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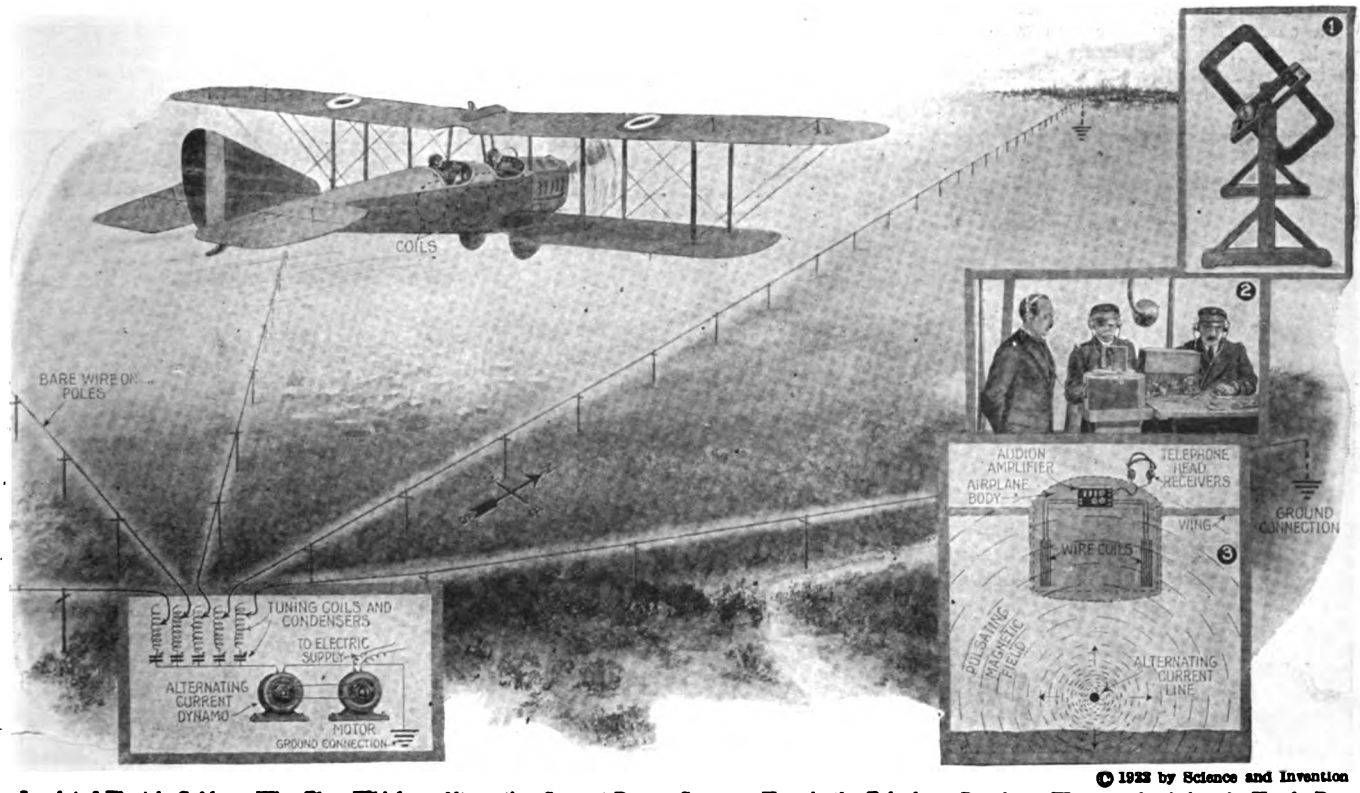
Electrified Wires Guide Night Fliers

SOME months ago the newspapers and technical journals carried articles extolling the virtues of the new alternating current cable, which was laid along the channel leading into New York Harbor, and by means of which a ship could keep directly in the channel in the heaviest fog or at night. As will be remembered, the sub-aqueous insulated cable lying at the bottom of the channel is supplied with an alternating current having a frequency of about 500 cycles. Two coils of wire are placed on either side of the ship above the water line, and a humming noise caused by the alternating electro-magnetic field set up about the conductor for a distance of 100 feet or more is distinctly heard in a pair of telephone receivers connected with the coils on a ship. By means of a switch, the right and left-hand coils may be connected with their respective telephone receivers, and in this way the pilot can, by switching in the one coil and then the other and noting the comparative strength of the sounds heard successively in the phones, tell when he is deviating from the course followed by the submerged cable. If the ship gets off the course, i. e., from a point directly over the A.C. cable, or nearly so, the sound in one phone is louder than in the other; also it becomes weaker in both phones the more the ship departs from the prescribed course.

A European electrical engineer named Loth has evolved a brilliant idea—he has adapted the alternating current cable and its humming electro-magnetic field to serve as a guide for aircraft, when flying at night or in foggy and stormy weather. Such weather conditions and also night flying in general present the greatest problems to the aviator and aerial pilot, and this ingenious electrical scheme for guiding aircraft bids fair to prove at least an able ally to the *radio compass*, which has been used quite extensively, especially in the U. S. Army Air Service.

The accompanying illustration shows how existing telegraph and telephone wires may be used for carrying alternating current and where new lines are to be installed, these may be buried in the ground a few feet, simply laid on the ground, or else placed on simple wooden poles. Telegraph and telephone circuits may be employed for this purpose, even when carrying their usual messages and conversations, if a current of the proper frequency is used, together with an apparatus which will interpret this inaudible frequency, such as the *beat* or heterodyne receiver. If a frequency of over 35,000 cycles per second is employed, there is slight chance of this interfering with telephone conversation or telegraph messages, and undoubtedly some such arrangement as this will be worked out in the very near future.

Mr. Loth has invented an appliance enabling pilots to proceed without danger from one airdrome to another in the darkest nights and thickest fogs. An alternating current of two or three amperes with a given frequency is sent along a telephone or telegraph wire connecting the airdromes. The airplane carries a small apparatus weighing about nine pounds, which is tuned up exactly to this frequency. This apparatus works a musical instrument or soundboard, giving a higher or lower note, according to the distance from the wire. The radius of action is considerable, sound being distinctly perceptible at a height of 3,000 meters or 10,000 feet.



An Insulated Electric Cable or Wire Thru Which an Alternating Current Passes Causes a Hum in the Telephone Receivers Worn on the Aviator's Head, Due to the Pulsating Magnetic Field Set up for a Considerable Distance Around the Wire. A French Electrical Engineer Has Adapted this Principle to the Guiding of Airplanes Flying at Night or in Foggy Weather, as Shown in the Accompanying Illustration. Fig. 1 Shows Side View of Receiving Coils on Airplane. Fig. 2 Shows Receiving Apparatus on Board Airplane with Mr. Loth, the Inventor, at the Left. Fig. 3 Shows How Expanding Lines of Magnetic Field About A. C. Conductor Affect Coils and Interpreting Apparatus on Board the Airplane.

Buying a Second-hand Car

By EDNA PURDY

WHEN one goes to a *used automobile* show there is not always an opportunity for taking out and testing every car in which one might be interested. And in dealing with a private owner he could tell all sorts of fancy tales of how few miles the car had been driven, alter his speedometer, etc. And in truth, when the car is tested out, the motor hums along smoothly, because the motor and the larger parts of the car can be altered and doctored up so that they seem very new and good.

But the engineer tells us that there are a few infallible tests of little things which are seldom susceptible of being adjusted or renewed in the used car. These little things can be detected without running the car, and in a few moments' time.

For instance, Fig. 1 shows a prospective buyer testing the rear wheels of a car. It is these rear wheel bearings which cannot be taken up and adjusted as can the front wheels to cover up age or mileage of a car. If it is loose and wobbly in the bearings, and the wheels is on as tight as it can be put, the car is not in a safe buying stage for the man who wants a used car. He is more likely to buy a "used up" car if these wheels are loose.

Figure 2 shows a wise young engineer testing a very vital tho seldom thought-of part, for wear, without taking the car out for a test. If the universal joint, which he is trying to wobble about, shows too much play, it is an almost positive indication that the car has seen its best days for general wear, tho the motor itself may have been renewed with new pistons, rings, etc.

At Fig. 3 we see a *steering wheel* test that should be applied to every used car. First lift up the hood and see if the steering knuckle adjustment has been turned as far as possible. If this has been done then take hold of the steering wheel and move it around back and forth to see if there is more than a slight play. More than this slight play is not only dangerous, but is a strong indication that the car has been used too long for the ambitious second-hand car purchaser to consider it seriously.

The accelerator pedal, as shown in Fig. 4, is an indication almost as exact as the thermometer in fevers, in telling the approximate use of a car—its age and mileage. In some cars, which have seen their best days, not to mention nights, the accelerator pedal is worn off as much as an eighth of an inch where the foot has constantly rubbed against the metal.

It is not a bad trick for the careful second hand car buyer to examine the bolts on the motor head to see if it has been necessary to remove that head many times for repairs. While these repairs may have consisted merely of scraping out carbon at different intervals, there is also the danger of cracked cylinders, and scored cylinders, which may have been the cause, and these causes will bear very close scrutiny before a check is written for the final purchase.

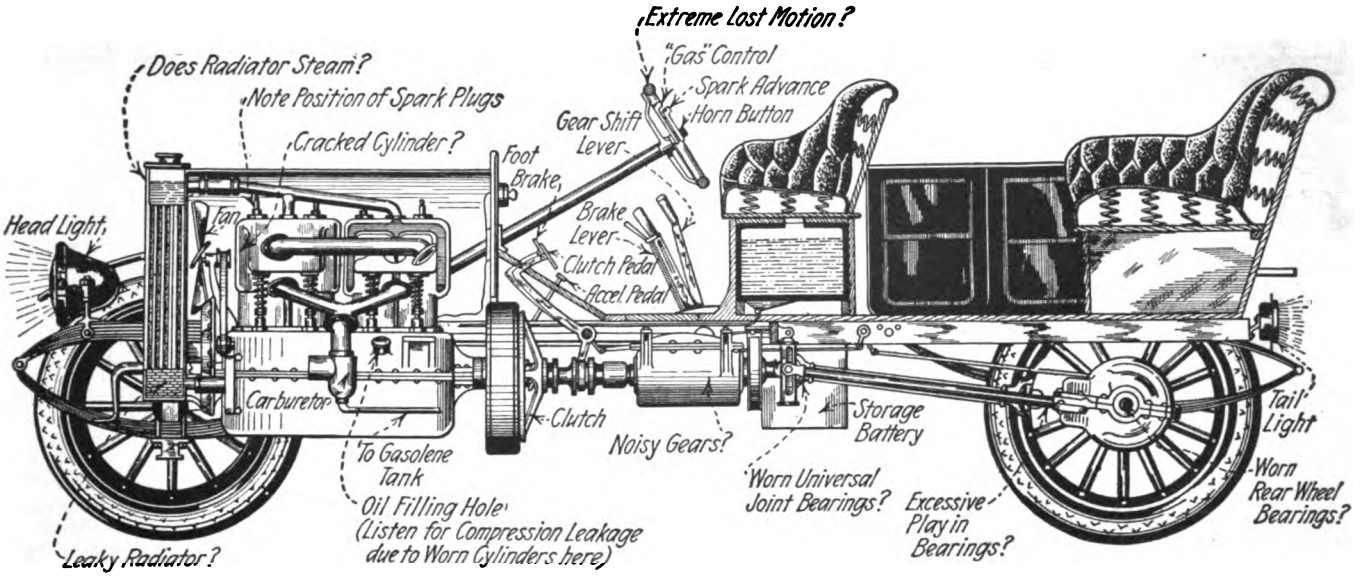
If a car has a *missing* cylinder, be sure to find out why; it may be due to score marks passing oil and fouling the spark plug, faulty valves or a worn-out carburetor. To test the compression remove the oil cap and listen close up to it, as someone turns the crank slowly; a distinct hissing noise indicating bad compression, due to broken piston rings, scored cylinder, or elliptical cylinder, which means a rebore job.

Five Photos Above Show Prospective Purchaser of a Used Car Looking for Excessive Wear. Top Photo—Examining Rear Wheel Bearings; Lower Photos From Left to Right, Examining Universal Joint for Excessive Wear; Noting if the Steering Wheel Has Too Much Free Motion; Examining the Accelerator and Other Pedals for Severe Wear and at Extreme Right, Inspecting Engine Nuts to See if They Bear Marks of Having been Removed and Replaced Many Times.

Important Points to Watch Closely in Buying a Second-hand Car.

The accompanying diagram will serve to show some of the more important points which should be carefully watched by the prospective buyer when inspecting a second-hand car. Of course, it is always best to purchase a used car from one of the regular motor car companies, many of whom conduct such departments, and who guarantee their used cars as being thoroly overhauled and rebuilt. Where a car is purchased second hand from a private family, the chances are it has had very good treatment. Otherwise it is always preferable to take along an automobile expert with you, and pay him $5 or $10 for his services, than it is to depend upon your own judgment, unless you happen to be quite an expert on automobiles.

Performance is, says H. W. Secor, the principal desideratum in the purchase of any motor car and, therefore, do not be satisfied with a drive around the block as a demonstration run for the car you are about to spend your hard-earned money for. Insist upon the driver climbing a hill, even tho it is a small one, and note carefully how the car climbs up the grade. Unless it is a very steep hill, the car, if in pretty fair condition and selling for not less than one-half its original price, should climb up all right in *high gear*. A very important point to watch and which is entirely ignored by seven out of ten motor car buyers, is to watch carefully if the engine *misses* in its explosions while climbing the hill. There are only about a dozen things which can cause this and several of them are of such vital importance that the prospective buyer should insist upon this defect being found and cleared up before he delivers the check and closes the sale, even tho he may have to wait a few days, until the dealer's expert goes over the car and cures the trouble. The writer lost over $300 and six months of exasperation and dissatisfaction on a motor car purchase, by not insisting upon this missing of one cylinder on a six-cylinder



It is, of Course, Impossible to Show by Diagram or Even to Tell of the Various Points that Might be Very Well Checked Up On While Inspecting and Riding in a Used Car With the Idea of a Possible Purchase. Unless One is Thinking of Buying a Very Cheap Used Car There Should Not be Very Much Noise in the Gear Box or at Other Points, for Usually This Will Become Very Aggravated if Already Noisy. One of the Best Tests to Put a Car to, is to Have the Demonstrator Drive the Car Up a Hill, the Steeper the Better. Note Whether the Water Cooling System Overheats as Indicated by the Radiator Steaming. If the Cylinders are Badly Worn or Perhaps Score Marked, the Fact Can Usually be Ascertained by Removing the Oil Cap and Listening at This Point While Somebody Turns the Engine Very Slowly With a Crank. A Swishing Sound Will be Heard if There is Considerable Wear or Marks on the Cylinder Walls, and the Greater This Trouble the More Pronounced the Sound from the Escaping Comprest Gas as the Pistons Rise and Fall. Be Sure that Both the Foot and Emergency Brakes are in Good Working Order or, if You Purchase the Car, and if Brakes do Not Hold Properly, Have Them Relined at Your Local Garage at Once, for You May Lose Your Life in Descending a Hill if the Brakes won't Hold and Further, You May Attempt to Stop Close to a Pedestrian or Other Vehicle, and Slide Into Them, Causing a More or Less Serious Accident.

car being cleared up by the dealer's expert. Everything was tried to solve this problem, but, as aforementioned, it was not fully overcome until after six months' experimentation was completed, trying this thing and that, with several replacements of many worn parts, even including the purchase of a new carburetor, which was claimed to be the cause of the intermittent misfiring by one automobile expert. The trouble was finally overcome in this case by installing all new piston rings with one oil groove ring on the bottom of the piston in the worst cylinder. Also special ionizing spark plugs, such as described in the December issue of this journal, were used.

Several reasons why some automobile engines miss on climbing a hill are as follows: Where the design of the engine is such that oil easily passes by the pistons, the oil running to the rear of the crank case causes an excessive rise in the level of the oil at the back of the engine, and the cylinders nearest the dash are flooded with oil. In one case this action causes the spark plugs in the third and fourth cylinders of a brand new four-cylinder car, of well-known make, to be fouled up with oil and thus to misfire. Another cause of misfiring is a cracked cylinder, and if the dealer denies that this is the cause it would be well to have him guarantee that the engine has not a cracked cylinder and incorporate this statement in the bill of sale. If a new spark plug or two are inserted by the demonstrator and the engine should misfire again after a short run of say a mile, or even less, and removal and inspection of these plugs show them to be covered with oil, it is a sign that there is either too much oil in the crank case or that the cylinders are worn so that new piston rings will have to be inserted. Possibly the cylinder block should be rebored and new oversize pistons and rings installed; or the oil pump may be exerting too much pressure on the lubrication system. This factor may be checked by noting the pounds pressure indicated on the oil gage found on the dash of many cars (about ten pounds being normal at average speed). Finally, the oil-fouled spark plugs might be due to score marks in the cylinder walls, caused by a piston ring having broken and scratched the polished walls at some time or other, the oil passing up these score marks.

Many second-hand auto dealers have ways of fixing up engines, which are in bad shape internally, and there is a metal cement resembling a hard solder which is sold for the purpose of filling in score marks and even cracks thru cylinder walls. Cases have come to his notice, says Mr. Secor, where such patched-up engines have been sold and, of course, after a short time the cement or alloy filling comes out, as it succumbs to the heat produced in the engine, etc., and, of course, the owner is strictly up against it. The only good remedy is to purchase a new cylinder block, or else rebore the cracked cylinder and insert a steel sleeve, which ought to be shrunk in and pinned.

The only good remedy for a scored cylinder wall is to rebore it and place an oversize piston and proper fitting oversize rings in it. Usually a very small amount has to be bored out. It is not always necessary to rebore all four or six cylinders in a car, it being possible to simply rebore but one or two cylinders, if these happen to be badly damaged, and providing the other cylinders are not severely worn to an elliptical shape. This, of course, will always cause more or less trouble, as the oil passes by the piston rings, for the simple reason that the piston ring has not yet been found possible, and never will be, which will fit tightly to conform to the walls of an egg-shaped cylinder.

Oil throwing in many cases can be overcome by using heavier oil than is ordinarily prescribed for any particular car. In one case the writer, during the summer months, used extra heavy oil in place of the stipulated medium grade, and followed this up by using medium oil in the winter when light oil was prescribed. It should be kept constantly in mind that the power plant or engine is the most important element in the car which you are about to buy. If the engine or anything connected with the engine, such as the spark (ignition) system, storage battery, self-starter or charging dynamo, are out of condition or severely defective they will cause you trouble until replaced by a new element or else very thoroly overhauled.

A very good trick followed by one expert in order to test the leakage of compression in the engine cylinders is to remove the oil filling cap on the side of the engine, place the ear close to this hole (or else use a piece of rubber tube or a piece of pipe between the ear and the oil hole) and listen minutely as someone turns the engine crank slowly. Loss of compression due to elliptic worn cylinders will be evidenced by a swishing or hissing sound as the comprest gas leaks by the piston. A new car in many cases will hold this comprest charge for some time, but a used car with badly worn cylinders will pass a considerable percentage of the comprest mixture by the piston.

If there is excessive noise under the car while in motion, this may be due to worn gears in the transmission speed change box, or there may be too much wear and lost motion in the bearings of the universal joints connected with the propeller or drive shaft, or frequently the joints connected with the propeller or drive shaft may be worn. Sometimes noise under the car may be due to excessively loose rear wheel bearings or shaft bearings. Sometimes a loose engine may cause a severe pounding noise, especially noticeable when working under a heavy load, as in hill climbing.

The cooling water system and radiator should not heat up in driving a few miles, unless something is wrong, such as a pump with its key cut off, or a leaky radiator which may cause a severe loss of water. Again the water may not be circulating properly, particularly in cars having no circulating pump, such as Fords; due to the fact that the previous owner has loaded the water cooling system with flaxseed or some other substance to fill cracks or holes in the circulating system, and this may be clogging up one of the circulating pipes or the radiator. Providing the car shows up in good shape all around and inspection reveals a few worn bearings, this need not deter the prospective purchaser from seriously considering the purchase of the car, as if the engine is in good running order, the worn bearings can be fixt up by a machinist or garage man at nominal expense. A trick followed by many second-hand car dealers is to load up the engine with extra heavy oil, so that it will not foul the plugs, especially on a short run of one-half mile or so; all of

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10,000 Years Hence

By H. GERNSBACK

Member American Physical Society

IF we go back but 100 years, and contemplate how the world looked as, for instance, in the days of Napoleon, we are apt to be amazed at the way in which the world has progressed in a technical sense since then. We believe we need not call attention to the fact that steam, electricity, and up-to-date technic have completely altered not only the face of the globe, but our very lives as well. If such a tremendous change has been possible in a short century, how then will the world appear in a thousand years, or ten thousand years, hence? The imagination fairly staggers at the attempt to picture what our civilization, if it still exists, will look like in the future ages.

The up-to-date scientist has little difficulty in predicting certain things that will happen in ten or fifty years, but ten centuries hence is a large order, even for the most intrepid imagination. That practically nothing of our present civilization will be left after ten thousand years may be safely predicted. We may also prophesy that the human beings, ten centuries hence, will live in entirely altered circumstances from those they now exist in. Captain Lawson, of aerial fame, for instance, not so long ago made the prediction that 10,000 years hence the human race will not live on the surface of the globe at all, but will live far above it. His reasoning is as follows:

He states that at the present time we are living at the bottom of a vast sea—the sea of air—our present atmosphere. We all know that on the surface of the globe this air presses upon every square inch at the rate of 14.7 pounds with a slightly varying pressure. The weight that the human body, for instance, has to sustain is approximately 30,000 pounds, a tremendous figure. We do not come to harm, of course, for the simple reason that the pressure is even in all directions, but our lungs have been accustomed to this pressure and if we suddenly should take this pressure away, our lungs would burst. Even aviators rising only two miles above the surface of the earth have great difficulty in breathing. It is the same with the other great sea, the ocean, which is also but a fluid, just like the atmospheric sea, with the difference that the water is of greater density, otherwise there is little difference, even chemically, between the two seas.

The fish living at great depth (the so-called deep-sea fish) sustain gigantic pressures upon their bodies, and if suddenly brought to the surface, burst like balloons. This is the exact counterpart of the human who wishes to rise to the top of the atmosphere.

Captain Lawson, following his analogy, predicts that centuries hence we will be living at the top of the atmospheric sea instead of at the bottom. In other words, the future human being will not be a deep-sea atmospheric animal, but will reside at the top of the atmosphere, comparatively speaking.

Captain Lawson does not state the advantage of this living miles up, away from the surface of the globe, but we may cite several apparent ones. Most of the human diseases probably are due to bacteria and small micro-organisms floating in our dense air. It may be doubted that such micro-organisms will be found two or three miles above the surface of the earth. Nearly all our diseases, such as tuberculosis, and all other infectious diseases, arise from micro-organisms, which are carried in the dense air, so by making our future abode two miles above the surface of the earth we would at once remove one of the greatest causes of death that humanity has to contend with.

Another change for the better in the upper atmospheric plane is the obvious one, that we will have continuous sunlight. No rain, no clouds, no thunder storms, no snow are to be contended with, once we rise above the highest clouds; and the latter never rise higher than two miles above the earth. More sunlight, as we all know, is most beneficial to human beings, and having 100 per cent of it all of the time we naturally will be far better off.

It would also seem that the race would be greatly benefited by the rarefied atmosphere as we would be able to move around better, and would not be oppressed by the atmosphere as we are now, particularly on hot days, when the air seems to feel like a thousand tons on our bodies.

These are only a few of the obvious advantages, but there are many more. Thus, for instance, at high altitudes there is no dust to be considered, and dust, as we all know, is highly detrimental to us. We, therefore, may surmise that the human race centuries hence instead of living upon the surface of the globe will live far above it in cities as we have them today, if cities they will then be called.

Our illustration depicts one of the future cities of about the size of New York floating high up in the air, several miles above the earth. The question of sustaining such a large body in a rarefied atmosphere will prove to be of little difficulty to our future electrical engineers. Just as we construct leviathans of the sea today, some of them weighing as much as 50,000 tons, we will construct entire cities weighing billions of tons, which cities will be held in space not by gas balloons, propellers, or the like antiquated machinery, but by means of gravity-annulling devices. Already experiments have been made whereby it has become possible to reduce the weight of substances by electrical forces.

Thus Professor Majorana, in an article printed in this journal three years ago, made it possible to produce negative gravity by reducing the gravitational pull on a lead sphere. Of course, this is but a crude beginning. Centuries hence, when we wish to raise the city of the future high up in the air, we will rely upon an electro-magnetic stream of force which by reaction upon the ether and the earth, lifts the entire city high above the clouds.

Our illustration is but a feeble attempt to show how it may be worked out. Four gigantic generators distributed among equidistant points thru the city shoot earthward electric rays of a nature which as yet we can only imperfectly imagine. These rays, which are not light rays by any means, but are tremendous lines of force, impinge upon the surrounding ether with such stress and speed that the entire city is lifted up to the height desired. These rays may be likened to water streams, which by reaction would hold up the city illustrated. In other words, if we imagine the four rays as shown to be substituted by tremendous jets of water pouring earthward, and provided these jets were continuous, we can easily understand that they would support the entire city by counter-action of the force of inertia of water pressing against the lower part of the city.

By increasing or decreasing the electrical energy of this future floating city it can be lowered or raised as we desire. By directing the rays sideways we will go in the opposite direction. Thus the "tain" of the future city will have a m[illegible] to steer the city with all its millions of inhabitants to any part of the globe.

Where does this tremendous conglomerate take its energy from? The sun, of course. The city of the future is not dependent at all upon the earth for its power. Solar energy, which is merely another form of electrical energy, will be converted into electricity and stored away covering all the needs of the vast machinery, and that of the populace as well. Also, we should not forget that atmospheric electricity is a power that we only dimly understand today. This power in the future will be turned to the use of mankind, and we will then tap a practically unlimited amount of electrical energy.

As our illustration shows, the city of the future will be entirely roofed over with a substance that is neither glass nor metal. It will be transparent, but as strong as metal and unbreakable. Over this dome-like structure, gigantic towers are placed, which suck in the static electrical energy as well as the solar energy. Within the covered city the atmospheric

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The City of the Future, 10,000 Years Hence, Will Not Be Located Upon the Surface of the Earth. It Will Be Floating Up Miles High, and Such Things as Snow, Rain, and Storms Will Be Unknown to the City Dwellers of the Future. It Will Have Perpetual Sunlight, and Weather Will Never Bother Our Future Citizens. Just as Our Leviathans of the Sea are Built to Remain on the Top of the Water at All Times, So the Floating City of the Future Will Remain Afloat Continuously, Supported Only By Shafts of Electro-Magnetic Rays, Which, Nullifying Gravity Keep the City Raised Up By Reaction. The City Dweller of the Future Will Not Be Bothered Much With Such Diseases as Tuberculosis, Because All of These are Now Transmitted Due to the High Density of the Air Near the Surface of the Earth. Three or Four Miles Further Up Bacteria are Not So Common as Near the Surface of the Earth.

View of Downtown Section of New York City, with the Woolworth Building and City Hall in the Foreground, as It Would Appear if a 250-Mile Gale Suddenly Swooped Down Upon the Great Business and Financial Section of the Metropolis. Those Structures Having High Towers, Such as the Woolworth and Singer Buildings, Would Suffer the Most from Such a Storm; the Towers Would be Blown Over and Smash Other Buildings in Their Path. All of the Streets Would be Showered with Stone and Concrete Blocks, and It Is Doubtful if a Single Soul Would Escape. New York's Skyscrapers Are Designed to Stand a 100-Mile Gale, but Such a Storm as That Described by Mr. Corrigan Would Present a Condition Such as Here Pictured.

If a 250-Mile Gale Struck New York

By C. S. CORRIGAN, C. E.

IT is said that an ordinary wind on the moon blows 250 miles per hour. Suppose such a gale struck New York City; what would it do to the Woolworth building towering 785 feet in the air? Oh! you say, we never had a storm that blew a hundred miles an hour, so it would be impossible to have a 250-mile gale; but airmen know that such gales, called aerial trade-winds, come within six miles of New York City every day, if we measure straight up, and that twelve miles up the wind blows 500 miles an hour all the time, at least Rickenbacker and other flying aces say so, and are even figuring on using these trade-winds to circle the earth by airplane in fifty hours or less.

Now suppose, that just to retaliate, one of these two-hundred-and-fifty-mile-an-hour aerial trade-winds should take a notion to drop down six miles to New York without slackening speed, it would only take a minute and a half to get here, then what? You assume a wise expression and say, "Oh, nothing, that air is only one-third as heavy as surface air, so it wouldn't push any harder than an ordinary 83-mile gale, say thirty pounds per square foot, and as the Woolworth building was built to stand a 100-mile gale, fifty pounds per square foot, it wouldn't be damaged at all."

But, hold on a minute, you just said that aerial air was only one-third as heavy as surface air, so, of course, it only presses five pounds per square inch in every direction, or one-third of the fifteen pounds per square inch that surface air presses in every direction. Then remember, it came so quick that the particles of surface air inside the building had no chance to get in line and march out, so, like people in a theater that catches fire, they all crowd and push fifteen pounds per square inch outward, while the aerial air only presses inward at five pounds per square inch; this makes a difference of ten pounds per square inch or 1,440 pounds per square foot outward pressure in all directions, including straight up. Figured for a wall 10x16 feet this would be equal to 160 Samsons pressing outward with all their might, 1,440 pounds apiece, 230,400 pounds in all. There are a thousand such walls in the Woolworth building so the temple cannot help but fall.

Suppose we deduct the thirty pounds per square foot on the side the wind is blowing against, we still have an outward pressure of 1,410 pounds per square foot, which is thirty times as much as the walls were built to stand, so the brick and terra cotta and doors and windows would all fly out into the face of the storm almost as hard as in any other direction, the tower and roof would fly up and the air cushion provided at the bottom of all elevator shafts, instead of gently stopping the elevators that were going down, would expand so suddenly that it would shoot the elevators full of people right out of the top of the shafts. Even the steel safes would blow open as if all the money had turned into T. N. T. Not only the Woolworth building but the whole city would be instantly and completely destroyed; still you think you told the truth at first, it wasn't the wind that did the damage, but the little two-thirds vacuum which the wind dropt in its flight.

