Described by Mr. Beach is a Simple and Efficient Little Machine Which Can be Built at Very Slight Cost, Particularly if the Engine is Purchased Second-Hand. This Little Machine Can be Built for $50.00, or Even Less, Depending upon Whether a New or Second-Hand Engine is Used, and Which Will Give the Builder Many Miles of Pleasure.

Gravity Defied?

IF seeing is believing, the writer has witnest the most wonderful defiance of gravity, projected on the screen to be sure, but not by any means a motion picture. So simple is the construction of the appliance, necessary for conducting this experiment, that it is given here for



Above Is a Simply Constructed, Specially Designed Post-card Projector, Whereby It Is Possible to Produce Those Effects of "Defied Gravity" Described Herein.

the benefit of the average experimenter; but before delving into the construction of the apparatus, a review of a few of the experiments will be taken up in order.

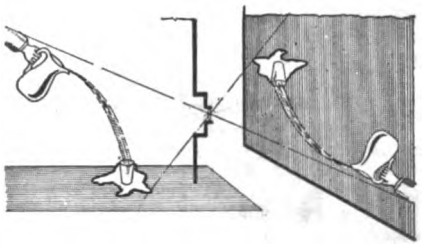
Many more results,—more pleasing, more startling, and far more satisfactory for conveying the desired impression can be conceived of by the dabblers in scientific matters. Therefore, but a few will be mentioned.

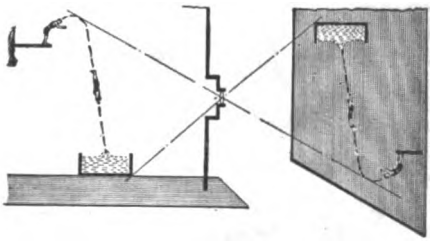
An ordinary cuckoo clock was seen to be suspended upside down, the weights rising perpendicularly towards the ceiling, and the pendulum swinging in an inverted position in the most grotesque manner imaginable. One would think that any moment the pendulum would overcome the effects under which it was laboring against the laws of gravity, falling to one side or the other, but no, it did no such thing! It kept on ticking away the minutes on the screen which had been erected for this demonstration.

A little dummy diver made of wood, then appeared on a ruler which acted as a spring board. Below him,—or rather above him, and inverted, was a container of water. The container remained apparently suspended from the ceiling of the room, and the diver was stuck fast to the wood, upside down, or so it seemed. At a critical moment, the diver was seen to move downward, turn and speed upward into the inverted container of water, where he sank beneath the peculiar inverted wave formation.

A pitcher of water was also held in an inverted position, but much to the dismay of the audience, the water remained within the pitcher. The glass was then inserted and appeared on the screen, suspended considerably higher and upside down. By tipping the pitcher, the water ran uphill. Funny? No, we consider it *uncanny*.

As to the construction of the apparatus which is used for producing these results, it is nothing more than a large postcard projector. The dimensions of the box proper are 14x18 inches and 15 inches high. In the front of this is cut an aperture made to fit a sliding box about 8 inches square in the extremity of which is mounted the lens. A two inch moulding surrounding this assists in cutting off extraneous rays of light and incidentally acts as a guide for the sliding or telescoping box. Suspended from the top, and mounted at the ends of metallic tubes, are two 200 watt nitrogen bulbs; the metallic tube which communicates with the opening in the top of the box provides for the escape of heat. The opening is closed by a tin cover. Two circular holes, four inches in diameter are cut,—one in each side of the box and a sleeve made of black cloth is tacked to the opening thus formed. In the top, another opening is made, fitted with a trap door, 6x6 inches to allow for the introduction of various articles, and there are four holes passing thru the base, which act as air holes and

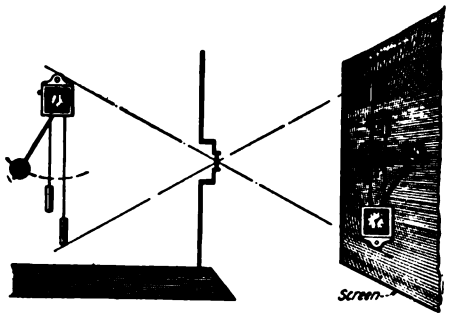




Above—Water Flowing Up Hill—Just Like the Mississippi River—but You Can See This Clearly in That It Is Projected Upon a Screen.
Below—A Midget Diver in the Form of a Toy Doll Whose Hands are Weighted, Jumps Off the Platform and Tumbles Into an Inverted Body of Water.

assist in the ventilation and in keeping the box cool. They are bored thru the base and are covered with an elongated tin strip. The inside of the box is now painted black, thus preventing reflection, and two metallic reflectors are installed so as to partly surround the lamps aiding in concentrating the light upon the objects. These were cut from tin cans, the inside of which have their original polish. The hands are now inserted into the sleeves and the articles with which the experiment is to be conducted are introduced thru the opening in the top. The lights are turned on and the lens and lens box are adjusted, until a clear focus is obtained and then the experiment is conducted. A single lens, ground double convex or a reading glass answers the "lens" purpose. It will be seen that all objects, which are right side up, inside of the projector, will appear upside down on the screen.

This device will also serve as a post card projector.

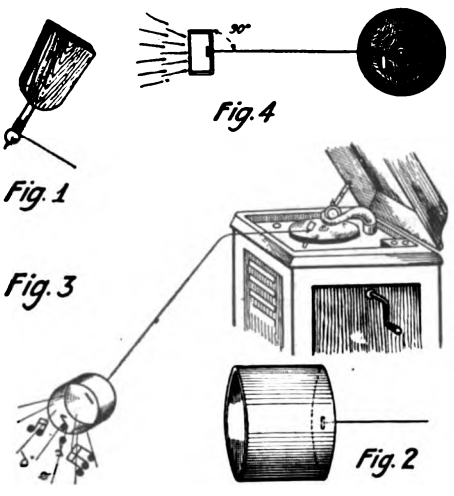


An Actual Moving Picture Without a Moving Picture Machine, of a Small Clock. This Is Seen to be Ticking Away Merrily and Contentedly in an "Inverted" Position.

Tin-Can Phonograph

A very interesting variation of the tin-can telephone of our childhood days is the following experiment which could appropriately be termed the "tin-can phonograph." The apparatus used in constructing this simple contrivance can be found in any household containing of course a phonograph, even tho that phonograph may be practically obsolete. An ordinary phonograph needle, preferably of the permanent type, that is, the kind which plays a record more than once, is imbedded in a small piece of wood (Fig. 1). Around the projecting part of this needle is wrapt one end of a 25 ft. length of small wire, or a cord (the wire from a telephone bell magnet was used by the author). The other end of the wire is past thru a hole in the bottom of an empty coffee or milk can, and then wrapt around a nail or match stick.

The method of operation is as easy as the construction of the device is simple.



One person will hold the small wooden block with the needle insert on the record at the correct angle. Another individual holds the can, pulling the wire taut so that the nail or match stick is held tightly against the face of the can. The can should be held at right angles

The "Tin-Can" Phonograph Is Great for the Boys, and It Brings Forward a New Version of the Old Style Cord Telephone Which We Were Wont to Amuse Ourselves With in Our Younger Days.

to the wire, otherwise the results are inferior. Anyone standing around the can can now hear the music played at quite a distance away. The scientific explanation is of course very simple; the musical vibrations are imparted to the needle by the revolving record and thence transmitted by means of the wire to the bottom of the can which acts as a diafram.

Contributed by
WILLARD E. MOORE.

Electric Ice Skates the Latest

By H. GERNSBACK and H. W. SECOR

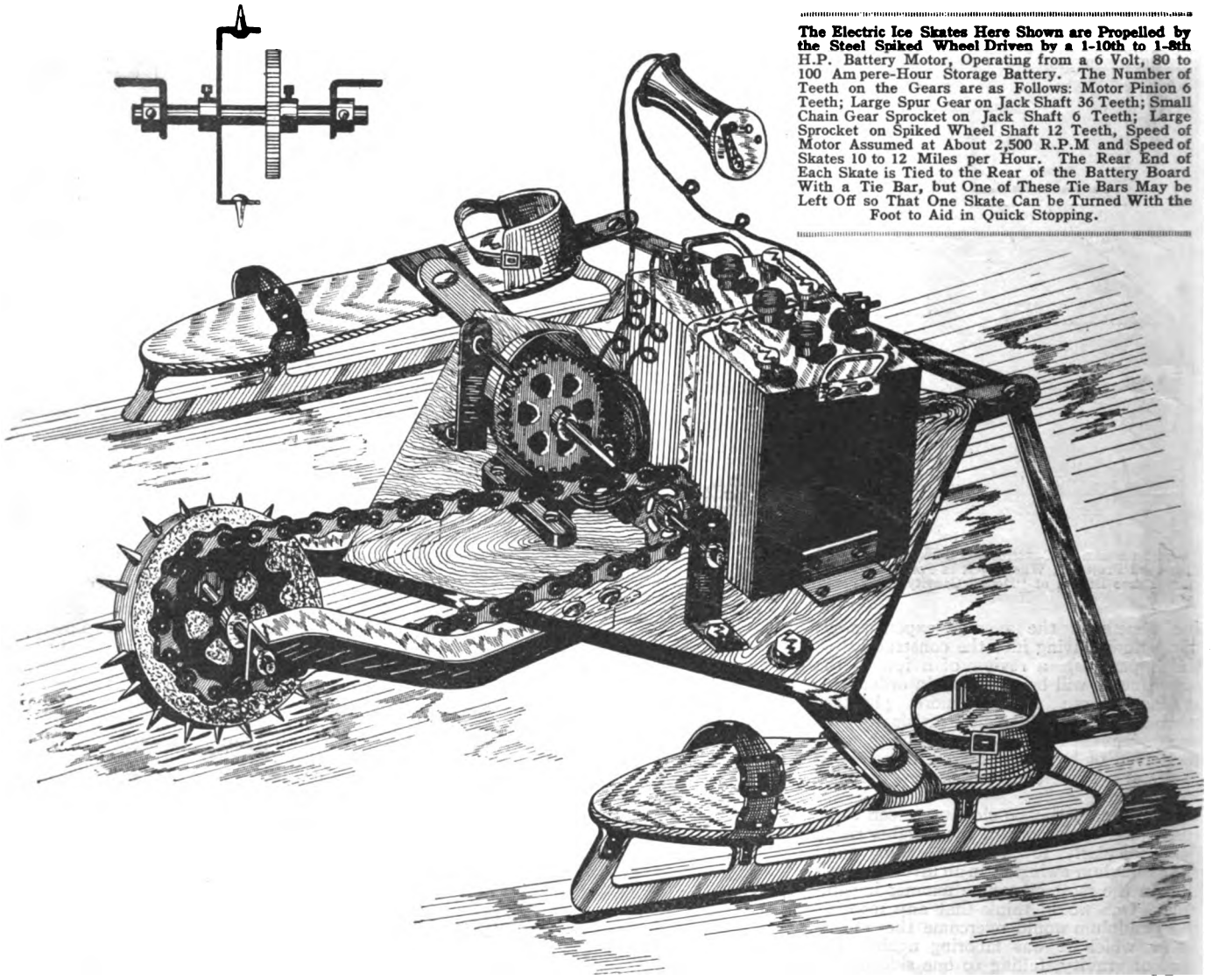
OUR front cover illustration shows something novel and interesting to all lovers of winter sports—electric ice skates. The motion is obtained in this particular design of electric ice skate, thru the medium of a spiked wheel, driven at a suitable speed by an electric battery motor of about 1/10th H.P. A storage battery rated at 6 volts and 60 to 80 ampere-hour capacity, will serve to propel the skater over the ice at a speed of 10 to 15 miles an hour, depending upon whether the wind is against him or is blowing in the direction followed by the skater. Various speeds are obtainable by means of a rheostat held in the hand, or otherwise strapt around the wrist or around the waist. For night skating a powerful electric spotlight consuming but little current, may be strapt around the breast, as the front cover illustration shows. If we want to go a step farther, we could connect to the battery circuit, electric hand warmers and ear muffs, but the battery will have plenty to do in operating the motor and, therefore, we will not add more load to it.

The first thing to decide upon in building a pair of electric skates is the type of skates to be used; we prefer the racing or hockey style skates, but the usual club skates with curved blades may be used as well, the only difference being that the hockey skates will be much easier for the novice to perform on, as they do not have a tendency to throw over or pivot about, this being obviated to a large extent of course in the electric ice skates here described, as a third point of support is provided by the spiked wheel.

The frame supporting the storage battery, motor and speed reduction gears, as well as the spiked driving wheel, may be made from a piece of substantial wood, such as oak; or else the whole frame may be made of bar iron or angle iron, and then may be covered with a piece of sheet iron or thin wood. In the design shown in the illustration herewith, the supporting base for the apparatus is made of 1¼ inch oak measuring about 12 inches wide by 12 inches long. A piece of flat iron bar about 1½ inches by ¼ inch or 3/16 inch thick, supports the wooden platform over the two skates, the ends of the center bar being pivoted to the skates with countersunk rivets, about ½ inch in diameter, so that the foot may rest over them when strapt in place with the usual toe and heel skate straps.

The storage battery is the same as used for ignition and lighting on automobiles and these may sometimes be purchased second-hand or rebuilt at a very reasonable price. The motor should be rated at 1/10th H.P. or more if possible, but of course the more the H.P. developed, the greater the current consumption from the battery. There are several different ways in which the spiked iron wheel may be driven, such as by belts, friction pulley drive, shaft and worm gear, or else by the usual spur gearing, shown in the present illustration.

(*Continued on page* 855)



The Electric Ice Skates Here Shown are Propelled by the Steel Spiked Wheel Driven by a 1-10th to 1-8th H.P. Battery Motor, Operating from a 6 Volt, 80 to 100 Ampere-Hour Storage Battery. The Number of Teeth on the Gears are as Follows: Motor Pinion 6 Teeth; Large Spur Gear on Jack Shaft 36 Teeth; Small Chain Gear Sprocket on Jack Shaft 6 Teeth; Large Sprocket on Spiked Wheel Shaft 12 Teeth, Speed of Motor Assumed at About 2,500 R.P.M and Speed of Skates 10 to 12 Miles per Hour. The Rear End of Each Skate is Tied to the Rear of the Battery Board With a Tie Bar, but One of These Tie Bars May be Left Off so That One Skate Can be Turned With the Foot to Aid in Quick Stopping.

$50.00 PRIZE CONTEST

HERE is a brand new sport for all out door lovers. It is a simply designed pair of ice-skates that can be driven electrically by means of a good storage battery, a starting battery being preferable. It should be remembered that ice gives probably less friction than any other substance known for practical purposes. Everyone knows that even heavy bodies can be moved over ice with very little effort.

No model, as yet, has been built of these skates, and we invite our readers to build these skates and send us good photographs and other constructional data of same. We will pay a first prize of $35.00 for the best set of photographs with an article showing how the builder constructed these skates. There will be a second prize of $15.00 for the second best article. The only condition we make is that the skates must be full size, that is, they must not be a small model.

This contest will close January 20th, 1922. Address all manuscripts to *Editor, Electric Ice Skates.*

On receipt of a stamped envelope, we shall be glad to send information, as to where the different accessories necessary to build these skates can be procured.

—EDITOR

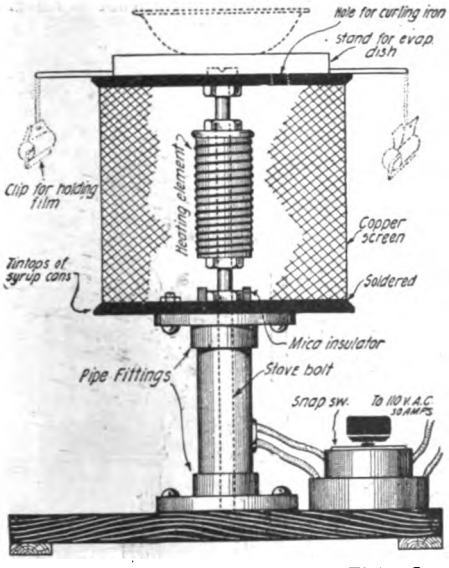
HOW-TO-MAKE-IT

This department will award the following monthly prizes: First prize, $5.00; second prize, $3.00; third prize, $2.00.
The purpose of this department is to stimulate experimenters toward accomplishing new things with old apparatus or old material, and for the most useful, practical and original idea submitted to the Editors of this department a monthly series of prizes will be awarded. For the best idea submitted a prize of $5.00 is awarded; for the second best idea a $3.00 prize, and for the third best a prize of $2.00. The article need not be very elaborate, and rough sketches are sufficient. We will make the mechanical drawings. Use only one side of sheet. Make sketches on separate sheets.

FIRST PRIZE, $5.00

ELECTRIC HEATER

In the illustration is shown a practical electric heater which can easily be con-



A Home-Made 110 Volt Electric Heater Which Can be Used for Drying Photograph Films, Heating Water or for Warming a Small Room or Other Compartment.

structed by any experimenter in his "lab" using mostly all old material. The evaporation-dish stand, film drying clips and curling iron attachment can be used if desired. The heating element consists of 28 ft. of standard resistance wire wound on a porcelain tube or fireclay cylinder.

The copper screen is soldered to the tin lids with hard solder, and mica insulation is used to insulate the resistance wire. The stand is made of pipe fittings and a length of 1"pipe. The whole heater must be mounted on a wooden or slate base to keep the heater from upsetting. This device will radiate sufficient heat to comfortably warm a 12' x 12' room, and it will evaporate liquid mixtures with amazing rapidity.

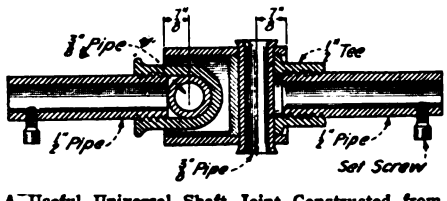
This heater is for use on 110 volt A. C. with 28' of No. 24 resistance wire.

Contributed by R. ROLAND RICHT.

SIMPLE AND DURABLE UNIVERSAL JOINT.

This universal joint drive is constructed entirely (with the exception of the shaft set-screws) of pipe and pipe fittings.

The body of the joint consists of a piece of two inch pipe, three inches long.



A Useful Universal Shaft Joint Constructed from Pipe Fittings and Pipe.

It has two sets of holes drilled thru the diameter of the pipe, at right angles to each other, the center of the holes being ⅞" from the ends of the pipe, and each pair of holes being large enough to hold snugly, a piece of ⅜" pipe. Two pieces of ½" pipe of a length to be determined by the constructor are used as drive shafts. These are threaded on one end and screwed tightly into ½" tees. The threaded sides of the tees are then filed or sawed down until they will be free to move when inserted in the two inch pipe. Care should be used in filing or sawing off the tees, to see that the same amount is filed off each side. This will make the drive shaft come exactly in the center of the two inch pipe. The two pieces of ⅜" pipe, 3¼" long, are inserted, each thru a pair of holes in the two inch pipe, and also the tee. They are then allowed to extend out the same distance on each side of the two-inch pipe, and are upset or riveted, so as to remain tightly in position.

The set screws may be placed where most effective. Two of these joints connected together by a suitable length of pipe will furnish a very effective means for out-of-line driving. Pinning the joints will secure the tees from unscrewing under heavier loads.

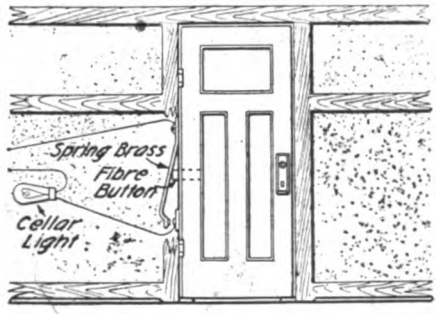
Contributed by E. W. McCLURE.

SECOND PRIZE, $3.00

HANDY CELLAR LIGHT ARRANGEMENT

Have you ever rushed down into the cellar in a hurry to obtain something and groped around in the dark for your light switch, and then forgotten to turn it off as you left? Have you then equipt your pull chain socket with a radium luminous pendant in order to find it more easily, and then cracked your shins on about four million boxes and cases in an effort to get at the little luminous speck? Four million may be exaggerating it a bit, but it seemed fully that number before I determined to put a stop to a repetition of these rather customary habits. Therefore, I inserted into the door jamb a spring brass switch, as illustrated, and into the edge of the door a fibre or hard rubber button, so located that when the door was closed the switch was opened automatically. Now when I enter the cellar, I merely leave the cellar door open and I have light during my entire sojourn. Upon closing the cellar door, either during the daytime or when I am thru "below deck," the light is turned out immediately.

Contributed by C. S. CIERPIK.

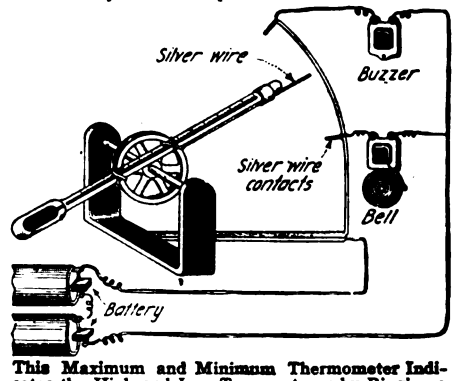


This Automatic Cellar- or Closet-Door Switch, Shown Greatly Exaggerated in Size, Will Save a Lot of Time and Cussing, for as Soon as the Door is Opened, the Light Flashes On.

THIRD PRIZE, $2.00

MAXIMUM—MINIMUM SIGNALING THERMOMETER

I fastened by wires a thermometer to the escapement wheel of a clock, I ran one wire alongside of the thermometer so that it protruded for a distance of about 1 inch beyond the tip; the other end of this



This Maximum and Minimum Thermometer Indicates the High and Low Temperatures by Ringing a Buzzer or Bell Respectively. A Balanced Thermometer Tube is Used in Building It.

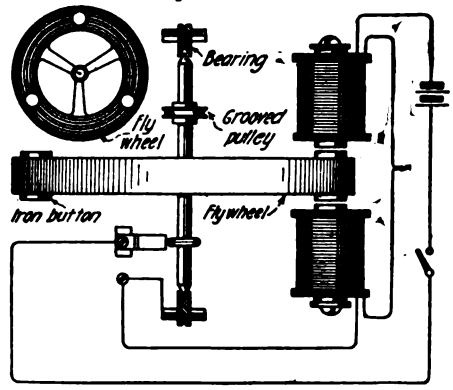
wire was soldered to the escapement wheel. Here very critical adjustment is necessary, and it may be found that, instead of placing the thermometer as illustrated in the diagram, the thermometer must be fastened below the escapement wheel. Into a cardboard strip are inserted two pins or two paper fasteners. It will now be found that as the temperature of the surrounding air changes, the mercury expands and therefore upsets the balance of the thermometer sufficiently to cause it to make contact with either the bell or the buzzer. As the mercury expands it also loses considerable weight on one side. This in turn causes the column of mercury to be pushed forward causing the device to tip. Silver wire contacts are best.