Now coming back to that 250-mile wind on the moon, where there is only 1/500th as much air pressure as in the storm I have just described, I'll say the wind wouldn't hurt you any more than a storm of light waves that shoot from behind a cloud and hit you at the rate of 186,000 miles per second. But I can't begin to guess what that perfect little imp of an almost perfect vacuum will do when dropt in the vicinity of the Woolworth building. I think I'll pass that up to the pretty little spark dropt by the pretty little cigarette in a powder house.

The worst storm ever recorded at the weather bureau in New York blew at the rate of 96 miles per hour, and the lowest reading of the barometer was 28.68, less than one pound below the normal 15 pound pressure; the worst part of the

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An Excursion Into the Past

By ERNEST K. CHAPIN

IT was autumn—trees and bushes all lit up in glory, open sky above and a ten mile stretch of hard gravel road ahead. From the twin-six cylinders of my new Speedex came a high-power hum that I knew meant "go as long as the gas holds out." The snap in the air, plus a little hootch under my belt, wuz making me feel pretty frisky, so I decides to shuve the gas to her and let her show a limit. I aint saying I was right. I knew it was risky. But the road was level for miles and not a thing on wheels in sight. In a jiffy I had her headed for the next county like all possest.

Suddenly the car shot thru a narrow neck of woods, and on entering the clearing one of these here criss-cross warnings that everybudy sees, but no one notices, snapt by me like a flash. I couldn't stop. There wasn't time to look or listen. A roar in my ears, an awful rap on the bean and it was all over.

The next thing I knew I was on the ground, the car all smashed to flinders and no train in sight. Well, I picked myself up and begun to look myself all over for missing parts but, would you believe it, my hand instead of touching my body seemed to pass right thru it just like thru air. Then I noticed trees and things seemed sort of shadowy and that I could see plumb thru them to other things behind. I started to scratch my head like I do when I'm stumped but I'll be switched if there was anything there to feel. "Mighty queer," you'll say, and so will I, for tho I had lost my head many times before it was never so far lost as that. Then it came to me like a flash that I must be dead, the trees and all around me ghost-stuff, and that, what I thought was myself, was my own ghost.

Well I didn't have much time to think about that and decide if I liked being a ghost or not, for the next moment a big shiny white space flyer swooped down out of the clear sky and lit on the ground beside me. An aerial chauffeur garbed in snow-white was in the driver's seat and motioning for me to get in. So in I got, supposing he had come to take me to the next world, and wondering just which way he would go with me.

Without a word he started the car and up into the sky we shot, the earth dropping like a ball below us. It got smaller and smaller most remarkably fast, and soon appeared no larger than the moon. A little later it was as small as a star, and soon I lost track of it altogether. Off to our right ol' Sol was blazing away most as bright as ever in an inky-black sky and yet I could see all the stars shining like little holes in a barn roof where the light comes thru.

"You ended your earthly existence rather abruptly," says the stranger, who I fancied much resembled a Martian.

"Yes," says I, "I knew I would if I kept that last bus of mine very long. She shore took to the road too well."

"You and your friends on earth are getting too anxious to move around quickly," says he. "The speed craze is killing people faster than I can conduct them to heaven and it is getting worse every year."

"But I seldom travel over 60 miles an hour," I points out, "and when I struck the limited I wasn't going over 85. Now that isn't so bad is it?"

"Most certainly, you should know that yourself."

"How fast be we moving now?" I asks.

"About one," says he, looking at the speedometer.

"About one? Surely you don't mean we are going only one mile an hour?" says I.

"No, no," he laughs. "I mean we are traveling at about the speed of light. If we went twice as fast the meter would read '2' or if three times as fast it would read '3.' You see in heaven all speeds are based on the speed of light."

"And how fast might that be?"

"Oh, about 186,000 of your earthly miles a second," says he casually.

I let that soak in a minute for it was too much for me to swallow all at once. "Then we are knocking off over half a billion miles an hour, according to your figures."

"That's about it."

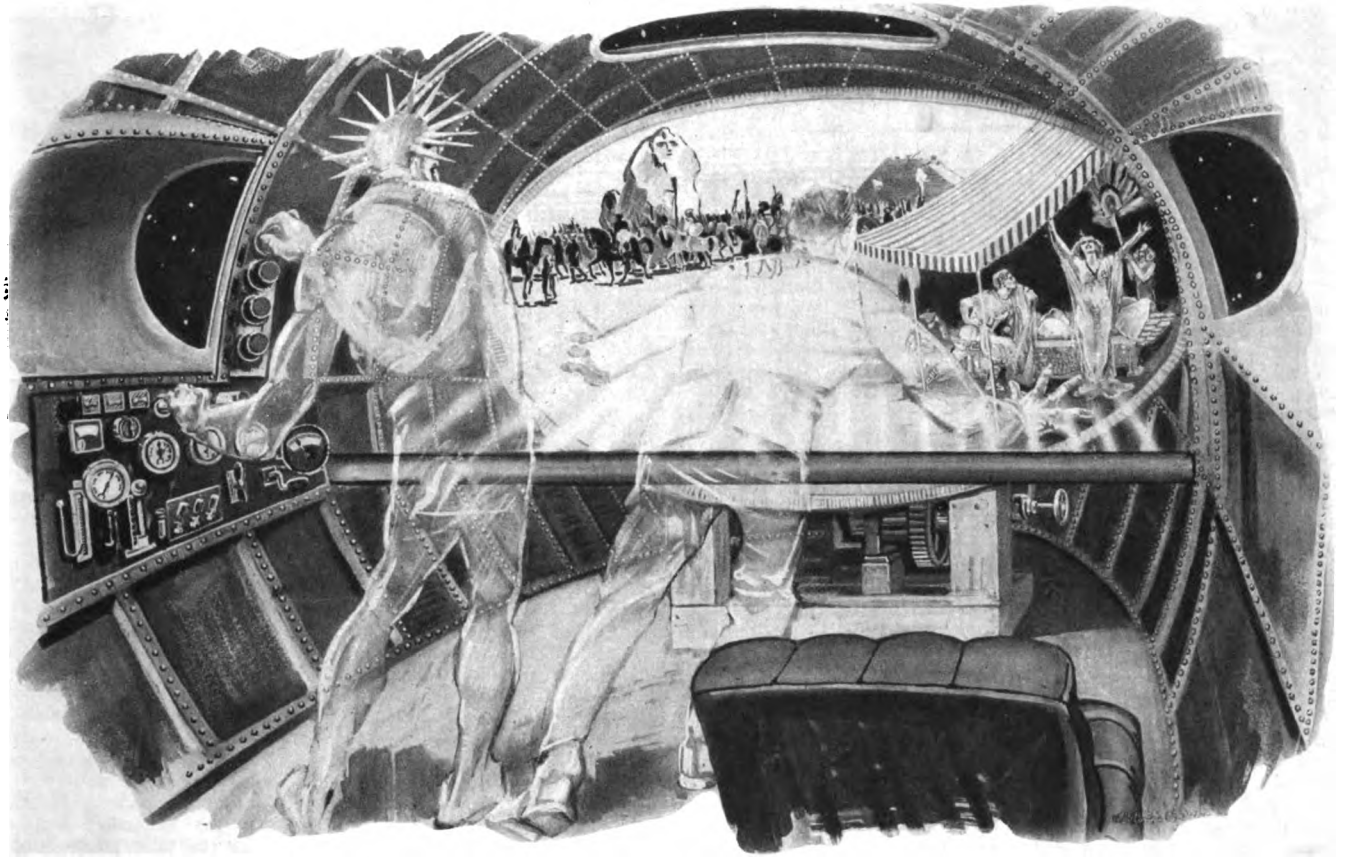
(*Continued on page* 983)

OUR readers will no doubt be interested in this scientific yarn. It will open up many new avenues of mental gymnastics. There is, of course, nothing new to the theme, except that the author has brought it up to date. The noted French astronomer, Flammarion, years ago already imagined a fantastic being whom he called "Lumen."

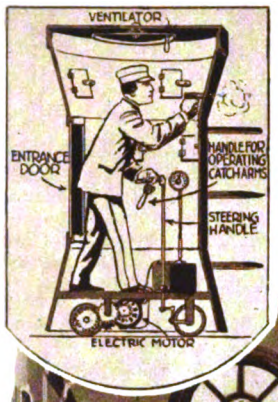
"Lumen" traveled thru space at a greater speed than light, traveling for instance from the Moon to the Earth. Turning back, he was thus enabled to see himself jump backwards, for the reason that he traveled faster than light.

Of course, all such themes are fantastic, and as Professor Einstein pointed out in his talks with Moszkowski, such mental experiments are pure "humbug." The main reason is that according to the theory of relativity, nothing can travel faster than light. Thus, for instance, the mass of a body becomes infinitely great when it approaches the speed of light. Therefore, a body having a speed greater than light becomes an absurdity.

—Editor.



"I Can Not Tell All the Things I Saw, and I Didn't Have Time to Stop for Everything, But I Managed to Get the Angel to Slow Down, or Stop for the Real Big Things. Napoleon and the Battle of Waterloo, Washington Crossing the Delaware, the Pilgrims Coming Over in the Mayflower, and the Queen of Sheba in All Her Womanly Glory, Are Only a Few of the Things I Saw With My Own Eyes As We Flew Along with the Speed of Light . . . . the Angel Explained 'That the Light That Was Reflected from the Earth When the Pyramids were Built Has Not Yet Past Many of the Stars. . . . We Shall Soon overtake it,' and on We Went. . . ."



Nowadays When Bank Robberies and Hold-ups Are More Frequent Than They Were in the Palmy Days of Jesse James, Even in Our Most Civilized and Best Policed Eastern Cities, This New Mobile One-Man Tank with Steel Thief-Catching Arms Operated from the Inside by the Armed Guard, Will Prove a Welcome Addition to the Equipment of Any Banking Institution. It Is Proposed by the Inventor to Place These One-Man Tanks in Niches in the Wall So That a Guard Can Enter Thru a Suitable Door and Lock Himself in. As the Inset Diagram Shows, a Small Electric Motor and Storage Battery Enables the Guard to Propel the Steel Tank Across the Floor at a Good Rate of Speed, and Where a Large Bank Has Several of them "Battle Practise" Will Develop a Scheme Whereby One or Two of the Tanks Will Make a Dash for the Door, So as to Cut Off the Retreat of the Bandits While Pistol Fire from the Guards Within the Tanks Will Cause the Bandits to Either Surrender or be Killed; or Again, One of the Tanks May Ensnare Them with Its Steel Tentacles and Hold Them Until the Police Arrive. When the Tanks Start Into Action, an Automatic Switch Is Operated Which Sends in an Alarm to Police Headquarters Besides Sounding an Alarm on the Street Outside the Bank.

One-Man "Tank" Protects Bank

STANLEY VELINSKI, a nimble-brained inventor, of Homestead, Pa., has given much thought to the best manner of combating the serious menace of bank hold-ups, and he has recently patented the one-man mobile thief-catching *tank*, here illustrated in action. Of course there are several different ways in which this tank may be built and different features may be embodied, but Mr. Velinski has devised a very clever and thoroly protective moving fort, we confidently believe. Frankly speaking, and altho we do not consider ourselves less red-blooded than other humans, we have never entertained any great love for a bank cashier's job, unless we could be extra well provided for against being shot and killed by bandits. A great many banks in different parts of the country have adopted different forms of steel protective shields and doors, which could be quickly dropped in front of the bank attachés, so that they would have at least a fair chance for their lives.

The Velinski thief-catching tank is designed to be built of bullet proof steel, and it is moreover quite mobile, being provided with an electric motor geared to the rear wheels, as shown in the detailed drawing. The guard may sit in it during banking hours, or enter it only when necessary. There are openings all over the shell of the tank, thru which the watchman or guard can fire at the bandits, these openings being normally closed by means of doors provided with spring-hinges and latches, which automatically lock the doors shut. A ventilator is provided in the top of the tank which may be closed when desirable. The tank is entered thru a self-locking door; a key-locked door is provided in case the guard should be wounded, so that a bank officer could open the tank. The tank is steered by a lever system attached to the front wheel.

This fearless fighting machine is built sufficiently heavy so that it cannot be pushed over and every bank ought to have at least two of them; one to chase the bandits and fight them, while the second pours forth a deadly stream of lead and steel from a pair of automatic pistols, as it rushes toward the street door, and effectually blocks the way for the retreat of the bandits. By means of the movable steel arms, which can be closed from the inside of the tank, the bandit or bandits can be caught and held until the police arrive. One or two men can be held in these arms, if they should charge the tank to get thru the door at the same time. Large banks having several of these tanks could, of course, chase half a dozen bandits, meanwhile keeping up a steady fusillade of pistol shots or sawed-off shot gun fire, until all the bandits were held powerless in the grip of the steel arms or were put hors de combat.

Power may be supplied to the electric driving motor of the tank in either of two ways; first, by the electric current supplied from a flexible cable which will permit the tank to move about the floor, or else the motor may be operated from a storage battery of the type used in automobiles for lighting and starting purposes. The storage battery method is preferable, of course, as the bandits might cut the cable, but, in any event, they would have to put up some battle to beat the tank fighter, and the chances are that they would be cut to pieces by the automatic pistol fire or shot gun discharges, before they could get out of the building. The new automatic steel doors or shutters, which can be dropt in front of the cashier in a fraction of a second, by simply pressing a foot pedal or bar running the length of the cashier's and teller's desks, should be installed in all banks, and the writer cannot see why more sheet steel, at least ¼" thick and bullet-proof, is not employed in building the lower part of bank partitions, instead of wood and thin marble or plaster board, which is liable to be punctured when hit by bullets from heavy calibre pistols or rifles fired by determined bandits. Mr. Velinski's tank will, of course, be fitted with suitable seats and electric light, which can be operated by the storage battery, or other source of current used. A separable plug connects the signal alarm wires to police headquarters; as soon as the tank starts into action, the guard pushes the button; as the tank moves the plug separates, but the alarm signal has reached the police. Yes, we have real fighting faith in this mobile bank protection tank.

If President Harding Spoke to 120,000,000 People

ONE hundred and twenty million people, representing the population of the United States, would be a large audience to speak before, wouldn't it? Imagine what power a man's voice would have to possess so as to enable every auditor in such an assemblage to hear his every word. Science now bids fair to enable the President of our country to talk to audiences of 50,000,000 people or even 100,000,000 perhaps before another new president is elected to office. So saith Mr. R. W. King, one of the American Telephone and Telegraph Company engineers, whose work on the loud-speaking device made possible the ushering in of a new epoch in space annihilation at the ceremonies over the bier of America's Unknown Soldier. It is well within the range of possibility that President Harding may see the day in his present term when he can sit at ease in the White House and talk at once to every city, town and hamlet in the United States that is tapt by telephone wires. An audience of 50,000,000 perhaps, or even 100,000,000.

The accompanying illustration shows in a striking manner the size of man President Harding would have to be if he were physically, and unaided by electrical science, to address an audience of 120,000,000 people, who, by the way, would fill a grandstand having a ground area of 6½ square miles. It has been computed that President Harding would have to stand 173 feet high, without his high hat, if he were to be proportioned as is the average man, and he would be able to rest his arm easily on the roof of the Capitol building, the dome of which rises 287 feet above the ground. This calculation was carefully computed and based on the fact that the average orator can speak clearly to about 5,000 people. But instead of having to even strain his voice, the orator of today can talk to vast audiences made up of thousands of people, thanks to the telephonic amplifiers which are based on the audion devised in the brain of Dr. Lee de Forest, less than 20 years ago. Amateur radio stations amplify the incoming radio signals with an audion bulb or tube, and they are not very cheap either, but the great resources of the American Telephone and Telegraph Company enables their engineers to utilize vast banks of audion or vacuum tube amplifiers, so as to intensify the spoken word to undreamt-of amplifications.

President Harding set a record for long-distance oratory on Armistice Day by addressing simultaneously three great throngs of more than 100,000 persons, gathered at Arlington National Cemetery, Washington; in San Francisco, and in New York. The electrical current that carried President Harding's funeral oration to the crowds at Arlington, San Francisco and New York was multiplied 3,000,000,000,000,000,000,000,000,000 times before it rolled out, converted into great sonorous sound waves, over the heads of the three widely separated audiences.

It took 3,000,000,000,000,000 amplifications to convey the oration and the other ceremonies to San Francisco, so that they could have been heard thru an ordinary telephone receiver. Then they had to be amplified a million million times by the loud-speaking device. A mere ten million billions—10,000,000,000,000,000—of amplifications were necessary to bring the ceremonies out clear and strong in New York. Ten thousand were used to bring the ceremonies here, and a million million to raise

(*Continued on page* 959)

As the Average Orator Can be Heard Clearly by an Audience of About 5,000 People, a Calculation Shows that if President Harding Desired to Talk to the 120,000,000 Citizens of the United States and its Possessions, He Would Have to Grow to a Height of 173 Feet, Figuring That He Would Grow in Proportion to the Average Man, i. e., in Three Dimensions, Height, Width and Depth. The Dome of the U. S. Capitol at Washington, Here Shown, Rises to a Height of 287 Feet Above the Ground, and Owing to the Perspective of the Picture, it Appears Smaller Than the President. It Has Been Seriously Suggested by a Well-Known Telephone Engineer that President Harding, Within His Present Term, Will Undoubtedly Have the Satisfaction of Talking to the Equivalent of 100,000,000 People, Thanks to the Tremendous Intensification of His Voice Made Possible by the Audion Amplifier. On Armistice Day, President Harding Set a New Record for Long Distance Oratory, by Addressing Simultaneously Three Great Audiences, Totaling Over 100,000 People, Thanks to Madame Science and the Audion Amplifier.

Popular Astronomy

By ISABEL M. LEWIS, M. A.

of U. S. Naval Observatory

Are Our Winters Growing Warmer?

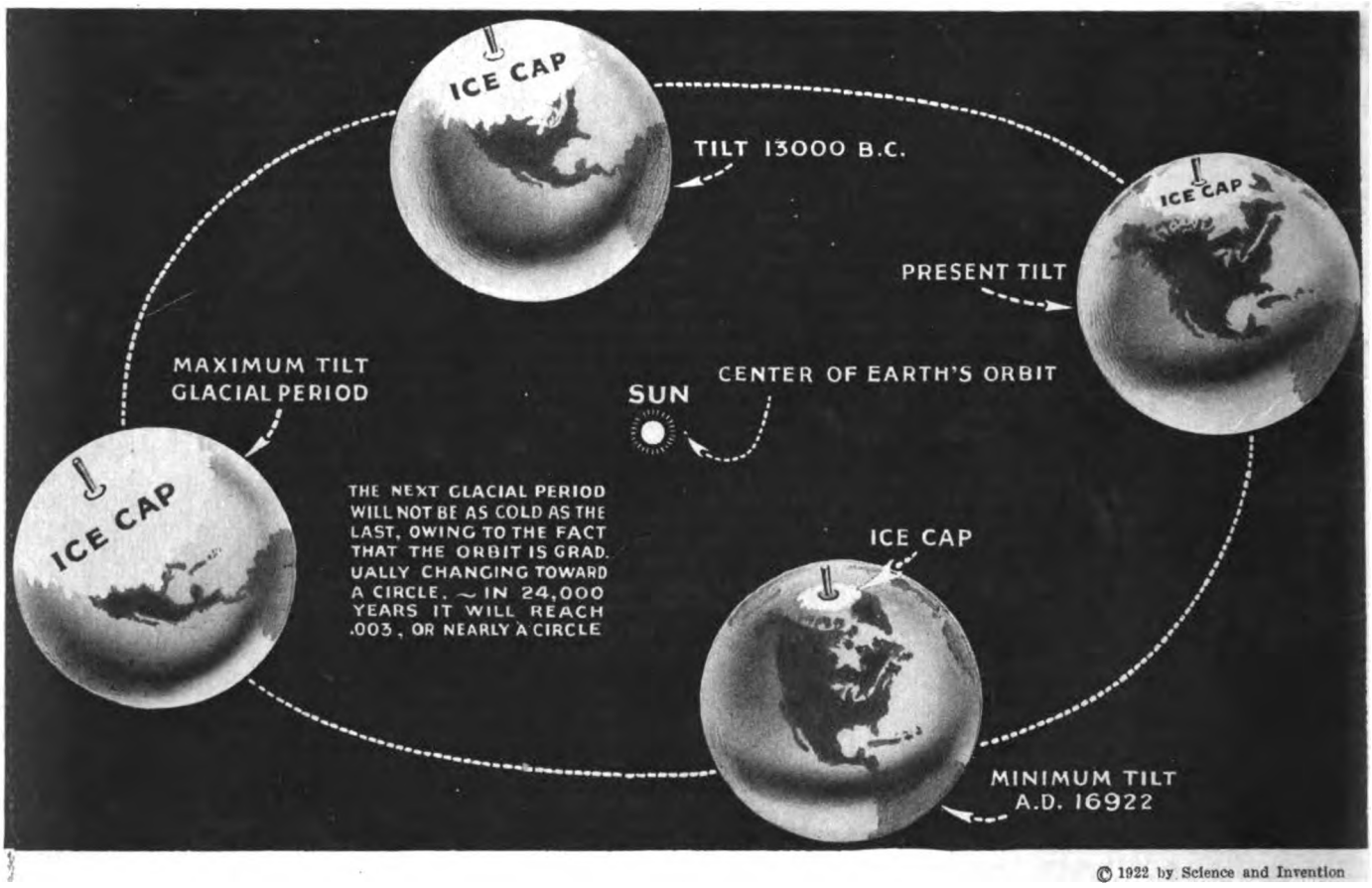
SEASONAL changes on the earth arise from the fact that the earth's axis of rotation is inclined to the plane of the earth's orbit or ecliptic. If the plane of the earth's equator coincided with the plane of the earth's orbit, so that the axis of rotation would be perpendicular to the plane of the orbit, days and nights would be equal in length all over the world and there would be no seasonal changes. There would be, of course, a gradual decrease in temperature from equator to poles, but the temperature at any one point on the earth's surface would be practically uniform thruout the year, while the change in temperature with latitude would be greater than it is at present. The effect of the inclination of the earth's axis of rotation from a position perpendicular to its orbit is to lessen the extremes of temperature between the equator and the poles and to equalize the temperature of the globe.

The less the obliquity of the ecliptic, which is the angle between the earth's equator and the ecliptic or plane of the earth's orbit and therefore the angle as well between the earth's axis and the perpendicular to the ecliptic, the less marked would be the seasonal changes. The winters are in that case warmer and the summers cooler than they would be if the inclination were greater. If the obliquity became less the sun would travel not quite so far south of the equator in the winter, and as a result its rays would be less slanting and more intense in the northern hemisphere, while in the summer it would come not quite so far north and therefore its rays would be more slanting and so less intense. It would follow that the winters would be warmer and the summers cooler and the seasonal changes less marked. If, on the contrary, the obliquity of the ecliptic should increase the winters would become colder and the summers hotter and the seasonal changes would be more extreme.

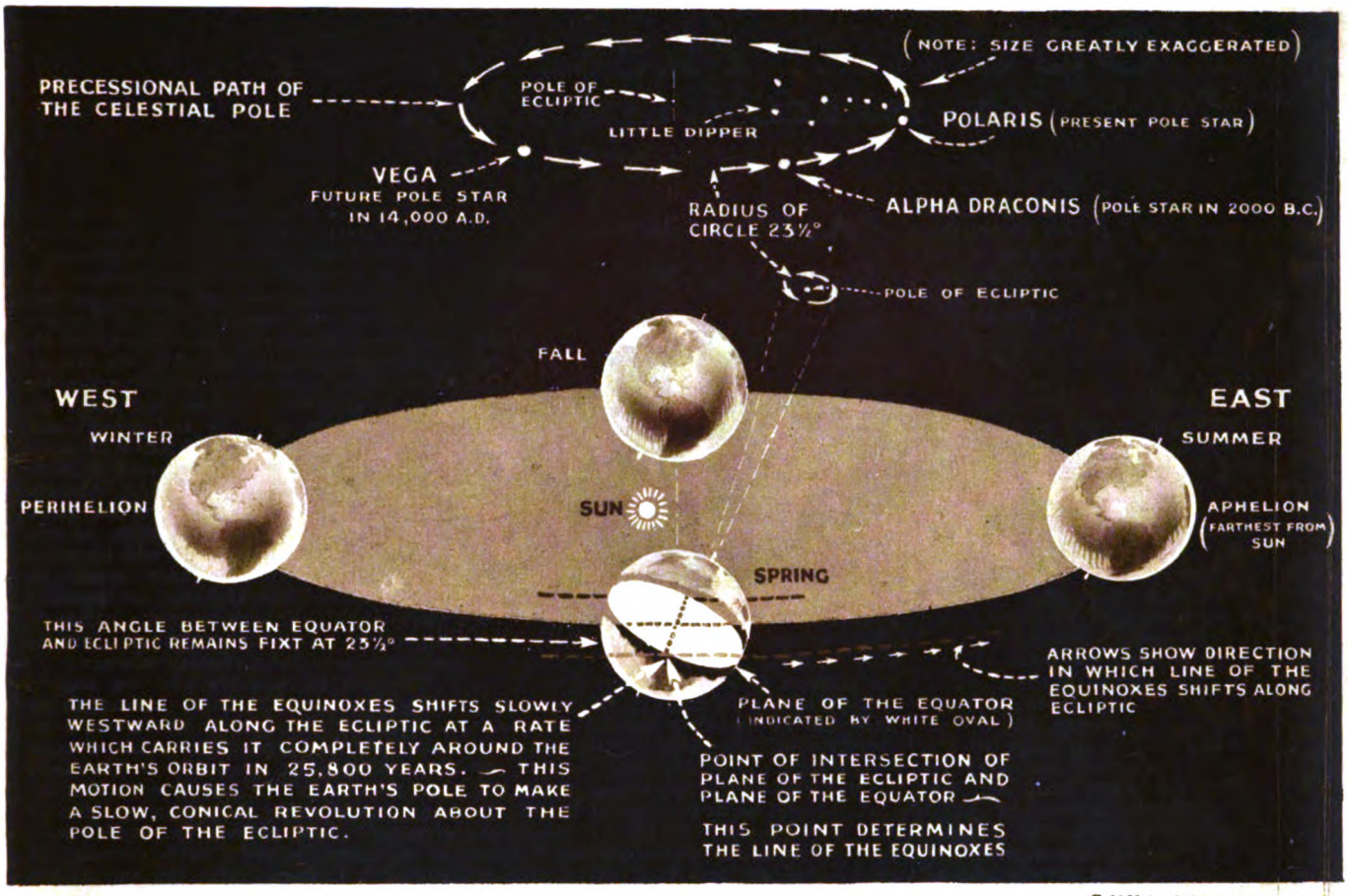
Now the only external forces that can change the tilt of the earth's axis or the obliquity of the ecliptic are the gravitational attractions of the sun, moon and planets for the earth. No changes taking place within the earth itself would possibly be great enough to shift appreciably the position of the axis of rotation. The change in the inclination of the earth's axis due to the attraction of the other members of the solar system can be found and it is known that the obliquity of the ecliptic is decreasing from this cause at present at the rate of *half a second of arc a year.* In the last two thousand years it has decreased twenty-four minutes of arc, less than half a degree, and it will continue to decrease in value for the next fifteen thousand years until it reaches its minimum value of 22¼° when it will begin to increase slowly once more. The maximum value of 25° will be reached only after the lapse of many centuries and no known forces can cause it to exceed this amount. It will, so far as is known, continue to oscillate slowly between these narrow limits indefinitely.

Some attempts have been made to explain the occurrence of glacial periods and intervening warm epochs in the past as due to changes in the obliquity of the ecliptic and consequently in the tilt of the earth's axis which would make the winters alternately milder and more severe for long periods and would also produce changes in the direction of ocean and aerial currents which would be even more effective in producing climatic changes in different portions of the globe. If the range in the variation of the obliquity were greater it would be easier to see how such changes might be brought about, but a change of less than three degrees between extreme values of the obliquity hardly seems sufficient to produce such great climatic changes.

Tho our winters are growing slightly warmer as a result of this decrease in the obliquity of the ecliptic, we cannot overlook the fact that other small changes are taking place gradually in the form and position of the earth's orbit that are quite as effective in producing climatic changes of long period. The earth's orbit, as we know, is not a perfect circle, but elliptical in shape, with the sun at one focus, instead of at the center of the ellipse. The greater the eccentricity of the ellipse, which is the ratio that the distance from the center to the focus bears to the semi-major axis (see Fig. 1), the greater is the variation in the distance of the planet from the sun in different



From the Above Illustration It Will Be Seen That the Earth Spins Around the Sun Not in a Circle But in an Ellipse. In the Course of the Ages the Axis of the Earth Inclines More or Less to the Plane of the Earth's Orbit. These Changes are Indicated in the Above Illustration. The Smaller the Tilt the Less Ice Forms in the Northern Regions, and Vice Versa. As the Maximum Tilt We Have the Glacial Period, as Indicated at the Left. Even the Polar Regions Will Be Comparatively Free From Ice in the Year A.D. 16922, Which Represents the Minimum Tilt.



In the Above Illustration We See What Makes the Seasons. At Our Present Time the Earth is Farthest From the Sun at Summer Time. This Condition Will, However, Not Prevail as in Ages to Come the Conditions Will Be Reversed, When the Earth Creeps Continuously Forward On Its Schedule So to Speak. When This Happens, the Earth Will Be Furthest Away From the Sun in the Winter Time, and We Will Be Approaching the Ice Age.

parts of its orbit. When the planet is nearest to the sun it is said to be in *perihelion* and when it is farthest from the sun it is said to be in *aphelion*. According to the laws of motion the planet also moves most rapidly when it is in perihelion and most slowly when it is in aphelion. If the eccentricity of a planetary orbit is high the amount of heat that it receives from the sun, when in perihelion, is much greater than the amount of heat received when it is in aphelion, since the heat received from the sun varies inversely as the square of its distance. This difference in the amount of heat that a planet receives from the sun in different positions in its orbit may be so great when the eccentricity of the orbit is high, that the effect is similar to seasonal changes of temperature produced by the tilt of the planet's axis of rotation. Mercury, for instance, is fifteen million miles nearer to the sun in perihelion than in aphelion and the amount of heat that it receives from the sun in the two positions is in the ratio of nine to four. As a result the planet has a short hot summer season, when it is in perihelion, and a comparatively cold long winter season, when it is in aphelion. The difference in the length of these seasons, if we may speak of them as such, is due to the fact that the planet moves most rapidly in perihelion and most slowly when in aphelion. Since Mercury's axis of rotation is perpendicular to the plane of its orbit it has no seasons in the sense that we use the word in referring to the earth's seasons.

Now the eccentricity of the earth's orbit is at present .017, and as a result the earth is about three million miles nearer the sun in perihelion than in aphelion and receives about six per cent. more heat in perihelion than in aphelion. At the present time when the earth is in perihelion, it is winter in the northern hemisphere and summer in the southern hemisphere; when the earth is in aphelion it is summer in the northern hemisphere and winter in the southern hemisphere. As a result of this state of affairs the summers of the southern hemisphere are hotter than the summers of the northern hemisphere, but they are also shorter because the earth is moving most rapidly in perihelion. The two effects, it can be shown, exactly counterbalance one another, so that the total amount of heat received in *summer* in the two hemispheres is the same. The winter of the southern hemisphere, however, occurs when the earth is in aphelion, and so it is both longer and colder than the winter of the northern hemisphere. We would therefore expect to find the southern hemisphere colder on the whole than the northern hemisphere, and this would doubtless be so if it were not for the fact that most of the water surface of the globe is in the southern hemisphere and most of the land surface in the northern hemisphere. As water absorbs heat more readily than the land, and parts with it more slowly, the southern hemisphere attains a higher temperature than the northern hemisphere, especially in high latitudes.

The eccentricity of the earth's orbit as well as the obliquity of the ecliptic is changing slowly. It is now decreasing and will continue to decrease for about twenty-four thousand years, until it will reach the value of .003, when the earth's orbit will be nearly circular and its perihelion distance will be only about five hundred thousand miles less than its aphelion distance, instead of three million miles as it is at present. Climatic changes due to the eccentricity will then be inappreciable. In past ages the eccentricity of the earth's orbit was at times much higher than it is today. It fluctuates irregularly in long periods between the values .003 and .07. When the eccentricity was .07 there was a difference of more than twelve million miles between the perihelion and aphelion distances of the earth from the sun, which certainly must have produced a very noticeable effect upon the temperature of the earth in different parts of its orbit.

If the perihelion and aphelion were fixt in position with respect to the solstitial points and equinoxes, climatic changes, due to a high eccentricity of the earth's orbit, would always be of the same kind and would always act in the same direction. For instance, the earth is now in perihelion in winter. If this were always so the winters would get continually warmer and warmer as the eccentricity of the orbit increased, and the summers would grow continually colder. This state of affairs would persist for ages so long as the eccentricity remained high. It can be shown, however, that combined with a high eccentricity of the orbit there is an oscillation of climatic effects in long periods, due to the fact that both the line connecting perihelion and aphelion, and the line of the equinoxes, are in slow revolution in the plane of the earth's orbit. As a result the earth will be nearest the sun in winter for a number of centuries, and then the conditions will be gradually reversed, so that the earth will be farthest from the earth in winter. With a high eccentricity very marked climatic changes result, which some geologists and astronomers firmly believe have caused the glacial periods of the past and the intervening warm epochs.

Owing to the attraction of the planets, the line connecting perihelion and aphelion

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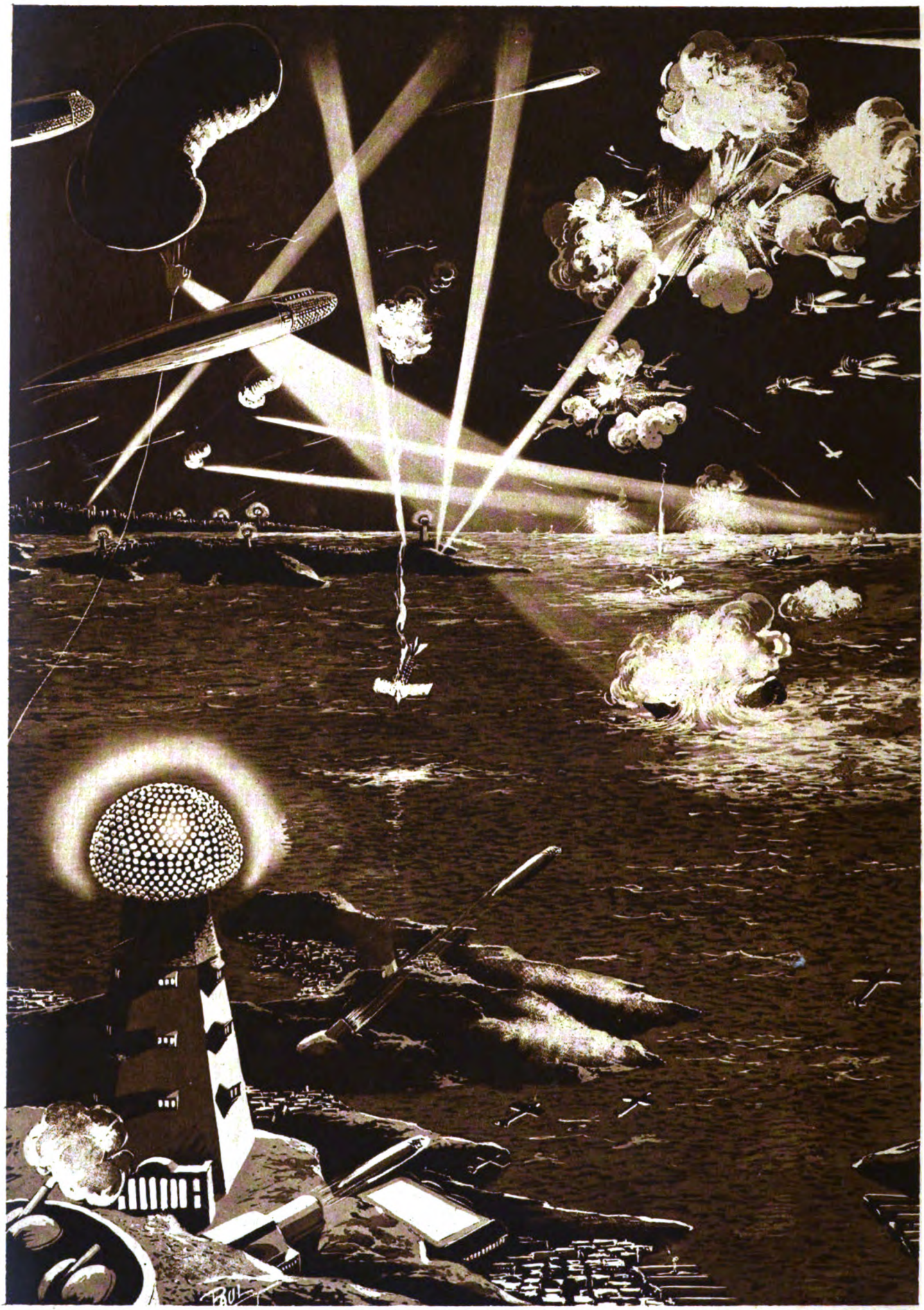


War of the Future as It Will Be Conducted From the Viewpoint of Dr. Tesla. Machines of Destruction More Terrible Than Anything Concocted By the Master Minds Behind the "World War" Armies and Navies, Will Sail Under the Ocean and Thru the Skies—With Not a Man On Board. According to Dr. Tesla These Death-Dealing Monsters of the Sea and Air Will Be Controlled and Directed From Distant Points Hundreds or Even Thousands of Miles Away By Radio Waves of the Proper Sequence and Frequency. The Tower-like Structures Seen On the Land in the Accompanying Picture are Transmitting Radio-Electric Power for Operating and Controlling the Sea and Air Defense Craft. When One of These Aerial Machines Passes Over an Enemy City, the Proper Radio Control Wave Is Flasht Out and the Giant Craft Drops Gas and Explosive Bombs, Destroying Buildings and People as Well. Man Will Be the Master Mind Behind the Future War, But Machines Only Will Meet in Mortal Combat. It Will Be a Veritable War of "Science."

An Interview With Nikola Tesla

By H. WINFIELD SECOR

AT the present day when many momentous problems in science and international politics are being weighed in the balance of logic and reason, it is a very opportune time, it seems, to listen to the views and ideas entertained on some of these problems by such a famous engineer and scientist as Dr. Nikola Tesla. The interviewer wended his way across Bryant Park in the shadow of the great Astor Library and ascended to the 20th floor of an adjoining skyscraper, where Dr. Tesla has his offices and laboratory. Having made known my mission, I asked Dr. Tesla the following questions.

The Disarmament Conference

Q. Do you believe that the Disarmament Conference now being held at Washington will do much good, especially with respect to prevention of war?

A. The extraordinary proposal of Secretary Hughes has produced a favorable impression thruout the world and the remarkable readiness with which it was taken up by the foreign governments is an auspicious beginning. Some agreements as to naval expenditures and status of the Powers in the Pacific have already materialized and that other results of value will follow there can be no doubt. But it is equally evident that they will consist merely of economic measures, which can have only a negligible influence as preventatives of war.

The primary object of the Conference is the reduction of armaments. As the safety of any country depends not on the absolute, but relative, military strength a proportionate reduction of the force and equipment suggests itself naturally as a means of lessening the cost of upkeep. This is a very old idea in the practical application of which insuperable difficulties have been encountered heretofore for want of proper standard of reference. The requirements are different in each individual case and an attempt to make the reduction on the basis of population, area, resources, industry, commerce, or any other national asset, would be manifestly futile. Moreover, participation by every nation is essential to the thoro execution of such a plan, and to arrive at an adjustment satisfactory to all would be next to impossible. All that can be accomplished at present is some equitable treaty between the few leading countries for minimizing the burdens of war, which is highly desirable for economic reasons but leaves the main problem unsolved. The idea that armed conflicts between nations can be prevented by written covenants involves a scientific fallacy. It is an attempt to put effect before the cause. Experience must precede the formulation of laws. Universal peace may be eventually brought about by civilizing forces and agents and international conferences will then only serve the purpose of giving clearer expression to a common desire. Nevertheless, the conclusions reached at Washington may prove of tremendous consequence in time to come, especially for this country which, until lately, has adhered to its traditional policy of isolation.

On general principles three courses are open to the United States. One is to continue arming and maintain an overwhelming superiority over other nations. The inexhaustible wealth of this country would easily enable it to keep up the pace and if safety is placed above every other consideration this should be done. The carrying out of the program would call for vast outlays but under the conditions existing American military supremacy might, perhaps, be the best means of insuring general prosperity and welfare. The second is to advocate complete disarmament insofar as the enforcement of law and order would permit. In that case this country would still be safe, as its resources would enable it to prepare for war quicker than any foe. The third is to enter an agreement with other powers, limiting the armaments, which would virtually mean an alliance involving more or less hazard and peril.

As regards the abolishment of war, the measures adopted by the Conference to this end will be as futile as all the previous ones. Opinions on this subject are divided. In the view of some, war is the greatest curse; others think it is a psychological necessity and beneficial—like a storm which clears the atmosphere. There is a perpetual conflict going on between nations as well as individuals. Ordinarily it is merely a competitive struggle, occasionally it becomes a deadly strife. This is primarily due to imperfect mutual understanding and the basic physical cause is the immense extent of the terrestrial globe. The most effective means towards insuring universal harmony and peace is, accordingly the annihilation of distance which must be brought about in three distinct respects: (1) dissemination of intelligence; (2) transmission of energy, and (3) transport of bodies and materials. All this can be done thru the development of the wireless art. As the first step I proposed twenty years ago my World-System which would leave all the present means intact and enable instantaneous transmission from one to any other point of the globe, of signals, speech, pictures and characters of every description. I have made important improvements since and am almost assured that a number of comparatively very small and compact plants, with a telephonic range of twelve thousand miles and devoid of high towers, will be put in operation in various countries. Of immeasurably greater consequence, however, will be the wireless transmission of energy, which can be successfully effected by the use of the same underlying principles and will make cheap motive power for all purposes available everywhere. Then it will be possible to propel flying machines at great speed without fuel and thus space will be annihilated and the impediments to contact and mutual understanding removed.

NIKOLA TESLA has no doubt one of the greatest intellects of his time. Our readers will be pleased to peruse his latest ideas concerning world matters of interest to all of us. We have stated in our columns before that Dr. Tesla is at least 100 years ahead of our times. Many of his prophecies have come true in the past, and we believe that the words which he addresses to the world thru SCIENCE AND INVENTION will be listened to attentively by all.
—EDITOR.

Future Wars

Q. What are your views on science in respect to future wars?

A. Discovery and invention ever tend to intensify the forces and agents for attack and defense. The wars of the future will have no semblance to those waged up to now. They will cause less physical suffering but will be all the more terrible. The countries engaged in the conflict will not send out armies, fleets, or aerial squadrons to meet in battle, but crewless vessels will be launched from one to the other with enormous speed and at distances of thousands of miles. Such apparatus does not exist but could be speedily constructed and in an article on "Telautomatics" which appeared in the ELECTRICAL EXPERIMENTER (former name of SCIENCE AND INVENTION) of October, 1919, I have endeavored to convey an idea of the same. These infernal engines will drop quantities of poisonous gases and other destructive chemicals on any city or place, the geographical position of which is accurately known. Battleships, guns, torpedoes, submarines and even manned flying machines will become of trifling importance and there will be no need for admirals, generals, or commanders of forces, as all the work will be done by electricians, engineers and mechanics.

International agreements will not stop war, for the simple reason that they will be ignored the moment the life of the nation is at stake. To preserve itself it will sacrifice everything else. That is why Germany violated the neutrality of Belgium and why Italy deserted her allies. Before universal peace can be attained the whole human race must be changed for the better, thru closer contact and cultivation of a higher ideal, which will gradually supplant that of patriotism.

Is There Vegetation and Life on the Moon?

Q. Do you believe that there is vegetation and life on the moon, which we have always been taught possesses no atmosphere capable of supporting such?

A. I have read with great interest the announcements of Professor Pickering, as well as some adverse comments on the same. Personally I am inclined to place greater faith in the statements of a painstaking specialist than in the opinions of those who have not studied the subject, however competent they might be otherwise. The observations of this astronomer, if confirmed, will be of great importance, not only to science, but because of the psychological effect on human beings. I have always thought that any evidences of life on other planets would be of incalculable benefit to our world, and this is why I have devoted much of my energies to interplanetary communication ever since I received, in 1899, the singular disturbances that, according to all experimental evidence, emanated from Mars.

Future of Electrical Engineers

Q. What are the chances today and in the immediate future for electrical and radio engineers?

A. As regards the application of electricity, although the development of late

(*Continued on page 957*)

Velocity and Acceleration

Professor JAMES S. STEVENS
University of Maine

THE suggestion made by defenders of the Einstein theory of gravitation that, if we were moving in a closed box with uniform velocity and all other influences were eliminated, we would feel no pull in any direction, and that it is only when the velocity ceases to be constant that we are conscious of a pull, which could not be distinguished from the attraction of gravitation, has caused the subject of acceleration to receive considerable attention at the present time. If anyone knew anything about acceleration before the time of Galileo he guarded that knowledge carefully. Aristotle told us that if a number of bodies were dropped to the earth from a definite height they would fall in proportion to their masses. He doubtless assumed also that they would fall with a perfectly uniform velocity. We are apt to hold Aristotle and his school responsible for the small progress made in experimental physics up to the fifteenth century. Although he did not think it worth while to attempt an experimental verification of his teaching, it would seem that in the case of falling bodies he had all the reason on his side. Aside from the mere fact that bodies do not act in this way it seems the most reasonable thing in the world to believe that heavy bodies will fall faster than light ones. Indeed, the absolute uniformity in time of fall for all sorts of bodies has suggested in the minds of some an added argument for holding to the theory of uniformity of all matter. If lead and cork are made up of exactly the same component parts, there is no reason why they should not approach the earth with equal velocity when dropped.

As in so many other cases, we are indebted to Galileo for experimental knowledge on this subject. By permitting a carriage wheel to roll down an inclined plane he measured the spaces passed over in successive increments of time and thus laid the foundation for the laws which govern the fall of bodies toward the earth. Fig. 1. His method of reasoning was an interesting one. Having determined by experiment that a body will fall 16.1 feet (approximately) in one second, we come to the conclusion that this number must represent the average velocity of the fall during that interval of time. Since at the moment of fall the body had a velocity of zero, it must have acquired a velocity of 32.2 feet per second at the end of the second, in order to verify the value of the average velocity.

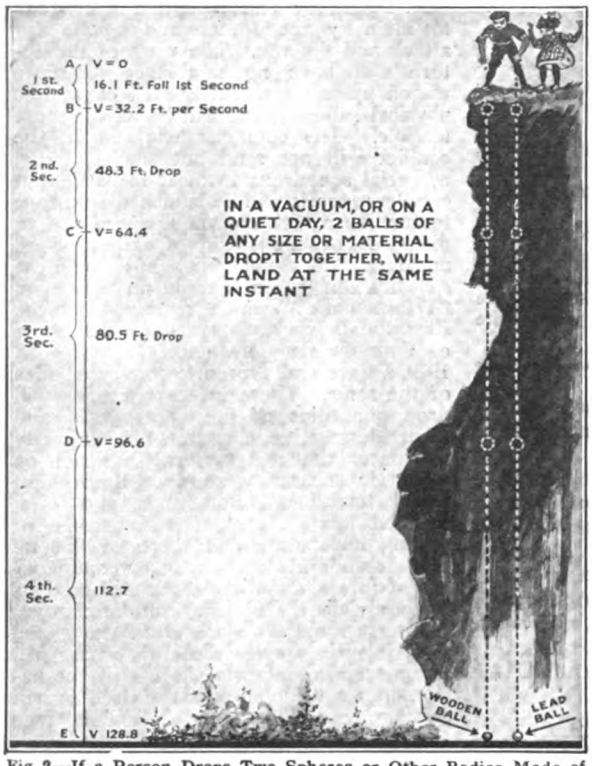


Fig 2—If a Person Drops Two Spheres or Other Bodies Made of Wood and Metal, Let Us Say, and at the Same Time, They Will Theoretically Both Reach the Ground at the Same Time. The Space Fallen Thru, as Well as the Velocity Attained by the Falling Body, Are Given in the Scale at the Extreme Left of the Picture.

Acceleration is the rate of change in velocity in a given unit of time. In this second the velocity has changed from zero to 32.2 feet, and this latter number, therefore, expresses the *acceleration*. We may assume this to be a constant quantity and we come to the conclusion that during the second second the body will travel 16.1 feet plus 32.2 feet, due to the acquired acceleration. The average velocity during the second second is 48.3 feet per second. It will be remembered that at the beginning of this second its velocity was 32.2 feet per second. Its final velocity at the end of the second second must, therefore, be 64.4 feet per second. The difference between the final and initial velocity in this second is, of course, 32.2 feet per second, the constant acceleration. See Fig. 2. This process of reasoning may be carried on indefinitely and it holds true, except for the fact that the falling body meets with a certain atmospheric resistance, which must be taken into consideration.

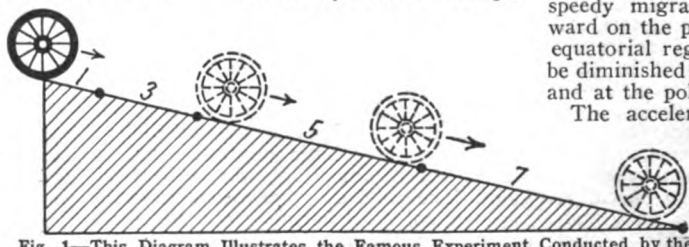


Fig. 1—This Diagram Illustrates the Famous Experiment Conducted by the Great Galileo Wherein a Carriage Wheel Rolling Down an Inclined Plane Passes Over the Ever Lengthening Spaces 1, 3, 5 and 7 in the First Four Consecutive Seconds.

The statement that gravitational acceleration is a constant is true only for a definite locality. As we go away from the center of the earth its value changes somewhat. Exprest in c.g.s. units, it is 978.1 cm. per sec. per sec. at the equator and 983.1 cm. per sec. per sec. at the poles. The irregularities in the earth make it impossible to deduce a mathematical formula which will determine the value of "g" (meaning gravitational acceleration), but this has been done by empirical methods, and the following is found to be a good working formula:

$$g=980.6056-2.5028 \cos 1-0.000003h$$

Where 1=the latitude and h the altitude. There is another factor which modifies the effect of gravitational acceleration, and that is called centripetal acceleration. It is illustrated when water flies off from a revolving grindstone and when an automobile skids upon turning the corner.

In our boyhood days we regarded it as a clever accomplishment to whirl a pail of water rapidly over our heads and note the fact that no water was spilled. See Fig. 3. We may consider that when the pail is inverted directly over our head the water tends to fall out due to a gravitational acceleration of 32.2 cm. per sec. per sec. If now we consider that the rope which is the radius of the circle in which the pail is revolving is three feet long, we find that we must revolve the pail with a speed of about two revolutions per second.

Considering the matter on a much larger scale we may determine the value of this centripetal acceleration on a point on a body located at the earth's equator, see Fig. 4, where the radius becomes approximately 4000 miles, and the time of revolution something over a 1000 miles per hour. The acceleration comes out 0.11 feet per sec. per sec., which is 289 times smaller than the gravitational acceleration. Mathematics show us that if the earth's rotation were speeded so that it would go 17 *times faster than it does,* a body at the earth's equator would be in *indifferent equilibrium. If it should happen to be a few feet above the ground it would REMAIN THERE.* See Fig. 4. If this speed should be increased more than 17 times all bodies so located would fly off into space. If any such condition should ever come to pass, there would be a speedy migration northward and southward on the part of the inhabitants of the equatorial regions, since this effect would be diminished as we went toward the poles, and at the poles it would become zero.

The acceleration of a body which is illustrating simple harmonic motion is very interesting. The bob of a swinging pendulum has its least velocity and greatest acceleration at the extremities of the swing. It has its greatest velocity

Fig. 3—Swinging a Pail Containing Water in a Circle Will Cause the Water to Remain in the Pail Due to the Centripetal Acceleration. With a Cord Three Feet Long the Pail Must Revolve Twice per Second in Order to Retain the Water.

and least acceleration at the central point. The same forces which cause the swing of the pendulum would operate if we dropt a body into a hole which was bored thru the earth. See Fig. 5. At the beginning it would have a minimum velocity and maximum acceleration. When it reached the center conditions would be exactly reversed, and if we *disregarded the resistance of the medium* (air) the body would fall (and rise) to the other side of the earth and repeat the process indefinitely. Under *actual* conditions its amplitude would be a decreasing one and it would eventually come to rest at the center of the earth. By calculating the mathematics of this problem one may readily determine the time of a complete excursion thru the earth to be about one hour and twenty-five minutes. It follows from this that a body would have no weight at the center of the earth. It is also true that if the earth were a homogeneous spherical shell free from the influence of any other object, a body placed within its interior would remain at rest in any position. This follows from the theory of potential and may be easily demonstrated as an approximation without the aid of higher mathematics. The relative accelerations which a body would possess on the various members of the solar system would give us an entertaining discussion, but this has been thoroly worked out in a previous number of this magazine.

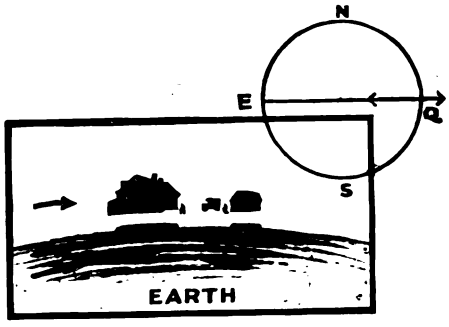


Fig. 4—Referring to the Circle Diagram of the Earth a Body at Q on the Earth's Equator is Acted Upon by Two Opposite Accelerations, One of Which is 289 Times Greater Than the Other. Lower Illustration Shows What Would Happen if the Earth's Speed of Revolution Was Increased to 17 Times Its Present Value. A Body Situated Above the Earth's Surface Would Then Remain Suspended There and Revolve With It; Any Greater Speed of the Earth Would Cause the Body to Fly Off Into Space.

There is a certain velocity value which has a remarkable characteristic. It is so nearly seven miles a second that if one were inclined to be superstitious he might think there was something sacred about the number. It is called the limiting or parabolic velocity, and it is the velocity which a body would have when it reached the surface of the earth from infinity. See Fig. 6.

Here again resistance of the atmosphere, terrestrial and celestial, which the body might encounter in its journey from infinity to the earth is neglected. If we reverse this problem we may show that if a body is projected from the surface of the earth with the velocity of seven miles a second it would go to infinity. The particular path it would take in this case would be a parabola. If its velocity were greater than seven miles a second it would still go to infinity, but by a hyperbolic course. If its velocity were less than seven miles a second its path would be an ellipse, one of whose foci would be the center of the earth. An interesting special case is observed when the velocity reaches about *five miles per second.* In this case the *orbit becomes a perfect circle* and its period of revolution would be 1h. 24.7 m. Incidentally this would be the period of rotation of the earth if, as has been suggested above, it increased in speed 17 times. If the earth had a satellite which revolved close to its surface it would have this particular rate of revolution. Many of Jules Verne's ideas have already been realized, and it is not outside the realm of possibility that a projectile may be fired from the earth with this parabolic velocity. Little advancement to the cause of science would be made by throwing a projectile to the surface of the moon or Mars.

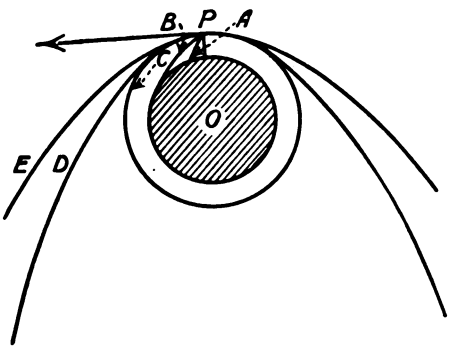


Fig. 6—A Body Projected Horizontally at P With a Velocity of Less Than Five Miles a Second Will Take an Elliptical Path—A or B, and the Center of the Earth O Will Be One of the Foci. If the Velocity is Five Miles a Second it Will Take a Circular Path C. With a Velocity of Seven Miles a Second it Will Describe the Parabola D, and With More Than Seven Miles Velocity the Hyperbola E.

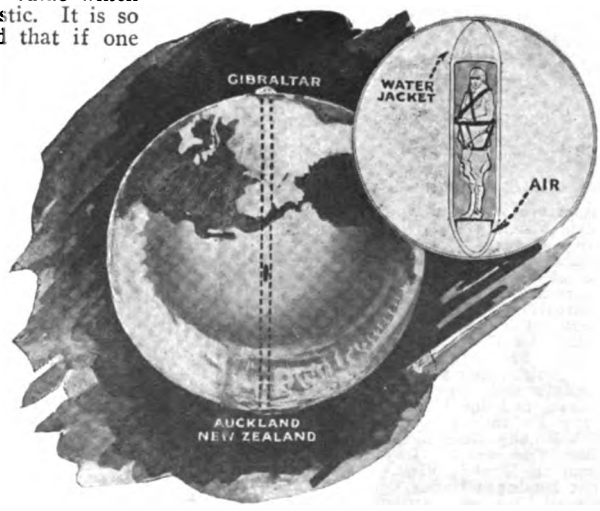


Fig. 5—If a Man Was Placed in a Suitable Carrier Like That Shown, and Then Allowed to Drop Thru a Hole Penetrating the Earth, He Would Pass Straight Thru the Center of the Earth From One Side to the Other. He Would Travel First to the Other Side and Then Back to the Starting Side, Half of the Time Going Down and Half of the Time Coming Up. Due to Air Resistance He Would Eventually Come to Rest at the Center of the Earth, but Theoretically, He Would Keep On Bobbing Up and Down From One Side of the Earth to the Other, Forever.

"Inventions" a Woman Wants

By Mrs. CARRIE MONNETT

MOST inventors, being men, fail to realize many of the real necessities of women. Many inventions are still needed which tho simple in nature, would be hailed with delight by all housewives. Here are a few that have suggested themselves to me. If there are patents covering these ideas I do not know of it. For years I have taken a piece of coarse wire, twisted it around the center of a rolled magazine or newspaper, bent the other end into a hook and presto a model coat hanger! This not only makes a model non-rust coat hanger but is a clever way of preserving old magazines. Now I would like a cheap wire device fitting the same purpose that could be snapt on instantly. They would be very convenient in traveling, requiring small space, ready for immediate use and could no doubt be furnished very cheaply.

The second idea is not so simple. You will please furnish me with an invention doing away with the necessity of winding thread on the bobbin or shuttle of a sewing machine, where a spool of thread may be used directly underneath furnishing the lower thread. An alternative might be found in a standardized bobbin, adjustable, furnished to purchaser with thread upon it.

I would also like a sewing machine needle fitted so as to be non-visible from the front.

Again—a starch for starching clothes, already prepared, ready for instant use.