Contributed by HARRY S. BINDER.

TOY MOTOR.

The fly wheel made of iron or wood has three buttonlike studs projecting from it to a distance of about ¾". The commutator is in the form of a three-pointed star so adjusted that the points line up with the equi-distant studs on the fly wheel. A brush makes contact with this commutator.

Contributed by R. GRIMANY.

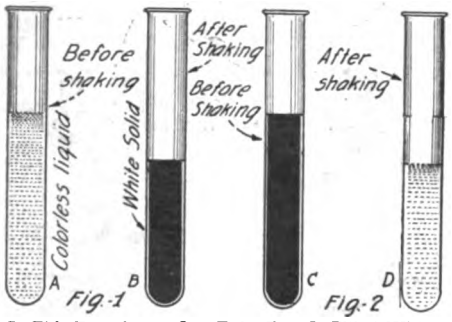


One of the Simplest Toy Electric Motor Designs Imaginable. It is to be Built with a Wood or Iron Disk, Provided with Iron Studs, and a Circuit-Breaking Arrangement as Shown.

THE WANDERING CHEMICALS

THIS trick is one which can be performed by anybody as it is always sure to work and mystify the audience. There is no complicated apparatus used, and the trick can be done in full light without any fear of detection whatsoever.

Two test tubes are used and for purposes of identification, one should be larger than the other. They are held up so that the audience can see their contents. (See Cut.) One tube contains a transparent colorless liquid filling about half of it while the other tube contains a white



In This Experiment One Tube Test Is Filled With a Transparent Liquid, While the Second Tube Contains a White Opaque Powder. After Shaking the Tubes, the Liquid Will Be Found to Have Changed to a Solid, and the Solid in the Second Tube Has Become a Liquid.

opaque powder. Both tubes are now given to some skeptical spectator, who is requested to keep them apart, one tube in each hand and to remember whether the liquid or solid is kept in the right or left hand. He is then ordered to close both tubes with his thumbs and shake them. After having shaken the tubes the audience will be surprised to find that both tubes have apparently changed places, the tube which contained the white solid now contains the liquid and vice versa, and now for the modus operandi.

Some curious and little known properties of two organic substances form the parts of our interesting trick. One of them is the property of salol to remain in the surfusion state with great tenacity (in open vessels in the presence of unfiltered air) Salol, being used in medicine, can be bought at any well stocked drug store. Ten grammes are placed in a clean, dry test tube, care being taken not to leave the crystals adhering to the walls of the tube. The chemical is then melted over a flame. Once liquid it is heated a trifle over its fusion point, so as to melt any particles of salol left in the liquid. This is then allowed to cool and is ready for the experiment even two or three hours after being heated. Carrying to and fro will not cause it to become solid, but vigorous shaking for a few seconds will transform the liquid into a solid.

The other is due to the property of solid camphor of rapidly melting into a liquid compound whenever ground or shaken with solid chloral hydrate, which are placed in the other test tube. The two chemicals must be finely powdered and the camphor is sprinkled with a few drops of alcohol before being ground. The two white powders look alike and are put into the tube in the following proportions: Camphor, 2 parts in volume; chloral hydrate, 1 part. The rapid shaking mixes and liquefies them.

Contributed by DAVID GOODMAN.

RECOVERY OF SILVER FROM PHOTOGRAPHIC SOLUTIONS

PHOTOGRAPHY is based on the fact that certain of the silver salts when exposed to the light become changed. In the process of developing and fixing much of the silver forms soluble compounds and goes in solution. As a result when the solution is poured down the sewer, all the silver goes with it. I have tried the following method and find that it works successfully. It is interesting as an experiment if nothing else.

The method I have tried is as follows:

1. The solution is first treated with nitric acid to obtain the silver in the form of a nitrate. After the first evolution of gas, the solution is heated until practically all solid matter is dissolved. If there is some that will not dissolve it probably is not silver.

2. A saturated solution of common salt (sodium chlorid) is prepared. This is added to the silver nitrate solution heated to near the boiling point. A white insoluble precipitate of silver chlorid is formed. This can be recovered by filtering.

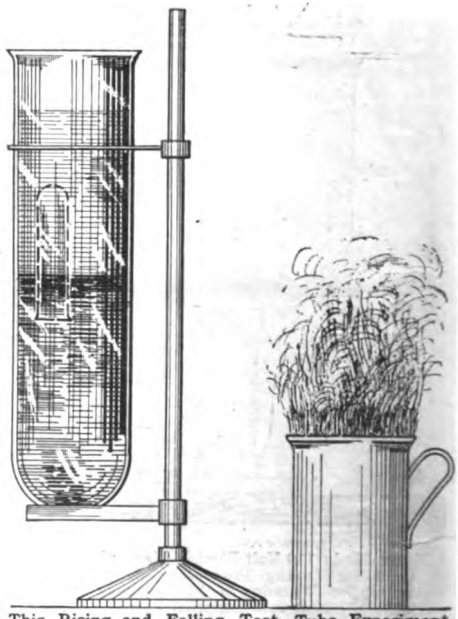
3. Acidulate the silver chlorid solution with sulfuric acid and add zinc (in any form of metal). Owing to the greater activity of zinc over silver, zinc chlorid will be formed and the silver will be precipitated in the form of a grayish spongy mass. This can be reduced to a lump or ingot with a blow-pipe.

Contributed by JOHN WIEDERHOLD.

A MYSTIFYING MOVEMENT

AN exceedingly pretty experiment in the evaporation of ether by heat is found in a German authority and we take pleasure in giving it to our readers.

A glass cylinder is to be filled with fluid. At the bottom a strong solution of salt is first placed so as to about half fill the tube. This must be a very strong solution. Then the cylinder is inclined over until the fluid nearly reaches its lip, and the upper half is most carefully filled with pure water. As it enters the cylinder, the latter is brought back gradually to the perpendicular. The great point is not to mix the two solutions. They must be kept separate. Next a test tube is needed. This has water put into it to within ⅛ inch or so of the edge. Ether is poured on top of the water until the tube is filled.



This Rising and Falling Test Tube Experiment Always Proves a Mystery.

The thumb is then placed over the mouth, the tube is inverted, and inserted into the cylinder, mouth downwards. Now the bottom of the cylinder with the heavier solution in it is heated; the ether in the tube will be converted into gas; a bubble will form in the top of the tube, expelling water; and the tube will rise to the surface. As it enters the colder part of the cylinder the water in the tube rises as the ether recondenses and the tube will sink again.

Of course, there is a certain tendency for the two to mix; so even if the lower part is kept warm, the motion will not last forever. As regards heating of the lower portion, there are several ways of doing it. The salt solution may be made in a separate vessel, heated therein and poured into the cylinder, and the cold water may be poured on top of it in the way described. If, however, the lower layers have to be heated after everything is in the cylinder, it is done by very carefully putting the cylinder into hot water for a depth not exceeding that of the salt solution. This has to be done with great care and very gradually to avoid cracking the cylinder. It is said that the experiment can be repeated over and over again on successive days. Of course, when the solution of salt by diffusion mixes with the water above, the experiment will no longer succeed. The essential point involved is that the salt solution must be so heavy that even when expanded by heat it will still be of higher specific gravity than the overlying cold water.

The best way of heating the salt solution is by a heating coil, surrounding the base of the cylinder, or by a small electric lamp immersed in the liquid.

Radio Central

By ARTHUR H. LYNCH

MUCH has already been written about the huge radio station on Long Island, New York which was officially opened, when President Harding pushed a switch button on his desk, in the White House, Washington, D. C., on November 5th. With all that has been previously said about this very wonderful station, there are still a few interesting points which have not been brought to the attention of the average man, and it is the average man, who will find this station of great value to him, in his business.

COMMA is the earnest hope of the American Nation STOP. WARREN G. HARDING. Unquote END."

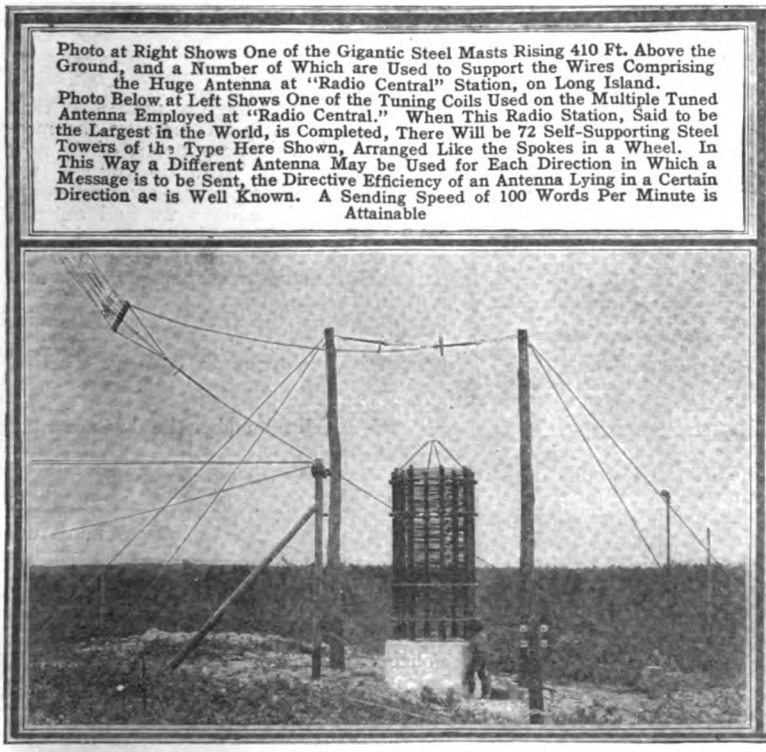
To those in the gathering, at the station as the message went through, it was quite apparent that a new era in radio communication had been born. Many of the old-timers, who have witnessed the opening and operation of many high-power transmitting stations, found something entirely different; something out of the ordinary, in the opening of Radio Central. In the high-power transmitting stations of yesteryear one was impressed with the din caused by the spark discharge, as it boomed its way across an air gap, under the control of the sending key. This great noise was not to be heard and had it not been for the thoughtfulness of the engineers in charge of the station, who installed a loud-speaker, operated by one of the transmitter relays and a sixty cycle current, the visitors would hardly have known that the message was being sent. Of course there were a group of relays which could be heard clicking, as they cut in and out the circuits of the magnetic modulators, thus forming the characters of the code, but, to the layman they would have meant nothing. As the President's Message was going thru a salute of twenty-one guns was fired, in his honor, which also took the attention of the onlooker from the massive machines themselves.

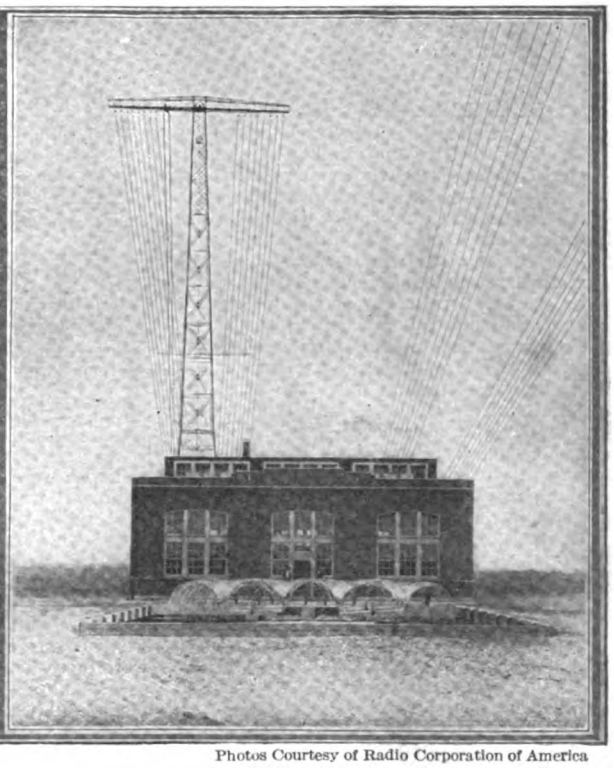
When the guests (and there were several carloads of them on the special train which was sent out from New York by the Radio Corporation) entered the brick power house, the Alexanderson alternator was running and overseers were busy watching the various meters on the control boards. Many were imprest with the number and delicacy of these devices, which have been built with watch-like precision.

In one of the accompanying photographs may be seen the power house, which, by the way, is a great deal larger than it appears to be. One of the giant steel masts may be seen, directly behind it and in the foreground is shown the cooling pond. It is interesting to note that there are now twelve towers, like the one in the photograph. Each is 410 feet high and the steel bridge-work, which is used to carry the wires for the antenna is 150 feet from tip to tip.

The cooling pond is used to supply water, which is circulated thru pipes which have been placed within the alternators, so as to prevent them from overheating when used for continuous service.

Photo at Right Shows One of the Gigantic Steel Masts Rising 410 Ft. Above the Ground, and a Number of Which are Used to Support the Wires Comprising the Huge Antenna at "Radio Central" Station, on Long Island. Photo Below at Left Shows One of the Tuning Coils Used on the Multiple Tuned Antenna Employed at "Radio Central." When This Radio Station, Said to be the Largest in the World, is Completed, There Will be 72 Self-Supporting Steel Towers of the Type Here Shown, Arranged Like the Spokes in a Wheel. In This Way a Different Antenna May be Used for Each Direction in Which a Message is to be Sent, the Directive Efficiency of an Antenna Lying in a Certain Direction ae is Well Known. A Sending Speed of 100 Words Per Minute is Attainable





Photos Courtesy of Radio Corporation of America

After the President closed the switch control button, which put the station in operation, the following message was sent and it was the writer's privilege to copy it, as it went thru:

"CQ CQ CQ President Harding's message being transmitted from the White House, Washington, D. C., which inaugurates the official opening of the Radio Central Station, New York, owned and operated by the Radio Corporation of America, Call Letters, W Q K STOP. Please distribute President's Message through other radio and wire services to all newspapers as rapidly as possible and acknowledge receipt to Radio Corp., New York, QUOTE. To be able to transmit a message by radio in expectation that it may reach every radio station in the world COMMA is so marvelous a scientific and technical achievement as to justify special recognition STOP. It affords peculiar gratification that such a message COMMA from the Chief Executive of the United States of America COMMA may be received in every land from every sky COMMA by Peoples with whom our Nation is at peace and amity STOP. That this happy situation may ever continue COMMA and that peace which blesses our own land may presently become the fortune of all Lands and Peoples

A Few Potent Facts.

Radio Central has been designed for World-Wide Wireless Communication. When the station is complete, there will be 72 self-supporting steel towers, of which twelve are already erected. At present two Alexanderson alternators have been put in place, tho but one is actually in operation. The motors which drive the alternators are rated at 500

(*Continued on page* 859)

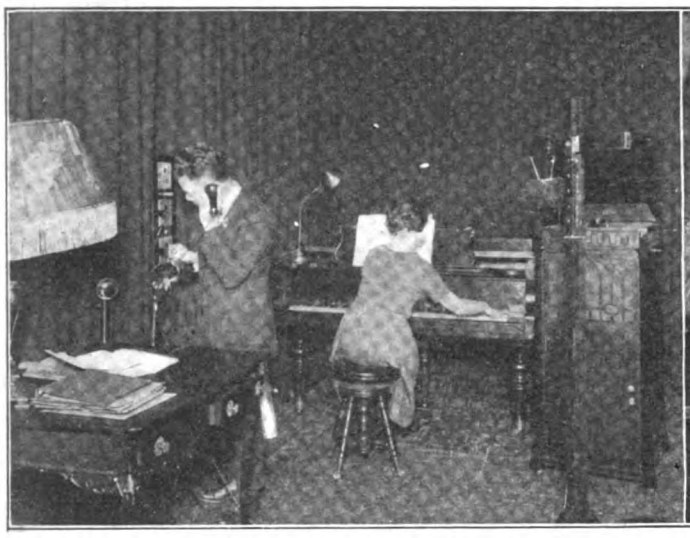


Photo Above Shows the Well-appointed Artists' Room at the Westinghouse Station in Newark, N. J., from Which Laboratory Wireless Telephone Music, Speeches and Daily News Items are Broadcasted Day and Night to Thousands of Radio Amateurs.

This Photo Shows Mr. H. Gernsback Giving His Wireless Talk Via Radio Telephone from the Westinghouse Laboratory in Newark, N. J., on the Night of November 10th. His Radiophone Speech was Heard by Thousands of Amateurs.

Jazz from the Air

By ROBERT E. LACAULT

THANKS to radio telephony, the audience of a lecturer is no longer confined to the number of seats in a room, and thousands and thousands of people may, at the same time, listen to a lecturer without even leaving their homes. While staying near the fire on a cold, winter night, a simple adjustment of a radio receiver brings in the news, a radio concert, or an interesting lecture, which everyone can enjoy.

To many people, this may sound impossible, or only a vision of the future, but it is, in fact, a vision of the present and for the benefit of those people who do not yet know the wonderful possibilities of radio telephony, we shall give in this article a little practical information to enable them to benefit by the lectures, concerts, news, etc.

Recently Mr. H. Gernsback, Editor of this magazine, and also of "Radio News" and "Practical Electrics," delivered the following lecture through the Radiophone Broadcasting Station of the Westinghouse Company, installed at Newark, N. J., and within a radius of over 100 miles, thousands of Radio enthusiasts could hear this lecture right in their homes.

The Past and the Future of Radio
Lecture Broadcasted by Radio Nov. 10th, 1921, by H. Gernsback
Editor of RADIO NEWS, SCIENCE & INVENTION, PRACTICAL ELECTRICS

My Radio Friends:—

When I come before you to-night, invisible in body, but audible in voice, one of my most cherished dreams since I was a little boy has been fulfilled.

The Westinghouse Electric Manufacturing Company has kindly asked me to come here to Newark to-night and talk to you on radio by radio. As editor and publisher of RADIO NEWS, SCIENCE & INVENTION, and PRACTICAL ELECTRICS, it is with great pleasure that I respond. As you all perhaps know, I have been in the radio game since its beginning, and as a matter of fact, I was the first individual in the United States to make and sell an amateur radio outfit. It is now exactly seventeen years since I turned out the first wireless outfit, which was advertised at that time in one of the November, 1904, issues of the *Scientific American*, as well as several other periodicals.

DO you know that it is possible now with a Radio outfit costing not more than $2.00 to receive free of charge every day radio telephone concerts by the best opera artists, violin and piano music, lectures, stories for the children in the evening, jazz music, etc.? The Westinghouse Electric and Manufacturing Company maintains broadcasting radio telephone stations at Pittsburgh, Pa., Newark, N. J., Springfield, Mass., and Chicago, Ill., from which stations the Radio telephone entertainments are broadcasted every day from 10 A. M. to 10 P. M. *Anyone* within range can receive this entertainment. If you are not as yet bitten by the Radio Bug, we would greatly advise you to get busy. A world of information and entertainment is yours for the asking.—*Editor.*

Those were the wild and woolly days of radio. I, who am responsible for the words RADIO AMATEUR, and who was a dyed-in-the-wool radio amateur, and still am, may be pardoned for trying to work in a few reminiscences of the good old days. In those days of the coherer, when wireless detectors had not, as yet, been invented, we had our one inch spark coils, and we were lucky if we transmitted one mile with ease. The radio amateur had just been born, and there were not one hundred of us in this country in A.D. 1904. There were, of course, at that time, no laws for radio, and whoever owned the biggest spark coil, and who controlled the heaviest "juice" was czar and master of the situation. He simply drowned out everyone else, and cared not a rap whether the other fellow put his message through or not. Not that it mattered a whole lot, because the messages in those days were mostly of the now famous variety of "How do you get my spark?" and other similar exciting news. Of course in those days we had quite a good deal of trouble selling wireless outfits, for the simple reason that few people believed that there was such a thing, and branded it as a fake.

I remember the time when the police department of the city of New York investigated my company to find out whether the outfit was a fake, or whether we were really selling a bona fide wireless set for $10.00. I well remember the day when the stalwart minion of the law walked into the office and critically inspected our little outfit, operated by four dry cells, and a one inch spark coil. In order to make it work at all, we had to have a miniature antenna on the spark coil, and a similar miniature one on the receiver, the latter composed of a coherer, decoherer, and a dry cell. We demonstrated the outfit to OUR satisfaction, but not to that of the policeman. He was not at all convinced, because as he put it, "If this contraption is a *wireless* outfit, why do you need all those wires dangling and sticking out from the instrument?"

This may be thought as in the light of a joke to-day, but to us in those dark days of radio, it was no joke at all. We finally convinced the good man by letting him walk around with the receiving outfit in his hands while we tapped away at the key at the other end of the room.

That finally convinced him, although he still growled about "those wires" when he left.

Of course this has all gone and
and I hope I am not boring you b
you of these ancient happenings
only doing so in the light of what I
say further on.

When I say that the radio telephone has always been close to my heart, I do so because ever since the birth of radio, I have always held that radio telephony was *the* thing that would make radio big. When I wrote the first book on wireless telephony in 1908, entitled, "The Wireless Telephone," I made the prophecy that in less than ten years we would have a wireless telephone not larger than one foot square

that would send intelligible messages clearly. That prophecy was fulfilled, and is now being realized.

At the time my book was written, there was of course no radio-telephone as we know it to-day. We still had spark and arc systems, but the continuous wave systems as we have them now, and which are due mainly to the invention of the audion, had not then been dreamed of. This has been changed, as you fellows all know, and wonderful progress has been made along these lines.

As I said before, wireless telephony has always been my hobby, and ever since as editor of "Modern Electrics," as far back as 1906, I started preaching radio telephony to the amateur; and while most of you considered it a joke, you realize that I was right, just the same. I am not an enemy of wireless telegraphy, but if amateur radio, and radio in general is to become the great art that I see it in the future, it will be done through radio telephony. The radio telegraph is all right for a few chosen ones, who know the code, but it does not lend itself to the public at large, all of whom can use the radio telephone if they make its acquaintance, and that is exactly our task. It is all right to hand your dad a pair of receivers, and let him "listen in." He will have a solemn look upon his face, and then ask you what it is all about. You tell him that it is the Mauretania in such and such latitude and longitude, sending out a ship report; but your dad is not at all interested in that.

On the other hand, if you hand him a pair of receivers, and let him listen to a grand opera concert, originating 1,000 miles away, you will instantly detect the change. And herein lies the difference. We must popularize radio, and it is the radio telephone that will do the trick.

As I have said before in my editorials in RADIO NEWS, the radio game may be likened to the amateur photographic business. Within the next ten years, we shall see every drug store selling complete receiving outfits, that can be put on top of the phonograph at home, and which can be worked by your six-year-old sister. All you need to do is to manipulate a few knobs, and from a concealed horn, the latest jazz band music will issue. To be sure, this music is broadcasted from a central station, which may be 1,000 miles away, or further.