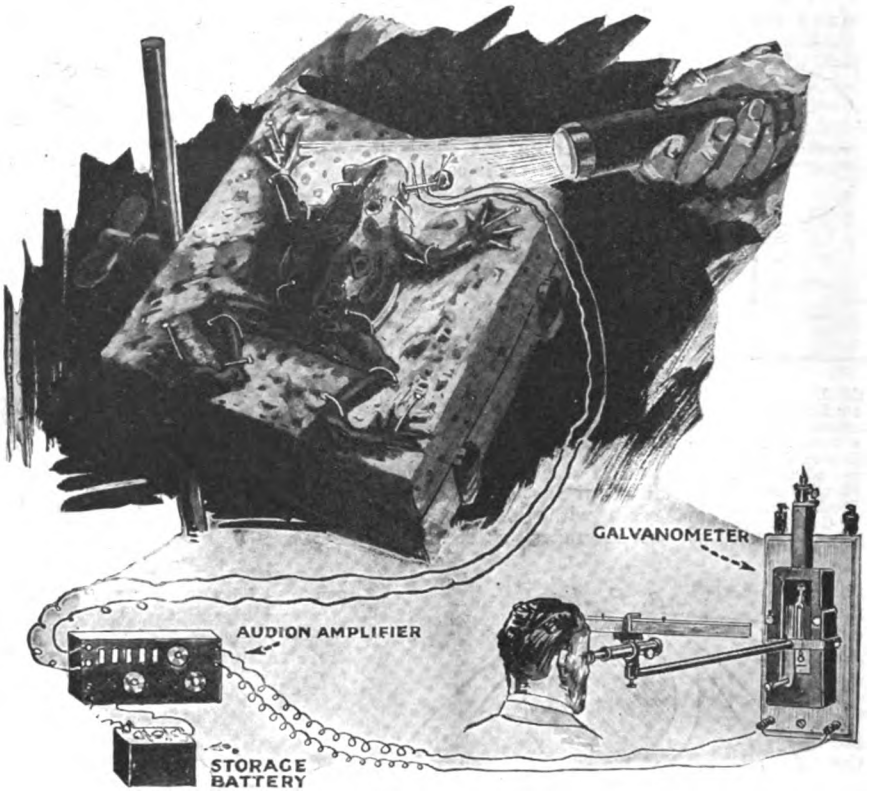
We call especial attention of the fair sex to Mrs. Monnett's letter, and hope that all our lady readers will co-operate with us in connection with this matter. Our women are doing the hardest kind of work, particularly housework these days, and due to their unmechanical natures as a rule prefer to drudge along in the same old humdrum way instead of turning inventors in order to lighten their work.

Thus we find that the electric washing machine, the vacuum cleaner, the electric iron, dish washers, and many others are not the product of women inventors, but have been designed or invented by men. This perhaps is as it should be because man after all is a better inventor and constructor. What we lack, however, is constructive advice from the women folk. The letter printed herewith proves this. If every woman would send in a letter to us telling us what particular job she wishes to be lightened, the publication of such a letter would probably result in some clever inventor solving the problem. We therefore invite the fair sex to send us suggestions as to what particular appliance they would like to have to make housework easier. Of course, we appreciate that every task cannot be made easy, and we hope that out fair correspondents should give the matter some thought, so we will not get too many impossible requests.

For instance, there probably will never be invented a machine that takes a chicken, plucks it, cuts it apart, cooks or broils it without hand manipulation, altho we might come pretty close to it. Then again, no machine will ever be invented that will take baby and give it a complete washing and dress it for good measure. These are the things that we must expect to do even if the millennium of mechanics and electricity has been reached. Now then, ladies, we hope to get some good letters from you.

Please address all communications to "Editor, Housework Relief," care of this publication.

Glass Eyes That "See"—A Possibility



Professors Chaffee and Bovie Recently Told Before a Convention of the Optical Society of America of the Remarkable Experiments They Had Carried Out to Show the Electrical Properties of Sight. In Their Experiments a Frog Was Used, the Frog Having Been Chloroformed First, of Course, and by Making Many Delicate Tests It Was Finally Determined That Whenever the Ray From an Electric Flashlight Impinged Upon the Eyeball That an Electric Current Past Along the Optic Nerve to the Brain.

Over Two Years Ago in This Journal, in an Article by H. W. Secor, it Was Pointed Out, as Many of Our Readers Will Remember, That There Was Every Reason to Believe That Sight Was Actually Caused or Produced by the Fact That When an Image Flasht on the Retina of the Eyeball an Electric Current Past Along the Different Optic Nerve Fibres, and Finally Reacted Upon the Sight Cells Located in the Rear-Central Part of the Brain. These Experiments With the Frog Prove the Fact Again.

UNDOUBTEDLY one of the greatest, if not the greatest, handicap to any person is the loss of their sight. We may lose an arm or a leg or even both upper or lower limbs, but so long as we retain our vision, it has been proven by many heroic unfortunates that optimism and cheerfulness as well as business abilities, can be developed and carried on just as well as by those in possession of all their limbs and faculties. Recently a very interesting scientific paper was presented before the Optical Society of America, by Professors E. L. Chaffee and W. T. Bovie of Harvard University, on the electrical action of the human eye and optic nerve system, from which it seems apparent that when sufficient study and research has been made on the human eye, it will make it possible to replace defective eyes with artificial ones, which, electrically or otherwise, in conjunction with the optic nerve, will give us back the power of perfect vision.

Until somebody donates an eye, however, little more progress can be made in that direction, for it is necessary to determine the exact strength of the electrical current, which, flowing thru the optic nerve to the eye, renders it sensitive to light, and whether the strength of this current varies in different individuals, or is a fixt quantity. Until recently, the opticians did not know what it was that enabled the human eye to see. Recent experiments, however, have establisht the nature of the force, by definite proof that the optic nerve is nothing more nor less than an electrical power transmission line and that electricity is the genie behind the power of vision.

Professors Chaffee and Bovie told the convention of remarkable experiments in which a frog had been used. The frog's eyes were removed from the sockets, leaving them still connected to the optic nerve. Then they connected an audion amplifier, such as is used in wireless telegraphy and long distance telephony, after which they threw a ray of light into the retina, and observed the reaction, which they were able to measure accurately. In this way they establisht the fact that the function of the optic nerve is to supply the eye with electrical power. It now remains to ascertain the measure of that power in human beings, and this can be done by experiment on a human eye with a living human being as the subject. When this is once accomplisht, the opticians now believe that it will be possible to manufacture a synthetic eye, which, when connected with the optic nerve, will function as the natural eye does.

The successful accomplishment of this feat, it is said, would virtually put an end to blindness, and restore sight to the thousands of blind thruout the world, with but few exceptions. Blindness, it is said, whether hereditary or due to accident or disease, is, in nearly all cases, caused by some defect or injury to the eye itself, and not to the optic nerve. Most blind people, the opticians assert, have perfectly normal optic nerves, which, if fitted with eyes in good working order, would perform satisfactorily. In such cases, it would only be necessary to make a pair of eyes for the patient and connect them up with his optic nerves, just as a telephone is connected, and send him home happy with perfectly good eyes.

$500.00 in Prizes in This Issue

SCIENCE AND INVENTION probably was the first scientific publication in the country that started out giving various prizes to its readers. This custom originated with us almost ten years ago, when the magazine first started, and has been preserved right along.

Today SCIENCE AND INVENTION offers more various prizes than any periodical, and these are all prizes that are within the reach of everyone. These are prizes where almost every reader can participate without straining his imagination or his faculties to a very great degree. In this issue will be found more prize contests than in any other issue, and the reader's attention is called to this particularly. This month there are over $500.00 in prizes, which will be found under the following headings:

Bottle Contest—$100.00—See page 922

Motor Hints Contest—$50.00—See page 928.

How-To-Make-It Department—three prizes have been increased from $10.00 to $50.00—See page 933.

Wrinkles, Recipes, and Formulas Department—$5.00—See page 934.

Radio Department, our great contest, "THE SIMPLEST RADIO OUTFIT"—$300.00—See page 937.

Scientific Humor—First prize $3.00, twenty $1.00 prizes—See page 943.

In addition to this, note that SCIENCE AND INVENTION pays the highest rates for contributions of all sorts. Ordinary contributions are paid for at the rate of one cent per word, and we have paid as high as three cents per word for special experiments, or special articles containing novel and scientific information.

The Editor is always glad to receive such contributions for consideration.

Explosives to Be Fired by Music

By ARTHUR KAYE

In the Future, We May See Engineers as Well as Military and Naval Men Detonating Explosives by Means of Musical Notes Sounded from a Bugle or Other Musical Instrument instead of Having Recourse to the Usual Electric Dynamo or Battery Wired to the Firing Caps. Major Harold C. Woodward, late of the U. S. Army, is the Sponsor for this Interesting Scientific Method of Exploding Powder Which Will Find Many Useful Applications in Blasting as Well as in Military and Naval Operations.

THE latest theory for discharging explosives now being tested by Government authorities employs sound waves to set off the shell. This amazing process of exploding shells, deep-sea mines, and other eruptive war contrivances, as well as the more peaceful explosives of peace times, has been advanced by Major Harold C. Woodward, late of the United States Army.

Undoubtedly this opens up many possibilities. Instead of the present cumbersome and dangerous methods of exploding mines, the future may see the task simplified, so that a band playing "Nearer, My God, To Thee" on the deck of one battleship may blow the enemy's flotilla to smithereens!

However, Major Woodward is entirely serious about the matter. In explaining it he said:

"To the average layman there is absolutely no connection between music and high explosives.

"Yet research work of recent years in the detonation of high explosives clearly brings out a sympathetic connection between the vibrating waves of a musical instrument, the detonating waves of a musical instrument and the detonating waves of the various fulminates.

"This may be simply explained thus: "A high explosive is one in which the various atoms composing a molecule

(*Continued on page 977*)

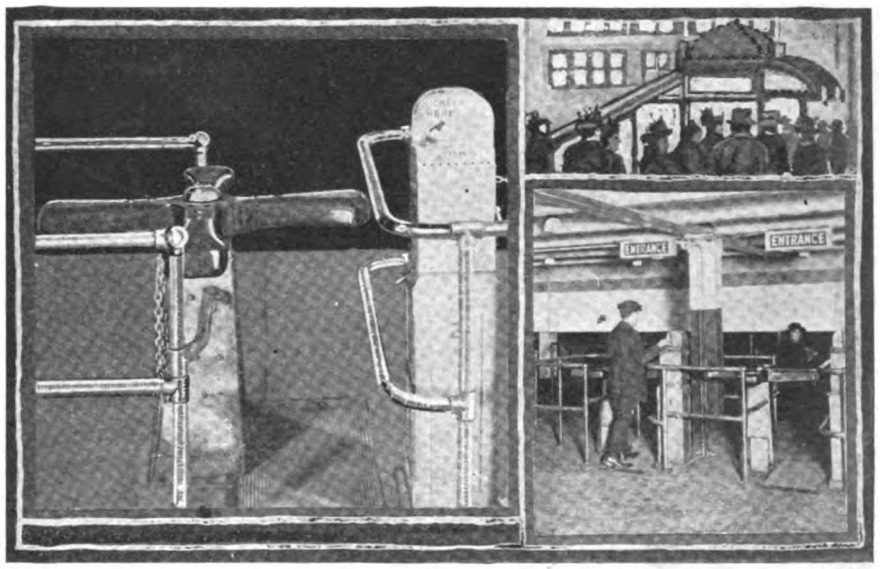
New Subway Turnstile

NEW York City's railway system is to be found chiefly in its subways. These subways carry about one-half of New York's entire population every day. Heretofore it has been necessary that the passengers line up in front of a ticket window, push their bills or coins thru the window and receive the proper tickets. These tickets are the passes which are then dropt into a box guarded by a ticket chopper.

This system has been in vogue for such a long time, that passengers were beginning to wonder whether or not an improvement would ever take place. Fortunately for the traveling public, the Interboro Rapid Transit Company has been studying the system for several years and has finally evolved a gate, which is an impassable barrier to any passenger attempting to enter the subway station, unless he first drops his nickel in a slot provided for the purpose. The same gate or turnstile permits of the free *exit* of the travelers.

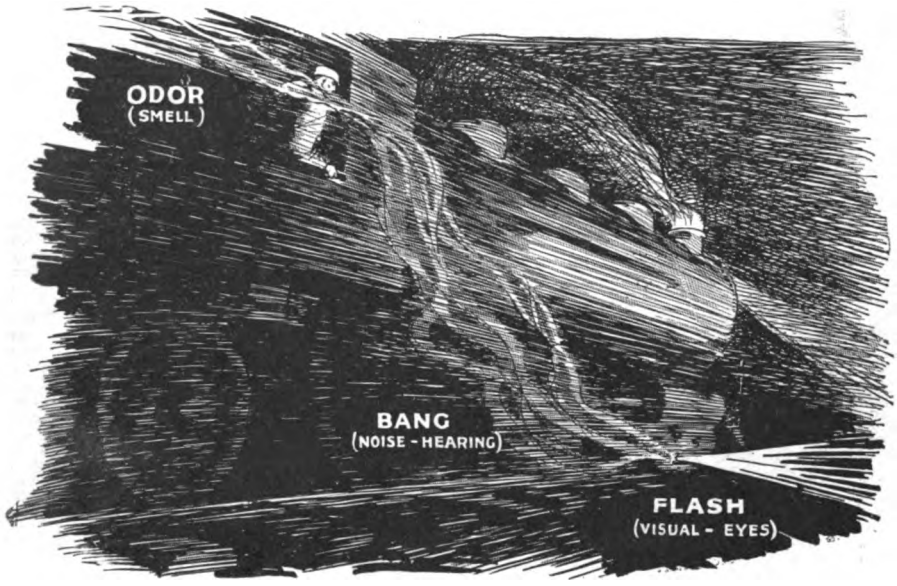
At some stations where no tickets were used, a sort of turnstile gate had been in constant operation, but it was imperative that the ticket agent unlocked the gate by pressing a lever with either his foot or his hand, before the passenger could pass thru. If the passenger were in just a bit of a hurry, and the ticket agent a trifle slow, a very unpleasant collision resulted as the passenger rammed the gate. With the present gates, such a condition is absolutely impossible. A nickel having been dropt into the slot, the gate may be turned by a pencil held in the fingers. Hence it has been nicknamed, the feather-weight pressure gate; because, figuratively speaking, very light force is required for its turning. Now whenever a traveler, who has occasion to use

(*Continued on page 946*)



Photos Above Show a Close-up as Well as a General View of the New Subway Turnstiles Being Installed in Subway Stations. "Your Nickel is Your Ticket"—No Ticket is Required. The Gate Automatically Passes You Thru to Trains When the Nickel is Deposited in the Box, and it Will Pass Outcoming Passengers without a Coin Being Deposited.

Odor, Noise, Flash Stops Engine



This New Railroad Torpedo Has a Triple Action—It Appeals to the Three Senses, Smell, Hearing and Sight,—so That it is Doubtful if an Engineer, Unless He Happened to Have Fainted or Died at His Post, Could Pass Such a Signal Without Heeding It.

This new track signal, a threefold signal torpedo, is one of the latest safety devices to be put into practical use. It has been adopted by the Canadian Pacific Railway. The appliance is superior to all others in that it gives warning thru three senses—sight, hearing, and smell—instead of thru sight or hearing alone, as do other signals. This new torpedo is impervious to heat, cold, and moisture, and is clamped to the rail by flexible steel bands that hold it firmly in place. When exploded by a passing train, it gives warning by a brilliant flare, a loud detonation and a pungent odor.

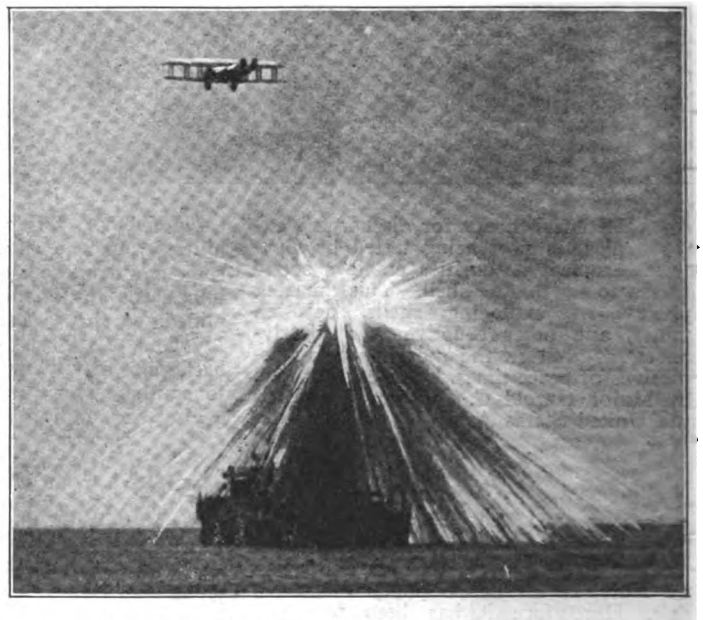
This track signal, in the form of a special explosive torpedo, is certainly a marked step in advance in this class of signaling devices, but the railroad trains of tomorrow will, we feel quite certain, not be dependent upon any form of signal which relies upon the human senses as a part of its working arrangement. What is really wanted is a good automatic train stop, which will cut off the steam or electric motor current on electrified railroads, and will also apply the brakes, when another train is in the block ahead, or when washouts or defective rails may lie just ahead around a blind curve, or perhaps hidden by a fog.

Effect of Phosphorous Bombs

The accompanying photograph shows the remarkable effect of a 100-pound phosphorous bomb, dropt from a plane, and striking the fighting top, i. e., the crew's quarters atop the steel mast of the battleship and from which position all the important sighting and range-finding occurs in locating accurately the enemy target. If under actual battle conditions, a bombing plane dropt a phosphorous bomb of this description so as to explode near the main top, it would have burned and killed the entire fire-control crew stationed there.

The day of the bombing plane in naval maneuvers is just beginning to dawn. Many naval experts still hold strongly to the idea that the *ship of the line* is the big factor in the sea battles which may be fought tomorrow, but the aviation experts have proved, at least in part, that they can drop bombs on ships in motion more accurately than they can when the target is standing still, and, moreover, they can wreak tremendous havoc on any ship by dropping bombs filled with high explosives heavier than have been used heretofore; and who shall gainsay them the important points which they endeavored to prove in the recent Army and Navy bombing tests on old warships?

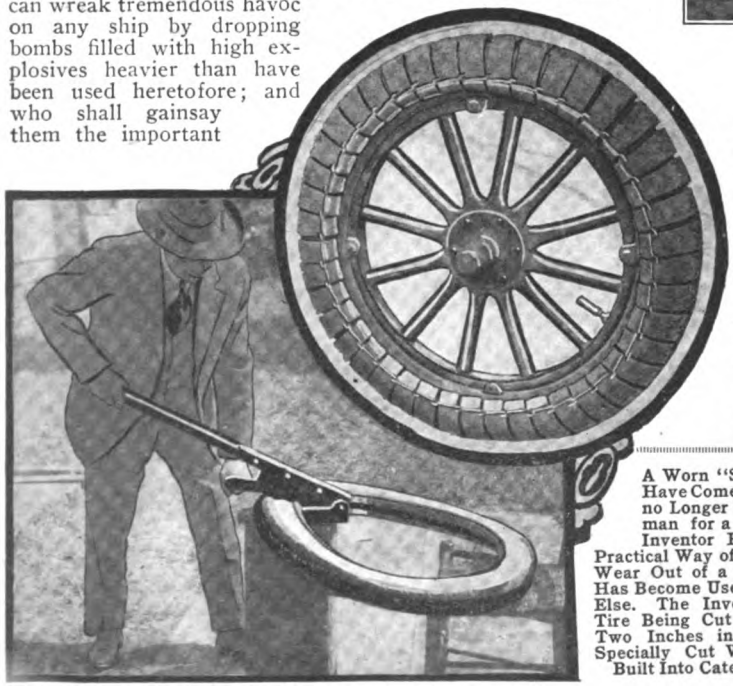
One naval expert challenged the men of the air with the argument that in the future naval battle, even if it occurred tomorrow, the bombing plane would never get within 10,000 feet of the modern warship.



A 100 Pound Phosphorous Bomb Striking the Main Top. It Would Have Burned and Killed the Entire Fire Control Party Stationed There in Battle.

Reclaiming Worn Tires

Here is a new invention that will bring cheer to the heart of every motorist, for with this simple device and the system employed by its inventor for reclaiming worn automobile tires many hundred miles can be obtained from old shoes you were going to throw on the junk pile. A worn *shoe*, as motorists have come to call a tire, need no longer be sold to a junkman for a song. A Texas inventor has found a most practical way of getting maximum wear out of a tire, long after it has become useless for everything else. The invention calls for a tire being cut into strips about two inches in width, and with the use of specially cut galvanized wire, the strips are built into caterpillar retreads. The saving in partly worn shoes by this over-tire method is winning popularity for it among motorists of ordinary income.



A Worn "Shoe," as Motorists Have Come to Call a Tire, Need no Longer be Sold to a Junkman for a "Song." a Texas Inventor Has Found a Most Practical Way of Getting Maximum Wear Out of a Tire Long After it Has Become Useless for Everything Else. The Invention Calls for a Tire Being Cut Into Strips About Two Inches in Width and With Specially Cut Wire the Strips are Built Into Caterpillar Retreads.

The old shoe or shoes are cut into strips about two inches wide by means of the cutter shown in use by the man in the picture, and these are afterward put in place around either an old or new shoe, and retained in this position successively as built up by means of the wire connections, in the manner indicated in the illustration.

Some motorists arrive at this result in a somewhat different way. i. e., by using an oversize shoe over the standard shoe.

Automatic Control of Motor Boats or Aircraft

ONE of the wonders of the present day has been the control of a motor boat going under its own power without a soul on board and governed from the shore by wireless. We have seen boats started from the shore, pursue a devious course as desired, and return to the pier, the control being exercised by a radio operator on the shore. But now we are going a step beyond that and the Winkley mechanically controlled boat is put adrift without a soul on board, with no wireless control from shore. She goes from right to left, follows a devious channel, evades buoys and shoals, and can work her way into a difficult harbor, entirely automatically.

There are four divisions or mechanisms in the Winkley apparatus. The navigator has to take cognizance of the direction of the course, so the first mechanism is a compass box with a gyroscopic compass within it. This gives the direction and Mr. Winkley has provided apparatus constituting another division of the mechanism which part he terms a steering box. By means of this the course is changed to right or left as predetermined before the boat leaves the shore and this is the second part of his mechanism. Now that control of the direction of movement and the power of changing it at any time is provided, the length of each course has to be fixed in advance. This is done by another of the mechanisms which is called the *timing box*. These three take care of a craft moving on the surface. The boat is held to her course by the compass box. The length of each course is determined and new courses are arranged by the combined action of the timing box and the steering box. Mr. Winkley is prepared to send the boat out in the densest fog on a devious, predetermined course and bring her back and he has already given some remarkable demonstrations of this automatic steering.

It can be seen how applicable this apparatus would have been in the blocking of the harbor of Zebrugge during the World War. Mr. Winkley, with a map of the harbor before him, would have set his apparatus to steer an unmanned ship into the mouth of the harbor, to be sunk across the entrance. There would have been no crew on board and no loss of life would have been involved. In the Spanish-American War, Mr. Winkley would have duplicated Hobson's feat and would have put a ship across the bottleneck and would have shut up the Spanish fleet, without risking the life of a single man on board the blocking vessel.

The possibilities seem endless and their extent is shown by some very remarkable trials which have been made during the last few years.

We now have to speak of submarines and airplanes. For their use Mr. Winkley provides the fourth mechanism, the *stabilizing box*, for submarines and airplanes are in delicate equilibrium, and Mr. Winkley takes care of that with this fourth piece of his apparatus.

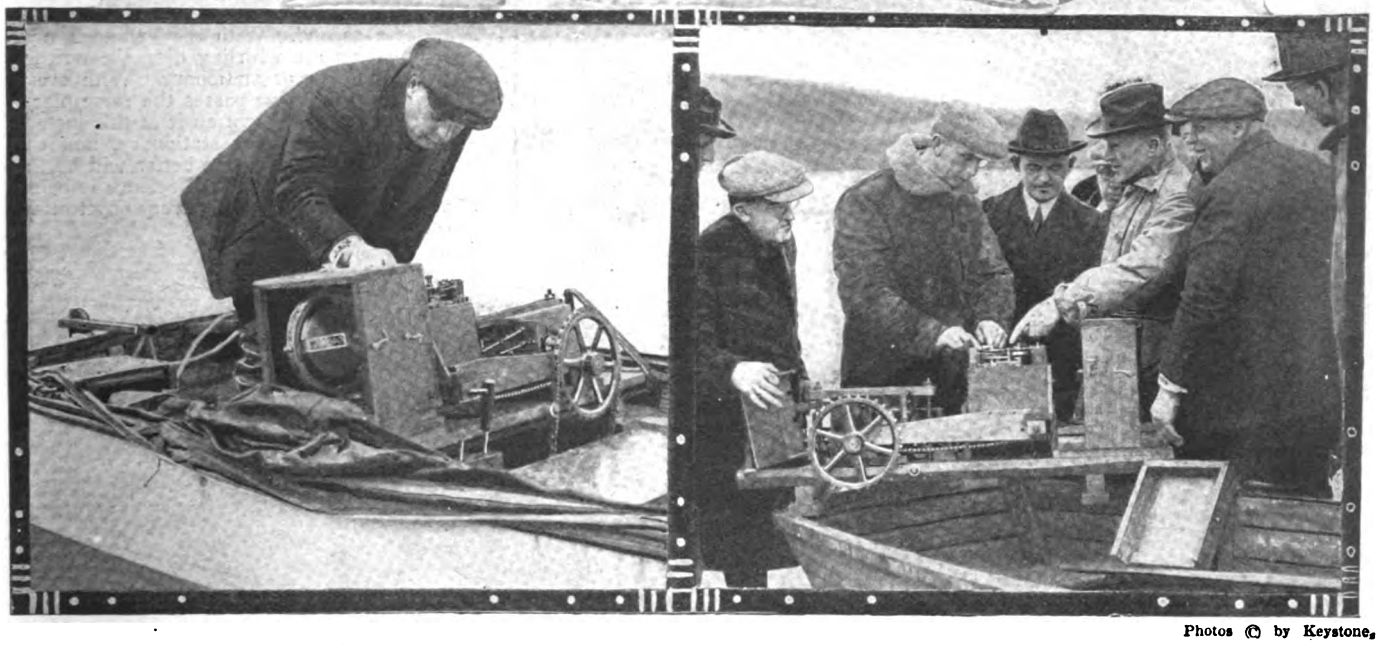
Of course the calculation of the course requires accurate knowledge of the chart and of the tidal effects; these being given, the navigator can lay out the course he desires the boat to follow and it will do it undeviatingly.

The compass box is the mechanism that keeps a constant base line from which the navigator can deviate his course.

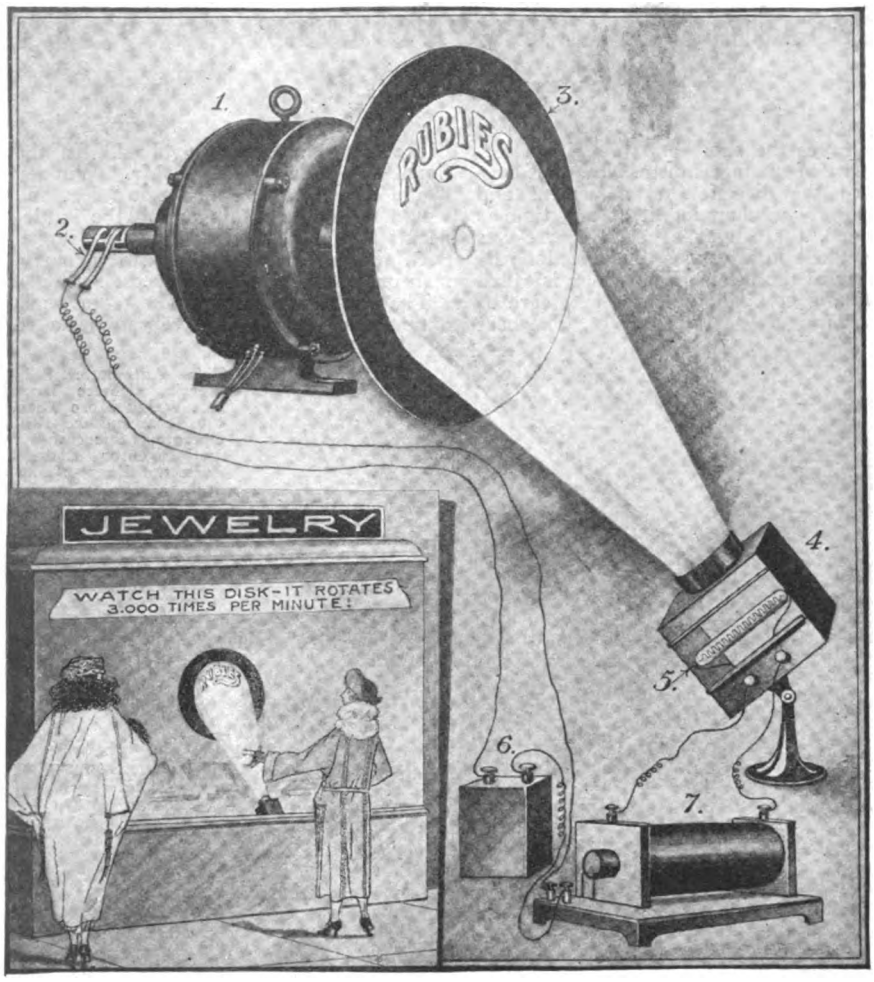
(*Continued on page* 976)

The Photographs Below Show the New Winkley Electro-mechanical Control System Applicable to Boats, Tanks, Automobiles or Aircraft. The Principal Directing Unit in Mr. Winkley's Control Machine is a Gyroscopic Compass. No Radio Waves Are Necessary to Direct Course Which the Ship Is to Follow.

This Automatic Ship Steering Device Does Not Weigh More Than 100 lbs., and It Will Operate Successfully, the Inventor Claims, Even the Largest Battleship. Mr. Winkley, the Inventor of This Remarkable Machine, Is Seen Plotting a Course on the Instrument at Lower Left.



Photos © by Keystone.



This Advertising Sign Is Something Quite Out of the Ordinary. As You Pass Before the Show Window Your Attention Is Attracted to a Sign Which States That the Black Disk You See in the Window Is Spinning at 3,000 Revolutions Per Minute. When the Luminous Rays From the Special Lamp Flash on the Disk, the Letters or Words on the Disk Will Appear Stationary, Due to the Synchronous Interruption of the Light Rays Provided By the Special Arrangement of Brushes and Revolving Copper Segment Secured on the Shaft of Motor. 1—Electric Motor. 2—Plate of Copper Connecting the Two Brushes Electrically at Every Turn of the Motor. 3—Discs on Which are Written the Different Advertisements. 4—Projector. 5—Lighting Tube. 6—Storage Battery. 7—Induction Coil.

Letters Stand Still on Whirling Disc

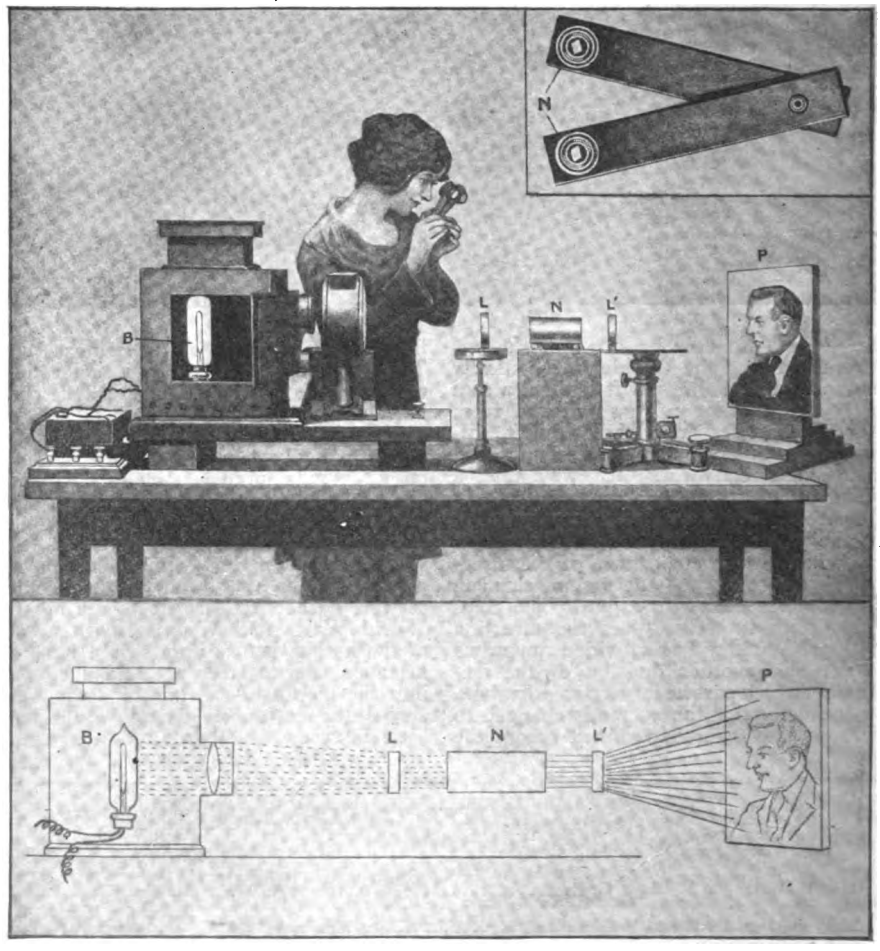
The disc on which are projected the texts of different advertisements and turning at high velocity gives the illusion of a fixt image. This is a method of advertising which has had great success in America. The different texts of the advertisements are written on a black disc, which a small electric motor turns at very high velocity (for example, 3,000 turns per minute). On the other hand, a plate of copper attached to the shaft of the motor brings two brushes into electrical contact 3,000 times a minute. The electric circuit thus closed comprises a battery which supplies current to the primary of an induction coil. This supplies a special lamp, which consequently is lighted 3,000 times a second. With the luminous rays directed on the whirling disc, the writing on it will appear stationary. With every turn the same text passes the same place, and if light is thrown on it at this instant the text will appear stationary, and the faster the disc turns the better will be the illusion. The progress of science is being applied more extensively every day to new commercial problems.

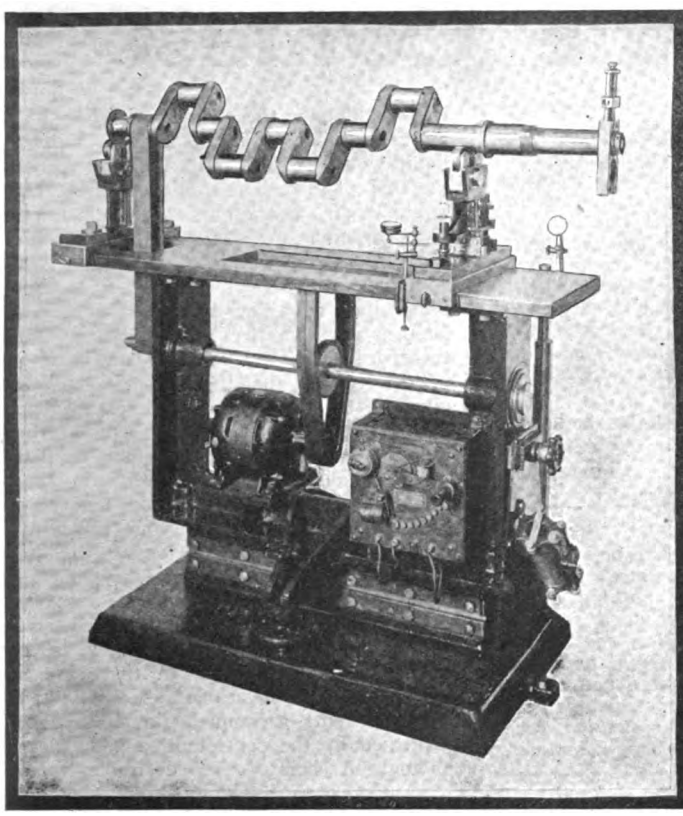
Making Old Pictures Young Again

The French Academy of Sciences has studied a report of M. Pierre Lambert on the use of polarized light in examining old pictures. The apparatus comprises the projection lantern B. A lens L brings the rays into parallelism for their passage through the polarizing prism N; a lens L^1 spreads the pencil of rays so as to illuminate the picture L. The rays which reach our eyes under these conditions are two kinds: the first, the rays reflected by the surface of the varnish, which are in great part polarized; second, the rays which are depolarized by diffusion on the surface of the materials comprising the paints. If one can extinguish the polarized rays, by placing between the picture and the eye a Nicol prism, only the useful rays will traverse the prism; thus lighted, the pictures reassume their strength.

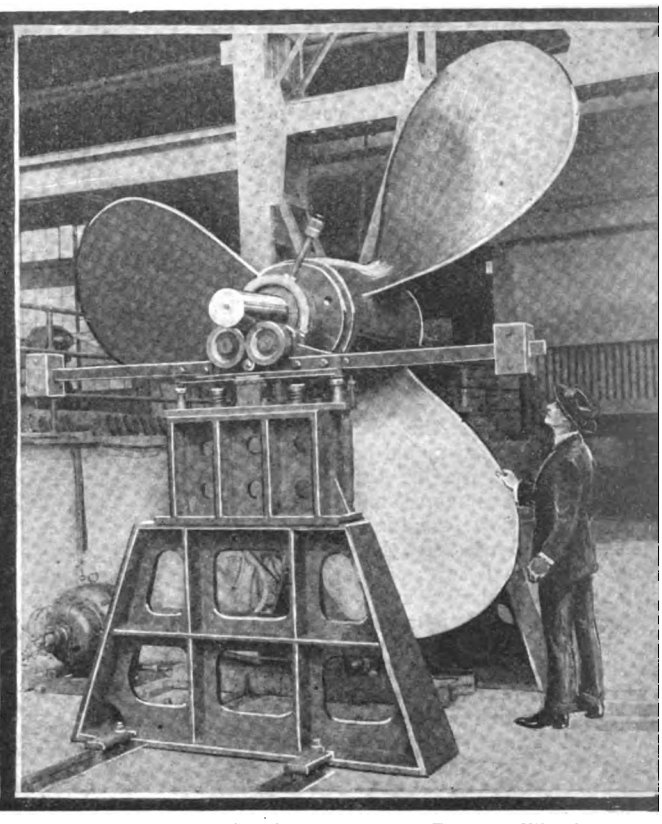
The observer is using a pair of Nicol prisms to look thru. In the lower right-hand corner the mounting of these prisms N is shown.

A French Scientist Has Recently Studied the Action of Polarized Light When Used to Examine Old Oil Paintings. It Is Claimed That in This Manner Old Pictures Can Be Observed Thru the Special Device Here Shown, With All Their Original Color Values. The Photograph and Diagram at the Right Show the Apparatus Used in the Laboratory of Physical Research of the Sorbonne at Paris. The diagram in the Lower Part of the Picture Shows the Apparatus Set Up for Viewing Oil Paintings With Polarized Light, "B" Being the Lantern; L, and L^1 are Focusing Lenses; "N" is a prism, and "P" Is the Picture or Oil Painting. The Small Detailed Insert in the Upper Right Hand Corner Shows the Simple Device Used to Hold the Two Nicol Prisms "N", Held Before the Eyes in Viewing the Painting. It May Be Set for Any Distance Between the Prisms, as the Two Strips are Pivoted at One End.





New Balancing Machine for Testing Auto Engine Crank-Shafts.



Balancing Huge Ship Propeller so as to Eliminate Vibration.

Vibration—The Energy Waster

VIBRATION accounts for hundreds, and even thousands of horse-power, which are wasted every day in all sorts of machinery from the largest steam turbine, or dynamo, down to the ubiquitous Ford automobile. Very few motor car owners, perhaps, realize that if their engine is out of balance when rotating at its normal speed, a considerable percentage of the horse-power they thus obtain is wasted in this fashion.

In plain language, vibration is one form of energy; it takes so many foot-pounds every minute to keep a piece of iron vibrating, every oscillation takes power. Almost everyone has noticed, undoubtedly, the balance weights placed on locomotive driving wheels, which act in such a manner that the two wheels and the axle on which they are mounted will stay in any position in which they may be placed upon two perfectly level knife edges. The simplest example of balancing a rotati machine is perhaps exemplified by the dinary electric desk fan. In balanc the motor armature, shaft and fan bla two parallel knife-edged tracks are leve in all directions, with a spirit level, a the armature and fan being rigidly secu to the shaft in the position which they to have when rotating, are placed upon knife edges. A small strip is cut from

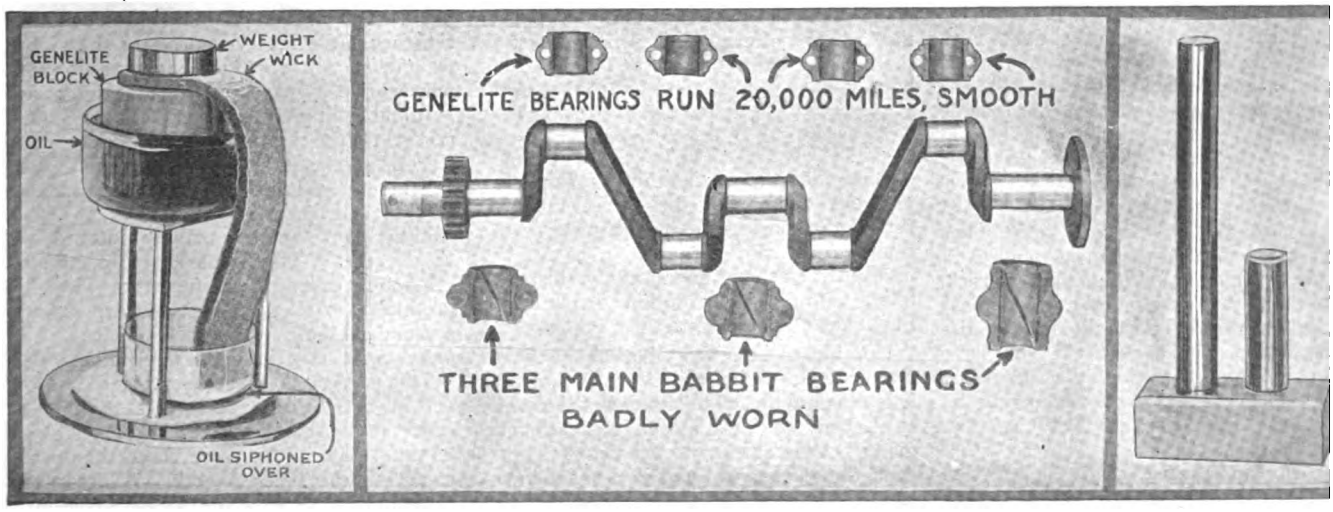
(*Continued on page* 981)

New Self-Lubricating Bearing

Development of a new bearing material which is a mixture of high grade bronze and grafite, having self-lubricating qualities of a high order, has recently been announced and has been subjected to various successful tests under service conditions.

The new material, known as Genelite, contains grafite amounting to 40 per cent. by volume of the whole mass. Fig. 1 shows the comparative volumes, the small tube representing the amount of grafite actually present in the large rod of genelite. Tests have shown a high degree of porosity, the bronze of the mixture being able to absorb as much as 2½ per cent. of its weight of oil. Fig. 2 is a piece of apparatus set up to show this feature of the material. Oil from the upper beaker is siphoned into the lower thru the rod of genelite and the woolen wick, by capillary attraction in both. This characteristic made use of in high speed applicati where oil is applied to the outside of bushing and carried thru to the bear surface by capillary attraction. Anot characteristic is that the bearing ne seizes, or freezes; the metals of the sh and the bearing never flow or weld gether. If a bearing sticks, owing to

(*Continued on page* 978)



2–Siphoning Oil Thru Genelite Block, Showing Great Porosity.

3–Improved Wearing Qualities of New Bearing Metal, Compared to Babbit Bearings.

1–Grafite in Genelite, Ab Two-fifths by Volume.

$100.00 Bottle Contest

WHAT do you do with your old bottles? Throw them away, no doubt. The editor was forcibly reminded of this when a milk bottle, intended for the cat, came sailing thru his bedroom window the other night, and not only disturbed his sleep, but his equanimity as well; in fact, to such an extent that he vowed then and there that empty bottles hereafter should become veritable treasures. The present article shows that he is in earnest with his good intentions.

As mentioned above, the average man or housewife throws away old bottles that are of no further use, be they of the variety that once contained milk, patent medicines or the now forbidden "hootch," ink, etc., etc. Bottles, we hardly need mention, come in all sorts of shapes and sizes. They are always made for one purpose, namely, to act as a container for fluids, pills, etc. But the editor, on that memorable night, could not help wondering whether there really was no other practical purpose that science and the inventor could bring forth to use these bottles for.

WE have attempted to show on this page a few ideas of what can be done with bottles. The other day the editor noticed one of the new popular, silk-clad dolls for decorative purposes about the house, made by a lady of his acquaintance. The lower part, which made up the hoop skirt, was nothing but a milk bottle all nicely covered with silk, as shown. An electric lamp placed inside the bottle produces a beautiful effect.

FIRST PRIZE	.....	**$50.00 in gold**
SECOND PRIZE	.....	**20.00 in gold**
THIRD PRIZE	.....	**15.00 in gold**
FOURTH PRIZE	.....	**10.00 in gold**
FIFTH PRIZE	.....	**5.00 in gold**
TOTAL	.....	**$100.00 in gold**

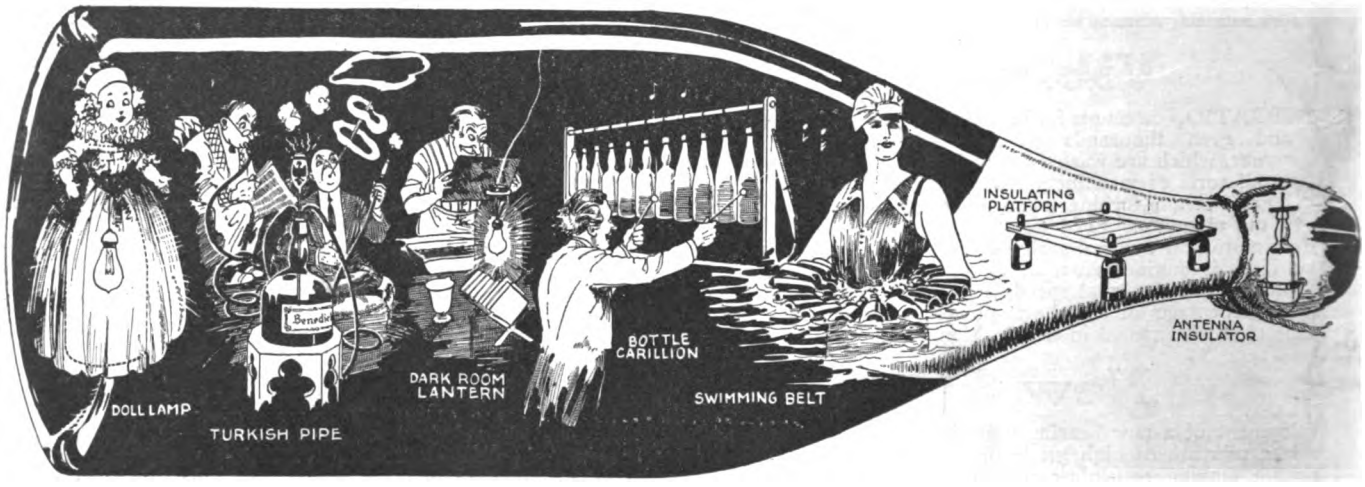
When the editor was a boy he once made a musical instrument called a "Carillon." This is nothing but a rack, which has suspended from it clear glass wine bottles, each bottle filled to a different height with water. If you have enough bottles you can play a tune just the same as on a xylophone, merely by striking each bottle with a small wooden hammer.

but would have to be quite original. Not all cases where a bottle is filled with a liquid would be ruled out. We have shown on this page a bottle filled with a red liquid, it also containing an electric lamp. The combination is for a photographic developing room. Here, you see, is a combination where the bottle is a container, not only for a liquid, but for a lamp as well. Such a combination would, therefore, be allowable.

Bear in mind that the first prize will be given to the contributor who sends in an idea that proves to be, in the eyes of the judges, *the most practical.* Remember that we want PRACTICAL ideas, and many practical objects can be made from old bottles. It is a test for your ingenuity to find the best one.

It is not absolutely necessary that a model of the idea be submitted with your entry, but if the idea is complicated, and cannot be clearly exprest either in a drawing, or photograph, in that case a model would be desirable.

In all events, a complete sketch must be furnished by the contestant, a good clear photograph being very desirable. No



Old Bottles!!! What Do You Do With Them? Ho, Hum. What Is the Use of Trying to Do Anything With Them, You Probably Will Say, But Here Is a Chance to Earn Some Real Money for a Little Spare Time Thought on the Subject of Using Old Bottles for Practical Purposes. Half a Dozen Practical Ideas are Shown Here as a Starter for You. 1—A Doll's Head and Dress are Placed Over a Milk Bottle, and an Electric Light May Be Set Inside of It, Giving an Artistic Decoration for the Boudoir or Parlor Table. 2—A Turkish Pipe Giving the Sweetest Smoke You Ever Smoked. 3—Photo of Dark Room Lamp Comprising Electric Light Suspended in Red Solution Inside Bottle. 4—Musical Carillon Made From a Set of Bottles, Each Filled With Water to a Different Height to Give the Successive Notes of the Scale. 5—Swimming Float Made From a Number of Corked Bottles Secured to a Belt. 6—Insulating Platform for Electrical Experiments Made From Four Bottles and the End of a Packing Box; Also How Antenna Insulators Can Be Made From Bottles.

We have attempted to show on this page a few ideas of what can be done with bottles. The other day the writer noticed one of the new, popular, silk-clad dolls for decorative purposes about the house, made by a lady of his acquaintance. The bottom part, which made up the hoop skirt, was nothing but a milk bottle all nicely covered with silk, as shown.

When the editor was a boy he once made a musical instrument called a *Carillon.* This is nothing but a rack, which has suspended from it clear glass wine bottles, each bottle filled to a different height with water. If you have enough bottles you can play a tune just the same as on a xylophone, merely by striking each bottle with a small wooden hammer.

But why go further? The illustrations shown on this page explain the idea. We are so sure that our readers will think up wonderful things to do with old bottles that we are offering this prize contest in the hope of finding real uses for discarded bottles.

RULES OF THE CONTEST

Only ideas for using bottles *for other purposes* than what they were intended for can be considered. In other words, we cannot consider ideas wherein bottles are used purely as containers, as, for instance, filling with different solutions or materials. Such ideas are obvious.

No ideas involving bottles used as chemical glassware can be considered, as it is obvious that almost any bottle can be easily converted into a chemical bottle, and many bottles are so used now. If, however, the contestant sends in a novel chemical experiment that employs a bottle in a new way, such an idea will be considered.

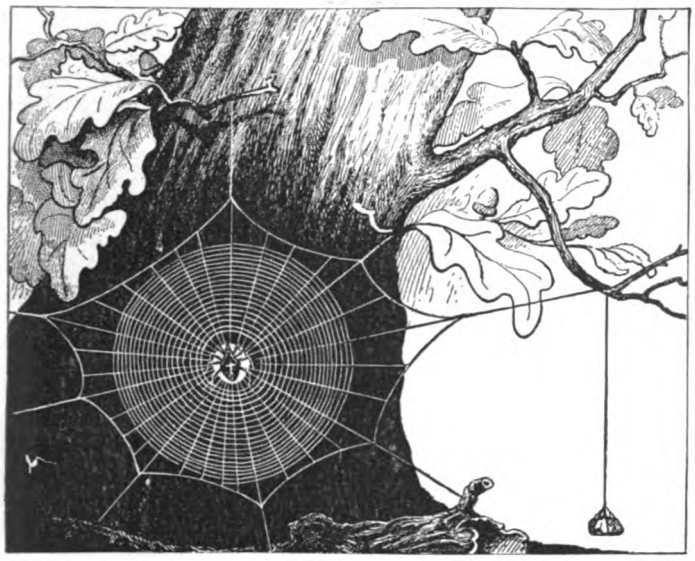
manuscript entered in this contest can be returned. We reserve ourselves the right to publish all worthy ideas that do not win a prize by paying regular space rates.

In publishing the various ideas all rights revert to the publishers. Use only one side of the sheet when writing, and use ink or typewriting. No penciled matter will be considered.

More than one idea may be entered by contestants. The contest is open to everyone, except manufacturers already producing articles made by incorporating a standard bottle into their device. All prizes will be paid upon publication.

This contest closes at noon, March 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, Bottle Contest,* care of this publication.

The Spider Engineer



Did You Think That a Spider Would be Wise Enough to Secure a Cord to His Web, Together With a Weight, as Shown in the Illustration at the Left, Whereby Any Slackness in the Strands of the Web Would be Taken Up? But Such is the Case, However.

Most of us have now and then marveled at the wonderful skill of the spider in spinning his nets at almost every conceivable spot, some of the nets and suspension lines being works of real ingenuity.

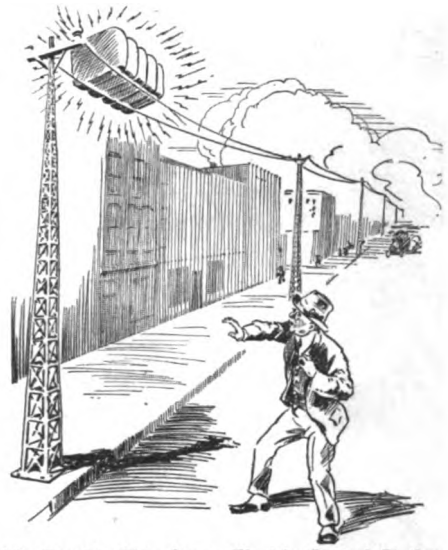
You have probably also noted how quickly the spider's net dries up in the morning, while the dew still hangs heavy on the trees and flowers, this being due to the fact that the spider shakes his nets early in the morning. One of the most ingenious accomplishments of the spider was, however, observed this summer just outside a large electric factory in Västeras, Sweden, where a spider had strung a suspension line from the web over a tree branch and down to a small stone on the ground, as shown in the picture. The stone not being so heavy but that it could be lifted with the line, it was thus observed that when the tree branch swayed due to the action of the wind the line glided along the branch, lifting the stone and thus keeping a fairly constant tension on the net without breaking the line or thread.—Guston E. Jansson.

"Some" Short-Circuit

SOME few years ago while the writer was operating a switchboard for a northern New York power company, we had a terrific short-circuit on one of our Troy feeders.

It blew up the oil switch, setting the oil on fire and filled the station with smoke.

The load dispatcher sent out linemen to locate the trouble if possible. It was soon done, a livery stable, about four blocks from the station, had been opening baled hay in the hay loft and one of the men tried to save time by throwing the wire out of the window and succeeded in throwing it across the 12,000-volt line.

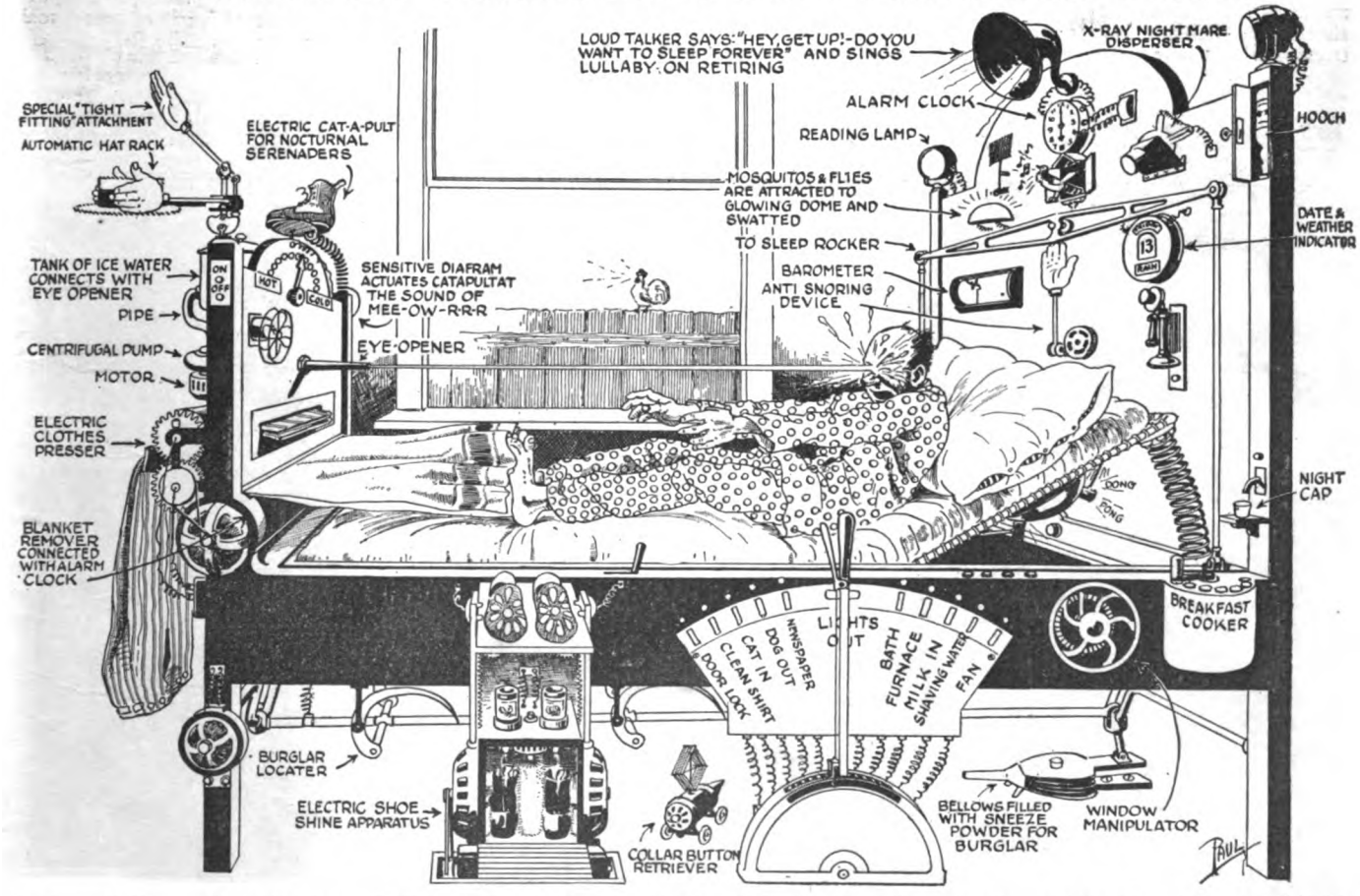


The Trouble Man for an Electric Central Station Reported Line Trouble as Follows:—"Short-Circuit Caused by Some One Throwing an Empty Bale of Hay on the Line," Instead of Stating That it Was Simply the Wire, and not the "Hay" Also.

The load dispatcher who was usually a very precise man, slipped a cog in making out his report this time, for the Glens Falls office was dumbfounded when looking over his report to find the cause; they noted that it was caused by "Some one throwing an empty bale of hay on the line."

Contributed by A. G. HARRIMAN.