Then, the day of the radio newspaper is quickly coming. The important news will be broadcasted by radio telephone every day at stated intervals, as will be weather reports, and other information useful in every community. But of course the developments of radio will not stop at radio telephony alone. Great and wonderful things are coming in radio which are undreamed of to-day. New uses are constantly being found. New improvements are going on almost over night. We cease to wonder when we hear of some new marvel that is being performed by radio, and simply shrug our shoulders, and say, "Well, that was predicted long ago." Thus, recently, a physician several hundred miles inland listened to the heart beats of a man lying unconscious on a ship 300 miles out in the ocean. Every heart beat was transmitted clearly and faithfully, to the physician, who was thus enabled to make a diagnosis.

We now move ships, and steer airplanes by radio. In a forthcoming issue of RADIO NEWS there is to be described how radio is being used in mines underground, to locate ores and coal veins, surely a surprising use for the art! To-day every radio station has its ubiquitous aerial on top of the house. That soon is going to be a thing of the past. Already two American inventors have demonstrated that far better results can be had by putting the aerial underground. They use the so-called underground loops. Of course these are necessary for long distance reception, but for your radio outfit on top of the victrola in the parlor, no underground loop or aerial

Westinghouse Electric Co's.
Newark, N. J. Station.

W. J. Z. WEEKLY
Broadcasting Program

MONDAY

10:00-10:15 Resume of the News of the Day, Musical Selections.
10:55-11:00 Weather Forecast for N. Y. and N. J.
11:00-11:15 Musical Program.
12:00-12:15 Resume of the News of the Day, Musical Selections.
1:00- 1:15 Resume of the News of the Day, Musical Selections.
2:00- 2:05 Musical Program.
2:05- 2:10 Marine News.
2:10- 2:20 Musical Program.
3:00- 3:15 Resume of the News of the Day, Musical Selections.
3:55- 4:00 Weather Forecast for N. Y. and N. J.
4:00- 4:15 Musical Program.
5:00- 5:15 Resume of the News of the Day, Musical Selections.
6:00- 6:15 Resume of the News of the Day, Musical Selections.
7:00- 7:45 Miscellaneous Program.
7:45- 7:50 Broadcasting of Suppliers of Receiving Equipment.
7:55- 8:02 Tuning for Regular Evening Program.
8:05- 9:15 General News, Resume of Football Games, Music and Artists.
9:55-10:00 Arlington Time.
10:02-10:06 Weather Forecast for N. Y. and N. J.
10:06-10:07 W. J. Z. Good Night.
(Last six items repeated every night, except Sunday.)

TUESDAY

10:00-10:15 Resume of the News of the Day, Musical Selections.
10:55-11:00 Weather Forecast for N. Y. and N. J.
11:00-11:15 Musical Program.
12:00-12:15 Resume of the News of the Day, Musical Selections.
1:00- 1:15 Resume of the News of the Day, Musical Selections.
2:00- 2:05 Musical Program.
2:05- 2:10 Marine News.
2:10- 2:20 Musical Program.
3:00- 3:15 Resume of the News of the Day, Musical Selections.
3:55- 4:00 Weather Forecast for N. Y. and N. J.
4:00- 4:15 Musical Program.
5:00- 5:15 Resume of the News of the Day, Musical Selections.
6:00- 6:15 Resume of the News of the Day, Musical Selections.
7:00- 7:30 Man in the Moon Story.
7:30- 7:45 Very Soft Music in Harmony with Man-in-Moon Story.

WEDNESDAY

10:00-10:15 Resume of the News of the Day, Musical Selections.
10:55-11:00 Weather Forecast for N. Y. and N. J.
11:00-11:15 Musical Program.
12:00-12:15 Resume of the News of the Day, Musical Selections.
1:00- 1:15 Resume of the News of the Day, Musical Selections.
2:00- 2:05 Musical Program.
2:05- 2:10 Marine News.
2:10- 2:20 Musical Program.
3:00- 3:15 Resume of the News of the Day, Musical Selections.
3:55- 4:00 Weather Forecast for N. Y. and N. J.
4:00- 4:15 Musical Program.
5:00- 5:15 Resume of the News of the Day, Musical Selections.
6:00- 6:15 Resume of the News of the Day, Musical Selections.
7:00- 7:45 Miscellaneous Program.

THURSDAY

10:00-10:15 Resume of the News of the Day, Musical Selections.
10:55-11:00 Weather Forecast for N. Y. and N. J.
11:00-11:15 Musical Program.
12:00-12:15 Resume of the News of the Day, Musical Selections.
1:00- 1:15 Resume of the News of the Day, Musical Selections.
2:00- 2:05 Musical Program.
2:05- 2:10 Marine News.
2:10- 2:20 Musical Program.
3:00- 3:15 Resume of the News of the Day, Musical Selections.
3:55- 4:00 Weather Forecast for N. Y. and N. J.
4:00- 4:15 Musical Program.
5:00- 5:15 Resume of the News of the Day, Musical Selections.
6:00- 6:15 Resume of the News of the Day, Musical Selections.
7:00- 7:30 Broadcasting for Benefit of Radio Amateurs.
7:35- 7:45 Miscellaneous Program.

FRIDAY

10:00-10:15 Resume of the News of the Day, Musical Selections.
10:55-11:00 Weather Forecast for N. Y. and N. J.
11:00-11:15 Musical Program.
12:00-12:15 Resume of the News of the Day, Musical Selections.
1:00- 1:15 Resume of the News of the Day, Musical Selections.
2:00- 2:05 Musical Program.
2:05- 2:10 Marine News.
2:10- 2:20 Musical Program.
3:00- 3:15 Resume of the News of the Day, Musical Selections.
3:55- 4:00 Weather Forecast for N. Y. and N. J.
4:00- 4:15 Musical Program.
5:00- 5:15 Resume of the News of the Day, Musical Selections.
6:00- 6:15 Resume of the News of the Day, Musical Selections.
7:00- 7:30 Man-in-the-Moon Story.
7:30- 7:45 Very Soft Music in Harmony with Man-in-Moon Story.

SATURDAY

10:00-10:15 Resume of the News of the Day, Musical Selections.
10:55-11:00 Weather Forecast for N. Y. and N. J.
11:00-11:15 Musical Program.
2:00- 5:00 Broadcasting of Football Game.
7:00- 7:45 Miscellaneous Program.
7:45- 7:50 Broadcasting of Suppliers of Receiving Equipment.
7:55- 8:02 Tuning for Regular Evening Program.
8:05- 9:15 General News, Resume of Football Games, Music and Artists.
9:55-10:00 Arlington Time.
10:02-10:06 Weather Forecast for N. Y. and N. J.
10:06-10:07 W. J. Z. Good Night.

SUNDAY

7:55- 8:02 Tuning for Regular Evening Program.
8:05- 9:15 General News, Music and Artists.
9:55-10:00 Arlington Time.
10:02-10:06 Weather Forecast for N. Y. and N. J.
10:06-10:07 W. J. Z. Good Night.

on the roof is necessary. The aerial will be right inside of the outfit. We are already doing this very thing to-day, and the outfit need not be larger than a foot square. That gives us sufficient space for the concealed aerial within the box. This has already been accomplished for reception of radio music over distances of several hundred miles.

Here is a stunt that I originated some years ago, and which for some reason has, as yet, not been exploited. The main reason is that it has not received the publicity which it deserves. The idea is, in short, Grand Opera by Wireless.

This is not a dream but a thing that can be accomplished with existing means by anyone who cares to spend the money. Imagine yourself sitting in any of our large moving picture houses. On the screen you see projected, let us say, the opera *Lucia di Lammermoor*. You see all the famous stars, including Galli-Curci, etc., going through their accustomed motions, but you hear, at the same time, their voices. No, this is not phonographic music, but Galli-Curci's voice. You hear her voice, and you see her at the same time on the screen, and she is "keeping in step"; you do not miss a note or a movement of her hand. How is it done? Very simply as follows: The opera is given in the usual way, and is filmed from start to finish, the actors going through their accustomed motions, and singing in their accustomed way. The film is developed, and sent broadcast over the country. On a Saturday evening, at a prearranged time, the moving picture houses all over the country begin to unreel the film.

In New York City let us say there is another auditorium, and upon the screen the same film is projected. Galli-Curci as well as all the other singers, stand in front of a microphone, the same as I am doing now, singing the various strains of the opera. With the film before them, they can watch the exact time at which to start singing, and having been filmed before, they know the time almost by heart, and are not liable to make mistakes by singing too soon, or too late. In other words, they will find no trouble to "keep in step" with their own movements, which they follow before them on the film.

At Kalamazoo, let us say, the movie operator hears the voices coming in, and he can time the film to suit the music. Should he go a few seconds slow, he can readily correct this by accelerating his machine to catch up with the singer, or vice versa. We thus will have real grand opera by radio, and the system is so simple that no synchronizing arrangements are necessary at all. At the present time, only a few thousand people can hear our great singers at our large opera houses at one time. By means of this, grand opera by radio, millions can simultaneously enjoy the voices as well as picturization of the opera.

Perhaps the greatest development will be the radio power transmission of the future. This is of course today only a dream, but Nikola Tesla already has demonstrated that it can be done, and it is interesting to note that this great savant's ideas are coming more and more to the front. Dr. Tesla contends that our radio conceptions are wrong from start to finish. He claims that it is not the radio waves that travel through the ether following the curvature of the earth, but rather currents that travel *through* the earth, and we seem to be coming to just this. If Tesla is right, power transmission by radio should be a simple thing. It will enable us to tap the earth at any point, and receive our energy to light and heat our houses. Of course all this is in the future, but we are surely coming to it.

Another new use of radio is sending pictures, photographs, etc., through the ether, and I believe that I cannot do better than quote part of my editorial from the November issue of RADIO NEWS.

Recently the signatures of General Foch, and General Pershing were sent

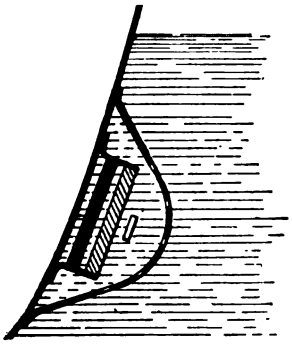
(*Continued on page* 848)

LATEST PATENTS

Submarine Sound Detector

(No. 1,378,420 issued to Ernest Merritt)

Heavy metal plates, such as the sides

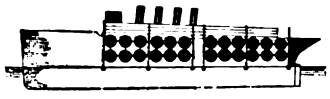


of a steel vessel, offer practically no resistance to subaqueous sounds. For this reason the so-called hydrophones or sound receivers placed under water for the detection of ships and particularly submarines, readily receive their impulses even tho at times they were placed within oil tanks in the vessel. But a screen made of an elastic material acts differently than the rigid sides of the vessel. For instance, a toy balloon of thin rubber exerts a very powerful screening effect The inventor has, therefore, devised a screen which he introduces around a microphone of such a nature that its walls are of the yielding type. By this means he is able to cut off substantially all sound by reflection and only hears a sharp indication of sound in a certain direction.

Unsinkable Boat

(No. 1,392,217 issued to Salvatore Ponzio.)

Hinged to the sides of a vessel somewhat below the normal water line are a plurality of wing-like structures, upon

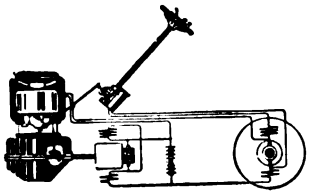


which are mounted a number of tanks or other buoy-like devices. Under ordinary circumstances, these wings are held in an elevated position by means of cables, trained about windlasses. In event of a mishap, these members are let down to the surface of the water, in this way preventing a ship from sinking. Bars rigidly attached to the vessel to hold the wing structures in the extended position are provided for. These are rigid enough to prevent a collapse of the wings and incidentally to maintain the ship on an even keel.

Driving System for Automobiles

(No. 1,378,514 issued to Sven R. Bergman.)

With this arrangement when an automobile is running along on level ground, the engine will be maintained at substantially constant speed, while the speed of the automobile is regulated by the controller. The invention is adapted for those automobiles which employ a gasoline motor to drive a

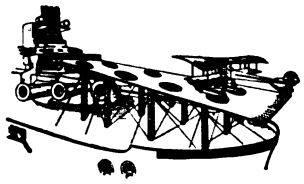


generator, which generator charges storage batteries and in turn supplies the motors coupled to the rear wheels. In the past, the storage battery occupied much space, because the motor was maintained at constant speed, furnishing power for the rear wheels on ordinary level roads, and at the same time assisting to charge the storage batteries. On up grades, the extra power required was drawn from the storage battery. Now, however, the storage battery "floats" on the line and may be charging, may be fully charged, or may be slightly discharging. In case of an increase of load, a load governor opens the throttle and increases the engine speed, so that all the surplus load is not thrown on the battery. In this way, the battery is always protected automatically against over-loads and hence its size does not have to be very great. At the same time this method does not otherwise effect the control of the automobile.

Plane Landing Apparatus

(No. 1,392,140 issued to Hugo Gernsback.)

In this invention which was more fully described in this magazine during the period of the world conflict, the in-

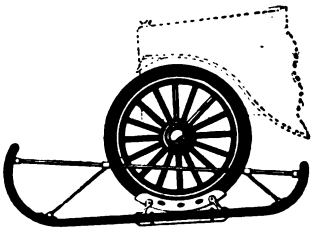


ventor provides for a platform of glass, suitably recessed. Into these recesses, electro-magnets are disposed, their upper surface coming flush with the surface of the platform. When it is desired to land a seaplane on shipboard for which this device is particularly adaptable, but not necessarily so, an operator by means of the proper switches energizes monster 60 inch electro-magnets, which exert a readily controllable tractive force upon the seaplane, bringing it to a stop. Searchlights are provided for use under the platform so as to illuminate the landing area. By simply reversing the current feed in the electromagnets, so that instead of retarding the action would be an accelerating traction, the seaplane can be shot off from the deck of the vessel. In order to be attracted the bottom of the skids have iron plates attached.

Auto Sleigh Attachment

(No. 1,392,438 issued to Nordahl O. Nelson.)

In this device the wheel of an automobile rests in a hollow curved holder, supported near its ends upon the runner by

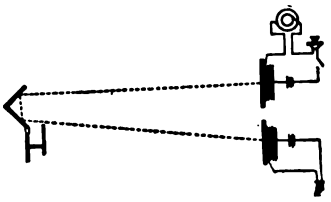


brackets. The holder itself is provided with openings so as to facilitate cleaning and eliminating excess weight. The runner is bent up at its ends. Attached to the bottom of the runner by means of bolts, is an anti-skid plate longitudinally grooved and presenting two sharp edges on either side of the groove, which cut into the ice or snow. These are detachably mounted and may be replaced when worn. The entire device is so arranged that it may be applied to an automobile almost as quickly as skid chains can be hooked on.

Signaling by Radiant Means

(No. 1,384,014 issued to Reginald A. Fessenden.)

This invention relates to a special form of apparatus which can be used for signaling by means of radiant impulses.



A tetrahedron or the corner of a cube of glass having portions of the sides of the cube which meet together at one corner, and these sides of the cubes silvered, could for instance be placed on the back of a soldier. Then this man could go forward for scout duty carrying his full equipment of rifle, etc. He is the front signaler. A rear signaler then swings a projecting lamp over the terrain keeping his eye at a telescope. As soon as the beam of the projecting lamp strikes the reflector, the rear observer sees a flash and knows that the projecting beam is in the right direction. At the same time the forward signaler sees the flash from the projecting lamp; the rear signaler then by moving the shutter can call the letter of the forward signaler several times. He then leaves the shutter open, and the forward signaler moves the shutter which cuts off the beam of reflected light back to the rear observer, and thus establishes communication. The forward signaler does not have to stop moving in order to communicate with the rear, the entire apparatus weighs less than eight ounces and it is claimed that it cannot get out of order.

Variable Area Wing

(No. 1,392,005 issued to Harlan Davey Fowler.)

This is a very interesting invention which makes it possible for the aviator

to change the area of the wings of an airplane, as well as change its chord and camber. The principle is clearly depicted in the diagram. By extending the area of the plane, it is possible to increase the lift of the craft, and start at a low rate of speed. As the machine increases in speed, the area of the wing may be decreased at the will of the operator, thus facilitating much greater flying speeds. The safety of the operator in landing is an acknowledged fact, because of the much decreased landing speed, when the area of the plane has been increased. Note particularly that the general curvature of the wing changes, even tho the stream-line effect is maintained.

Thermic Telephone Transmitter

(No. 1,389,242 issued to Pieter de Lange and Robert Aernout Baron Van Lynden.)

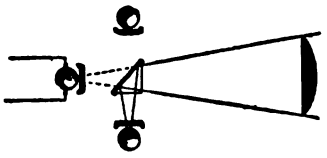
The joint invention of these two Netherlanders is an improvement in thermic telephone transmitters, which transmitters have the advantage of being able to stand greater quantities

of energy and of lasting for almost unlimited time. Within a sounding box are located some very thin conductors. These conductors are slightly heated, and due to the peculiar arrangement of the sounding box, the sound penetrating from the outside acts upon the conductors changing the conduction of current. The theory of operation has not been determined with certainty; it is probable, however, that the alternate compression and rarefaction of air taking place within the transmitter thru the action of the sound waves, subjects the material of the very thin wires to alternate compression and expansion, say the inventors, and since the conductivity of the metals depends upon their density, it would seem plausible that the result of change in current intensity is due to varying resistances corresponding to the changes in density of the wires. Another theory advanced by the inventors is that the rapid compression and rarefaction of air alternately cools and heats the wire, thus changing the resistance and hence the current.

Signal System

(No. 1,389,061 issued to Daniel J. McCarthy.)

A novel means of light signaling is incorporated in this device recently patented. Mounted upon a solenoid is

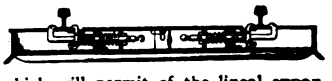


a triangular glass prism. This prism may be rorated thru an arc of 90° by means of two other solenoids. Three lamps suitably arranged and bearing red, green, and yellow colors, are so connected that when the control for the green light is switched on, the glass prism is drawn upward by one solenoid, and rotated by another so that the reflection of this light caused by the prism passes thru the same external lens opening. In order to change the light to yellow, it is merely necessary to throw the switch which incandesces the filament of the yellow lamp. This incidentally causes a 90 degree rotation of the prism because of a solenoid connected in series with the lamp. During all these rotations the red lamp, constantly illuminated, is hidden from view by the opaque back of the triangular prism. Should, however, there by any failure in the circuit, or one of the signal lamps burn out, the prism drops downward, allowing the red rays to show clearly thru the glass magnifying lens.

Rail Tie

(No. 1,392,146 issued to Roscoe M. Grizzle and Aaron H. Thacker.)

A new railroad tie which promises to eclipse many now upon the market, in that it is practically uncreepable, yet



which will permit of the lineal expansion of the rail due to changes in temperature, is the joint invention of the above named engineers. The metallic tie upon which the rails rest, has a hooked end for engaging the outer flange of the rail, and a swinging member for engaging the inner edge of the rail. Independent spring means acting on each member exert pressure upon the rails holding them rigidly in place. Cover plates are provided to close the opening of the slots thru which the hooked clamps pass, and a method of releasing the spring mechanism is also mentioned. In this way it is possible to rapidly change the rails upon permanent ties.

Scientific Humor

Can't See the Point Said the Pinhead.—"I'm tired of this," said the sofa.

"Well, I've been walked upon lately, and beaten too," said the carpet.

"I've been switched," said the electric light.

"We've been struck," said the matches.

"Well, I'm up against it too," remarked the wall paper.

"I'm going to strike," cried the clock.

"Shut up," yelled the door.

"Cut it out," shouted the scissors.

Whereupon the gas, getting very angry, grew hot under the collar, and after flaring up and refusing to throw any light upon the matter, went out.—*Stanley Schock.*

Gast.—Mr. Brown (in chemistry class): "You may recite on either gas or chloroform."

Student: "May I take ether?"

—*Max B. McLaughlin.*

Guaranteed.—A timid middle-aged lady with an intense horror of dentists has her teeth put in first class condition. The dentist informs her they will remain so the rest of her life without causing any more trouble.

Some thirty years or so later, the lady has more trouble with her teeth and goes to the same dentist.

Old lady in disgust: "I thought you told me I would never again have trouble with my teeth, so long as I lived."

Dentist, perplexed: "I did, Madam, but I never thought you were going to live forever."—*Beatrice P. Smith.*

This Is No Joke, Says the Joke Editor.—"Hold your tongue," said the shoe.

"Lead others," said the chain.

"Don't hang around," said the rope.

"Be self-supporting," said the suspenders.

"Always keep cool," said the refrigerator.

"Keep your secrets," said the phone.

"Never get heated up," said the test-tube.

"Learn to see through people," said the X-ray.

"Never give a blow-out," said the fuse.

"Don't give out," said the battery.

"Well, I'll be dinged," said the bell.

"I'm on the blink," said the light.

"I'm right on the tick," said the watch.

"Well! I'll be swamped," said the canoe.

"Let me reflect," said the mirror.

—*Gordon Smith.*

Hah! Hah!!—"Why do you specialize on giving your patients laughing gas?"

"Well, you see our fees are considered large, so when we present our bill he'll be in a good humor, and pay us promptly."—*Raymond I. Long.*

So That's Why They Shoot Holes Into Our Pocketbooks.—"Did you know that most all flowers are armed?" asked a student of botany.

"Armed!" exclaimed the other incredulously, "With what?"

"Pistils," replied the learned one, and dodged around the corner.—*William J. Ladd.*

First Prize, $3.00

Fahrenheit or Centigrade.—Bim: "I hear old Joe Goofus past away last night."

Bam: "Yeh, the poor fellow swallowed a thermometer and died by degrees."

—*Arthur Nelson.*

Hot Thrills.—Ben: "My father makes a living giving the public thrills."

Gwen: "An aviator?"

Ben: "No, a fire alarm salesman

— *Glenn J*

Stringing Dad.—"Papa will b strung."

Resourceful Groom: "That's We'll wire him."

—*No*

And a Humped Back.—"Inner or well as the outer peculiarities of ma changed from age to age—witness t useless appendix, the vanished tail. do you suppose will be the next cha

"It may be, if Prohibition la enough, the same process of evol provide man with the interior org... camel!"—*Wright Field.*

WE receive daily from one two hundred contributions this department. Of these o one or two are available. We desir publish only scientific humor and contributions should be original if sible. Do not copy jokes from old or other publications as they have li no chance here. By scientific hum mean only such jokes as contain thing of a scientific nature. Not prize winners. Write each joke on arate sheet and sign your name a dress to it. Write only on one sheet. No letters acknowledged postage is included.