An Electric Chanticleer Proclaims the 'Morn

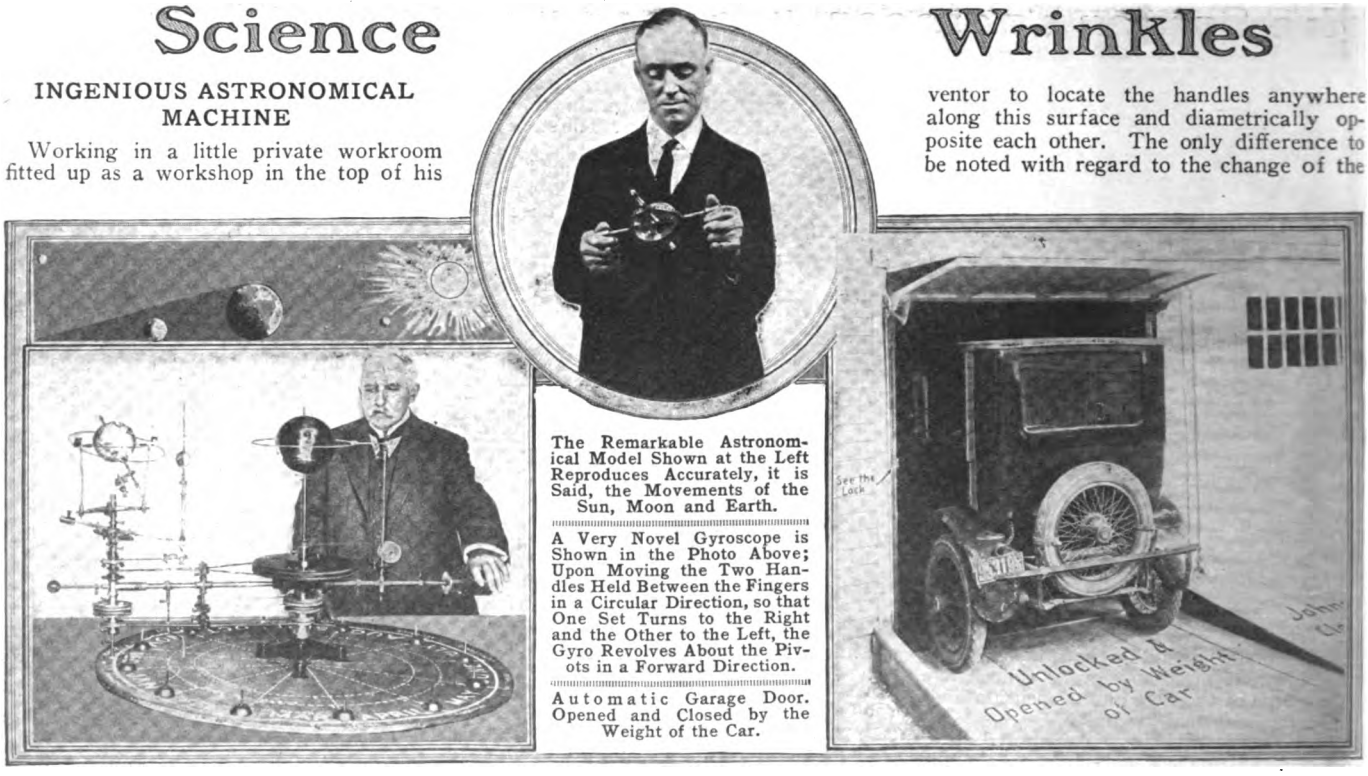


In Rostand's Famous Play, "Chanticleer," a Barnyard Rooster Proclaims the Morn in Loud and Lusty Tones, but Here is the Very Latest Conceit in Scientific "Eye-Openers," Especially Intended for Those Who are Perpetually Late at the Office or Factory. We Believe Everything is There, Friends, Even Down to an Electric Shoe-Shiner, but if There Is Anything Missing, We Give You the Full Privilege of Adopting It on Your Own Bed Without any Royalty Fees. Do not Overlook the Radio Controlled Collar Button Retriever, a Real Masterpiece, and, for the Old Maids—Pipe the Sure-Fire Burglar Locater and Annihilator.

Science Wrinkles

INGENIOUS ASTRONOMICAL MACHINE

Working in a little private workroom fitted up as a workshop in the top of his house at 43 Fellowes Road, London, England, Dr. William Wilson has perfected a wonderful astronomical model which with mathematical accuracy reproduces the movements of the sun, moon, and earth. With this model it is possible to demonstrate the nature, number and character of the eclipses possible in any year, to illustrate such obscure points as the retrograde motion of the moon's modes and the forward motion of the line of apsides of the moon's orbits. The photo shows Dr. William Wilson with his astronomical machine.



The Remarkable Astronomical Model Shown at the Left Reproduces Accurately, it is Said, the Movements of the Sun, Moon and Earth.

A Very Novel Gyroscope is Shown in the Photo Above; Upon Moving the Two Handles Held Between the Fingers in a Circular Direction, so that One Set Turns to the Right and the Other to the Left, the Gyro Revolves About the Pivots in a Forward Direction.

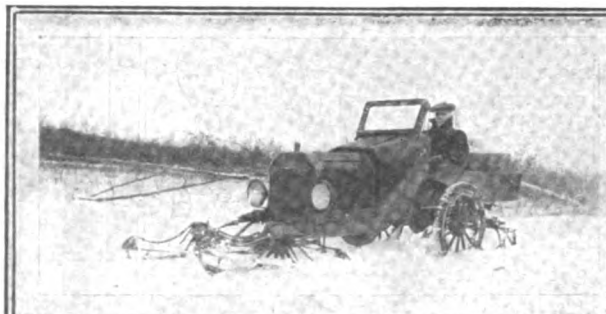
Automatic Garage Door. Opened and Closed by the Weight of the Car.

NEW GYROSCOPIC THEORY

In the photo herewith we see a rather novel stunt and possible explanation of the gyroscope's peculiar action. Upon moving the handles, in a circular direction so that one side turns to the right, and the other to the left, the gyroscope revolves about the lateral pivots in a forward direction. By shifting the movement of the handles so that the motion is exactly opposite to what it was previously, the gyroscope turns in the opposite direction, even tho it is rotating all the while. The holes along the rim enable the inventor to locate the handles anywhere along this surface and diametrically opposite each other. The only difference to be noted with regard to the change of the position of the handles is that the movement is much more rapid. The inventor claims that he has invented a fourth force derived from three other forces. From the movement of the right hand and the movement of the left hand, together with the movement of the flywheel of the gyroscope, all of which are constantly rotating, he says that he obtains a fourth movement of the entire mass of the gyroscope which rotates at right angles to the axis if the handles are placed in the position illustrated, or at various other posi-

(*Continued on page 987*)

Motor Sleigh



Here is a Motor-Sleigh I Devised and Built Last Winter. The Front and Rear Ends are on Runners, the Front Ones Being Built on the Regular Wheel Hubs and then Slipt on to the Spindles Like the Wheels, Steering in the Same Manner. A Wide Flange is Built Part Way Up on to the Front Runners to Keep the Front End from Sinking Too Deeply in Loose Snow. The Drive Shaft has Been Shortened as Much as Possible, in this case to 8", to Permit Plenty of Engine Weight to Come on to the Drive Wheels. The Hind Runners Take Part of the Weight, but Where More Traction is Needed, There is a Lever for Lifting These Hind Runners Completely Off the Snow, Thus Transferring the Weight to the Drive Wheels.—Contributed by Dr. E. W. DeLong.

Writing Device

The Two Photographs at the Center and Extreme Right Show a Child Using Mr. Victor Hansen's Clever Invention, Which Should Aid considerably in Teaching Anyone to Write. There are Three Aluminum Letter and Figure Strips. The Strip Desired is Placed Over the Edge of the Pad, and After Tracing a Letter with a Pencil Point on the Aluminum Several Times, the Student Writes It on the Pad Paper.

Fortunes from Little Things

By CHARLES FREDERICK CARTER

No. 8. Marvelous Tale of the Safety Razor

"WELL, Gillette, how's the razor?" For six weary years King Camp Gillette, a traveling salesman, had to endure this sneering salutation from the numerous breed of smart Alecks. It served him right, for he had no business to let any one know he was so foolish, as to imagine he could improve the good old razor, with which mankind had shaved itself, or had been shaved, ever since Adam first sprouted a dusky down on his upper lip.

Not many years later the tune changed to, "Gillette, Old Man, why didn't you give me a chance?" You see it turned out that the smart Alecks were wrong, as they usually are, and that Gillette could, and did, improve the razor very much, indeed. In fact, his safety razor proved to be the biggest little thing ever turned out of the patent office, earning net profits of $4,500,000 a year less than seventeen years after the first steps had been taken to form the first company to manufacture it, while the business was then, and still is, on the increase. Altogether the story of the Gillette Safety Razor constitutes one of the most fascinating of all the wonder tales of business.

It is rather a nice question to decide whether Gillette invented the razor on purpose or not. He was wild to invent something that would make money, but he didn't care whether it was an automobile tire chain or a combination collar buttoner and tooth-pick, or what it was. He was traveling for the Crown Cork and Seal Company, manufacturers of the bottle cap described in the first article in this series; and he had formed a firm friendship with William Painter, the inventor of the bottle cap. Gillette had invented a number of things which had made money for others, but none for himself, for he had not yet cut his eye teeth. One day Painter said to him,

"Gillette, you are always thinking and inventing something, why don't you try to think of something like the Crown cork, which when once used must be thrown away and the customer keeps coming back for more?"

From that hour the idea of inventing something cheap which would have to be thrown away when once used and replaced by a new article became an obsession; yet nothing happened for some years.

One summer morning in 1895, when Gillette was forty years old and was becoming fed up on traveling, he prepared to shave himself. The razor was so dull he could not tell back from edge until he took a chance, when it bit, gouged and scratched so savagely he knew he had guest right. He held the old thing off at arm's length intending to apostrophize it in language befitting the provocation, when he suddenly became transfixt with joy.

The Name of Gillette is Synonymous with the Safety Razor in the Minds of Many Shavers, in Fact so Many, That This Useful and Extremely Efficient Little Device Has Made a Large Fortune for Its Inventor—Mr. King Camp Gillette. Like Many Other Small Yet Necessary Inventions, the Safey Razor Required Considerable Research and Experiment in Perfecting Not Only the Shape and Size of the Instrument, But Special Steel Had to Be Made Before the Blades Finally Proved Entirely Successful. It Was Not So Many Years Ago When the Average Man Looked Askance at You When You Said "Safety Razor."

Before his mind's eye floated a vision of the Gillette Safety Razor substantially as it is today; for it has never been changed in form or principle involved, but only in refinements. Without stopping for breakfast he hustled out to a hardware store in Boston and bought some pieces of brass, some steel ribbon such as is used for clock springs, a hand vise and some files. Then he went back to his hotel room and there fashioned the first safety razor with his own hands.

That was the only easy step. Nobody would listen to his crazy idea of a razor, the blades of which were to be used once and thrown away, any more than any one would listen to Alexander Graham Bell's equally mad scheme for talking thru a wire.

But Gillette had lots of fun planning what he would do with the enormous profits he would make, once things were going nicely. For one thing he calculated that he could buy steel at 16 cents a pound and that a pound would make 500 razor blades. He found later the steel would cost many times 16 cents and that a pound would make somewhat fewer than 500 blades. Moreover, the Company, when it was formed at last, had to pay out a quarter of a million dollars in cold cash for laboratory experiments to find the proper steel.

No progress whatever was made for six years after the idea was formed. Then thru a friend he was introduced to a Mr. Heilborn, who agreed to help form a corporation. First, tho, they arranged with W. E. Nickerson, a Technology graduate, to develop the razor. Nickerson stipulated that they must first raise $5,000 and put it in a bank, half to be for his salary, the other half for rent, tools and incidentals. To get this amount in real money they formed a company with a nominal capital of $500,000, one-fifth of which was to be sold for $5,000, or five cents on the dollar par value. Get-rich-quick oil companies had nothing on the bargains offered in original Gillette stock.

Even at that they could raise only $3,250 in three months of strenuous endeavor. Gillette finally gave $40,000 of his own stock as a premium to induce a man to make up the remaining $1,750 in real money needed. Nickerson proved to be the one man capable of perfecting the razor and of inventing the machinery needed to manufacture it economically but he spent all the $5,000 and the company was in debt nearly $12,000 before he succeeded. Nobody would buy a share of stock at any price. Creditors were pressing. The board of directors assembled for one parting look at the remains and screwed down the coffin lid on their fond hopes.

Going out to lunch Gillette met a man to whom he owed $19,700. He looked so glum his creditor, who had been shaving with one of the first razors, asked what was wrong. The upshot was that John Joyce, the creditor, agreed to buy the company's bonds for $100,000 at 60 cents on the dollar, advancing $5,000 at a time as needed with the privilege of stopping at $30,000 if things didn't look right. In an hour the thing was done and the first money paid into the treasury.

From that day the Gillette Safety Razor has had plain sailing. Gillette had given away nearly all his stock in the company in vain efforts to float the concern; but he was fortunate in being able to buy back a large interest before prices were marked up too high. At first the Company did nothing but manufacture, turning the product over to two young Chicagoans to sell. The young men had no money, so they borrowed $3,000. Their profits did the rest. Less than three years later the Gillette Company bought them out for $300,000.

By the beginning of 1918 the Boston factory was turning out blades at the rate of 370,000 a day, which meant approximately 22 miles of sharpened edge. The output of blades and razors produced by one thousand employees was five times that produced by 1,800 employees nine years before, thanks to the wonderful machinery developed by Niokerson. In 1919 the Company manufactured 2,315,892 razors and 17,320,517 dozen blades, but even this did not meet the demand for on January 1, 1920, there were unfilled orders on hand for 207,685 razors

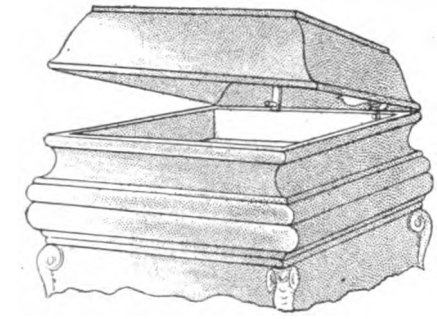
(*Continued on page* 977)

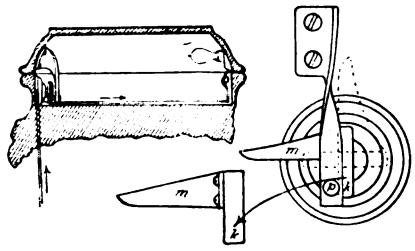
Home Mechanics

Conducted by WILLIAM M. BUTTERFIELD

AUTO ELECTRIC LIGHT FOR PHONOGRAPH

An automatic light applicable to top or record cabinet of a phonograph is shown in the illustrations below. The automatic feature consists of two pieces of metal,

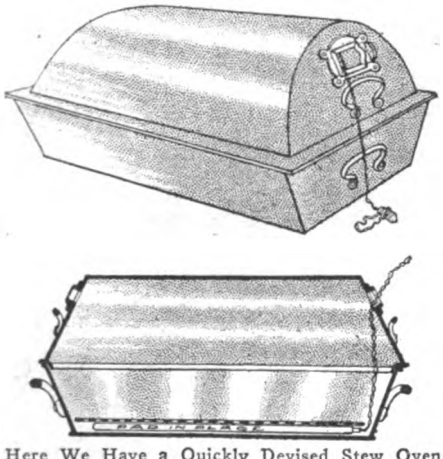




Automatic Phonograph Light. An Ordinary Snap Switch Is Fitted With a Metal Blade "M" So That When the Lid Trip Pin "P" Strikes It, During Raising or Lowering Operations, the Switch is Actuated So As to Open and Close the Circuit to the Lamp. This Scheme Is Suggested Where a 110-volt Lamp and Switch Are Employed; If a Low Voltage Battery Lamp and Switch Are Used, Then Ordinary Spring Brass Contacts Actuated by the Lid May Be Utilized.

one for the lid, the other for the key on an ordinary electric current switch. The light consists of any desired style of electric fixture, wired and installed in the conventional way, using a common quarter turn switch of the style shown. The light may be within the phonograph cabinet, on a table, or even on the wall, if so desired; the wire simply running thru the cabinet where the light is placed.

The drawings illustrate the plan admirably; it is one where a piece of material



Here We Have a Quickly Devised Stew Oven or Warming Oven. It Is Improvised From a Double Cooker and the Household Electric Heating Pad. Fine for Raising Bread.

attachable to any moving body, such as a door, a cabinet lid, drawer, etc., carries a projection (P) so arranged as to engage a special piece (M), on a key of any current switch, as said lid, door or drawer is opened, thus causing the key to turn on the current as it is moved in one direction. The current is turned off by a reverse movement of the lid, door or drawer, thus causing the projection (P) to engage the key (K), forcing it to turn in the direction necessary to shut off electric connections.

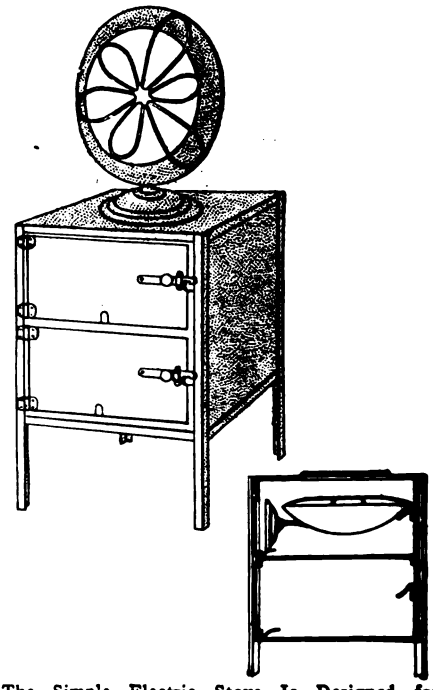
DOUBLE COOKER STEW OVEN

A way to provide a quickly devised stew oven, warming oven, etc., is shown below. It is constructed temporarily—without injury to the implements used, by employing the kitchen double cooker and the household warming pad in combination. The ordinary electric warming pad will furnish heat enough to raise bread or biscuits, stew a pot once it is brought to boiling on the stove or keep a meal hot if confined in an enclosed chamber such as is provided in a double cooker.

HOME DISHWASHER

A dishwasher that does not interfere with the common use of the kitchen sink is shown below. It consists of a chest of any convenient size or shape with a lid that can be closed, making a water-tight inner chamber; a series of attached pipes so constructed and placed as to throw cascades of water in all directions within the space they enclose; a strong metal basket, with mesh as open as possible, fitting easily within the space within the spray pipes and thus removable as shown; a leader pipe connecting the dishwasher with the sink pipes (in the manner also shown), having separate stop-cocks, and a system of drainage that is sufficient to carry off water more freely than it can be introduced within the chamber of the dishwasher.

A combination of this character is shown in details in the drawings, thereby providing the home mechanic with the necessary hints for construction. The dishes can be piled in the basket with their soiled surfaces exposed more easily if the basket is taken from the washer and placed in the sink. When this is done, and a piece of soap laid securely on the top of the pile, the basket with its load is placed in the washer for washing. This will take only a few seconds. Rinsing and drying is accomplisht by first removing the soap then letting the hot water run until the pile of dishes is thoroly heated. The basket is then removed as at first and placed in the sink; the dishes will dry completely in a few minutes.

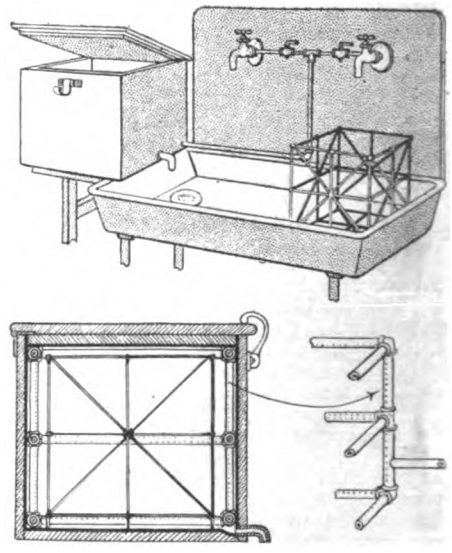


The Simple Electric Stove Is Designed for Utilizing, As a Heating Unit, One of Those Popular Polisht Copper Reflecting Heaters, Which You Plug Into a Base Receptacle to Heat Up the Bathroom or Spare Room. The Electric Heater Is Placed Inside Either Compartment As Shown, or It May Be Set on Top of the Oven as in the Larger Picture, When the Air in a Room Is to Be Warmed.

COMBINED ELECTRIC RADIANT HEATER AND COOK STOVE

A space-saving device is illustrated above, wherein a common radiant or indeed any small electric or gas heater, can be made to heat a room and cook a meal all at the same time. The device consists

(*Continued on page 976*)



Who Said Dish Washers? Everyone Hates to Be Bothered With Washing Soiled Dishes and the Author Shows a Simple Dishwashing Machine in the Accompanying Drawings, Which Most Anyone Can Construct With a Little Care. The Cost Is Slight and With Hot and Cold Water Available, It Will Cleanse the Offending China With Alacrity. If Steaming Hot Water Is Used, the Water Will Entirely Evaporate, So That the Dishes Will Not Have to Be Dried With a Towel.

Editor's Mail Bag

"HEADLIGHT OF PROGRESS"

Editor SCIENCE AND INVENTION:

There is one feature that has been overlooked by all the critics that have found space in the "Editor's Mail Bag," which to me has been worth many times the cost of your magazine in the past. *It is its ability to lift a man out of a rut.* I have four highly skilled men in my laboratory on a development that has occupied our attention for more than four years, while my own mind has been busy waking and sleeping. I have made a study of every electrical and acoustic work published, all the scientific publications having any bearing upon our work and have studied the files of the patent office back over a period of thirty years for a knowledge of "the prior art," but all tend to confine a man to "the rut of past experience" which is not conducive of progress.

SCIENCE AND INVENTION, from my reading, has proven a "Headlight of Progress." It has "Vision." It not only records the worth while achievements of the hour, but initiates new thoughts of inestimable value to the man in search of new methods. It makes one *think*, and when thoughts take an analytical turn, they beget other thoughts that can be applied to one's own specialty. This is of intrinsic value and more productive of results than hours of research in the rusty archives of the past. This is what SCIENCE AND INVENTION has done for me, and I appreciate the assistance it has brought me as I would the counsel of a most trusted friend and confidant.

D. A. REYNOLDS.

National Audiphone Company,
New York.

AN ANONYMOUS BRICK-BAT

Editor SCIENCE AND INVENTION:

Your magazine is becoming more and more a boys' magazine all the time. You have various departments for boys all thru your magazine and you don't have enough "stuff" of interest for your older readers. You will say "I hope you don't want to begrudge the young scientists and inventors the knowledge that is contained in SCIENCE AND INVENTION." No, you need not begrudge the young scientists, but you must not make your magazine ALL for the young readers. You must have as much "stuff" for older readers as you have for the young ones. You must have things of interest to readers in their late teens and early twenties. You must also have things of interest to men of 25, 30 and up. There are lots of men who would take your magazine if it wasn't so full of "kid stuff" such as the various departments you run for small boys. You MUST have MORE "grown-up stuff" if you want your magazine to be popular among older and more experienced readers. YOU MUST HAVE MORE SCIENTIFIC FICTION, MORE SCIENTIFIC ARTICLES, MORE SCIENTIFIC HUMOR. Everybody has a sense of humor and everybody enjoys a good joke.

MIND—THE TERRIBLE MECHANISM

Editor SCIENCE AND INVENTION:

I am an enthusiastic reader of SCIENCE AND INVENTION and am keeping a file of your magazines for reference and study. The articles on "Popular Astronomy" are especially interesting and instructive. The admirable editorials by yourself are usually the first items of most absorbing interest to me, in that they are written for the purpose of stimulating and stirring the imagination along scientific lines, and developing mental activity towards production of concrete ideas for the advancement of pure science. I most sincerely beg to differ with some of your correspondents in the opinion that some of the articles deal with too fantastic contrivances. "Much has been achieved by attempting the impossible" and the motive behind the description in your magazine of things which seem impossible in the present day is to set in motion the most intricate, and if I may say,—terrible, piece of mechanism in God's creation; namely, the human mind. There is no limit to the potential power of this piece of mechanism, through the medium of thought, and anything which tends to accelerate its action towards higher accomplishment is not in vain. The little short stories, or scientific fiction, which you print serve their useful purpose in this direction.

I enclose herewith a clipping from a special edition of a local paper describing a so-called "Power Wheel," purporting to be the source of unlimited free power, the idea of a railroad brakeman. This item only goes to show that the perpetual motion cranks have not as yet stopped "cranking." As I am a native of Arkansas and rather jealous of that honor, I am glad that the inventor of this Wheel has admitted that he came from Texas. When I read the description of this contrivance, I referred to your February, 1920, issue and turned to page 1013, "Perpetual Motion Contest," which, if it had been read by this gentleman, would have convinced him of the fallacy of his deductions.

I wish to assure you again of my great interest in your magazine.

F. O. GARRETT.

Little Rock, Ark.

WE call especial attention to Mr. Reed's letter appearing in the adjoining column. Here indeed is a very interesting suggestion, and one that cannot fail to appeal to many of our readers.

We shall be glad to open the columns of this page to our contributors who desire to discuss ideas or problems which as yet lie in the future, and which are not perfectly understood. In the words of Mr. Reed, the new page would be:

"One of theoretical science, a sort of gathering place where the thinkers of the land could meet, and exchange and discuss their opinions. A place where such topics of world-wide interest as life, motion, electricity, matter, space, etc., are gone over."

We, therefore, invite our readers to submit their letters to us, marking same to the attention of the *Mail Bag Department.—Editor.*

OUR FANTASTIC ARTICLES

Editor SCIENCE AND INVENTION:

I am a subscriber to your magazine, and as you invite readers to offer suggestions I write to state what I think of your magazine.

The most valuable and important feature of your magazine, in my estimation, and what makes it particularly interesting, is your proposals of new schemes and inventions. I like these speculative articles that the conservative magazines usually avoid. Here you fill a gap not filled by any other publication. Some of your readers and critics in the "Editor's Mail Bag" seem to scoff at this feature of your magazine, calling your scheme visionary and fantastic. While you will, no doubt, cheerfully admit yourself that some of your proposed schemes and inventions are unworkable without further development, and some may be entirely impossible; yet your articles give food to the imagination and lead one into interesting trains of thought and give one new ideas. Your magazine is valuable to the inventor.

The other important feature of your magazine is that you give descriptions of the latest inventions and processes and news of things in general in the realm of science and invention.

A writer in the November issue of your magazine seems to think that you ought to fill up your magazine with articles "rehashing" the philosophies of the ancients which have already been "rehashed" so many times that there is not a kernel of grain left in them. No, for my part I would not care to get knowledge of the ancients from a magazine, but rather from books on history.

The reproduction of matter contained in standard text books, I consider as "dead lumber" in a magazine. I for my part prefer to study astronomy, chemistry, and so forth from a standard text book on the subject, but, of course, any new aspects or discoveries on these subjects should find a place in your magazine.

PETER F. SCHULTE.

Norway, Iowa.

A GOOD SUGGESTION

Editor SCIENCE AND INVENTION:

You will see by the inclosed coupon that I am satisfied with the magazine as it is; and yet, I have marked for more of certain departments. The subjects marked are the ones I like; the others I care nothing for. Yet, knowing that all people are not alike and that many must enjoy such lines of study, I am content for it to remain as it is. The marking of these other subjects merely show my preference.

There are two features of SCIENCE AND INVENTION which deserve the commendation of every student of the world—thinkers who are trying to unravel some of the mysteries of the Universe. One of these is the editorials; the other one is certain articles by other writers who bring to our vision pictures of things to be in the years to come. I am sure that these must be an inspiration and an encouragement to those who are looking ahead. One thought leads to another, and sometimes they span a chasm between a life and its goal; who knows what these impressions will lead to? To read some of your editorials where you affirm that there are no impossibilities in the field of science is to reinforce one's faith in a bright future for us mortals. When the world realizes the accuracy of that statement its progress will increase with astounding rapidity.

But the large masses of humanity are very far from such a conclusion. Sometimes to mention the merest unknown trifle is to invite their scorn. This, at first hand, looks very strange; for the great sphere around us might be compared to a closed box which a man might hold before another asking him to guess at the contents. There could be a million guesses made without a single one being correct. And so it is with this vast realm around us; we will be guessing at the realities in its unexplored depths many centuries hence, and be missing our guess. But as the factors are different in the making of men so must the finished product be. No, the time has not yet come for

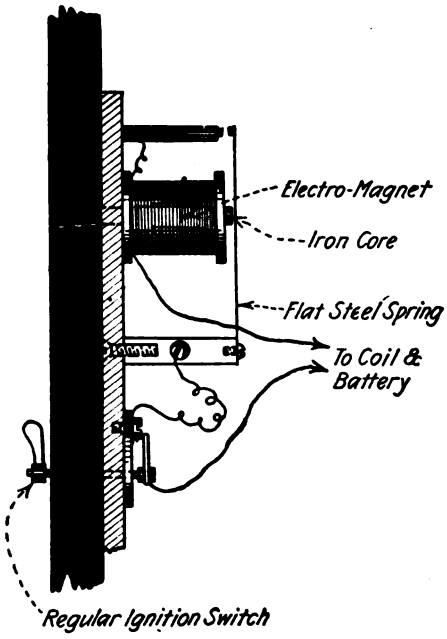
(*Continued on page* 977)

MOTOR HINTS

First Prize $25.00

A MAGNETIC THIEF-PROOF SWITCH

The illustration herewith shows a simple and easily made secret ignition switch,



Secret Thief-Proof Ignition Switch Which Can be Installed on Any Motor Car. This Switch is Mounted on the Rear of the Dash, and to Close the Circuit You Employ a Horseshoe or Bar Magnet, which is Placed in Contact with the Iron Core of the Magnet which Projects Thru to the Face of the Dash. This Causes the Armature Spring to be Attracted and, the Circuit then being Closed, the Electro-Magnet is Energized and Holds it Closed. The Usual Ignition Switch is Opened to Stop the Engine.

which can only be closed by means of a magnet carried in the door pocket of the car, or in your pocket. Not one person in a thousand would ever tumble to the fact that this switch acts in the way it does. It operates on the same principle as do several of the electrical toys on the market. A soft iron core, such as that from a bell magnet, is mounted on a piece of fibre, and a thin spring steel armature is secured in the manner shown. The magnet may very well be one obtained from an electric bell, but usually this will have to be rewound with heavier wire, as the resistance of the magnet coil for this switch should not be more than one ohm, and preferably much less.

To close the switch, the steel magnet, either of the horseshoe or straight bar type, is placed against the iron core protruding thru the dash instrument-panel, and the core being thus magnetized, will attract the steel spring armature, thus closing the ignition circuit, if the usual ignition switch has already been closed. The ignition current passing thru the coil, will now hold the armature in the closed circuit position against the magnet coil, and this will not be opened again until the regular ignition switch is opened. Silver, tungsten, or platinum points should be placed on the contact post, as well as on the free end of the armature spring to make a good circuit.

Contributed by P. T. FARNSWORTH.

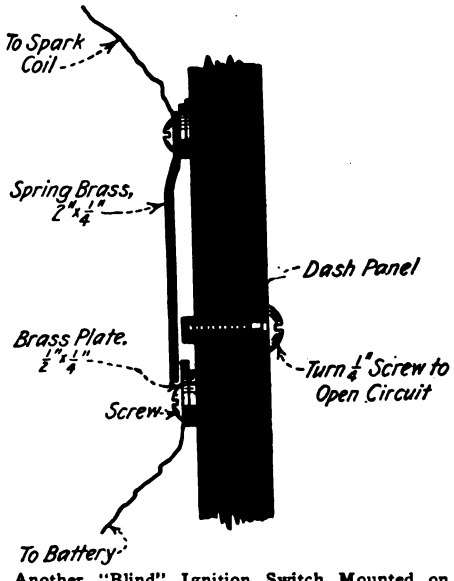
Second Prize $15.00

ANOTHER SECRET IGNITION SWITCH

The secret ignition switch shown in the sketch herewith is simple to build and also to apply. It should be connected in series with the usual ignition push button, so that the engine can be stopt readily with the convenient switch supplied for the purpose. When you are about to leave the car for a length of time, simply give this screw a turn with a little screw driver carried in your pocket, and the contacts in the rear of the instrument panel are forced apart, thus opening the ignition circuit connected with it.

The trouble with any ignition switch is the fact that the average automobile owner places too much confidence in the switch, and does not stop to think that automobile thieves are usually pretty smart men, and that possibly one of the first things they will attempt to do, if they have a chance at all, will be to look under the dash, and not finding the wires concealed or housed by a steel covering or otherwise, will attempt to short-circuit the wires leading to any lock or secret switches. The space under the dash, at least where wires are in evidence, should be housed in, to prevent thieves using *jumper* connections under the hood; the latter should be locked down in every case. It is well to camouflage the secret screw switch here shown as much as possible, by placing three screws or more on the instrument panel or dash, but not in too regular order which might attract the eyes of the thief. The screw should be flush with the panel circuits normally and the switch should be arranged so that when given one turn, it will just open the contacts. A slight depression in the panel should be provided back of the screw head, and of just the same size, so that it will not be noticeable and attract attention toward the screw.

Contributed by W. G.



Another "Blind" Ignition Switch Mounted on the Rear of Dash or Cowl; the Switch Blade Being Moved Away from the Contact by Means of the Machine Screw which is Given a Quarter Turn with a Screwdriver.

NOTICE TO CONTRIBUTORS

KINDLY note a change in this contest. For the coming months we would like to receive from our contributors articles on the following subject:

ELECTRICITY ON THE CAR

We believe that there are hundreds of new electrical ideas that can be incorporated in the car that our readers would like to know of. What we are particularly interested in are novel stunts, new devices, new kinks, and new hints made possible by the electric current.

In order to win a prize the first requisite is that the device or suggestion be practical. The term PRACTICAL will be the keynote of this contest.

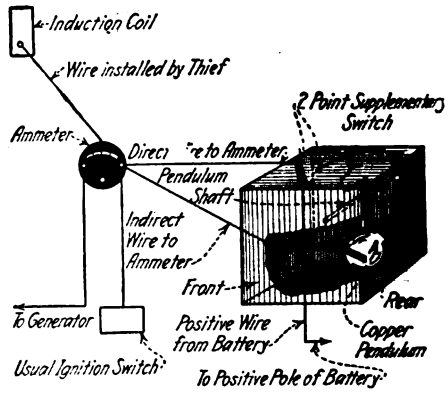
You will be more apt to win a prize if you will design the device yourself, and make a photograph of it, sending the same to us. Ideas are all right, but the reader wants to see that the device actually has been made, and WORKS.

The following prizes will be paid:

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 $1.00. Each article submitted should not be longer than about one hundred to two hundred words.

Address all manuscripts to EDITOR "MOTOR HINTS," care of this publication.



A Unique Car Lock that Catches the Thief, as its Inventor Explains. When the Thief Lets In the Clutch with a Jerk, the Pendulum Flies Back and Breaks the Circuit, the Engine Stalls Immediately and the Thief is Puzzled. He Tries the Stunt All Over Again, and Before He Knows it, a Policeman is Inquiring Into the Strange Performance of "His" Car.—Third Prize

Third Prize $10.00

CAR LOCK THAT CATCHES THIEF

With the idea of catching the thief, as well as baffling him, the following "ignition cut-out" has been devised:

A copper pendulum hangs inside a small wooden box, so that it swings parallel with the length of the car. A wire from the top of the pendulum runs to a switch (attached to box cover) which is inserted in the positive circuit from the battery. A fork, formed of copper wires, is placed so that the pendulum bumps against it when the car is at rest. A wire runs from this fork to the battery post of the ammeter. The box is fastened to the dash under the instrument board. When the car is parked the driver turns the supplementary 2-point switch so that the current is diverted to the device.

The lock is then ready for the thief. Failing to pick the ignition switch lock, he runs a wire from the battery post of the ammeter to the induction coil. To start the engine he has only to step on the starter. BUT when he lets in the clutch with a jerk—all thieves start in haste—the pendulum flies back and breaks the circuit. The engine stalls immediately and the thief is puzzled. He tries the stunt all over again, but gets no further than letting in the clutch. Meanwhile he is creating a lot of commotion and attracting attention which is fatal to any thief's future.

Contributed by F. C. RUSSELL.

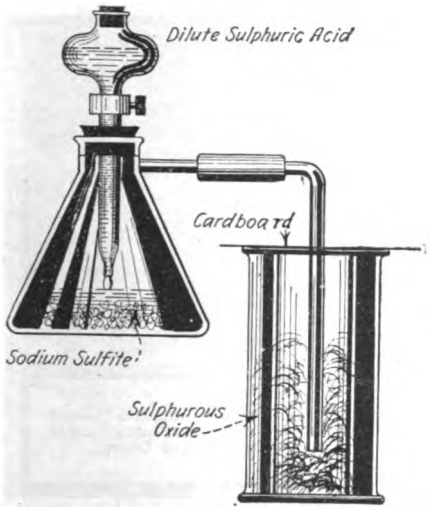
(*Continued on page 952*)

Practical Chemical Experiments

By Prof. FLOYD L. DARROW

Sulfur and Sulfuric Acid. (Concluded from January issue)

Changes in Sulfur upon Heating: Fill a test tube nearly full of crushed roll sulfur and very slowly heat it in the Bunsen flame. You will observe that it first melts to a thin yellow liquid, after which it becomes a thick cherry-red liquid, so viscous, that you may turn the test tube upside down without the sulfur running out, and finally becomes thin again and next boils, becoming nearly black in color. When it is boiling, pour the liquid sulfur into a jar of cold water and it will assume a plastic condition and you can stretch it like rubber. No other common substance can so easily be changed into such a variety of forms.



Glass Apparatus Set up for the Preparation of the "Chamber Crystals," a Very Interesting Study in Experimental Chemistry. Fig. 4.

Action of Sulfur and Metals: Heat a little sulfur in the bottom of a test tube to boiling and drop into the hot vapor a thin strip of copper foil or gauze. Immediately you will observe the copper strip glowing, and upon removing it, you will find that the copper has changed into a brittle bluish-black substance called copper sulfide.

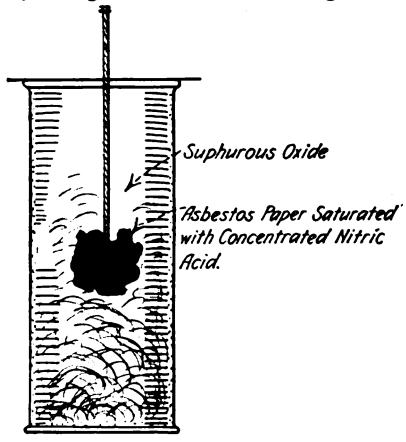
Mix thoroly one volume of pulverized sulfur and two volumes of iron filings. Place some of the mixture in a test tube, and heat the lower end of it. When the contents of the tube begin to glow, remove the test tube from the flame, and you will find that the glow continues and gradually spreads thruout the whole mass. When the test tube is cold break away the glass and you will have a hard mass of iron sulfid. Pulverize it and place a little in a test tube. Cover with dilute hydrochloric acid and cautiously smell of the escaping gas. What is it?

On a square of asbestos place half a teaspoonful of powdered sulfur with an equal amount of powdered zinc. Place in a good draft and ignite the mixture with a wax taper or the flame of the Bunsen burner held at arm's length. A very rapid combustion will occur and a residue of zinc sulfid will remain.

Thus you see that sulfur has a great affinity for these metals and in Nature metallic sulfides are among the most important of the ores.

Preparation of Sulfur Trioxide: Sulfur trioxide is the immediate ancestor of sulfuric acid. It is the anhydride of the acid, that is, it is the oxid, which with water produces the acid. Apart from this fact sulfur trioxide is interesting in itself.

To prepare it arrange apparatus as shown in Figure 1. In the length of combustion tubing place a small quantity of platinized asbestos. Platinized asbestos is a catalyzer. By that we mean a substance that hastens or retards a chemical reaction, without *itself* being affected in the change. This substance is rather expensive, but a half an ounce should not be beyond the reach of the average home laboratory.



Another Phase of the Experiment in Preparing "Chamber Crystals," the Asbestos Paper Being Secured on the End of a Wire and Then Inserted Into the Glass Chamber or Tube Containing Sulfurous Oxid.

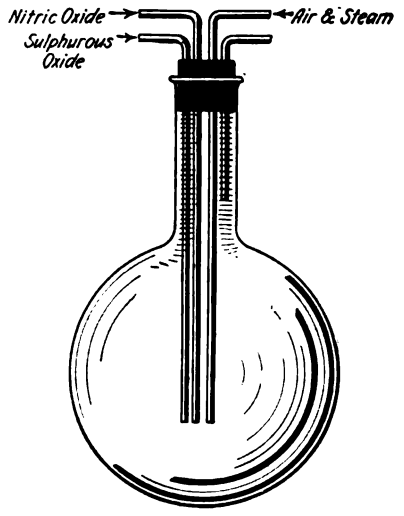
Thru one of the inlet tubes pass a stream of sulfur dioxid. This gas can be generated by the action of dilute sulfuric acid on sodium sulfite placed in an ordinary hydrogen generator. But do not begin to generate the gas until everything else is ready. Thru the other tube pass a stream of oxygen from an oxygen generator or blow a stream of air thru with a hand or foot bellows. Under the platinized asbestos place a four-tube burner or a large fish-tail burner. A high temperature is not required, and when the burner has been going for a few moments begin to pass thru the tube the sulfur dioxid and air. At the other end of the tube a cloud of white fumes will appear. This is sulfur trioxide. If the substance is past into water by conducting it thru a bent tube dipping beneath the surface of water in a small beaker, sulfuric acid will be formed, which can be tested for with litmus and also by another test to be given a little later.

If the apparatus shown in Figure 2 is attached to the end of the combustion tube and the sulfur trioxide made to pass thru a test-tube surrounded with a freezing mixture of salt and ice, a mass of silky white crystals somewhat resembling asbestos can be obtained. Sulfur trioxide solidifies at 15 degrees Centigrade.

In the above experiment you have illustrated the "*Contact Process*" of manufacturing sulfuric acid. Instead, however, of passing the sulfur trioxide into water it is past into a dilute solution of sulfuric acid itself. This avoids the dilution due to water alone, and the acid may be concentrated to any desired degree.

Action of Sulfur Trioxide and Water: Except with special precautions about to be described *never pour water into a vessel containing sulfur trioxide.* The very great affinity of these two substances for each other causes them to unite with almost explosive violence.

In the bottom of a cylinder place an inch-layer of sand and set in it a porcelain crucible, containing a small quantity of the sulfur trioxide crystals, that you have prepared. In the mouth of the cylinder place a funnel having the stem directly over the crucible. Upon pouring a few drops of water into the funnel they will fall upon the sulfur trioxide, uniting with it with great energy. See Figure 3.



Glass Flask in Which Sulfuric Acid is Prepared by the Chamber Process. Fig. 5.

Production of the so-called "Chamber Crystals": Generate a cylinder full of sulfur dioxid as already described using the apparatus shown in Figure 4. Fasten a piece of asbestos paper to a wire and dip it in concentrated nitric acid. Then lower the asbestos into the cylinder of sulfur dioxid. The cylinder will fill with red fumes of nitrogen peroxid and in a few moments the walls of the cylinder will become coated with chamber crystals. They have the appearance of frost on a window pane and when water is added to them they unite with a hissing sound and form a solution of sulfuric acid.

Lead Chamber Process of Manufacturing Sulfuric Acid: This is the older and the more important of the two great commercial processes of manufacturing this acid. All the details of this process cannot be given here but a study of the accompanying photograph together with figure 5, and the description about to be given will enable you to carry out the process beautifully.

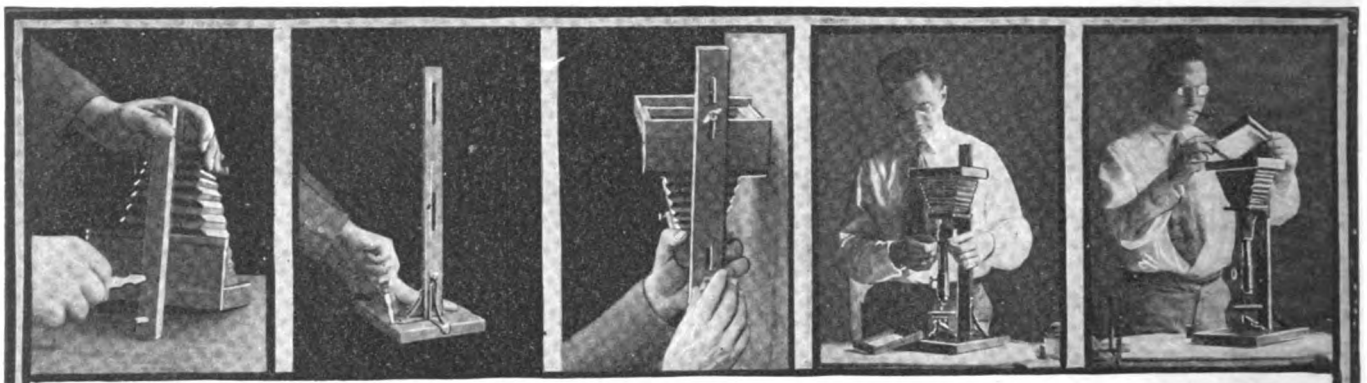
Select as large a flask as your laboratory affords. If you can find it, an empty carboy in which acids have been shipt will be excellent. A bottle in which spring water has come will be equally as good, and a gallon bottle or even a smaller one will serve. Fit in the neck of it a tight fitting stopper, a rubber one if possible. Bore in this stopper four holes. For this you ought to have a cork borer and if you are making a hole in rubber moisten the boring tube with a dilute solution of sodium hydroxid. Make the holes of the proper size to fit the glass tubing that is to be inserted next. Bend and fit tubes as shown in the figure.

To one of these tubes connect a sulfur dioxid generator, to another a nitric oxid generator and to the third a hand or foot bellows. The generator for nitric oxid is exactly similar to that used for sulfur dioxid, except that copper and nitric acid are used instead of sodium sulfite and dilute sulfuric acid. The copper should be first covered with water and then concentrated nitric acid added as described in the December article. The air should be blown thru a

(*Continued on page* 982)

A Microphotographic Camera

By DR. ERNEST BADE



How to Make a Microphotographic Camera. From Left to Right: 1.—Screwing the Bellows to the Movable Upright; 2.—Firmly Attaching the Upright to the Base with Angle Irons; 3.—Fastening the Bellows to the Upright with Winged Screws; 4.—The Light-tight Sleeve Is Past over the Upper Part of the Microscope After the Slide Has Been Placed on the Stage; 5.—Remove the Ground Glass and Replace It with Ordinary Window Glass.

From Left to Right: 1.—Take a Small Hand Lens and Focus with the Aid of the Micrometer Screw. It Is Impossible to Focus on Ground Glass; 2.—After Having Passed Thru the Steps It Is Placed in Xylol to Harden. Then It Is Placed on the Slide, a Drop of Canada Balsam Added, and the Cover Glass Carefully Lowered on the Object; 3.—When Preparing an Object It Is Past Thru Different Concentrations of Alcohol; 4.—Take Out Your Watch and Expose by Removing the Cardboard.

THE last few decades have seen an amazing development in the manufacture of glass and glass lenses suitable for the most varied uses, and the compound microscope is nothing more than a series of bits of glass, ground in a certain way, and mounted in tubes.

All these structures, as well as countless others, can be cut into thin sections with a razor and examined under the microscope. The object thus cut or sliced is placed on a glass slide, a drop of water added, and it is then covered with a cover-glass. That is all that need be accomplished for simple observation or when a photograph is to be taken of it. The production of a permanent slide is sometimes an advantage, as the processes thru which the section must go, lighten it and make it more transparent. It is placed successively in 30%, 60% and 95% alcohol, and finally in absolute alcohol. This *dehydrating process* will be found satisfactory for other than delicate structures, which require more elaborate apparatus and are only used with the higher powers (720 diameters and more, especially oil immersions).

The object must remain in each alcohol step at least two hours. When these steps have been past the object must be hardened in xylol for at least the same length of time before it is ready to be mounted. Place it on a glass slide and carefully cover it with a drop of Canadian balsam. Take a cover glass, hold one end of it with the finger and hold the other end vertical with a scalpel or needle. Slowly lower the cover glass so that all the air is excluded. When the object has been mounted place the slide in a horizontal position, and gently press the cover-glass with a slight weight. The slide must remain undisturbed in this position until the balsam has hardened.

Then a photograph can be taken of it, but the object must be *perfect*. An imperfect object will give but an imperfect and blurred photo. The photo will never show more than can be seen with the eye, and another important detail is that only flat surfaces without depth can be taken. Therefore if the object on the slide is too thick, the details become foggy.

Camera lenses are not required in an apparatus for taking microphotographs. In fact, the simplest device which can be made with this purpose in view, consists of a strong base, an upright, and a movable bellows. The upright is countersunk into the base and further strengthened with an angle iron. The upper part of the upright receives two slits as shown, thru which wing-screws pass. The bolts are attached to the upper and lower slats attached to the bellows. The lower part of the bellows has an opening about the size of the microscopic eyepiece. To this is attached a light-proof cylinder of cloth about three inches in length. The lower end is slipt tightly over the microscopic eyepiece. The upper part of the bellows receives a three-sided frame in which a plate-holder fits snugly.

When the apparatus has been assembled the slide is placed on the microscope stand in the usual way and clamped in place. Then, after finding the desired section to be taken, the microscope is placed on the baseboard and the cylinder of cloth is slipt over the eyepiece. Place the ground glass on the upper part of the bellows. Then turn the mirror on the base of the microscope in such a way, that a circle of light thrown on the ground glass is equally intense at all points. Now remove the ground glass and, taking a hand-lens, focus with the aid of the micrometer screw until all parts of the image are sharp and clear.

When this has been done to the satisfaction of the operator, put a piece of cardboard in front of the stage and mirror. Attach the plate-holder to the upper part of the bellows. Pull out the shutter and expose by simply removing the cardboard from the mirror. After development a sharp, clear-cut picture will be had of the object if the time of exposure was correctly judged. With artificial illumination two or three minutes will be required for very clear and transparent objects magnified with low power. A much longer time will be required for higher diameters as well as for more opaque objects.

Cold Light from Sunshine

By L. B. KIRBY

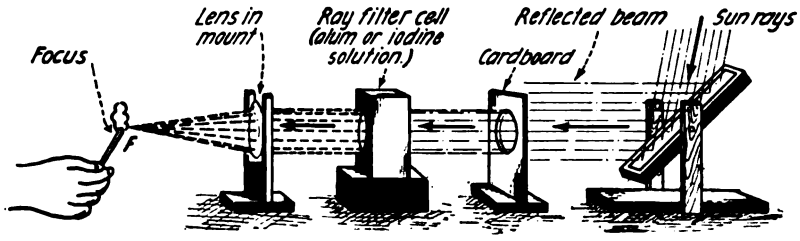
IT is very easy to show that the energy, which comes from the sun, consists of several parts—one visible manifestation, which we call light, and an invisible constituent which gives heat. The total emission is known as radiant energy, the invisible portions as radiant heat and actinism.

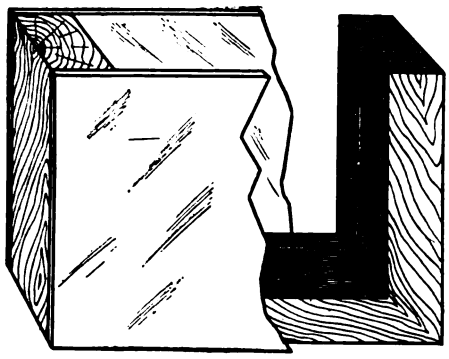
The apparatus required consists of a small, flat, framed mirror of good quality, a double convex lens—the larger the better, several used dry plates 4" x 5" and a piece or two of stout cardboard.

Prepare an adjustable frame for holding the mirror as shown in the diagram. The uprights and pivots should fit so as to hold the mirror fast in any position. Remove the film from the dry plates with hot water, and clean thoroughly. Then cut two pieces of wood, as shown, from a smooth board one inch thick, and cement the glasses to each side of them to form the cells. A waterproof cement is made by adding 10 parts of a concentrated solution of potassium bichromate to 10 parts of gelatine dissolved in 100 of water—keeping the whole mixture always in the dark. Paint the wood exposed inside the cell with this and it will harden in the light and not leak water.

A piece of cardboard is mounted on a base; a circular hole is cut in it slightly smaller than the lens. At least two cells should be prepared.

The experiment may be performed anywhere under cover, but preferably in a dark room. Place the mirror in the sunlight and direct the reflected beam horizontally to the apparatus table. Place the perforated cardboard in the path of the light. A circular beam now passes on through the lens and





Arrangement of Apparatus and Detail of Glass Filter Cell Used in Producing "Cold Light" from Sunshine.

can be focused on a screen at "F." It is well known that the focus is hot as well as bright, for if the lens is sufficiently large it will instantly set fire to paper, ignite gunpowder, or a piece of magnesium.

If a cell is filled with water and put between the cardboard and the lens, the focus loses nothing in illumination but becomes much cooler and the tank hotter.

Now add some clear solution of common alum to the water in the cell and test the focus with the mercury thermometer. It will be found to be simply at room temperature—that is, the alum cell has almost entirely cut off the radiant heat and left a point of cold light.

The question now rises—is it possible to screen out the light rays and allow the radiant heat to pass through the lens? The answer is yes! This is done by filling a cell with a solution of iodine in carbon bisulphide so that the light will be completely shut off. At the dark focus (in the same place as before) we may now observe the startling phenomena of a match taking fire, powder burning, ice melting rapidly, etc. In short we have focused the radiant heat.

Solutions of sulphur and of phosphorus act similarly to the iodine and are said to be diathermal substances. Glass and air are also diathermal although they are permeable to light.

If the unfiltered light is all focused on a prism so as to produce a spectrum, an examination with a thermometer (of fair delicacy) will show that the heat rays are at the red end of the spectrum and mostly out in the dark region beyond the red. The temperature rises steadily, going from the violet to the red, and is highest in the dark space of the ultra red. It can be shown that the invisible spectrum of this region (radiant heat) represents four times the energy of the visible or luminous spectrum.

From these simple experiments we can see that the radiant energy of the sun passes comparatively undiminished through the atmosphere without greatly heating it, but that the heat is absorbed by solids and at the surface of bodies of water, warming them. Part of it is reflected back from the earth, heating all objects near its surface.

Multiple Thermostats

I once read an article telling how to make motor driven contact flashers for display purposes. I thought that probably this fussing with motors could be omitted entirely if thermostats were used. This seemed rather a hard proposition, but after a while I evolved the solution. It is, however, still far from perfect.

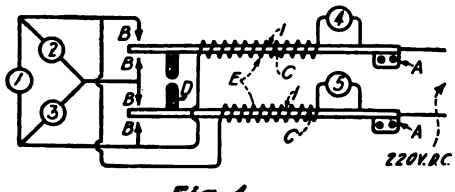


Fig. 1

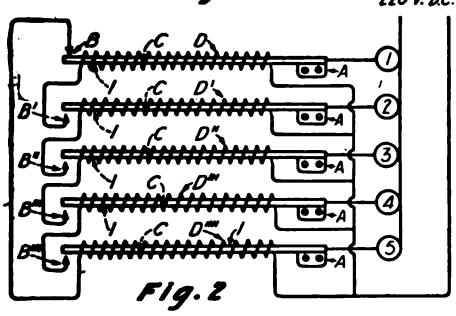


Fig. 2

With This Multiple Thermostat Very Curious and Interesting Lamp Switching Arrangements May be Worked Out. The Two Designs Here Shown Will Provide Many Hours of Amusement, and This Scheme Is Also Valuable for Electric Sign Displays, Etc.

Referring to Fig. 1, A are supports, B stationary adjustable contacts, and C compound strips or thermostatic metal combinations, E coils of resistance wire, and D two non-conductor strips which prevent short-circuiting; 1, 2 and 3 are lamps regulated by the flasher, and 4 and 5 are series lamps for protection. It is easy to see how this device works. When cool both of the thermostatic bars are on the lower contacts when light No. 3 is fully illuminated, whereas 1 and 2 are practically out. This causes some current to flow thru the resistance coil on the upper metallic bar, opening the upper contact. This cuts off all the lights. When the upper bar finally reaches the top contact, light No. 1 is lit. The resistance on the lower bar now heats up, causing this to rise and then light No. 2 will light up. The bars gradually cool and the operation is repeated.

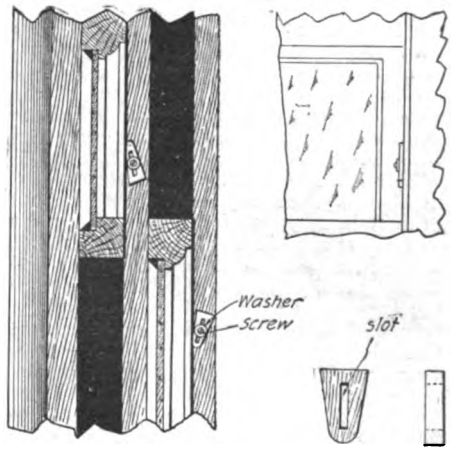
In Fig. 2, 1, 2, 3, 4, and 5 are lights. A are the supports for thermostatic metal bars, C; D, D′, D″, D‴ and D⁗ are the resistance elements of these thermostatic bars and B, B′, B″, B‴ and B⁗ are the contact screws. It is very easy to note exactly what would happen as when B is closed, light No. 1 is illuminated and D⁗ is being heated. Finally B⁗ closes, lighting light No. 5 and D‴ is being heated, etc. Meanwhile the lamps will continue to blink on and off in very irregular orders, giving a very pretty effect if each lamp is of a different color.

Contributed by ESTEN MOEN.

Simple Window Lock

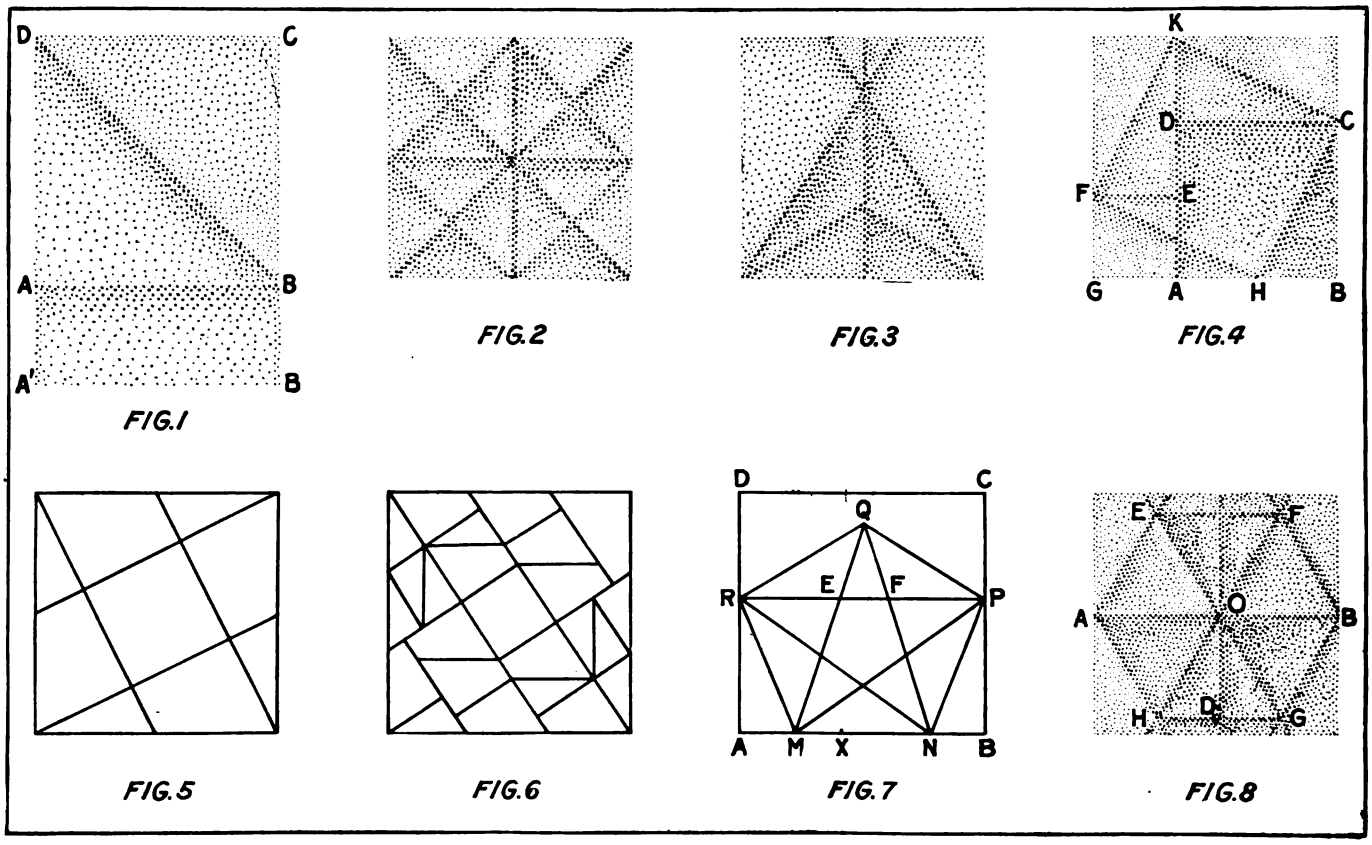
The illustration shows a useful arrangement, whereby it is possible to open the window and keep it in any position and also to lock it at the same time. It is made almost entirely out of wood, with the exception of the screw, and does not scratch the woodwork. I have also made some of these out of tin, and found them to be very effective, but they are not as efficient as the wooden ones, as they mar the window sash considerably. Nevertheless I never need worry that someone is going to enter my "Lab.", even tho the window is partially open at night.