All jokes publisht here are at the rate of one dollar each the first prize of three dollars best joke submitted each month. event that two people send in joke so as to "tie" for the prize, sum of three dollars in cash will to each one.

Easy Graft.—"What," began t fessor of agriculture, "is meant by ing?"

"Cutting in where you don't belong, an sticking there," replied the son of a prominent politician.—*William J. Ladd.*

A Secondrate Joke.—"How much is your nitrate of soda?" inquired the prospective buyer.

"Just the same as the day rate," replied the smart clerk.—*William J. Ladd.*

'Twould Make an Iron Cross.—Smith: "Why did Jones buy that big magnet?"

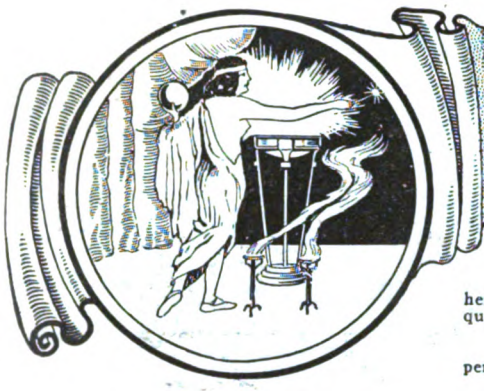
Brown: "He heard Stella had an iron constitution, and he thought it would attract her to him."—*James L. Coffrey.*

The Room Was Full, Too.—The PENCIL has made quite a few pointed remarks about the SPONGE being soaked all day, and the WASTE-BASKET full, also. The SCISSORS are cutting up, and the PAPER WEIGHT is trying to hold them down. The MUCILAGE is sticking around to see the STAMPS get a good licking in the morning. The INK'S well, but feels blue because BILL is stuck on the FILE. The CALENDAR is expecting to get a month off, and the BLOTTER is taking it all in.—*Robert P. Fish.*

Very Plane.—"In one way the auto is far ahead of the airplane."

"How's that?"

A Grand Finale.—Musical Professor, explaining why he had to have his new car towed in, "It's like this, the engine made staccato reports, then the car changed keys, and went on four flats, and it ended up with a grand pause."—*Allison Manners.*



THE ORACLE

The "Oracle" is for the sole benefit of all scientific experimenters. Questions will be answered here for the benefit of all, but only matter of sufficient interest will be publisht. Rules under which questions will be answered:

1. Only three questions can be submitted to be answered.
2. Only one side of sheet to be written on; matter must be typewritten or else written in ink, no penciled matter considered.
3. Sketches, diagrams, etc., must be on separate sheets. Questions addrest to this department cannot be answered by mail free of charge.
4. If a quick answer is desired by mail, a nominal charge of 25 cents is made for each question. If the questions entail considerable research work or intricate calculations a special rate will be charged. Correspondents will be informed as to the fee before such questions are answered.

instance. If a wax mold (paraffin is good for amateur work) is used it is of course a non-conductor of electricity and its surface has to be made conducting by brushing over it a thoro coating of powdered grafite. The grafite-coated mold is immersed in an electroplating bath as the cathode or negative pole. This bath may be composed of an 8 to 10 per cent sulfuric acid and water solution; copper sulfate is then dissolved in this solution until the bath is saturated at ordinary temperatures. The electrolyte is kept saturated by the addition of copper sulfate crystals or by using a copper anode (positive terminal). For printers' composition or type matter is to be reproduced, the two cases containing the prepared molds are suspended back to back between large copper anodes; in this manner the grafited surfaces of the molds, face the anodes directly. The product obtained by multiplying the current in amperes flowing thru the bath and the time in hours that the molds are immersed, indicates the thickness of the copper deposit. In commercial electrotyping tanks the solution is agitated or caused to constantly circulate by mechanically operated paddles or perforated drums, or else by comprest air liberated from tubes placed beneath the surface of the electrolyte. After the plating is of sufficient thickness, the copper shell is separated from the mold and it is strengthened for further use by melting hot type metal on the back side, as explained in the July issue of this magazine, in a very complete article describing "How Electrotypes Are Made." The usual potential employed for copper plating is three volts.

2. How are glass plate and glass jar condensers silver plated?

2. There are two general methods in use for accomplishing this result. The first method involves the grinding and blasting of the surface of the glass which is to receive the copper deposit, and after being thoroly cleansed, this roughened surface on the glass is coated with finely powdered grafite (plumbago). The glass has thus been made conducting, the glass plate is then suspended in a suitable electrolytic bath, as already explained, and the copper deposit built up to the usual way, to any depth desired.

The second method of making copper, silver, or gold deposits on glass, is the *burning in* method. This process the metal, in a finely powdered state, is applied on to the glass, the metal powder being fused on the glass when it is heated in a special furnace to a degree somewhat lower than the melting point of the glass. The advantage of the burnt on coating, especially for high tension electrical condensers, is the fact that this plating is very smooth.

Problem in Geometry

(1175) Henry Morgan, Charleston, South Carolina, writes:

Q. 1. What is the simplest way of calculating the length of the tangent C in the accompanying diagram, if the depth D of the ring is 600 ft., the diameter of the inner circle A is 4,000 ft., and the length of the hypothenuse B is 4,600 ft.?

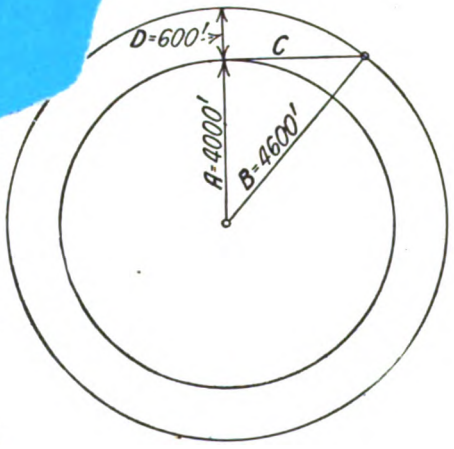


Diagram Illustrating Query No. 1175, Wherein the Querist Wishes to Know How to Calculate in the Simplest Manner, the Value of the Unknown Tangent C, When the Values A and B are Known.

A. 1. The easiest way of computing the length of the tangent C is to apply the geometrical law for solving a right angle triangle. Using this formula we have:

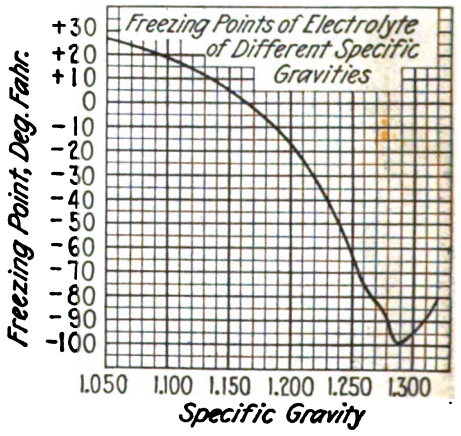
$$C = \sqrt{B^2 - A^2}$$
$$= \sqrt{5,160,000}$$
$$= 2271 \text{ ft. for the value of C.}$$

Freezing of Storage Batteries

(1176) John H. McGraw, Jersey City, N. J., writes the Oracle:

Q. 1. Is it true that if I keep my ignition storage battery on my automobile fully charged at all times during the winter, that it will not freeze?

A. 1. Yes, this is true to a very large extent and the more the storage battery becomes discharged, the higher the temperature at which it will freeze. You will find a new book by Mr. C. J. Hanks entitled *Storage Batteries*, a very useful one for such practical information, and we are pleased to reproduce herewith a chart given by him, showing the different freezing points of storage battery electrolyte at changing specific gravity values. For example a 1.300 or fully charged specific gravity electrolyte freezes at 95 degrees below zero Fah., while a battery normally discharged freezes at a temperature slightly above zero. You should use a hydrometer syringe to keep a careful check on the specific gravity of your battery electrolyte daily during cold weather, as a battery has been known to become fully discharged within a few hours, owing to a *ground*, a *short-circuit*, or a severe overload on the battery. If the battery becomes greatly discharged so that the lights are very dim and the self-starter motor will not turn over, it is almost useless to try and recharge the battery fully by running the engine. The editor has learned this by actual experience and knows of one motor car owner who kept his engine running in the garage all day so as to drive his charging dynamo on the car, in an attempt to charge up the battery, but no worth while results were obtained. The battery when fully discharged like this is best removed from the car and taken to a battery service station, where it can be recharged properly. Some motorists have a rectifier in their garage and when the battery electrolyte shows a state of half charge or less, it is recharged.



Cut Out This Graphic Curve Showing the Various Freezing Points of Storage Battery Electrolyte, and Paste It in Your Pocket Note-Book; It Will Come in Handy. The Care of the Storage Battery on Your Motor Car is One of the Most Valuable and One of the Most Important Things to Watch in the Winter Time. In General, if the Storage Battery is Kept Well Charged There Will be but Little Danger of Freezing, as the Graphic Curve Here Shows; While as the Degree of Charge Decreases in Value, the Freezing Point Rises. It Is a Very Good Idea to Have a Small Rectifier in Your Garage or Cellar and in This Way Give the Storage Battery a Freshening Charge, Whenever It Drops Below a Certain Value; Particularly Where the Car is Used but Little, as the Battery Loses a Certain Degree of Its Charge per Week, Even When Standing Idle.

placed
illustrated here-

The secret of this screen lies in the fact that its surface is divided up into a multitude of vertical corrugations, each of which under the magnifying glass is seen to have beveled sides. This screen is therefore claimed by its makers to reflect the image of the picture at a thousand different angles and more, thus eliminating the distortion caused by using the ordinary screen.

Upon receipt of stamped and addressed envelope, the editor will supply the name of makers.

Copper Plating Glass

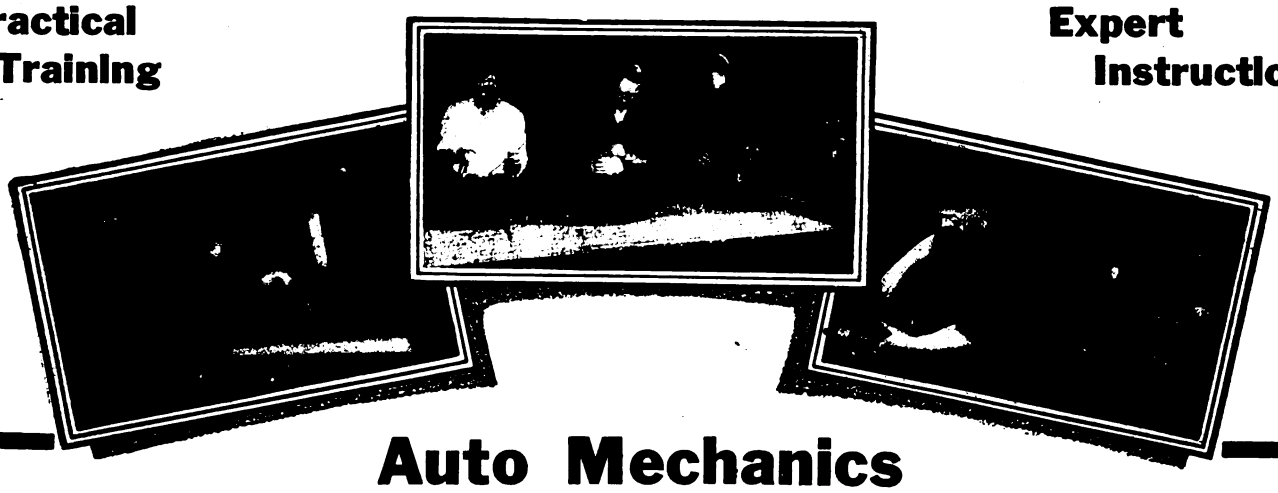
(1174) James Thornton, Elmira, N. Y., asks:

Q. 1. How are electrotypes made?

A. 1. Electrotyping is the art of reproducing metals, engravings, printers' type composition, et cetera, by the electric deposition of copper or other metal in an electrolytic bath.

A wax mold is first made of the object which is to be reproduced by impressing the metal in wax, for

Practical Training **Expert Instruction**



Auto Mechanics

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Here is a secret of success. 9 out of 10 auto mechanics are weak on electrics, while 75% of car troubles come from the electrical end. Moral: *Learn the electrical end of the auto business and get bigger pay.* Why putter along knowing only part of the business? Why not check up your knowledge and prepare yourself for a step ahead? Big-pay jobs are open for men who know. Special advanced training at the MICHIGAN STATE AUTO SCHOOL, in Detroit, the auto center, will make you an Expert Auto Electrician, the step ahead for auto mechanics.

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Special Course for Garage Men

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The course includes scientific teaching and experiments of electrical operation, induction, magnetism, regulation, circuits, etc. The student has actual practice in testing, wiring and adjusting every part of starting, lighting and ignition system; also over-hauling all systems; tearing down and assembling; operating them on live motors; trouble shooting on live cars; building and repairing of storage batteries; armature winding; farm lighting systems. This course is advanced work, and will enable experienced mechanics to do better work and earn better salaries—to reach the top.

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Jazz from the Air

By ROBERT E. LACAULT

(*Continued from page* 843)

across the Atlantic by radio on the Belin apparatus. There is no good reason why the amateur cannot do the same thing for smaller distances at any time.

In the very near future, the amateur in New York will buy the first copy of a New York newspaper, wrap it around his cylinder, and send out a whole sheet by radio. A thousand miles away, another amateur will have a receiving machine that will reproduce the printed page, type, pictures, and all in less than a half hour. This is a thing impossible to do by ordinary wireless telegraphy, if every word had to be transmitted. The radio picture transmission solves all this. Thus, in time, a great piece of news "breaking" in the city, will be sent broadcast by the enterprising amateur, who will send the entire front page of the newspaper, for instance, and the radio facsimile can then be exhibited in a distant town from 18 to 24 hours in advance of the receipt of the actual newspaper.

All this is not a mere dream, but it already has been accomplished to-day. It is up to the amateur to make the thing popular.

Of course, I realize when I speak to you from the Westinghouse Station in Newark, N. J., that this is quite a wonderful feat, considering also the fact that thousands of you fellows are listening. But this is only the beginning. The Westinghouse people are now trying to induce the American Telephone and Telegraph Company to make it possible for other speakers, as well as myself, to speak to you hereafter, not from Newark, but from our own homes. This will be done by using the ordinary telephone. In the future all I will have to do, is to call up the Newark Broadcasting Station, and my voice, relayed and amplified, will be sent out to you by radio. So, if I have not bored you to death to-night, by this somewhat wild and rambling talk, I may be with you again in the not too distant future.

As this talk is somewhat in the way of an experiment, I trust that all of you who have heard me to-night will be good enough to send me a postal card or a letter advising me just how my voice came in, and how you like the idea of a radio lecture. You may address me as usual at 233 Fulton Street, New York City.

Before I close, I must tell you of something that has been worrying me all the time I was speaking, and that is that this speech is eternal. Some months ago, in one of my editorials, I mentioned the fact that radio waves are eternal, as are light waves; they travel according to our present conception out into the ether, and through space at the rate of 186,000 miles a second. We see to-day the light waves shot off by some far away star, which light may have originated from that star perhaps 10,000 or 100,000 years ago. And those light rays are just coming down to us now. It is the same with radio waves.

As I speak, these waves go out into eternity, never to return, never stopping, ever traveling onward. The thought is appalling that while I speak here my voice may be heard 100,000 years from now on some distant planet, belonging to it sown little solar system. For to believe that there is intelligence only upon this earth is grotesque, and rather foolish. Equally appalling is the idea that if my message is received 100,000 years hence on that other planet, and if they succeed in deciphering it, how they will laugh, and hold their sides over my feeble mutterings which I am shooting out to them to-night.

I thank you.

As may be noted in one of the last paragraphs, Mr. Gernsback requested his audience to advise him as to how far and how loud his voice was heard. During the following week an avalanche of cards and letters came in from listeners who enjoyed the lecture, asking for more Radio talks of the same kind. We were surprised to learn how many persons enjoyed it and we were pleased to note that several of the station owners mentioned the fact that their families as well as themselves had enjoyed the lecture as much as the concerts, which are being sent every evening, thanks to a loud talker, rendering the voice almost as loud as if the lecturer was himself in the room.

This broadcasting of lectures opens a new era in educating people, and it becomes possible for a scientist to speak at the same time to several thousand persons who otherwise could not attend the lecture, being too far away, and the number of seats in the lecture room being too limited. With suitable receiving apparatus, the voice may be heard plainly and very clearly, in fact free of certain noises which are often heard in the ordinary phone, using a line, and with a loud talker connected to an amplifier, such a volume of sound is obtained that it is possible for a very large audience to listen to the lecture being sent. The loud talker in this case takes the place of the lecturer himself, who is, so to speak, "multiplied."

To give an idea of what may be accomplished along this line, we can mention the Magnavox Telemegaphone, which, when used with the proper type of amplifier, produces such a volume of sound that it may be heard more than a mile away. If installed in a public place in every town within the range of the transmitting Radiophone station, it is easy to imagine how many people can hear the voice of the lecturer at the same time, assuming that the audience listening around each Telemegaphone is composed of 1,000 to 2,000 people.

Such an installation would prove useful in any community, for, with the broadcasting by Radio telephone of the news, the market reports, the correct time, lectures, concerts, etc., almost everybody in a small town could hear this every day and take advantage of the interesting part of the broadcasting program. For instance, the jeweler would get the correct time within one-hundredth of a second, sent twice a day, and adjust his clocks and watches; the farmer would receive every day the market reports concerning his particular kind of business; everybody could listen to the last news before they appear in print in the local papers, and occasionally the kiddies could listen to the fairy tales sent for their benefit.

However, it is not necessary for you to wait until such an installation is made in the town; you can install right now, a Radio receiving set for your personal use and take advantage of the free transmission which is constantly in the air. At the present time, several Radiophone broadcasting stations are in operation practically all day, until 10.00 o'clock in the evening. Such stations are installed at Pittsburgh, Pa., Newark, N. J., Springfield, Mass., and Chicago, Ill., the last mentioned station being installed on the roof of the Opera Theatre and used every evening to broadcast the singing and playing picked up from the stage by several microphones.

Everybody can take advantage of these transmissions, for it isnot necessary to ask any permission for the installation of a receiving set to pick up the very interesting transmissions being sent every day.

To receive Radiophone transmissions, the same equipment used for Radio telegraphy is needed and may consist of a very simple apparatus, if it is to be used within a few miles of the transmitting station. At the present time, some complete outfits are available, and the manufacturers are designing some new sets, especially for the purpose of receiving Radio concerts. The demand being

(*Continued on page* 850)

Jazz from the Air

(*Continued from page* 848)

great, the supply needs to be very large and every manufacturer turning out new instruments, the competition will bring down the prices. This effect already has been felt on the market and it is possible to-day to buy a good receiving set for a reasonable price.

Some enterprising firms use another system; they deliver and install a receiver in your home, absolutely free of charge and let you listen in for a day so that you can see how the signals are coming in, right in your home. The following day, the firm takes either the set back, or its price, leaving it where it is. This form of advertising is undoubtedly the best, for it shows to the buyer how it works and what can be heard with it, while if the set is bought in a Radio store, the customer often wonders how it will work at home.

In several Radio stores, the display in the windows are of a new style and instead of a quantity of parts and various instruments, a complete receiver, including the antenna and ground connection, is placed alone in the window, with a large sign explaining that with this apparatus the news, the music and all that is broadcasted by radiophone and radio telegraph may be heard. The program of the broadcasting is also given, in some cases, and a label on each part of the apparatus indicates what it is used for. This display attracts much attention and several persons who never stopped before to look at this window, now take an interest in it. This is the proof that Radio is becoming more popular every day; then, why don't YOU listen to the Radiophone also? You will find much pleasure during the winter evenings listening to the invisible lecturers and singers. Now is the time to install a Radio set and if you do so, we are sure you will never regret it.

COAL SUBSTITUTE FROM WASTE CULM AND PITCH

A coal substitute, made by coking a mixture of culm or waste anthracite coal and coal-tar pitch or other bitumens, was described by Donald Markle, of Hazelton, Pa., at the meeting of the *American Institute of Mining and Metallurgical Engineers* in Wilkes-Barre, Pa.

This new product, which has been named *anthracoal,* is said to be superior to coke. Tests reported indicate that it is denser, harder, tougher and stronger than coke, and that when struck with a hammer or passed thru crushing rolls, it breaks with an irregular fracture, similar to anthacite, but with very little fine material such as produces waste.

Anthracoal can be made in a coke oven upon the same large scale as bituminous coke, and can be produced with little greater expense; therefore, it should prove a tremendous factor in utilizing the anthracite culm now going to waste. Its commercial development is the outcome of experiments made in 1914, in the chemistry laboratory at Lehigh University, said Mr. Markle. Tests made to duplicate, as far as possible, actual commercial conditions indicate that the process is practicable and the only difficulties encountered are of a mechanical nature that can be remedied and that anthracoal has demonstrated, by tests and actual use, its excellent qualities as a domestic fuel. Several carloads of anthracoal were shipt to different retail dealers, who reported that the customers were satisfied with the product and had no difficulty in burning it. Also, anthracoal commanded the same price as the best anthracite, and the customers to whom it was sold asked for more.

Baseball "Movie" Scoreboard

(*Continued from page* 805)

projectors containing the necessary lenses each in addition to holding a sketch of a baseball player in different poses. In order then to show the pitcher throwing a ball to home plate, a series of photos of the pitcher in motion are flashed with great rapidity upon the screen, all upon the same spot. This means then, that the 8 or 10 pictures of various positions assumed by the pitcher flashed upon the screen with such great rapidity, due to the fact that the lamps in back of their respective projectors and slides have been rapidly illuminated and extinguished, give the effect of a motion picture. Such action takes place with each and every one of the players and at any point in the game, various actions may take place—such as slides, walking off, playing between bases, etc. There are six or seven attendants each operating two switches which control the lights for different operations.

In addition Mr. Coleman has developed an advertising sign which is on a different principle entirely. Several people are to be seen walking toward a store and they are supposed to hear music or to be attracted by some other agency. Some of them enter the store and walk away again seeming perfectly satisfied. Words are flashed upon the sign and the action takes place with remarkable rapidity. This sign is small enough to be applied anywhere and will, without a doubt, stop hundreds of customers or passersby because it is in reality a colored motion picture which requires absolutely no attendant.

We have mentioned the achievements of the great "Baby Ruth", as the fans call him, but this was before the action of Judge Landis, and the player was still in the game.

The Solomobile—How to Build It

By WILLIAM J. BEACH

(*Continued from page* 836)

In addition to the switch a carburetor regulator is mounted on the hatch, which is a graduated disc having a 3/16" rod extending thru it, and down to the carburetor where it engages in a slot made in the needle-valve regulator proper; the upper end of the rod has a knurled cap and pointer so that by turning the knurled cap, the needle-valve is adjusted and the most suitable mixture readily arrived at, at all times even while astride the machine and without the necessity of removing the hatch or placing the hand near the hot motor.

A sheet of metal, preferably galvanized iron, is fitted from the rear of the deck around the curved back of the body and fastened with round-head screws; the bottom of this metal cover has a spring clip attached to it so that the stand may be held clear of the ground when not in use.

Underneath the body and at the forward end another similar sheet of metal is secured having a series of *louvres* cut in it and bent so that they will collect the air and deflect it to the motor.

Foot-boards are attached on each side of the body at any desired place according to the rider's own idea of leg comfort; one of these foot rests is provided with a pedal which operates a brake situated on the rear wheel.

The wheels and front mud guard are standard and easily obtainable. The wheels are 20" in diameter and fitted with 2" tires and inner tubes.

The fork is a reconstructed heavy bicycle fork provided with shock absorbers of a very simple design, which really do not require any detailed description as the drawings explain the simple arrangement.

The gas control and compression release is by Bowden (flexible) cable which is led from the motor along one of the stringers inside the body, then up thru a small hole in the deck, then to the handle bars where the control levers are fulcrumed.

A Ship That Steers Itself

(*Continued from page* 807)

magnetic compass, with its respective correcting devices, which compensate for other disturbing metallic factors within the room.

The rudder of the vessel is controlled by two large electric motors which connect by means of a worm and sector with the rudder head. Hence very little effort is required on the part of the pilot to control the rudder, whether the gyro-compass is being used or not.

In addition to the various telephones and speaking tubes, the vessel is equipt with a novel fire alarm annunciator. The second officer explained how this operates. "This annunciator is regulative and may be set for any desired temperature. A number of small drops are so arranged that should fire start below deck or in any stateroom, a trip would release the cover to the automatic drop, thus indicating the presence of fire. At the same time an alarm sounds. The Captain or the pilot then directs the fire-fighters to the room. Altho the clanging alarm itself can be turned off, it is absolutely impossible to reset the annunciator and forget the location of the fire. Incidentally, should fire break out in another part of the vessel, the alarm would again ring and another drop would expose a number or letter.

Popular Astronomy

By ISABEL M. LEWIS, M.A.

(*Continued from page* 830)

time obscured by vapors. Most lunar observing is done—necessarily—with smaller instruments because the majority of astronomers appear to be of the opinion that the moon is a dead world, and those who are in charge of powerful telescopes seem to feel that other fields of research will prove more fruitful. Possibly it is for this reason that we know so little about our nearest neighbor in space! There are more unsolved problems confronting us here on the moon than there are among the distant stars.

Geologists tell us that more oxygen is to be found in the first six feet of the earth's crust than in all of the atmosphere above. May oxygen not exist then in the surface rocks of the moon as well?

Volcanic action, we are told, is primarily an escape of gases from the interior, chiefly hydrogen, nitrogen, hydro-carbons, sulfur, and various compounds, as well as vast quantities of steam. Beneath the surface chemical change is continually taking place which results in the release of an enormous amount of heat. Energy is sometimes released sometimes stored up by these chemical changes. Some gases mentioned above combine with the oxygen in the surface rocks and heat is evolved. We are all aware of the fact that the temperature increases about one degree Fahrenheit for every hundred feet of descent at the earth's surface. That there is great inherent heat in the earth's surface crust no one denies. Why not conceivably in the moon's surface crust as well?

Volcanic action implies the presence of water beneath the surface and tho water cannot exist as such *on* the surface of the moon owing to the absence of an atmosphere, there is no reason why the ice and snow and hoar-frost that do undoubtedly exist there, cannot be changed into water at points where they come in contact with the interior heat of the moon in cracks and crevices and low-lying districts. This seepage of water into the surface rocks would supply the means for promoting volcanic activity on the moon today. Some of this water would be expelled again in the form of steam from volcanic vents, which would be transformed almost immediately into hoar-frost, snow, and ice and so the cycle of change would be maintained.

It should be borne in mind that only volcanic activity on an enormous scale would be plainly visible to us even with the powerful telescopes at our command. Ordinary eruptions such as occur on our own planet would be very difficult to detect. Since the escaping vapors would rapidly pass into the solid state and settle down upon the flanks of the crater-cones or vents, we would observe in general little if any change in an object unless we chanced to be looking at it at the time of the eruption, when it might appear to be temporarily obscured by a veil of vapors. What are the chances that we would be carefully observing at the precise time of an eruption, a minute marking, two or three miles in diameter—say, on a surface as large as all of North America, a surface that is covered with some 30,000 charted craters, numberless crater-pits, streaks, rays, spots, clefts and rills in intricate systems, mountain chains and valleys and a mass of intricate detail?

If we were looking at the earth from the moon with the aid of a powerful telescope would we be apt to notice an eruption of Vesuvius or Katmai or Mauna Loa? Objects four or five miles in diameter would appear

as hazy spots with nothing distinctive or remarkable in their appearance. Yet vapor and steam arising from terrestrial volcanoes would be carried by our atmosphere over an area of many square miles, while there is no atmosphere on the moon to spread the vapors that may arise from similar volcanic vents. It would have to be a cataclysmic change indeed to be accepted beyond dispute as evidence that change is taking place on the moon, and the days of gigantic upheavals are probably over on our satellite as well as on the earth. If volcanic activity is still taking place on the moon it is probably in a mild form such as a comparatively quiet emission of gases from volcanic vents and fumaroles. Such forms of activity would not be plainly visible at this distance, even with the aid of powerful telescopes. The problem of detecting changes on the moon is complicated by the fact that a change of illumination greatly alters the appearance of all lunar markings. Such a change is continually taking place in the course of the month. A marking that stands out in bold relief at lunar sunrise or sunset will change entirely in appearance a few days later under a high sun or even disappear from view entirely. These changes in phase or illumination have to be taken account of in the search for evidence of actual change. To decide whether or not change has actually taken place the object must be viewed under similar conditions of phase, illumination and definition, so far as they can be obtained. Even when special care is taken in this respect the suspected evidence of change is usually "explained away" as due to differences in illumination or seeing, by those who have not observed the object themselves and are not in sympathy with the view that the moon is anything but a dead world.

As regards the question of life on the moon, it is interesting to consider the facts brought out by the investigations of C. N. Fenner of the Geophysical Laboratory of the Carnegie Institute made recently in the Valley of Ten Thousand Smokes. The activity there is entirely of a fumarolic nature and ninety-nine per cent of the emanations are water vapor. It was observed that blue-green algae were living at the edge of active vents emitting ammonia compounds at a temperature of 212° F. They were not found, however, near vents from which ammonia compounds were not being emitted. If life exists there under such conditions it is not inconceivable that suitable conditions for the support of certain forms of life, animal as well as vegetable, might be found in low-lying valleys and crevices and upon the floors of craters such as Plato, where certain gases essential to the support of life might be evolved from volcanic vents and fumaroles which would be too minute to be visible to our eyes.

As having a possible bearing on the unsolved problem of the origin of lunar craters it is interesting to note that the investigations of Fenner also show that the top of Katmai was not blown off, but fell in or sunk, and that at present there exists a crater several thousand feet in diameter partly occupied by a lake in which rises a parasitic cone. It is conceivable that enormous quantities of gas and steam may have collected beneath the lunar surface in various regions, when volcanic activity was taking place on a tremendous scale in the past, and that these gases were finally expelled in such quantities that the surrounding regions sank over an area of many square miles, central peaks being forced upward in some instances as the subsidence took place. The absence of atmospheric pressure and the small surface gravity on the moon, might permit the expulsion of gases from the interior on a far greater scale than could take place on our own planet. It may be that this sinking of the surface locally after the expulsion of great quantities of gas and steam is the true cause of the origin of the lunar craters.

Electric Ice Skates the Latest

By H. Gernsback and H. W. Secor.

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A reasonable reduction ratio has been calculated for the gears here shown, so as to be compatible with a speed of about 10 miles per hour, when the electric motor rotates at 2,500 or 2,800 R.P.M. The gear on the motor should have 6 teeth and the jack shaft gear meshing with it, about 36 teeth. On the jack shaft alongside of the 36 tooth gear is placed a six tooth or similar small sprocket wheel; a chain connects this small sprocket with a larger one having about 12 teeth, which is mounted rigidly on the shaft supporting the spiked ice wheel. The spiked wheel should have an approximate diameter of 6 inches overall, and the spikes should of course be made of steel hardened to a fair degree, otherwise they will wear considerably after a time. Where steel is not available, ordinary wrought iron bar, such as that to be found in any blacksmith's shop or machine supply house, may be used and the spikes after being ground or forged into shape, can be hardened quite nicely by heating to a cherry red and then plunging into melted cyanide of potassium. You will have to talk like a "Dutch Uncle" to your druggist in order to obtain a small quantity of this cyanide of potassium, and convince him of just what you are going to do with it, for it is a deadly poison. If you have a blacksmith or machinist make the spikes for you, he will take care of the hardening himself of course. There are several ways of making these spikes as they do not have to be round at all, a pyramid shape being very good, and lending itself well to forging operations. The disk on which the spikes are mounted, may consist of a sheet of ⅛-inch iron having a ⅛ inch by ½ inch iron band riveted to the disk by means of right angle brackets, the teeth then being riveted into the band. Another way would be to use just the steel disk and rivet the teeth into holes near its perifery, by turning the base of the teeth at right angles. The teeth should measure about 1 inch in length, and be about ¼ inch in diameter at their base, and the teeth spaced about 1 inch apart. In some cases two rows of teeth are used on motor driven ice speeders, staggering the teeth so that those in one row fall opposite the gaps between the teeth in the adjacent row.

The supports for the jack shaft supporting the small sprocket wheel and 36 tooth gear, which may be of brass or iron (which gears are procurable from a dealer in gears, or else from some old phonograph or other machinery), should be made of a wrought iron bar measuring about 1 x 1¼ inches, and of suitable height to allow the gears to clear the base. The two angle-iron brackets supporting the spiked wheel forward, are bent to the shape desired by heating red hot and dressing to the proper shape on an anvil. A blacksmith can do this for you while you are thinking about it, at slight cost. This angle iron should measure about 1 x 1 x ⅛ inch thick. The tie bar connecting the rear of the base with one of the skates so as to help in steering the machine, may be made of a light piece of wrought iron measuring, say, ¾ x ⅛ inch. This tie bar might be joined across the two skates and the rear of the base, but it is preferable to leave the one skate free for *braking*.

The sprocket wheels and bicycle chain used may be obtained from an old bicycle or from a cycle repair shop. The starting motor from an old automobile might be used in building such a machine as this, but it develops more power than is compatible with the battery that can be carried. As such auto starting motors develop as high as ½ H.P. and will spin a 6 or 8 cylinder engine, which a strong man can hardly turn over, one has to remember at all times that a tremendous amount of electrical energy is taken, proportionately speaking, from the storage battery. Such a motor will take from 300 to 500 amperes from a battery and think nothing of it. The battery does the "thinking."

The wiring of the control switch and of the battery and motor is quite important, and care should be exercised so as not to choose too small a wire, or else there will be too great a voltage drop and heating of the wire, and most important of all, the motor will not be able to obtain the necessary current to develop its rated H.P. In general for a 1/10th H.P., 6 volt battery motor, about No. 12 rubber covered copper wire should be used, and a test should be made with an ammeter and volt-meter to see that the motor is deriving its proper voltage and current, and noting when this does occur whether the wires get warm or not. Under proper operating conditions, these wires should not get noticeably warm at all. The speed controller may be composed of a few coils of iron or German silver resistance wire about No. 18 gage, connected to a series of switch points in the usual manner to form a rheostat.

Where a 1/10th or ⅛th H.P., low voltage motor is not obtainable, two 1/20th or 1/15th H.P., 6 volt motors may be used, placing one of them on either side of the 36 tooth gear, or else one above the other, each adding their quota of mechanical power to the driving shaft.

Speaking of the mileage that can be negotiated with a 1/10th H.P. outfit as already outlined, we may figure this out as follows: A 1/10th H.P. electric motor will require about 150 watts, as its efficiency is only about 50 per cent. As the current is found by dividing the watts by the voltage available, we ascertain that about 20 to 25 amperes will be taken from the battery when the motor is developing its rated H.P. Thus, if under favorable conditions and skating with the wind, we figure on let us say, a speed of 15 miles per hour, then with a 60 ampere-hour battery, the skater should be able, theoretically, to obtain three times 15, or 45 miles. With an 80 A.H. battery, we might call the range 4 x 15, or 60 miles, and with a 100 A.H. battery, 5 x 15, or 75 miles for the five hours of skating available from this size battery. Actually, however, the storage battery will not perform in just this fashion, as the normal discharge rate for lead plate cells is 8 hours and, therefore, the current rate for these 8 hours is (for a 60 A.H. battery), about 8 amperes and not 20 amperes. When you discharge a storage battery let us say in three hours, instead of in eight hours, the total A.H. capacity of the battery or also the watts output, is lower than that obtained when we are careful to distribute the load, so that it will spread over 8 hours before exhausting the battery. Thus, it will be seen that two batteries or more might be used, if sufficiently strong skates are available or specially made, and hence there is opened up a very interesting field of experimentation to the winter sport enthusiast.

Do We Need Eye-Glasses?

By JOSEPH H. KRAUS

(*Continued from page* 826)

the lens itself, which change was attributed to a tightening of the ciliary muscles, or the muscles which attach to the lens proper. After a long series of researches, Dr. Bates by means of actual photographs proved that the lens does *not* increase in thickness for accommodation, and that *perfect accommodation was possible in individuals who had had their lenses removed in cataract operations,* in cases in which a glass lens was substituted. It is obviously impossible for a glass lens to change its thickness. He then further proved upon fishes, animals and man, that accommodation is not possible when the oblique muscles of the eyeball are cut. When the muscle is sewed up accommodation becomes perfect.

The three most common diseases are far-sightedness, or hypermetropia, in which case the eye is too short and the light rays focus behind the retina; short-sightedness, in which the globe is elongated, and may be focust upon near objects only, otherwise known as myopia; and astigmatism, in which the eyeball deviates from its normal curvature and is not uniform.

It would, therefore, seem that all defects of near- or far-sightedness, or of astigmatism, in which objects appear to have a colored fringe, are due entirely to the muscles acting upon the eyeball itself, and are in no way due to the lens. Photographs upon the lens and sclera prove definitely that the lens does not change its shape. The fundamental principle of eye training is what Dr. Bates calls *central fixation.* In other words, *seeing best where you are looking.* Dr. Bates claims that the eye is not as delicate an organ as it is supposed to be, and he proved it by looking directly at the sun and then picking up a page of fine type and reading it perfectly. He claims that the eye is not injured by either motion pictures, artificial light, or the actinic rays of the sun. He states that the only time that the visual power of the eye is materially lowered is when it is subjected to a severe strain.

His two methods are practise and rest. The patient for instance, is told to look at something black and then cover his eyes with the palms of his hand avoiding pressure on the eyeball. If he remembers the black perfectly, he will see black, not gray or any other color. When black is remembered just as well with the eyes opened as with the eyes closed, the patient noticeably improves and all pain from head and eyes generally disappear. The patient is also asked to imagine when his eyes are closed that he sees a boy and a girl on a see-saw, the boy moving upward while a girl is moving downward, and vice versa. This exercise is very restful indeed. The patient is then likewise requested to hold one hand in front of the eyes, move the head rapidly from side to side, when he will seldom fail to notice an apparent movement of the hand. With some patients it will take weeks to do this. So that the reader may not think that these exercises are merely hypothetical, we are showing here a photograph of a patient cured by these methods who not only suffered from myopia, but whose eyes were considerably out of line. This is only one of many thousands of cases. Dr. Bates has written a book on his new discoveries, which every sufferer from eye trouble should read.

Wheel-less Subways of To-morrow

(*Continued from page* 816)

runner" subway train, his idea being to make the tracks hollow and by pumping cold brine solution thru the hollow tracks, they will be caused to develop a tenacious coating of white snow-ice, the same as you may see on the brine pipes in any refrigerating plant. Mr. H. Gernsback advocates a modification of this idea, which is also shown in the illustration, and here hollow tracks are used thru which oil is pumped at high pressure; at periodic intervals along the top of the tracks there are small holes thru which streams of oil can trickle. The action of the passing trains will keep the tracks well lubricated. One of the principal features of wheel-less trains and cars is that they will ride very smoothly, and engineering tests would seem to indicate, that there is some chance of developing this system, so as to prove more economical in operating cost and electrical energy consumed, than in the present method where wheels are used. There are a number of different modifications and changes which could be devised of course in developing such a railway system. The oil for example might be carried in tanks on the car and fed thru small holes in the shoes, instead of having the oil passing thru the hollow rails.

AN AIR-PROPELLED MONORAIL CAR

Mr. Frank Kish, of Cleveland, Ohio, is sponsor for the new air-propelled monorail car, shown in one of the accompanying illustrations. This car is propelled by means of an air screw, or as it is commonly called, a propeller at the forward end, with suitable vertical stabilizing rudders provided fore and aft, as shown. The car is designed to be propelled either by electric motors driving the propellers and blowers; which latter send a powerful stream of air up under the side wings to help stabilize the car on its single rail; or else the usual high powered gasoline engines of the airplane type may be used. The car trucks have their wheels staggered so that half of them are on opposite sides of the track, which practically precludes the possibility of the car leaving the track while rounding curves, and it also helps to balance the weight and increase the stability. At stations or in yards where the blower motors or engines would be stopt, cars would be maintained vertically by guide rails at either side, suitable wheeled shoes being provided for the purpose on either side of the car.

The inventor arranges the two large blower pipes at the forward end of the car, so that they will send upwards a powerful stream of air on either side of the car, and just under the top wings, so that a strong lifting effort is created—not sufficient to raise the car from the rail, but just enough to stabilize the car, owing to the opposite reaction forces set up on both sides. This is caused by the two jets of air impinging against the under surface of the two wings. A gyroscope driven by an electric motor or otherwise was used some years ago by Brennan, in building the first practical monorail car which actually carried passengers. Of course the gyroscope could be used to stabilize this monorail car, instead of relying on the vertical air rudders, and the two powerful jets of air impinging under the wing surfaces on the two opposite sides. The gyroscope when used in stabilizing such a car does not have to be as large as one might think, and furthermore, it does not require such a great amount of energy to drive it. Even battleships and ocean-going steamships have been stabilized with remarkable success by using a Sperry gyroscope, measuring not over 15 ft. in diameter.

When electric motors are used on the Kish type of monorail car, the current is taken from a third rail of usual construction, smaller than the main rail but running parallel to it.

Radio Central

By ARTHUR H. LYNCH

(*Continued from page* 841)

horse-power and the alternators themselves at 200 kilowatts. These alternators are capable of adjustment for wave lengths from 15,800 to 20,000 meters.

The construction of Radio Central began in July, 1920, and the first test signals were sent out in October, 1921.

1,800 tons of steel were used to erect the first twelve towers, each tower requiring approximately 150 tons. For the foundations of these twelve towers 8,200 tons of concrete were employed, and the concrete base for each leg of the towers was sunk nine feet below the ground.

The distance between two adjacent towers is 1,250 feet and the distance from the first to the twelfth tower is nearly three miles.

Each antenna (two have been completed; there will be twelve), consists of sixteen silicon-bronze wires, three-eighths inch in diameter, suspended from insulators hung from the cross-arms, atop the towers. Each antenna comprises approximately twenty-five miles of this wire.

450 miles of copper wire had been buried in the ground in starfish and grid-iron fashion, forming the *ground system*.

Mr. Alexander E. Reoch, Assistant Chief Plant Engineer, Radio Corporation of America, informs me that the antenna reistance, for the unit now in operation is one-half ohm; the antenna capacity is .055 microfarad; the antenna voltage is 100,000; the antenna current is from 600 to 700 amperes and the wave length is 16,450 meters.

This station can attain a sending speed of 100 words per minute, for each unit, which means that its aggregate capacity, when entirely completed, will be approximately 600 words per minute.

There is practically no limit to the distance this station will transmit, as is made evident from reports of its being heard in all parts of Europe, South America, Australia and Japan.

The power, for the station, is generated by the Long Island Lighting Company, at Northport, Long Island, and is carried to the station, over a seven-mile line, at a voltage of 23,000.

No Radio Operators at Radio Central.

The actual transmitting, from Radio Central, is controlled by a direct land wire system, from the Central Traffic Office, located at 64 Broad Street, New York City, nearly seventy miles away.

The receiving station which is to operate with this giant transmitter is located at Riverhead, Long Island, about thirty-six miles away. As is the case with the transmitting station, there are no operators at the receiving station, for the signals are likewise carried by direct lines to the Central Traffic Office, in New York City. By carrying on all the receiving and transmitting in New York City, it is possible for a continued sending and receiving service to be operated at the same time, under a central control, which is a very distinct advantage.

In order to appreciate the great advance in radio science which stations of this character offer, it is interesting to note that, by reason of the constant speed at which the Alexanderson alternator can be operated, it is possible to operate with but a very slight variation of the wave length of the transmitting unit. This speed regulation is a very important consideration and the governor which is used on the alternators is a masterpiece of electro-mechanics.

How Window Glass Is Made

By ROBERT G. SKERRETT

(*Continued from page* 817)

a malleable iron affair known as a "bait." This is about 4 feet long, has a bell-shaped lower end from 8 to 10 inches in diameter, and is pierced throughout by an inch-and-a-half annular passage, through which compressed air is fed downward during the formative period of a cylinder. The bait takes the place of the hand-gatherer's tube or "punty," and the compressed air supplants the human blower's breath.

To make a draw, the bait descends until its flaring mouth is immersed in the molten glass within the basin or pot, as the case may be, and almost instantly some of the vitreous material clings to the relatively cool iron. The next moment the operative in the blower booth starts the electric motor which lifts the bait steadily. At the same time, this expert worker turns on the compressed air—the quantity depending upon the speed with which the cylinder lengthens as the bait rises. With these machines it is possible to make cylinders from 25 to 35 feet long, ranging in diameter from 18 to 30 inches. A single-strength cylinder can be produced in 35 minutes and one of double-strength in 50 minutes. Indeed, cylinders measuring 466 inches, after both ends have been removed, can be fashioned in this manner.

It is authoritatively claimed that this method of glass making renders it feasible to manufacture glass of better quality and of a greater range of thicknesses than can be obtained by hand blowing. In fact, a good deal of glass, 3/16ths of an inch thick, passing as plate glass, is made in this manner and is employed widely in the glazing of large windows and for automobile windshields. Again, very thin glass, for photographic negatives and picture framing, is now turned out here in this way. Formerly we bought the latter materials abroad.

When the big cylinders, just described, have been cut into several rollers, each about 5 feet long, these units are "shawled" or split lengthwise, after which they are flattened and annealed in the fashion followed in dealing with the hand-blown commodity. The sheets of glass coming out of the lehr are given a cleansing bath in a mixture of water and muriatic acid, and so prepared the stuff is ready for cutting up into commercial sizes.

Probably no departure in the manufacture of window glass is more significant or has required more expensive experimenting than that by which glass can now be drawn mechanically into continuous sheets 5 feet wide and 200 feet long. The apparatus, that do this, handle the incandescent, sticky substance somewhat after the manner that taffy is pulled by machine. In the operation, a bait is used which is in the form of an iron bar, horizontally suspended. This is lowered into the molten bath, where the movement of the glass toward the bait is stimulated by the rotary action of knurled fire-clay cylinders. When the bait has made a gather, it is raised electrically about 30 inches, carrying with it a trailing film of glass. This attached and plastic sheet, constantly growing, is then pulled at right angles over a horizontal roller and thence to a near-by traveling metal belt which serves the purpose of a flattening table. The table cools or sets the glass. Having reached the end of the table, the bait bar is snapped off, and the sheet is caught at its outer edges by clamps. These clamps move the glass by electric drive from end to end of the contiguous lehr, in which it is annealed. After a run of 200 feet, the sheet issues from the furnace and passes directly to a cutting table where it is, for

the nonce, divided into units 5 feet wide and 208 inches long. Subsequently, these are cut into sizes familiar to the trade.

The "strength" of the glass so manufactured is determined by the speed of drawing, which can be regulated to a nicety. Glass 1/24th of an inch thick goes over the bending roll and on the flattening table at the rate of 8½ feet a minute, and 24 inches of ¼-inch glass can be produced every sixty seconds. Manifestly, this particular mechanical process for the manufacture of sheet glass obviates the employment of the highly-paid flattener so necessary in the hand-blowing and machine-blowing plants. One of these glass-drawing equipments will make in the course of twenty-four hours as many as 700 boxes of window glass.

Now we come to plate glass, which is made by a somewhat distinctive method; and the raw materials are white or silica sand of a select grade, limestone, soda ash, salt cake, arsenic, and carbon. The batch, instead of being melted in a tank, is placed in large pots. These are modeled by hand, fashioned of clay especially prepared for the purpose, and are then dried and allowed to ripen over a period ranging from two to six months.

It takes a batch seventeen hours to melt; and when the potful of glass is ready to be poured it is withdrawn from the furnace and carried by an overhead crane to an expansive iron casting table. The glass is poured upon the table, where it is confined at the sides by metal battens of a height according to the thickness of the sheet of glass to be formed. A heavy roller, actuated by a transmission chain, is drawn to and fro over the plastic glass, thus ironing it out into a sheet. From the casting table, the sheet is pushed mechanically into the first compartment of a multi-chambered lehr, and from there on it is automatically shifted from one chamber to another, in each of which the temperature is lower than the preceding one. Finally, the properly annealed glass issues from the last chamber to a special cutting table, where it is trimmed into sheets having a maximum dimension of 160 by 240 inches. At this stage the surfaces of the glass are rough and the material is translucent but not transparent. Moreover, the glass is twice as thick as it will be when polished and ready for sale.

Plate glass is finished by first grinding and then polishing each surface, and this is done on circular cast-iron tables, 20-odd feet in diameter, to which a number of sheets of glass are secured by cement. In the first operation the glass is ground down by the abrasive action of varying grades of sand—the table revolving the while. In some plants the tables are rotated by steam engines and in others by electric motors. In principle, the polishing tables are similar, save that numerous mechanical disc-like rubbers are fed with rouge and water.

The remaining forms of building glass are known as obscured, wire, and opalescent glass; and according to the latest figures the twenty-five factories engaged in this business manufacture yearly about 55,000,000 square feet of these materials, representing a value of more than $4,900,000. The milky appearance of opalescent glass is due to certain ingredients used. Obscured glass is heavy glass upon which a figure has been impressed, usually only upon one side. The modeled surface is due to an engraved cylinder which is rolled over the plastic sheet while it is on the casting table. Wired glass may be smooth on both sides or obscured on one of them, and, as the term implies, it is characterized by a network of polished steel wire which is imbedded in its mass. By one method the wire is rolled in between two sheets of glass while they are plastic, and by another process the mesh is forced into a single thick plate at a time when it is sufficiently yielding for this to be achieved.

Automatic Phonograph Runs on Dry Cells

(*Continued from page* 821)

phonograph motor is a correct one.

This phonograph will repeat a record any number of times simply by setting an indicator needle to the number representing how many times the record is to be replayed, a very desirable feature where people like to dance to phonograph music.

The machine is entirely automatic, the tone arm and reproducer rising from the record and returning to the starting position all by itself, the reproducer lowering on to the record and starting to play, etc. No setting of the tone arm is necessary as the automatic stop on this machine will positively lift the tone arm and stop the motor when the last bar of music plays.

A new universal reproducer with mica diafram has been developed for this machine by its inventor. It is the only reproducer which will play Edison, Pathé, as well as lateral cut records by a simple twist of the reproducer head. A diamond point is fitted on the front of the stylus so that when the reproducer is turned with the mica diafram facing downward, it plays Edison records. This machine was demonstrated to one of the editors and played Edison records with a steel needle.

The secret of the remarkably efficient electric motor developed for this machine, which will be on the market within a few months, its inventor states, lies in the fact that it is an impulse motor. The moving element of the motor, which revolves the turn-table shaft, runs on ball bearings, and it is composed of a fly wheel about 1 ft. in diameter, having a series of large iron projections or teeth extending all around the lower side of the rim. These iron projections which are about 3″ long and 3″ apart, pass between the poles of two sets of electro-magnets, as shown in the drawing. The electro-magnet coils are excited first from one set of batteries and then the other, thru an ingenious commutator and brush arrangement. When the motor speed rises above normal, the brushes are lifted off the commutator and there is also a set of movable governor weights mounted on the upper side of the fly-wheel, which act by friction on the shaft of the motor to keep the speed within bounds. A clever switch arrangement of very simple design is placed near the batteries, so that after a certain period when the speed of the motor may drop too low, owing to the batteries being partially exhausted, the switch block can be lifted and simply replaced in a different position, when the two batteries will be connected in series, thus supplying more voltage to the motor and compensating for the drop in potential incurred by the partial exhaustion of the batteries.

On the front of the phonograph cabinet is a push button which will stop the phonograph instantly, causing the tone arm to lift and return to its non-playing position without lifting the cover.

PEELING TOMATOES CHEAPLY

H. M. Miller, chemist, has invented a machine for peeling tomatoes very cheaply. Miller claims that by its use the cost of cleaning tomatoes will be reduced 65 per cent, and that instead of 30 per cent of the fruit being available for "solid pack" he will be able to raise it to 80 per cent at the same time cutting down the waste from 45 to 10 per cent and running the machine at a capacity of seventy-five tons a day.

Denizens of the Ether

By HAROLD F. RICHARDS, Ph.D.

(*Continued from page* 821)

antelope, a graceful, slender-legged inhabitant of the plains of Tartary. Motoring tourists have compared the speed of this animal to that registered by their own speedometers, and assert that it has attained a rate of sixty miles an hour. Yet this velocity is vanishingly small compared to that of electromagnetic pulses, for a light wave could travel to the sun and back while the antelope ran 16 miles. The transmission of an electromagnetic signal between two terrestrial stations is practically instantaneous.

The ether is, by definition, what is left in a space from which we have removed all material substance, and obviously we can perform no experiments in that region without introducing apparatus which is itself composed of matter. It is therefore interesting to consider how we know that light and the other types of radiation consist simply of waves in the ether. In the seventeenth century and early part of the eighteenth, light was said to consist of material particles shot like bullets from a luminous body, and a comprehensive corpuscular theory was elaborated. Objections developed, but the overthrow of this theory was due chiefly to the discovery that two spots of light can produce darkness.

This striking experiment is relatively simple. Monochromatic light falls from a sodium flame upon a diafram which contains two narrow slits close together. The only light which illuminates a screen set opposite the diafram is that which passes thru the slits. One would suppose that when both slits are open the spot of light upon the screen would be twice as bright as when a single slit is used. But experiment shows that the distance between the slits can be so chosen that when only one slit is open, there is a bright spot on the screen; but when both are open the screen is *totally dark*.

This apparently paradoxical result is incapable of explanation by the corpuscular theory, for we know that if two bullets strike the same spot on a target the latter will receive twice as much energy as it would from one impact. Wave motion, however, accounts adequately for this interference phenomenon. Consider a rope tied at one end to a rigid support and held horizontally by an experimenter. If the free end of the rope be moved rapidly up and down a wave motion will be set up in the rope so that the familiar *loops* and *nodes* will be seen. Now suppose that another experimenter simultaneously imparts to the rope a vibration which would of itself cause every loop to be reversed in direction, so that when one segment of the rope is curved upwards by the first vibration, it is curved downwards by the second. Obviously the effect of the two simultaneous agitations of the rope will be to produce *no apparent vibration*. This analogy affords a simple explanation of the apparent paradox described above. The light from one slit reaches the screen in a phase of vibration *opposite* to that of the light from the second slit, so that when the two vibrations are superimposed upon the same spot in the ether, they neutralize each other. It is such experiments as this, which show that light consists of a periodic excitation or wave motion, and since electromagnetic pulses are transmitted with greater facility by a vacuum than by a material medium, we must suppose the vehicle to be *non-material*. The ether is our confession of ignorance. Webster quotes Lord Salisbury as having said that *ether* is a noun invented to serve as subject for the verb *to undulate*.

Probably the most familiar manifestation of interference is the beautiful colors seen in a soap bubble. These colors are due to interference between the light reflected from the outer and inner surfaces of the thin film. But anyone can perform a simple interference experiment by looking at the sky thru a narrow slit formed by two fingers. When the distance between the fingers is properly regulated thin, black lines will be seen running the *length* of the slit despite the fact that the whole space between the fingers is exposed to the sun's rays. These lines are, of course, due to interference between the rays striking the two sides of the slit. The writer has whiled away many minutes of waiting for street cars by observing the beautiful interference effects produced when the sun or a street arc, is viewed thru the eyelashes. Many curiously colored rings can be seen at the points where two hairs come sufficiently close together to produce interference.

The sensitivity with which we are able to detect and measure this electromagnetic energy carried by the ether is astounding. When the eye reads by the light of a candle three feet away, it is receiving only one erg of energy per second. This amount of energy would have to fall continuously upon one cubic inch of water for 10 years and 142 days in order to raise the temperature of the water one degree Fahrenheit. When the eye perceives a star of the sixth magnitude, it is responding to one ten-millionth of even this small amount of energy. Electrical means of detecting electromagnetic energy when it exists in the form of X-rays are fully as sensitive as this marvelous natural instrument, the eye, and the results obtained by use of the audion in picking up radio waves from weak stations are too well known to require comment. An amateur station may radiate a total energy of only a very few watts, and if the receiving station is located fifty miles away we must look upon this energy as spread over the surface of a sphere fifty miles in radius. Thus a receiving antenna which encloses an area of perhaps 200 square feet actually receives only an excessively small fraction of the original energy radiated.

In the case of radiant heat, too, our means of detection are enormously sensitive. The radio-micrometer devised by Boys will respond to the electromagnetic energy emitted by a candle at a distance of two miles. In this case the amount of energy actually received by the measuring apparatus is of the same order as that taken in by the eye in detecting a star of the sixth magnitude. This statement may seem to contradict what has been said above, for the eye cannot see the candle at such a distance, but we must remember that only about 2.4 per cent of the total emission of the candle lies in the visible part of the electromagnetic spectrum.

How the Auto Thief Works

(*Continued from page* 812)

top of the transmission case, poked a screw driver into the *works* and released the trigger which was in contact with the lock, so that it sprung clear of the lock. He then replaced the cover of the gear box, put the nuts back, watched his chance and crept out from under the car. Next he hopt in, "gave her the gun" and was off to call on the judge who happened to be the owner of the car, all in fifteen minutes.

Owners of Sedans or closed cars often place false security in the fact that they can lock all the doors from the inside and then lock the final door from the outside, as they leave the car. This is pretty good protection in a general way, but it is only half the story. A Sedan fully locked has been stolen so easily that it would make your hat fall off to even listen to the sad tale—and in the case recited to us, the theft was made on a busy street in one of our large cities. The thief watched his chance and simply cut a corner of the glass out of one of the doors locked with a button from the inside, by means of a diamond glass cutter; he then past his hand inside, turned the button and, presto! the Sedan had a new owner. This is the old store show-window trick in a new guise.

Some people think that the thief cannot get away with the car because of the color of the paint or because they have their monogram on the door in gilt letters, or because of the engine or car number giving them away—but all of these things matter not a whit, as the motor car theft records of the past few years have shown. Stolen cars are repainted, the numbers changed, and in some cases police records show, that the cars have been dismantled and the engines changed from one to another, ad infinitum.

A really comical auto theft related to us by a member of the New York Detective Force, was that where the thieves beat a carburetor or gas line lock for the small sum of 10c. Cheap, wasn't it, and it happened just like this. For several days they tried to steal a new Cadillac car, but they could not get away with it. Once or twice they got the engine started, but it stopt again. One of the gang hung around in the vicinity of the car and watched the owner start off each day. He finally discovered that the owner very adroitly slipt his key thru a hole in the floor, and so he discovered later, had unlocked a valve in the gas line. The day after, the crook genius walked into a nearby drugstore and bought 10c worth of rubber tubing. With a pair of cutting pliers, he severed the gasoline pipe at either side of the lock, joined the two ends with a piece of rubber tube, and away went the Cadillac, and without the owner's consent.

The steering wheel lock of which there are several on the market now, including those fitted with six-tumbler key locks, as well as those fitted with a combination lock, such as are found on office safes, is undoubtedly one of the best devices available and is used very extensively. It might be said at this point that the spike lock on the wheel or the hub lock, or the wheel chain and lock used by some owners, do not conform with the Fire Underwriter's rules, as the car cannot be moved except for a distance of a few feet in case of a fire nearby. If you do not carry fire insurance, it makes no difference, but you may lose your car if it cannot be pushed out of immediate danger.

The steering wheel lock seems to be a very good protector on the average, a point in its favor being that a car equipt with it cannot be towed, as when locked the steering wheel simply spins around on its post or column, and thus a man cannot sit inside the car and steer it while it is towed. One expert on motor car theft prevention, mentioned that he had known of a case where a car fitted with a steering wheel lock was stolen by being towed, and in order to make the car follow freely behind the towing car, the pins in the steering knuckles were removed so as to leave both the front wheels free. It is doubtful whether the car could be towed very fast. Of course the master thief would also attempt to pick the lock or damage it if possible, so as to release it.

Steel bar locks of various styles have been manufactured for quite some time and aside from the fact that the lock on these devices use a key and this renders it open to the science of the expert crook, there are other ways of beating the bar lock. Even if the bar is of hardened steel, no matter how hard in fact, there is a way to beat it. Do you remember reading how hardened steel safe plates and doors have been opened by the electric arc method or the oxy-acetylene flame? That is the answer. If the lock bar cannot be filed or sawed, then your scientific crook may try to fuse it with electric current taken from the lighting circuit, or failing this from the storage battery in the car itself.

When the car is in the owner's garage there is probably no better protection, all things considered, than an electric alarm attached to the garage door, which will cause a constant-ringing relay attachment to set a large bell in action in the house, preferably in the owner's bedroom, which will keep on ringing when once started. The owner will then have a chance to use his trusty automatic or shotgun and "believe me, Xantippe"— if there is anything that a crook of any vintage hates, it's a charge from a shot gun, especially buck shot of the "BB" variety. The writer has a closed circuit electric alarm on the garage, so that if Mr. Wiseguy cuts a wire he will fool no one but himself, for the current ceasing will cause a sensitive relay armature to drop away from its magnets, closing a local circuit thru a 12" electric gong in his bedroom. When you hear this alarm at 2:00 a. m. in the morning, you grab your gun and run to the nearest window, and switch on the lights to the garage and around the house.

Ultra High Speed Atoms and Their Effect

By ROGERS D. RUSK, M. A.

(*Continued from page* 834)

"Blown to atoms" is a common expression when an ordinary explosion occurs, but in a radioactive substance even the atoms are blown to pieces. In an ordinary explosion tremendous forces are liberated simply by the atoms of the explosive substance rearranging themselves. If an addition to these atomic forces, the forces within the atom could be utilized the result would be unbelievably greater. In radium only a comparatively few atoms are exploding at any one time and yet the energy liberated is over a quarter of a million times greater than could be obtained from burning the same amount of coal.

When ultra high speed atoms strike an ordinary gas particle, it is possible that some similar explosion occurs under the proper conditions, and that atoms which do not have any tendency to disintegrate themselves like radium, may thereby be made to disintegrate.

In this Department we publish such matter as is of interest to inventors and particularly to those who are in doubt as to certain Patent Phases. Regular inquiries addrest to "Patent Advice" cannot be answered by mail free of charge. Such inquiries are publisht here for the benefit of all readers. If the idea is thought to be of importance, we make it a rule not to divulge all details, in order to protect the inventor as far as it is possible to do so.

Should advice be desired by mail a nominal charge of $1.00 is made for each question. Sketches and descriptions must be clear and explicit. Only one side of sheet should be written on.

Recording Phonograph Records

(529) Wrentham Sothern, Chelsea, Mass., requests our opinion on an electric arc method of making phonographic records; the stylus or arc, is moved by electro-magnets.

A. The methods which you describe of making phonographic records has been tried in slightly different ways, but has been found far from satisfactory. Instead of vibrating the arc, as you describe, the amount of current flowing across the arc is varied, thus giving a hill-and-dale record, instead of a lateral cut effect. We doubt very much whether you can cause the arc to change as rapidly as is necessary in this particular contrivance. The idea would be worth while experimenting with, however, and if the experiments prove practical we would advise that you proceed with securing a patent.

Automatic Crossing Gate

(530) R. H. Reitz, Lewisburg, Pa., submits an idea of an automatic crossing gate, in which the gate juts up from the roadway.

A. As far as the construction is concerned, the device is simple but the initial cost of installation is very large. In addition, you have this possibility. If the front wheels of an automobile, or a truck, were to pass the gate and the gate suddenly rise, what would happen to the rear end of the truck imprisoned at the top of the gate; and if the forward end of the truck were upon the tracks, we believe there would be a terrific smash, should the train hit a team of horses and wagon, or strike a loaded automobile. Nevertheless, this objection, could perhaps be removed, but then the cost of installation would be so considerable that we doubt whether the railroad companies would look upon the idea favorably. The advantageous feature of your system is that it allows traffic to pass off the tracks and safely to the other side, blocking all subsequent traffic successfully.

Lock Idea

(531) F. Sajovec, Cleveland, Ohio, says he has devised a lock that can be made in any size whatsoever, being especially suited for small trunks, suitcases, etc. It is made of two tongs-shaped pieces of steel, the key separating them when the lock is opened.

A. We do not believe that the idea of a lock advanced by you is worth considering, for the simple reason that it could be opened too easily and it would get out of order very quickly. If anyone attempted to force the top of a trunk open, he could bend the movable iron tops and then, when the key is subsequently inserted into the lock, it could not be opened again. We do not advise a patent upon this idea.

Selling "Unpatented" Ideas

(532) Willes M. Thompkins, Los Banos, Calif., having invented various mechanical devices, asks our advice about selling the same without securing a patent.

A. Altho you can secure a possible buyer for some of your mechanical ideas without having obtained a patent upon the same, we do not advise that procedure, for the simple reason that you are not really safe-guarded in any manner whatever. Why not secure a patent upon the best one of the lot and attempt to sell it and then try your other ideas, using some of the money that you may obtain from the first one for their development.

Puncture-Proof Auto Tire

(533) A. N. Sammarone, Akron, Ohio, writes that he has perfected an absolutely puncture-proof tire, and has proven it to be such. He then destroyed his plans and the model because he feared someone would steal it from him.

A. There is very little possibility of an invention being stolen if you have establisht sufficient claims of priority, and hence, we think it was absolutely unnecessary for you to have destroyed the first model of the puncture-proof tire. Unless you secure a patent you are never entirely safe, whether that be in America or in Italy, and you can rest assured that just as much crooked work is done in the foreign countries as in this country. Remember that the American courts, altho very easy to get into, are hard to get out of. With regard to your statement that "the Italians are downed and ideas stolen from them," we could counteract that by mentioning thousands of Italian inventors. Mr. Marconi is only one in the list. There are hundreds of thousands of promoters who would today seriously consider promoting an idea such as you claim to have invented, and you should have found no difficulty in securing the proper financial backing. We would certainly advise that you save up your pennies and start patent proceedings.

Multi-Propeller Airplane

(534) John A. Spencer, Long Beach, Cal., enters a description of a multi-propeller airplane in which rising, steering, back and forward movement is executed by means of the numerous air-screws.

A. Altho we do not doubt but that your idea of an airplane would work, its practicability is very slight for the reason that the cost of such an installation as you describe would be prohibitive. Theoretically, there is nothing wrong with your principle, but the design must be worked out so as to be a little more feasible. We assume that you intend to use only one motor to drive these propellers. Can you imagine the cost and weight of such a motor, which will drive all propellers at once? Also take into consideration the extreme difficulty in handling a machine of this nature. We will be glad to enlighten you further upon this idea, if you will make your questions more explicit.

Bicycle Light Generator

(535) Earl Sprain, of Eldora, Iowa, asks our opinion of a small generator attached to the back of a bicycle wheel to be used for lighting purposes.

A. Your idea is not new. It has been tried, and in fact, is being sold in this and other countries at the present time. The only special feature which you have incorporated is the governor regulating a small rheostat.

Generally, devices of this nature have been arranged so that the governor does not allow the generator to be rotated rapidly when its speed is quite high, i.e., it allows power to be transmitted to the armature only intermittently, thus keeping the generated current down low enough to prevent burning out of the filament.

We doubt the commercial possibilities of this idea.

Magnetic Wheel Brake

(536) Elmer Meyer, St. Louis, Mo., enters an idea of a magnetic brake for vehicles.

A. The idea which you have evolved is quite novel and altho we do not advise an immediate patent upon it, we would advise that you build a model of quite large size and give it extensive tests

before proceeding with regular patent proceedings.

You will find that there are many drawbacks which must be overcome and it would be best for you to rid your invention of these before proceeding further.

Airplane Parachutes

(537) John Madden, of New York City, sends a description of an airplane equipt with seven parachutes and asks our opinion.

A. Your idea is as old as the proverbial hills and many patents have been issued for attaching parachutes to airplanes, but heretofore one or two parachutes at the most have been quite sufficient. In your contrivance you propose seven or eight of them, which in our opinion is entirely unnecessary.

The great difficulty with parachutes has been their uncertainty in opening when the airplane is falling slowly or being but a short distance from the ground has no time to acquire velocity enough to open the parachutes. If the airplane is making a tail spin, a nose dive, a plunge or flying in an inverted position the parachutes will not work.

We do not believe that you could secure a patent upon this idea, neither do we think a patent would be profitable or beneficial.

Selling A Patent

(538) Geo. Moore, Glen Allen, Va., requests information on selling a patent.

A. The manner in which you sell the patent or subsequently conduct its manufacture depends entirely on the value of the patent and to what extent you intend manufacturing the same. Thus if the article is a commercial utility, which could be employed universally, you could not do it proper justice by manufacturing it on a small scale yourself, even tho your profits would be large. It would be far better for you to place it in the hands of a large concern, who manufacture such appliances and who have an established reputation, and also the facilities for advertising the appliance widely. Under such circumstances the number of sales will more than compensate for the additional profit which you would have obtained, if you had manufactured the appliance yourself.

Manufacturing and advertising costs money and a good financial backing is essential to the successful exploitation of a patent. We would, therefore, advise you to place the device in the hands of a modern concern, they in turn are to give, let us say about $5,000 for the right to manufacture this small article, thus showing their good faith. The contract should then call for 10 per cent royalties on subsequent sales.

Flush Tank Valve

(539) D. M. McCianie, Monroe, La., asks us for patent advice on a noiseless flush-tank valve.

A. In view of the lack of specifications, regarding the construction of your flush-tank device, we are unable to give more definite information than as follows:

If you are in a position to manuiacture and exploit these flush-tank valves and if they operate as you state, we would advise a patent, but otherwise, unless you are financially fixt so that you need not worry about the immediate outcome or exploitation of the valves, we would hesitate to advise such patent. There are at least twenty noiseless perfect sitting valves on the market at the present time, which have no rubber in them whatever, and hence cannot wear with ordinary usage.

Any machinist will undoubtedly find many devices which are in greater demand than flush-tank valves.

Automobile Spring Wheel

(540) Elmer Switzer, Pekin, Ill., requests our opinion of an automobile spring wheel.

A. Your device looks practical and plausible enough, but we doubt whether it would be profitable. There are numerous companies placing wheels on the market having solid tires, the wheels themselves being of springlike nature, so as to absorb all the shocks which they do quite readily.

Other wheels again have had air-comprest spokes terminating in hard rubber tire sections. Again these devices did not seem to warrant general use. With your device, therefore, there are these objections. We do not believe it will be universally adopted; there is not even as much elasticity in this wheel as in other wheels incorporating the springlike construction.

Therefore, we earnestly believe that such a device will hardly be worth while patenting unless you have a fabulous sum of money behind you to manufacture and advertise the same, and even then we doubt if it will "take."

Airplane Speedometer

(541) Wesley S. Malloy, Columbia Falls, Montana, submits a sketch of an interesting speedometer for airplanes working on a geometric calculative principle, the earth being the constant.

A. The speedometer which you have designed for airplane use is far from satisfactory for many reasons. In the first place, it is not instantly indicating, and necessitates different adjustments for each height. This requires entirely too much fussing on the part of the individual reading it, and also requires his undivided attention for a few minutes.

Altho the device itself is quite ingenious, we do not hold that it will by any means take the place of present instruments which serve the purpose equally well.

An instrument much needed at present is something which will give an accurate *instantaneous* reading without the necessity of regulation.

Realistic Storm in Stage Play

(*Continued from page* 806)

of the storm increased by means of wires and ropes secured to these parts of the setting, in such a way that the audience could not see them.

The effect of a high running sea with white beach-combers rolling in on the shore of the island, was cleverly presented by projecting the necessary moving images of waves and white-caps on the lower part of the back drop, where the shore line could be seen. After the storm had abated and the sky started to clear once more, the beautiful clear atmosphere that we note after a summer shower was duplicated. The birds sang, the wind died down to zero, and the woman who was lost somewhere on the island returned to her husband (who rushed about thru the woods calling to her during the storm) and he is agreeably surprised to see her carrying a child, which was born during the storm.

Quartz—Its Place in Nature

By DR. ERNEST BADE

(*Continued from page* 820)

splintery fracture is chert. Large quantities of flint are found in limestone and chalk quarries. This is the substance which was so prevalently used for arrow and spear heads as well as for cutting tools of all kinds, sizes, and shapes, during the stone age. Its later more universal application for lighting fires by means of sparks, and its use in muzzle loading flint locks, has long since been lost thru the introduction of matches and percussion caps.

Another important member of this class is *jasper,* which has been used for delicate works of art and more massive vases, when larger and more perfect stones have been found. It is opaque thru its content of clay, and it occurs in the most profuse varieties of colors the more common being yellow, red, and brown.

The third and last great division of the quartz family is the *opal;* it is amorphous, massive, and hydrous, having from 3 to 13 per cent. of chemically combined water. The general appearance of this mineral is glassy or porcelain-like, some of its varieties showing an opalescent play of colors to such a high degree that they are among the most chromatic of our gems. The internal play of colors is most marked in the precious opal, and in the more valuable stones it varies from green to red, blue, and yellow. The phenomenon of this opalescent effect is said to be due to the refraction of a beam of light within the stone which is caused when it strikes the curved plate-like particles superimposed and adhering to each other, thus breaking it up into the prismatic colors.

Hyalite is a clear colorless opal resembling a drop of water frozen to ice, while the wax opal is characterized by its waxy luster. But the most peculiar of all is the hydrophane which is only transparent and only shows its play of colors while moist. Wood opal, as the name implies, is fossilized wood which has been petrified and still shows tthe structure of the wood, the cells themselves being filled with this hydrated quartz.

The siliceous material, generally found deposited around siliceous hot springs and geysers, is geyserite and it is abundantly found in Yellowstone Park and in Iceland. Tripolite or infusorial earth (Fuller's earth) is another substance which belongs to this group. It consists of a fine grained deposit of siliceous shells of diatomes, small microscopic sea organisms, which, thru the ages, have accumulated and now form thick beds. It is used as a mild abrader and a polisher, it is added to water glass and putty, and many and various are its industrial uses.

These various stones, common, precious, as well as semi-precious, are nothing more than silica—that lowly mineral which is most profuse. All the mineral matter of these various varieties are, in the final analysis, exactly the same, or they differ among themselves chemically in such a slight manner that it is often impossible to detect the minute traces of impurities, which help to make some of them so desirable.

But sand, pure quartz, has its own technical importance. It is an essential constituent in the making of concrete which consists of lime, sand, and kaolin. This, after it has been burned, powdered and mixed with water, will harden under the influence of the water, calcium silicate and calcium aluminate being formed. And so it can be said that sand, which formerly was valueless, is now a gold mine for him who has it in easily accessible places.

The Vibrator of Death

By HAROLD F. RICHARDS, Ph. D.

(*Continued from page* 824)

strikers, he demands that she be constantly under the eyes of a dozen of my men. I can hardly spare them."

A cold, calculating glint came into Flocon's eyes as he said this, and Elon remarked sharply:

"Denbaule's voice is worth a dozen strikes—or jobs."

Flocon's gaze fell under Elon's penetrating glare.

"Yes, yes, to be sure. But she can't be everywhere at once. This morning I had advices that the chemical workers in Dijon had gone out, and all the men from eight mills in Lyons. There may be a general railroad strike within forty-eight hours."

"The situation is undoubtedly grave, replied Elon, "but nevertheless it seems a matter for Camproger's internal policy. Still, if Denbaule—"

"Hopkins, this case is different," interrupted Flocon. "The workmen are not really dissatisfied, but are being subjected to the most insidious propaganda. Altho the Syndicalists have gained some power in the last few years there are still no closely coördinated unions, for the French temperament is too individualistic to be governed by mass rule. But the literature plays upon the people's natural misgivings about the eventual validity of their large holdings of war bonds; it paints vivid pictures of employers' excesses, and interprets the present unfavorable rate of exchange in a light, which leads the workers to fear that the francs saved for old-age retreats will be worthless. The people may soon see their error; but at the present rate, not before there is terrible suffering and the ministry has fallen."

Flocon took a deep breath, and I wondered whether he was more interested in the suffering of the people or in holding his job. Elon sat staring at the bowl of his pipe.

"What form have the warnings taken, Flocon? The usual note?" he inquired suddenly, and I knew that he was thinking more of the danger to Marie Denbaule than of bread-lines and riots.

Flocon drew out a white envelope; Elon studied the exterior for a moment, then read the note. The snap came back into his eye, the eager spark that I had not seen there since the mystery of the Girondin Murder Syndicate in which Madame de Verzou was the central figure. He ran his glass quickly over the writing, looked through the paper at the window, then tost it to me. The note ran, in a strong, regular hand:

Mlle. Marie Denbaule:—The people of France will not be duped by one who poses as their friend. The death of an opera singer will be a small matter in comparison to the eternal victory of the masses. Without compunction we will still your beautiful voice, cast the misty fog of death over your flashing eyes, quiet forever the gestures of a sublime actress. Continue your speaking at your peril.

—The Elect of France.

"You are right, Flocon; this is a serious case," said Elon, abruptly. "Ah, you should have seen her in *Carmen* a year ago, Andrews. Superb! And when she quelled that riot yesterday in the *Boul' Miche*—I don't wonder that these Frenchmen go back to work when she—" He glanced quickly from me to Flocon,

as if ashamed of his unwonted outburst. "But surely, Flocon, it would be a relatively simple matter to time the appearance of the inflammatory circulars in the various towns, and then trace back the lines of distribution to their focus."

"We have done all that. Every indication is that the infection radiates from Marseilles, but we have found nothing there, altho every possible printing shop has been turned inside out. The postal authorities have been examining every suspicious package, but nothing has resulted."

"Is Gaudet in town now?" asked Elon.

"We traced him to Marseilles three days ago, where my men have him under constant surveillance."

"And I noticed by the papers that Marie Denbaule left this morning for the same place," observed Elon.

"Yes," answered Flocon, with evident P. L. M. is growing at that terminus, and she is determined to stop it at all costs. Strike on that artery would paralyze the country."

"Flocon, I have never sympathized with the French government in its political troubles; for your system, with its ever-changing ministries, reeks of inefficiency. But the circulars which I have seen look like out-and-out Bolshevism, and if I can throttle that sinister influence I shall be serving America as well as France. Furthermore, this personal danger to Marie Denbaule requires immediate action. Andrews and I will take the five-twenty for Marseilles tonight. Is Valonne still in charge down there?"

"Yes," answered Flocon, wtih evident relief.

"Wire him to-night an accurate account of the exact times of first appearance of this inflammatory literature in every town that has been affected; also, as nearly as you can, a complete record of Gaudet's movements for the past month," said Elon, crisply. "I presume you have been keeping a close watch upon any influx from Moscow. These nation-wide strikes may possibly be a result of the Bolshevists' international campaign projected at their recent meeting in Bremen. The late trouble in Budapest bears all the marks of Krampdorf's crafty hand."

"Krampdorf!" ejaculated Flocon. "He was reported killed in the attempted establishment of the first commune in Berlin, ten months ago!"

"My dear Flocon, criminal agents should not obtain their information from the newspapers," replied Elon, smiling coolly. "The poetic phraseology of this warning to Marie Denbaule reminds me strongly of Krampdorff's literary style, especially that peculiar construction, 'without compunction,' at the opening of a threatening sentence."

"But Gaudet's leadership of the Radicals, his absences, his unwonted silence, his known designs upon Camproger's portfolio — conclusions are obvious, surely. Hopkins, if you will net him as you did Owslench a year ago, the present ministry and, I may say, I personally, will owe you a great debt of gratitude," he added, ingratiatingly.

"No harm, Flocon," replied Elon, pleasantly. "Just wire Valonne the information I mentioned, and set your best men to find Krampdorff. Valonne can let you know the progress made. And Flocon," he concluded, his tone changing to one of incisive command, "if I detect the slightest laxity in your efforts to protect Marie Denbaule, I will throw up the case at once."

Elon and I hastily threw our necessary belongings into suitcases, checked out at the desk and stept to the curb.

A man flashed the badge and motioned us into a waiting car.

We were soon ensconced in the Marseilles express. Elon stretched his lank form diagonally across the narrow aisle that separated the white-clothed seats in the small compartment, and in a moment was puffing serenely at the curiously carved pipe without which he had never been photographed. His long chin sank down upon his chest until it touched the little black bow, while I surveyed the flying landscape, my own short legs bent at the knee and my feet on the edge of the seat before me. Suddenly he aroused me from contemplation of a cluster of little stone cottages.

"Andrews, Flocon may not have sufficient imagination to become a genuinely astute criminologist, but he does know psychology. Did you notice how apparent it was that he did not care to detail sufficient men to guard Denbaule?"

"He gave the impression that he was short of men."

"He has twice as many men as he really needs. But he was shrewd enough to see that, if the popular singer should actually be injured on account of her efforts to combat the strike propaganda, then the people would be so enraged against the invisible source of agitation that they would voluntarily return *en masse* to their work. Flocon is clever enough, but I think I made it clear that I consider human sacrifices to be out of date."

He lapsed into silence, while I tried to sleep. Suddenly he remarked:

"Andrews, I don't wonder that these people idolize Denbaule. She will sing tomorrow, despite a thousand threats, for she possesses the dominant spirit, without which the most perfect voice will fail to thrill an audience. You and I may solve a knotty problem by the application of science, yet we could not move a dozen persons. I estimate that in her five-year career Denbaule has given her inspiration to 150,000 people, but ten days after our cold science resolves this national crisis nobody will remember anything about it. But these stupid trains—here we are stopt again. They remind me of a game of checkers—not so long to move, but a long time between moves."

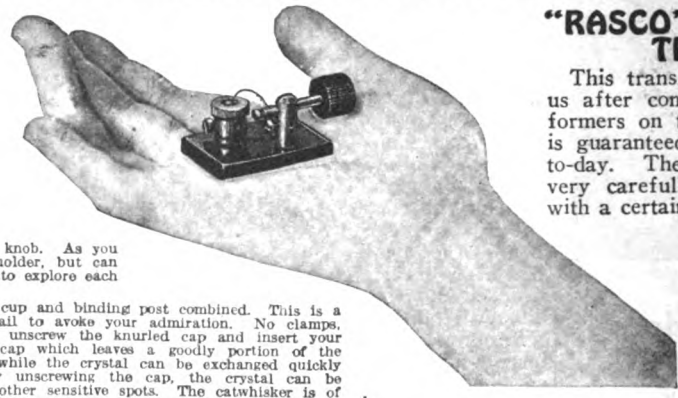
I settled myself to doze, for I knew from long experience that Elon was not contemplating the fruits of inspired temperament, as seriously as his conversation might indicate. Many times I had listened to his effusions about a thousand apparently unrelated subjects, only to hear him suddenly dart out a crisp sentence which showed that he had been unraveling a mystery all the time. I had often marveled at this power of abstraction, this ability to speak eloquently while his mind was relentlessly sifting out the essential from the non-essential and arranging the selected details in such logical order, that I wondered why I might not have deduced the simple solution of an apparently hopeless tangle of complications. I knew that back in his head he carried a picture of Denbaule, with her slim throat and large eyes, and that he would waste no time in solving a case which surrounded her with such personal danger. I dozed intermittently, and as I looked up from time to time I saw Elon examining a pamphlet under his lens or the written warning to Denbaule, and twice I was awakened by the rustling of a huge map. Once I muttered a profane reproach as he pulled me down flat upon the seat; but in a second I understood his action, for a heavy missle crashed through the window. Cautiously I peeped over the sill and saw a throng of workingmen rioting.

"Avignon," said Elon, quietly. "You slept thru a nasty mess at Lyons."

From that moment the conductor disregarded the expostulations of fevered passengers who wished to leave at way-stations, and the engineer showed a fine indifference to the possibility of torn tracks.

(*Continued on page* 875)

THE RASCO "BABY"



The smallest and most efficient detector in the world—as well as the cheapest. Our illustration is an actual photograph, and while the various details can be seen at a glance, we feel so enthusiastic about it that we must tell you all of its good points. First, there is a solid hard rubber composition base, size 1½" x 1⅛". We have not forgotten two holes to screw down the detector.

Then we have the nickel holder and binding post combined which holds the sliding, knurled, hard rubber composition knob. As you see, this knob not only revolves in its holder, but can also be moved back and forward in order to explore each point of the detector crystal.

Next we see the patent nickel detector cup and binding post combined. This is a little marvel all by itself and will not fail to evoke your admiration. No clamps, no soft metal to fuss with. You simply unscrew the knurled cap and insert your crystal into the stand, screw home the cap which leaves a goodly portion of the crystal exposed. The contact is perfect, while the crystal can be exchanged quickly in less than three seconds. By slightly unscrewing the cap, the crystal can be changed in position, in order to explore other sensitive spots. The catwhisker is of phosphor bronze and is attached to the horizontal bar by means of a filister head screw. Can be readily exchanged in less than two seconds. Wires can be connected to the binding post in a jiffy. All metal parts are nickel plated, and you will be proud of this little masterpiece.

No. 1898 Rasco Baby Detector complete with galena crystal, prepaid..... **50c**

No. 1899. The same but furnished with an additional piece of tested radiocite crystal, prepaid **75c**

"RASCO" AUDIO FREQUENCY TRANSFORMER

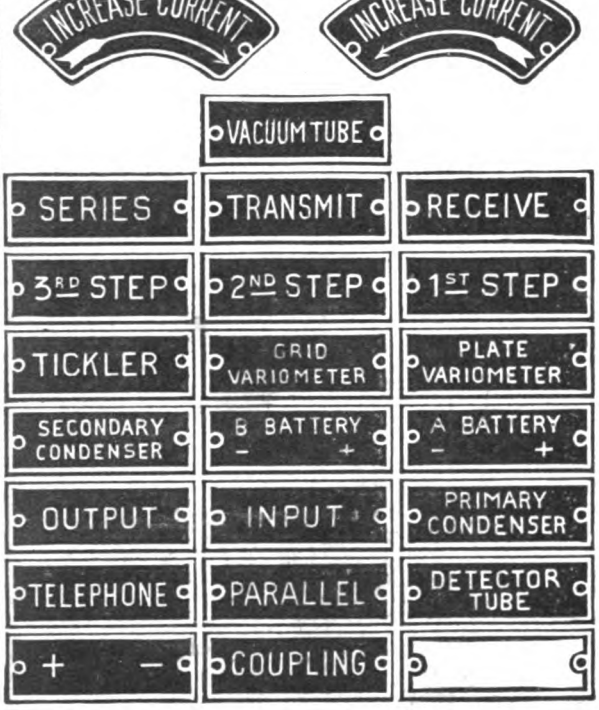
This transformer has been developed by us after comparing all the various transformers on the market. This transformer is guaranteed to equal any on the market to-day. The primary and secondary are very carefully built and are impregnated with a certain wax in vacuum. The stampings are of the best silicon steel. Only the very best material is used throughout.

Realizing the fact that most amateurs desire to "make their own" we *furnish this transformer unassembled.* Directions which accompany the transformer are such that anyone can put the parts together in about ten to twelve minutes. This saves you considerable money, for the reason that manufacturers who assemble the transformers must charge you for the assembling work.

Illustration as shown is in full size. The weight complete is ten and one-half ounces. *Note also that we ship all goods prepaid.* **We pay the freight.**

No. 1100 "Rasco" Audio Frequency Transformer **NOT ASSEMBLED**, prepaid

$2.65



"RASCO" NAME PLATES

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The Vibrator of Death

(*Continued from page 873*)

The big station at Marseilles was almost deserted when we alighted at five-thirty in the morning, but Elon was in instant conversation with a colorless man whose head reminded me of a rodent animal. Elon introduced him as Valonne, head of the local branch of the service. As we stood just outside the railings in the underground trainshed a huge, rubber-tired truck, piled high with trunks, came bearing noiselessly upon us. Valonne saw it in time to shout a warning, and we jumped aside as it swept past and plunged through the heavy iron railings. Elon glanced quickly in the direction from which it had come, but saw no one, and remarked quietly to Valonne:

"Apparently you are not the only person who has received word from Paris since we left."

Valonne shrugged his narrow shoulders and motioned us into his car. There was no disorder in the streets as we rode swiftly to the *Hotel des Deux Terres*. The boulevards were deserted except for small knots of workingmen conversing earnestly, yet one could not fail to be imprest with the diversity of this picturesque metropolis of the Mediterranean, with its massive buildings of white stone facing on broad boulevards which opened at intervals into incongruously narrow and dirty alleys.

"I'll get the data at your office at eight," said Elon, as Valonne attempted to detain him at the hotel entrance. "Now I must sleep."

Ten minutes after registering we reposed comfortably in bed. I found myself alone upon waking, and my hand rustled against a note on Elon's vacant pillow.

"*Andrews: Meet me at south entrance to Sunshine Park at one-thirty. In meantime go to Margulier et Fils, 47 Allée de Meilhan, and have 500 dodgers printed, 12 by 18 centimeters, dull paper, every letter in ten-point caps, bold face. Must be ready by noon tomorrow. Here is the copy:*

> Unprecedented Sale
> Fleece-Lined Ermine Robes
> Every dealer selling genteel evening robes will err greatly if he does not attend our remarkable auction sale of fleece-lined ermine garments. Every robe guaranteed perfect, free from defects, quality unexcelled, invisible seams. Small deposit and credit fee ensure September delivery. Sale extends three evenings, May 16-18, eight to ten.
> Andrews and Henbee,
> American Furriers,
> 14 rue Endemonee."

I read the copy with amazement. Whom was he now seeking, that he should lure him to a furrier's auction sale at this season? Why such accurate specifications of type? I read the note again, testing whether our usual code for ephemeral notes would shed light upon the mystery, but reversing the words by three's made no sense. I drest quickly, snatched coffee and rolls in a café next door, and sought the *Allée de Meilhan*.

The address led me to the old quarter just west of the main wharves. I past rapidly along an odoriferous street where ear-ringed women sold fresh bread and stale fish, and entered a tiny establishment. A boy was operating a small hand-press and a bent old man wearing a green eye-shade leaned over the only type-case in the room. He listened attentively while I explained my wishes, and promised to have the job ready at ten the next morning, altho he stipulated a bonus for the rush feature.

I now found myself amidst a mass of speculation which led me nowhere. I wondered whether Elon had already cornered

Gaudet, whether Krampdorff was in Marseilles and what red ring might be associated with him, and again I repeated the singular wording of the advertisement which Margulier was setting up. But involuntarily my thoughts came back to condemn Flocon for his half-veiled willingness to allow Denbaule to appear unprotected as champion of order. I caught her name in the two-inch head of a newsboy's paper, and found the entire front page of *Le Travailleur* given over to a raging protest against the proprietor of Sunshine Park. One paragraph was outstanding in its virulence:

"Jacobs deserves ruin, for against the tide of the People's upward rush he arranges a Denbaule demonstration. And the popular favorite is a thousand times a traitor in directing her influence against the masses whose acclamations have raised her to the pinnacle. We earnestly hope that Denbaule will cease her misguided efforts; but, if she continues, the sacrifice of a superb artist will not be too much to further our cause."

While I was still some distance from the park I saw a great steel spire towering in the air, and knew that it must be the thriller which had created a sensation when installed a week previously in the pleasure-garden, modeled after the resorts of New York. As I approached the entrance I saw the lofty shaft begin to swing slowly thru the air, and I speculated upon the probable sensations of the two passengers who swayed back and forth on the tip of a slender spire as tall as a three-story building. I forced my way thru a dense throng chattering volubly about the approaching Denbaule appearance and found Elon near the South entrance. He was watching a group discharging arrows at a live pigeon tethered by a one-foot rope to the tip of a flag-pole, at a franc for five shots.

"Not such bad shots, these Frenchmen," he remarked. "They have had to change the pigeon four times in the last half—" He stopt suddenly, as a loud roar burst from the mob which thronged the grounds. "Ah, I couldn't stop her."

I followed his gaze to the clubhouse veranda, across which a small party was making its way towards the steps. Even with my view obstructed by the hats, which filled all open spaces between amusement booths, I recognized Denbaule's loose hair and large eyes. The crowd gave way to permit the passage of the little party, while a shrill-voiced barker continued his shouting:

"Ride the Swaying Thriller! Get the vibration of a life-time! Feel the new sensation! Step right up and buy your tickets! One more ride before Denbaule sings!"

The group had now reached the entrance of the vibrator. I recognized Valonne at Denbaule's side, but I had never seen the dapper Jew. Elon whispered that he was Jacobs, manager of the resort. I caught a quick exchange of recognition between Elon and Denbaule, and knew that his morning program had included an interview with her. She made a striking figure, for she held her slender body erect, and her white shoulders and slim neck shone in sharp relief above a dark dress over-netted with black lace. Her black eyes flashed fearless greeting to the workmen who prest about, and she smiled gaily; but I noticed dark circles under her eyes and remembered her almost incessant activity of the past three weeks. The party disappeared into a tall wooden structure which rose at the side of the towering spire, and I turned my attention to the novel amusement device from which Denbaule was scheduled to sing.

The lofty steel shaft rose vertically to a height of fully sixty-five feet above the concrete foundation in which it was fixt. It was about four feet thick at the base, and from this width it tapered upwards as a slim pyramid. The tip of the spire bore a canopied structure large enough to hold easily the two chairs which were fastened to it, one

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The Vibrator of Death

(*Continued from page 876*)

at each side of the pole. Close to the bottom, fifteen feet from the ground, the largest electro-magnet I had ever seen was built into a massive foundation. The magnet must have weighed two tons, and I reflected upon the immensity of the magnetic force which would be required to deflect the huge column and so start its vibrations. At the side of the shaft stood a tall, slender wooden structure containing an elevator, obviously for the purpose of conveying passengers to the platform near the tip of the spire.

"It's a weird contrivance," I remarked to Elon. "Spectacular, perhaps, but how anyone can enjoy—"

"Andrews, you should use your imagination," he interrupted. "It embodies motion, novelty and sudden change, which are at the root of every successful amusement device. When I was a boy I used to sit perched in the top of a tall Lombardy poplar overlooking the bay, and as the wind blew I swayed back and forth and dreamed of adventures way off beyond that rolling sea—where we are now, Andrews. Jacobs executed a stroke of vision when he commercialized this familiar sensation. But I can't quite understand why he risks the popularity of his resort by arranging this counter-strike demonstration. Hear that muttering."

An ominous rumble superseded the varied exclamations, and I looked up to see the figure of Denbaule standing at ease on the platform high in the air. Her huge Newfoundland dog stood looking down gravely over the edge of the platform. Jacobs stept to Denbaule's side and motioned for silence, but the incensed crowd was in no mood for introductory remarks. He hesitated, but Denbaule made an imperative gesture and we saw the gangplank lowered to form a bridge from the platform to the ledge at the foot of the chairs on the tip of the spire. Two attendants strapt Denbaule into one of the upholstered chairs and the dog into the other at her back. The gangplank rose, and Denbaule lifted her ostrich fan in signal to the operator on the ground. I looked across to the enclosure and saw him close the switch of the electro-magnet.

Involuntarily the crowd burst into cheers as the free end of the steel tree began to swing slowly thru the air, but leaders among them hist loudly and the cheering stopt. In a few seconds the magnet had brought the swaying column to its full amplitude, and Denbaule rocked back and forth with gentle rhythm. The motion reminded me of a long rope swing turned upside down to defy the laws of gravity, for Denbaule moved at high speed in the center of the arc and then gradually slowed down until at the end of each swing she changed direction so gently that I knew there could be no strain upon the straps which held her safely in her lofty perch.

Suddenly the crowd hushed to listen, and the mellow tones of the soprano floated down upon a scene as quiet as the interior of a bank vault. Instead of directing her song towards heaven, as I had seen her do on the stage, Denbaule was now bending forward as much as the straps would permit, and she sang *The Prayer* from *La Tosca* directly into the upturned ears of a larger audience than she had ever before commanded. She reached the end of her song, held her gaze steadfast upon the crowd for a full thirty seconds, then spoke.

"My poor countrymen, are you hungry?"

No reply was ventured. The tip of the rod swung back to its other limit, returned, then Denbaule spoke again.

"Are your aged parents comfortable?"

This time there were a few rough cries. "No! No!" as if the leaders had recovered their wits and wished to break the spell; but Denbaule continued, at the end of the next swing of the lofty vibrator, which thus seemed to punctuate her simple remarks with dramatic emphasis.

"Are your children suffering?"

"Yes," came in stronger chorus, then one loud voice shouted, "We want the money of the parasites, we want—"

"Then why don't you go back to work and earn it honestly?" came the reply, smooth and clear, yet as full of feeling as if straight from the heart without passing through the throat.

The raucous voice attempted to answer, but a hundred approving shouts ascended to drown out the objector. Elon grasped my elbow and pointed to the tip of the vibrating spire.

"See—it's speeding up!"

He dashed off and I saw him struggling furiously to make way through the crowd. The rough workingmen whom he thrust aside mistook him for a protestant against their beloved singer, and I saw his progress impeded by a dozen hands. I tried to follow but the surging mass was impenetrable. Before my eyes the gentle sway of the huge vibrator had become a jerking shake. I could not make out Denbaule's expression as she swished back and forth in shorter and shorter arcs, and faster and faster. She shrieked, more poignantly than I had ever heard, and the dog at her back howled piteously. The crowd stared aghast at the tragedy taking place before its eyes. Jacobs jumped to the front of the platform and called excitedly to the operator on the ground. I looked over to the enclosure and saw that the operator had disappeared.

I struggled fruitlessly to get to the switch, but saw Elon finally vault inside the enclosure and shut it off. Denbaule's cries had ceased, and now jets of red spurted from nose and mouth every time the violent reversal of motion occurred at the ends of the short arc in which she swished.

Gradually the motion slackened. The great shaking rod came finally to rest and eager attendants lifted the unconscious girl from her chair. Even at that distance I could see that the delicate oval of her face was streaked with red. Quickly she was brought down in the elevator, and a doctor from the crowd pronounced her dead.

All was now confusion, but the awed exclamations on every side showed that even in death the beautiful singer had served the cause she fought for, and it was evident that the reaction which Flocon had anticipated would set in by the next morning. The set expression on Elon's face showed that even he felt the tragedy deeply.

It was five minutes after we reached our room before he spoke. Then his tone was one of bitter self-reproach.

"I should have had Valonne lock her up."

"But how could anyone foresee such an accident?" I exclaimed.

"Nothing happens without a cause, Andrews, and when Denbaule was so hated in certain quarters—" He paused, then lit his pipe and snatched his hat. "They have given us something more definite, now, if we can only read the signs." He even smiled, and as we strode rapidly towards Valonne's headquarters he asked me suddenly:

"Did you order the dodgers?"

"Margulier promised them for ten tomorrow."

"And the type?"

"Ten-point caps, bold face."

"Good. But here we are."

He brushed aside formalities.

"Valonne, I understand that Professor Jules Langevon invented the Swaying Thriller and sold it to Jacobs. I want you to come with me to see him."

"Faculty of Science," Elon instructed Valonne's chauffeur, and shortly we stopt

before one of the most imposing of the University buildings. It was seven o'clock and the halls were quite deserted, but an attendant directed us to the end of a dark corridor.

"Professor Langevon is engaged in research there," he said, pointing. "Knock before opening the door, for he is working with very delicate apparatus which must not be disturbed."

Elon knocked impatiently and a gruff response came quickly:

"Who is there?"

"Valonne, of the Secret Service. He wishes to consult you in a scientific matter."

"You will have to return in the morning," replied the voice. "All the measurements will be ruined if that door is opened now."

"The matter is very urgent, my dear Professor. I must beg you to see us at once," replied Elon.

"Impossible," came the curt answer. "Good-bye."

Elon threw open the door, disclosing a scene that was hardly scientific. A woman of about thirty-five sprang from the lap of a bearded man in dirty laboratory robe, and the professor rose in unconcealed rage. Elon cut short his exclamations.

"Hopkins is my name, this is Mr. Andrews, and this is M. Valonne, with whose name you are undoubtedly familiar. You are the inventor of the thriller that has just killed Denbaule, and we must insist upon examining your laboratory."

Professor Langevon threw up his hands in speechless wrath. The woman had meanwhile slipt from the room. Elon drew his automatic and eyed it contemplatively; and the professor, now a more dignified figure, than when startled in his amorous adventure, calmed at once.

"You are welcome, gentlemen, altho you are doubtless aware that your unceremonious entrance into my private laboratory requires an apology."

"We shall appreciate your kindness very much, Professor," replied Elon. "Ah, this is the apparatus with which you have performed your celebrated researches on reciprocating motion," he exclaimed, pointing to a motor whose driving rod was attached to a small, box-like carriage which stood on two rails.

"Quite so," returned Langevon, mollified. "You see how it operates."

He closed a switch and the carriage ran back and forth on the rails.

"Most ingenious, Professor. And now may I have a large rubber bag filled with water?"

"Certainly," responded Langevon, with evident surprise. "I noticed one of the boys mending a football bladder in the workshop. Will that do?"

Elon nodded assent, and Langevon returned in a moment with the oval bag filled with water. Elon hung it freely in the center of the carriage, then started the motor and gradually advanced the control. The carriage oscillated to and fro with increasing speed, so that the bag swung against one end of the carriage and then the other. Water squirted from the valve at each bump. As the oscillations became more rapid the force of the bumps increased, and finally the bag burst. Elon's eye lit, but he said only:

"A striking demonstration of inertia, Professor. A thousand thanks for your kindness."

"You saw what would happen to a human heart?" he asked, as we were again in our room.

"You mean the experiment with the rubber bag?"

"Exactly. As soon as the speed of the thriller reached a certain limit the changes of direction at the ends of the swings were so sudden that Denbaule's heart was bumped forcibly against the walls of the thoracic cavity, and finally the valves burst. You recall the spurts of blood?"

I saw it all in a flash, but he was speaking again.

"Now we know that the effect of vibrating too rapidly could easily be predicted. Here is the next step."

He had erected a thin rod of spring steel vertically upon a wooden base. He connected a dry cell to an electro-magnet at the bottom, and the rod swayed back and forth. It was, in fact, a miniature Swaying Thriller. Occasionally he changed the position of a sliding weight which he had clamped to the rod, and took observations with a stop-watch. I observed that the nearer the weight was to the tip, the more slowly the rod vibrated, but while I was trying to draw some connection he rose quickly.

"And now to examine the shaft."

The park lay in complete darkness when we reached it, but nevertheless Elon maneuvered cautiously before scaling a fence near the looming spire. He took a coil of insulated wire from his grip, quickly climbed a pole and connected the wires to the two power lines which fed the park. He brought the loose ends to ground, attached two rods, then in a trice was ascending the narrow ladder attached to the steel column. At intervals he tapt cautiously with a hammer, then I saw a blinding flash as he touched the rods together against the side of the shaft. I knew that he was melting a hole thru the steel with his electric arc and platinum electrodes which had been of such service in the Fulton Bank case. He withdrew the electrodes, inserted calipers, and called:

"8.2 centimeters; take it down."

He made measurements at intervals of six feet, while I tabulated the figures that he gave me. He returned quickly to ground after the last measurement, disconnected the wires, packed his tools and returned to the hotel, where he plunged into calculations which covered sheet after sheet. I watched for a few minutes, interested in the curious symbols, but finally threw myself upon the bed.

It was nine in the morning when I awoke, but the electric lights were still burning brightly and the carpet was covered with a deep layer of penciled papers. Elon bent over the table, a cup of black coffee at his elbow. I heard him murmur:

"13.5, too low, too low—but there's nothing else."

"You snored fearfully," he exclaimed, looking towards me. "Get those dodgers this morning and meet me for dinner at the Palais Crystal, at six-thirty."

He jammed his hat on his head and strode out, leaving me to speculate upon the significance of the figure 13.5. Margulier had the dodgers ready promptly at ten, and as I returned to the hotel I heard newsboys crying the tragedy. One paragraph especially interested me:

"Government engineers testified that such a shaft can vibrate at only one speed, which is determined entirely by its rigidity and distribution of weight; and they set up apparatus which showed that the only effect of the magnet is to maintain the natural rate of the rod. Their testimony proved that the accident was due to crystallization of the steel under the enormous stresses involved. Examination of the shaft this morning revealed a series of small holes apparently made with a welding torch, but these were held to have had no effect. The manager of the park, Mr. Jacobs, as well as the inventor, Prof. J. Langevon, were completely exonerated, and the shaft is being strengthened for an early re-opening."

Elon was taciturn at supper, merely stating that we would have an interesting expedition during the evening, and I wondered whether, after all, there was any connection between Denbaule's death and the venomous propaganda. We smoked leisurely until nine, watching the colorful diners seated under the glass canopy of the sidewalk cafe; then Valonne called with two of his men, and the five of us motored out the road that

skirted the bay. Elon watched the shore closely and halted us in a cluster of trees about four miles from town.

Half an hour later a heavy truck stopt directly opposite our hiding place. Four men alighted and dragged two cylinders to the water-front. The moonlight shone upon them as they attached a long hose to the nozzle of each tank, then we heard the muffled wheezing of pressure suddenly released. The breeze brought a pungent odor to our nostrils, and Elon whispered laconically:

"Chlorine."

Presently he prest the key of a small wireless sender in the automobile, and almost immediately a lighted launch moved closer to shore. The four men stopt work with sharp ejaculations of disappointment, hastily re-loaded the cylinders and turned the truck towards town. We trailed them at a safe distance.

The lumbering truck led us straight to Sunshine Park. Elon cautiously followed them towards the clubhouse, then motioned us to come on. He led us into what seemed to be an employee's entrance and halted beside a sink in a basement lavatory. Stooping he fingered among the pipes leading down from the sink, then in the semi-gloom we saw a small door swing inwards. Elon wriggled thru the narrow opening, and we followed him down the large corridor into which we had emerged. He held up a hand in warning, then darted at full speed around the corner.

Four men jumped as if shot, only to face five leveled revolvers. Elon advanced quickly and handcufft the four two by two.

"I think this is all of them, Valonne," remarked Elon, with a smile of satisfaction, "but your men might guard that entrance."

I looked again at the four men who stood against the wall. One I recognized immediately as Jacobs, manager of the resort. Manacled to him was an immensely tall and emaciated man, clad in a dignified black frock coat. His singularly bearded and massive head towered above the cringing Jew at his side. The other men were garbed as workers, with bare forearms and dirty hands. Their faces revealed merely the stolid indifference of stupidity.

Elon walked quickly to the single type-case that stood between two hand-presses, and fitted every letter from one of the compartments into a printer's type-assembler. He mounted the type in a form, ran off a proof and examined it eagerly under his glass.

"Valonne, the case is now complete," he remarked quietly. "You may arrest Jacobs, Krampdorff and their two helpers as murderers and revolutionary plotters."

"It's a lie!" shouted Jacobs, his face blanched and knees sagging, but Krampdorff said coolly:

"My dear Professor Hopkins, perhaps you will tell us by what right you enter our private workroom and address us as murderers? Surely you realize that you have no evidence to substantiate such charges."

"The French Government may use its own discretion about the revolutionary literature with which these racks are filled," said Elon, grimly, snatching one of the folders from a shelf, "but, as for myself, I shall enjoy seeing you electrocuted for the murder of Marie Denbaule."

He turned quickly to Valonne.

"I owe you some explanation, my dear Valonne. I will trace the evidence briefly. I had no sooner come to Marseilles than I noticed the dodgers which Jacobs had issued to advertise Sunshine Park, and I observed the same peculiarly ragged scratch across the face of one capital E that I had seen in the revolutionary dodgers. You are aware, of course, that under the microscope such minute scratches are as distinctive as the finger-prints of criminals.

"Naturally this aroused my suspicion, Valonne, but you informed me that the printers whose name appeared at the bottom of the amusement dodgers had just been

raided without result. The obvious conclusion was that the printer of the amusement dodgers was using Margulier's name as a blind. In order to test this point I had dodgers, overloaded with E's printed at Margulier's shop."

He exhibited one of the *furrier* dodgers.

"You will note, Valonne, the preponderance of E's. In average copy the percentage of E's is slightly under 9; so I judged that 24 per cent, almost 1 in every 4 letters, would exhaust his small stock of type and thus show whether the scratched E was in his possession. The microscope reveals no evidence of it.

"This was sufficient to center suspicion upon Sunshine Park, but in the meantime the murder had occurred. A simple experiment proved that a skillful scientist could easily predict the physiological effect of vibrating too rapidly. It is well known that the rate of vibration of a rigid shaft depends only upon its rigidity and distribution of weight. I found by a mathematical investigation that 3,798 pounds of material must be removed from the upper part of the shaft in order to increase its rate from 30 to 180 vibrations per minute, which were the values I had noted at the park, and the double fact that the acceleration had occurred gradually and in public indicated that this material must have *flowed* down from the *interior* of the shaft after being released by a timed valve. I found that the upper half of the shaft contained a hollow space of 4.5 cubic feet, and by simple division I ascertained that the material removed must have weighed 844 pounds to the cubic foot. In other words, its density was 13.5. There is no liquid possessing *exactly* this density; but mercury, commonly known as quicksilver, has a density of 13.6, and I concluded that perhaps the hollow space had not been truly conical, as I had assumed in my calculations.

"The simplest method of removing this mercury while thousands were looking was to allow it to run into the sewer, so I expected to find it at the outlet of that particular trunk, fifty feet west of Pointe Cochon. It was quite clear that we were dealing with criminals of the highest intellectual caliber, so I anticipated an effort to remove the mercury from the little depression on the bottom of the bay at the sewer's mouth, where the metallic fluid must remain on account of its density. You know the remaining details, Valonne. Our auxiliary on the launch interrupted the chemical experiment of these worthies, which consisted simply in pumping comprest chlorine gas into the pool of mercury. The mercuric chlorid formed by chemical reaction would dissolve in the surrounding water. Thus your men will find some mercury left as evidence and perhaps some dead fish, also, floating upon the surface of the water; for mercuric chlorid, dissolved in water, is a deadly poison."

"But Gaudet?" stammered Valonne, completely dumbfounded by Elon's rapid fire of revelations.

"You may wire Camproger to beware of Gaudet's underground political activities; but, as regards the complications of the last few weeks, Gaudet does not possess the requisite mental acumen. And Valonne, continued Elon, glancing at Jacobs, "you may find this pamphlet useful in your case against Jacobs. If I had run across it sooner in the library I should have been spared the trouble of solving an excessively difficult differential equation. My compatriot here, I am sorry to admit, filled the chair of Physics in the College of New York until 1916, when he was expelled on account of his radical socialistic activities."

Valonne grasped the pamphlet and I looked over his shoulder. On the title-page appeared the caption: "A Paper Presented Before the New York Academy of Science, entitled: 'The Vibration of a Rigid Shaft as a Function of its Rigidity and Distribution of Weight—A Mathematical Study'."

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Power from the Air

DURING the War there was developed in Germany a new art—or science—that bids fair to revolutionize our present means of obtaining power.

This art, which is as new now as wireless was twenty-five years ago, will attain proportions during the next twenty years that may appear fantastic to-day. The inventor of the new science, an engineer of note, Herr Hermann Plauson, has devoted years of labor to his researches and he has now actually in use small power plants, that generate electricity direct from the air, day and night, without interruption at practically no cost, once the plant is constructed.

We had occasion, in one of our former issues, to describe the system, roughly, from cabled dispatches, but complete information is available now. The amount of electrical power that resides in our atmosphere is astounding. Herr Plauson found in his experiments that a single balloon sent aloft to a height of 300 yards gave a constant current at 400 volts of 1.8 amperes, or in 24 hours over 17¼ kilowatts! By using two balloons in connection with a special condenser battery, the power obtained was 81½ kilowatts in 24 hours! The actual current delivered was 6.8 amperes at 500 volts.

The best balloons used by the inventor are made of thin aluminum leaf. No fabric is used. A simple internal system of ribs, stays and wires, give the balloon rigidity as well as a certain amount of elasticity. The balloon, when made airtight, is filled with hydrogen or better, with helium. It will then stay aloft for weeks at a time. The outer surface is dotted with extremely sharp pins, made sharp electrolytically. Ordinary pins did not prove good current collectors, as they lacked extreme sharpness. The pins themselves were made from amalgamated zinc, containing a radium preparation, in order to ionize the air. It was also found that by dotting the outer surface of the balloon with zinc-amalgam more current could be collected. Even better results were obtained with polonium-amalgam. Plauson states that the function of these amalgams is purely photoelectric.

One hundred of such captive balloons, separated one hundred yards from each other, will give a steady yield of 200 horse power. This is the minimum, because in the winter this figure increases up to 400 horse power, due to the higher electrification of the atmosphere.

We need not go into the technic of how the current is finally made useable for industrial purposes, suffice it to say that the problem has been entirely solved by Herr Plauson. By using batteries of condensers, high tension transformers, etc., the current can be transformed to any form desired, such as for lighting lamps, running motors, charging storage batteries, etc.

Plauson also invented a sort of electrostatic rotary transformer which gives alternating current without the use of condensers and transformers. Indeed, its output is very great, as it actually "sucks" the current down rapidly from the collector balloons. There is no doubt that this invention will soon come into universal use all over the world. We will see the land dotted with the captive balloons, particularly in the country and wherever water power does not abound. Indeed, the time is not distant when nearly all of our power will be derived from the atmosphere. So far it seems to be the cheapest form of power known, it being much cheaper than even water power—the cheapest form of power known to-day.

Not only that, but as the inventor points out, no devastating thunder storms occur near such aerial power plants, because the balloons act not only as lightning arresters, but they quickly discharge the biggest thunder cloud, safely and noiselessly through their grounded spark gaps.

H. GERNSBACK.

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