Contributed by WILFRED A. LOWELL.



This Simple Window Lock Made from Metal or Wood Is Fastened on the Side of the Window Frame, and the Sash May be Held and Locked in Any Desired Position.

Geometrical Paper Folding



It Is Surprising Indeed How Many Intricate Geometrical Problems May Be Demonstrated and Studied as in no Other Way, By Simply Folding a Piece of Paper as Here Illustrated. In the Accompanying Story Some of the Wonders of Geometrical Paper Folding are Expatiated Upon By Prof. T. O'Conor Sloane, in an Interesting and Valuable Contribution.

FOLDING paper has long been counted one of the amusements of childhood, but now it has been somewhat developed, and it is found that it can be used very effectively for the solution of geometric problems and demonstration of theorems.

Even dry geometry becomes amusing when one considers the simple means used to solve its problems. The first thing to be thought of about paper is that it gives us the means, by simple folding, of making a perfectly straight line, which is the second thing in geometry, the first, of course, being a point. Paper lies perfectly flat, and if we double over a piece of paper and press the fold down we have a perfectly straight line.

The next problem to be solved is to draw one line at right angles or perpendicular to another; the first fold is to be counted as one of the lines. Now, if we double over the paper at right angles to the fold, as near as may be, and next bring the two parts of the fold to correspond and lie exactly over each other, the folding will give us a line exactly perpendicular to the first one. This is a solution of one of the classic problems of the geometrician.

Then, if we want to make a rectangle, all that is necessary is to first make a straight line by one fold, make two folds on lines at any desired points perpendicular to it, as just described, and then join these by a line parallel to the first, which means perpendicular to them. By doubling over and making the doubled-over part correspond to the other, again we have the principle applied which was just used, and we have a rectangle.

To make a square, we take a rectangular sheet of paper shown in the first illustration, and fold it so that the line at the side D C will correspond exactly with the side D A. This gives us the diagonal fold D B and then folding across from A to B, seeing that the fold is exactly at right angles to the sides D A and C B, we have our square.

The next figure is self-explanatory, and shows one of the many figures which can be obtained from the square by folding; if it is done with a nice piece of paper the effect is very pretty, and it can be applied to table linen quite successfully. So much for the square and rectangle.

The equilateral triangle is made from the square by doubling it so as to get a line through its center perpendicular to the base. If now one of the lower corners is carried up to the perpendicular line so that the base of the square will intersect the perpendicular at a distance from the other corner equal to its own length, we will have the apex of an equilateral triangle, which is completed by folding. The smaller triangle in the same drawing is an isosceles triangle.

The fourth diagram gives us the proof of the Pythagorian theorem of the square of the hypothenuse. G F H is the right angle triangle of the theorem. G F E A is the square of one of the short sides. A B C D is the square of the other short side, and the square of the hypothenuse is F K C H. It will not take much puzzling on the part of the reader to find that the two smaller squares make up the area of the large one.

Now comes the cutting of paper. A square cut into several pieces is shown, each oblique line extending from a corner to the middle of the opposite side. We have nine pieces which can be placed so as to form nine squares, each of the size of the middle one. When the pieces are put together they give us the original square, and this forms a very interesting problem and if it is followed out geometrically it will be found to include the square of the hypothenuse in considerable abundance.

The mathematically disposed reader will see that it is based on the formula $1^2 + 2^2 = 5$. It forms a nice puzzle, but certainly yields in complexity to the next one, which we commend to the most patient of our readers.

In the diagram for the pentagon, the point X is what is known as the median section of the line A B. This is obtained with practical accuracy, as 7/17th of the line A B. M is the center of the line A X and gives one point of the pentagon. The point N is at the same distance from B; by doubling over the paper first about M and then about N, the lines N P and M R are laid out equal to N M. This gives three sides of the pentagon. It is then well to fold the square through Q (vertically as it is placed), and then by doubling over at P and R carrying M and N respectively to the vertical Q, we have

(*Continued on page 987*)

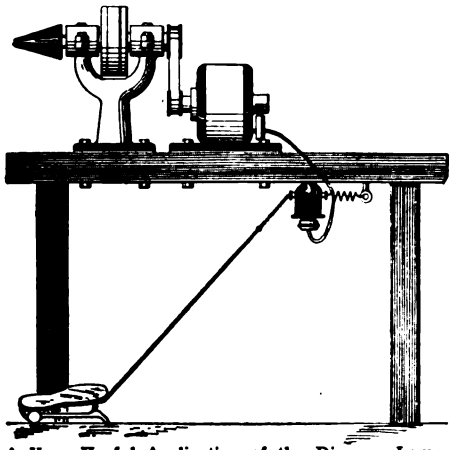
HOW-TO-MAKE-IT

This department will award the following monthly prizes: First prize, $15.00; second prize, $10.00; third prize, $5.00.
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 $15.00 is awarded; for the second best idea a $10.00 prize, and for the third best a prize of $5.00. 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, $15.00

DIMMER LIGHT SOCKET AS A RHEOSTAT

Some time ago I desired a rheostat for use with a small motor and having none on hand at the time I removed a dimmer light socket



A Very Useful Application of the Dimmer Lamp Socket, Here Employed for Controlling the Speed of a Small Bench Motor.

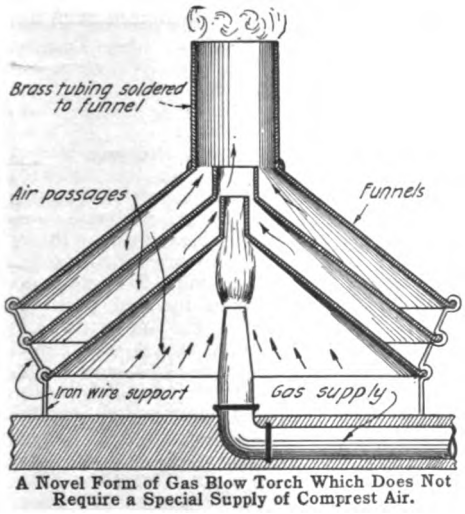
from the bed-room and arranged it as shown in the accompanying sketch and I must say it was some rheostat. It is advisable to mount the pedal in such a manner that it will automatically come up again.

Contributed by JOHN MIGNONE.

BLOW TORCH

The following is a description of a blow torch, which needs no special supply of air, and which can be constructed by the average amateur with tools and old material found around the work shop. It consists of three iron funnels (the kind used to fill bottles with), a piece of brass tubing one inch in diameter and 4" in length, some iron wire and a suitable base. Its construction is clearly shown in the diagram. The distance between the funnels is to be found by experiments. This torch will give sufficient heat to melt brass and to do light brazing.

Contributed by
FERDINAND ROTHBERG.

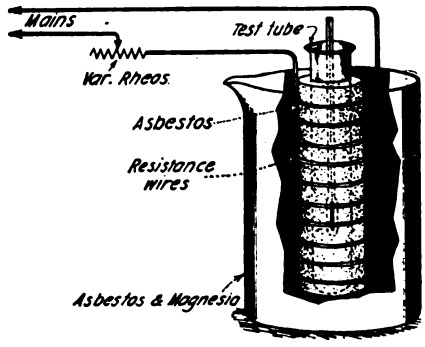


A Novel Form of Gas Blow Torch Which Does Not Require a Special Supply of Comprest Air.

SECOND PRIZE, $10.00

AN ELECTRIC OVEN

Description is given herewith of a small electric oven. The materials needed are as follows: two beakers as used for chemical experiments, one of 500 c.c. capacity and one of say about 200 c.c. (long shape), an ordinary resistance unit (200 ohms for 200 volt circuit), and some asbestos and magnesia. The small beaker is placed inside the large one in which a layer of mixed asbestos and magnesia has been placed. The wire of the unit is now bent round the small beaker so as to fit as close to the glass as possible. Around this is closely packed a layer of asbestos and then mixed asbestos and magnesia prest in as tight as possible. The two wires from the resistance are led away to the baseboard, on which the contrivance has been mounted, and these are affixt to binding posts. If it is desired to control the temperature a bored cork can be fitted into



A Simple Electric Oven, Useful for the Laboratory, Is Readily Constructed in the Manner Here Illustrated. If a Standard Resistance Unit—Which Can Be Purchased in Practically Any Electrical Supply Shop Nowadays—Is Not Used, Then the Heating Coil May Be Constructed from Some German Silver or Other Resistance Wire, Using a Sufficient Length of it Which Will Give Enough Resistance to Permit the Wire Becoming Hot Enough Without Burning Out the Coil, Usually Just Under a Red Heat. The Proper Length of Wire Can Be Measured Off and Tested Before It is Wound into a Coil.

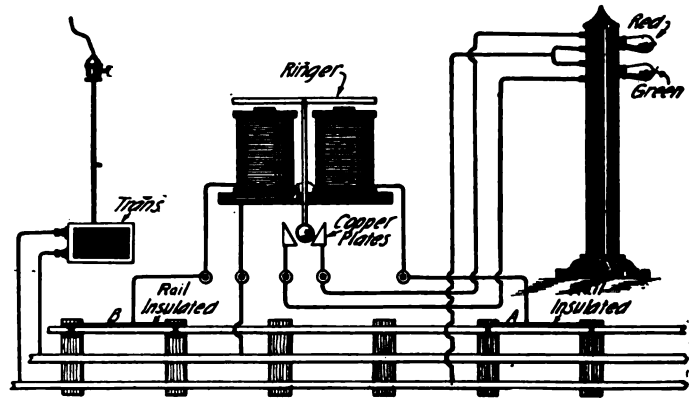
the top of the inner beaker and adjusted to take a thermometer reading to a fairly high temperature, and a variable resistance can be placed in the circuit. The above is very simple and cheap and with proper management the temperature can be very easily controlled. It will be found very useful in the experimenter's laboratory in place of a water oven or air bath, doing away with the mess and continual attention necessary to prevent it running down and burning thru. A large boiling tube can be used.

Contributed by JOHN V. NEWSON.

THIRD PRIZE, $5.00

TOY RAILWAY SIGNAL SYSTEM

I have made one of these novel signals and it worked very successfully. The only necessary thing to do is to rewind the magnets with bell magnet wire for 6 volts.



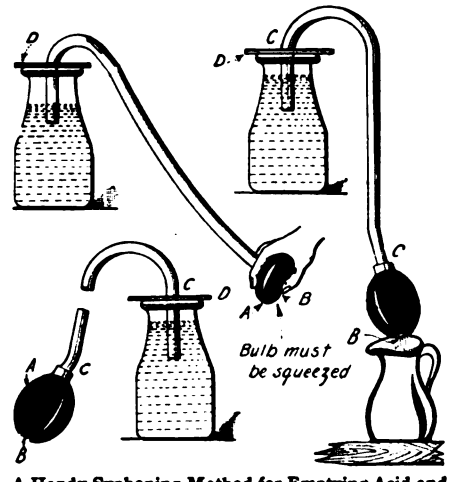
A Clever Automatic Toy Railway Signal System Operated by Means of a Relay Constructed from a Polarized Telephone Ringer. The Relay Swings First in One Direction and Then in the Other, Lighting Either the Red or Green Lamp, as the Case May Be. Two Insulated Track Sections Are Necessary, as Shown.

Armature pivot swings over and makes a contact with the copper plate, and then it lights a bulb; that is, when the train runs over the insulated tracks A, which causes the red light to flash on. The train continues running until it reaches track B, and then the signal switches on a green light.

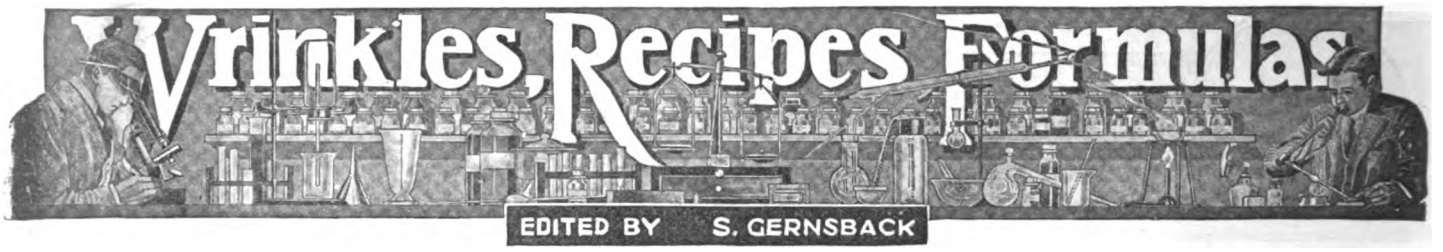
Contributed by ROY F. HOYE.

A SIMPLE SIPHON

Siphon made from an old atomizer bulb, from which the valve had been removed, and a piece of rubber tubing. The finger is placed over the opening and the bulb squeezed, forcing the air out. The bulb is then allowed to expand, finger still on the opening. The bulb is subsequently lowered to a point below the surface of the liquid within the container and the finger removed.



A Handy Syphoning Method for Emptying Acid and Other Liquids from Bottles, Constructed from an Atomizer Bulb and a Piece of Rubber Tubing.



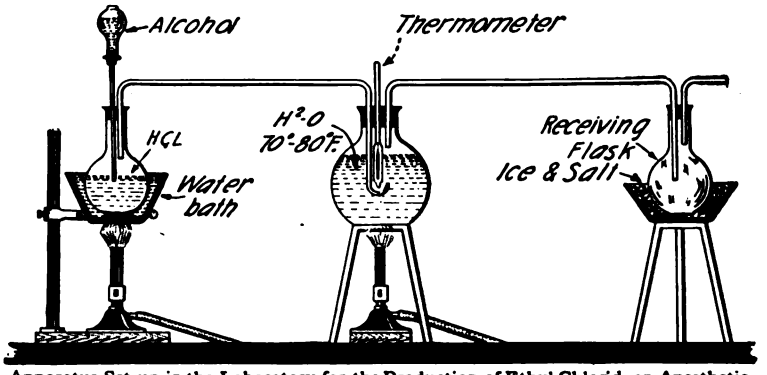
Anesthesia for the Amateur

By CHARLES S. WOLFE

Hereafter a $5.00 Monthly Prize Will be Paid for the Best "Wrinkle" Submitted.

WHILE it certainly is a fact that the administration of a general anesthetic is no job for the experimenter, yet there is at least one local pain killer which he can handle without risk to himself or others, the making and using of which should afford him quite a little amusement and much instruction.

Cocaine, and most of the local anesthetics, besides being out of the amateur's reach require some training in their manipulation, it being necessary, usually, to inject them into the system by means of the hypodermic needle. *Ethyl chlorid* is free from this and other objectional features, its action being secured by merely spraying the skin with the chemical.



Apparatus Set up in the Laboratory for the Production of Ethyl Chlorid, an Anesthetic Which is Coming More Extensively Into Use Every Day. The Method of Preparing it is Quite Simple and Elaborate Apparatus is not Required.

Many people are not aware of the anesthetic property of ethyl chlorid, but it is in daily use by physicians and especially by chiropodists, who use it extensively in operating on corns, callouses, and bunions. Its preparation is not difficult, and the method is given for the benefit of those who would like to experiment with its peculiar properties.

Into a flask of sufficient capacity put equal measures of hydrochloric acid and ethyl alcohol placing the HCl in the flask first and adding small quantities of alcohol from time to time by means of a separating funnel. Provide a second flask, half full of water, the temperature of which must be between 70 and 80 degrees, F. A third flask, loosely corked, is placed in a suitable receptacle and packed with crushed ice sprinkled with common salt. This flask receives the final product.

Arrange the three flasks as indicated in the drawing, connected by glass tubing suitably bent. Apply a gentle heat and distill. The product passing into the wash bottle will contain some acid and some water, which the water will retain. The ethyl chlorid freed from these impurities, passes into the ice-packed flask, where it condenses.

Keeping it, after it is made, is more difficult than the manufacture, for it has a very low boiling point, volatilizing readily. Provide strong bottles, well closed with ground glass stoppers and, if not for immediate use, seal and keep in the coolest possible place.

Ethyl chlorid may be purchased by those who do not care to prepare it in 50 gram glass tubes with a spraying nozzle attached. Such a tube sells for about fifty cents to $1.10, and may be had at most drug stores.

Projected on the skin in a fine spray, it rapidly lowers the temperature of the part affected, producing a cold so intense that the sense of feeling is temporarily lost. The removal of splinters, lancing of boils, etc., can then be effected without the slightest inconvenience to the patient.

The writer has always worked with the nozzle from one of the tubes sold with the commercial article. For those who do not have a nozzle of this kind, he suggests that an atomizer be tried. For this purpose a cork should be inserted into the "bulb" end of the atomizer and sealed with wax. A tight fitting stopper or a valve should then be inserted or attached to the spraying nozzle which may be removed when the ethyl chlorid is to be used. A fine spray, such as an atomizer produces, is just what is wanted and all that is wanted.

Hold the nozzle about six inches away from the spot to be operated on, and spray. The skin will turn first an angry red which is followed by a white, parchment-like appearance. This is the time of anesthesia, which endures about two minutes. It may be renewed as often as desired by simply respraying.

Ethyl chlorid is dangerously inflammable, and due precautions must be taken against contact with naked flame.

For the benefit of that class of experimenters who like to have things right, and know that they have them right, the following tests for determining the purity of the product are appended.

Ethyl chlorid boils at 53.6-55.4 degrees F.

On disolving 1 milligram (mg.) of Ethyl chlorid in 20 mils. of alcohol (both previously cooled to the temperature of melting ice) and adding a few drops of silver nitrate solution, T. S., no turbidity is produced at once. The presence or absence of hydrochloric acid is thus determined.

Shake 10 mgs. of Ethyl chlorid with 10 mgs. of distilled water, both cooled as above, and allow the supernatant stratum of chlorid to evaporate. The residual fluid should be neutral to litmus. Add a few drops of potassium dichromate and a little diluted sulphuric acid and boil. No odor of aldehyde should develop, nor should a greenish or purplish color be produced in the liquid. This is the test for alcohol.

On evaporating 5 mgs. of the chlorid, no noticeable odor of a foreign nature should arise, and there should be no weighable residue. To be standard, the product should meet all of the above conditions.

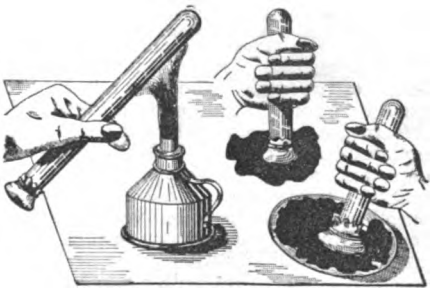
If too much is applied and for too long a period a sore may be produced such as caused by a frost-bite.

Removing Spilled Ink

From a German authority we get the following method for removing ink which has been spilled on a table. It requires a test tube and piece of fine meshed muslin.

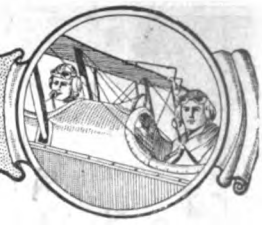
Over the mouth of the test tube a little bit of fine muslin is fastened and may be tied or secured by a rubber band. Holding the tube as shown in the drawing, it is heated over an alcohol burner. There will be some moisture in it presumably, and the heating does not want to be pushed so far as to convert this into steam, but a good warmth is necessary.

When it is well warmed, the mouth of the tube with the cloth over it, is placed in the ink which has been spilled; as the air in the test tube cools, and any water which has been mixed with the air will return to the liquid state, a partial vacuum will be formed, and the ink will rise into the tube and leave the table. Two or three of these applications will presumably take care of a great deal of ink. To empty it, the tube is held in an inclined position mouth downwards over the ink bottle and heat applied as before, which will expel the ink from it; or if the cloth is of large mesh, it may be made to leave it by skilful shaking, which of course implies the danger of spilling the ink about. Whether used for the purpose of picking up ink or not, it certainly is an interesting suggestion for a physical experiment.



Here is One Way of Removing Ink Spilled on a Table Cloth or Elsewhere, the Ink Being Removed Rubbing the Cloth Covered Test Tube Mouth Over It, the Tube Having Previously Been Heated.

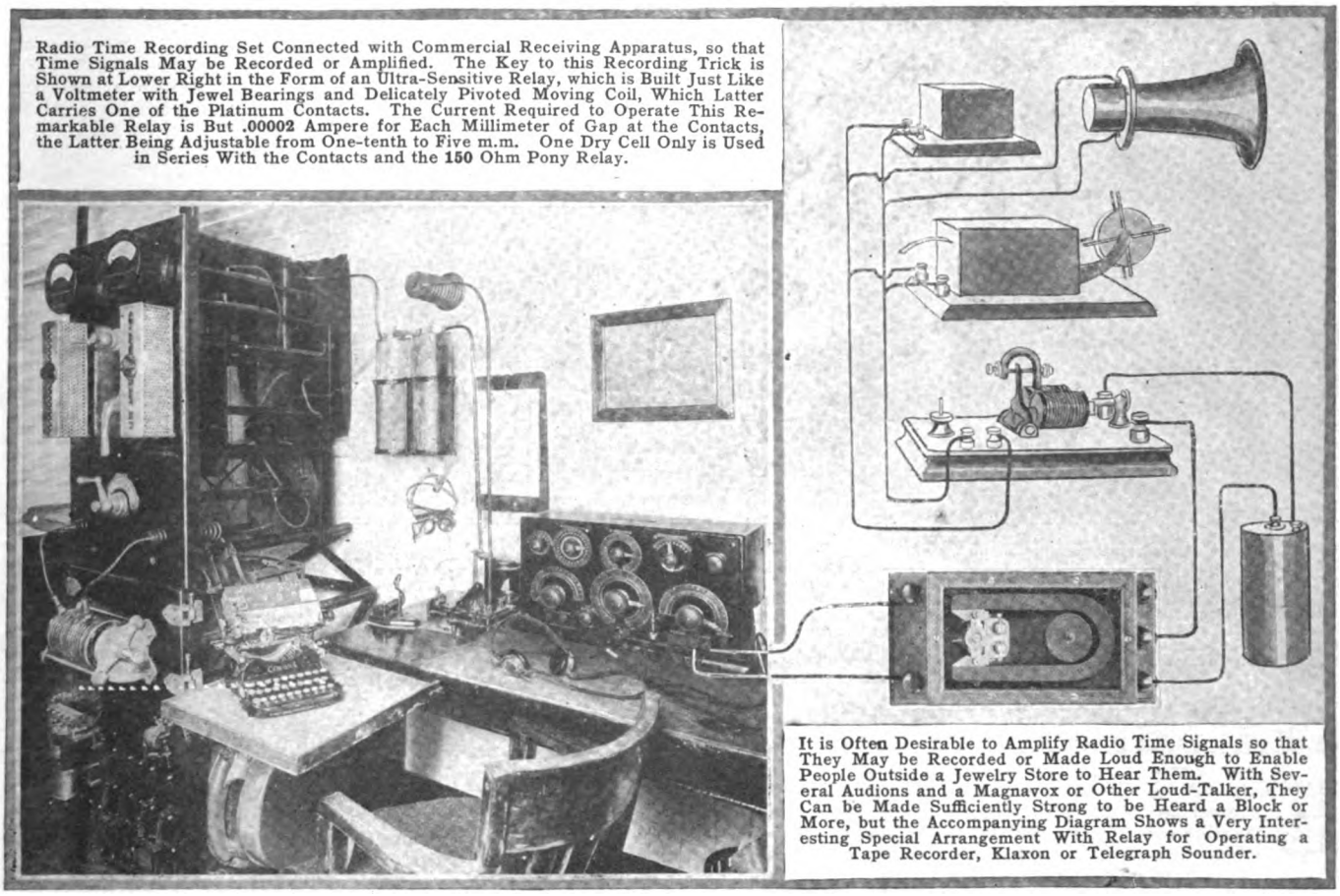
RADIO DEPARTMENT



Recording and Amplifying Radio Time Signals

By ARTHUR H. LYNCH

Radio Time Recording Set Connected with Commercial Receiving Apparatus, so that Time Signals May be Recorded or Amplified. The Key to this Recording Trick is Shown at Lower Right in the Form of an Ultra-Sensitive Relay, which is Built Just Like a Voltmeter with Jewel Bearings and Delicately Pivoted Moving Coil, Which Latter Carries One of the Platinum Contacts. The Current Required to Operate This Remarkable Relay is But .00002 Ampere for Each Millimeter of Gap at the Contacts, the Latter Being Adjustable from One-tenth to Five m.m. One Dry Cell Only is Used in Series With the Contacts and the 150 Ohm Pony Relay.



It is Often Desirable to Amplify Radio Time Signals so that They May be Recorded or Made Loud Enough to Enable People Outside a Jewelry Store to Hear Them. With Several Audions and a Magnavox or Other Loud-Talker, They Can be Made Sufficiently Strong to be Heard a Block or More, but the Accompanying Diagram Shows a Very Interesting Special Arrangement With Relay for Operating a Tape Recorder, Klaxon or Telegraph Sounder.

THERE are various activities in modern life which require time to be measured with even greater accuracy than one one-hundredth of a second a day. That is cutting it rather fine, but it is necessary. For instance, a vessel traveling in the vicinity of the equator, in making a calculation of its position, will be almost a mile out of its way if its chronometer is three seconds fast or slow. True, a mile doesn't seem like much, when a vessel is on a six thousand mile voyage, but where that vessel is making port in a fog and the entrance to the port is narrow, with rocks on either side, a tenth of a mile may mean the difference between the safety or the destruction of the vessel and its cargo and lives. The importance of time to the railroads, where trains travel at the rate of better than a mile a minute, is very keen; a faulty block signal and an inaccurate watch in the engineer's pocket may spell disaster.

By far the safest way to check up ships' chronometers is to leave them on shipboard and have enough confidence in the radio signals sent out by the government which are accurate to within one one-hundredth of a second, to navigate by a chronometer checked from them daily.

The matter of checking marine chronometers is such a very important one, not only to the mariners, but to every one, that it cannot be given too much attention. The traveling public and the merchants of the world depend implicitly upon the accuracy of the ship's chronometer; without it commerce would be practically impossible.

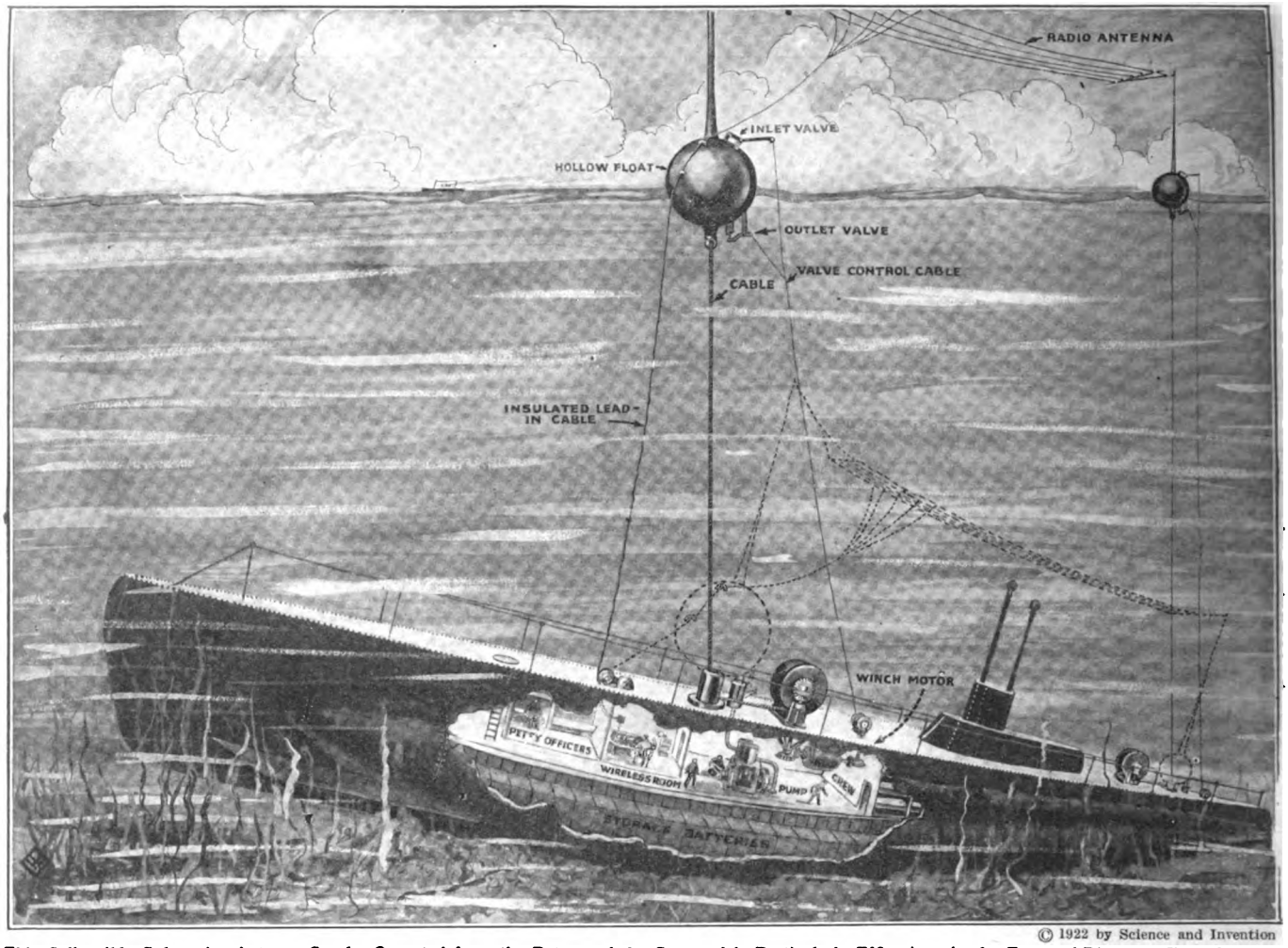
The governments of many nations have realized this fact and have gone to tremendous labor and expense to keep the mariners supplied with a means of checking their timepieces. It is now possible for a vessel to leave the United States and make a trip entirely around the world without having to pass a single day without the signal of accurate time, sent from Annapolis or some other high power station which carries on this service.

With this truly marvelous service at the disposal of the merchant marine, it seems as though complete advantage of it would have been taken, as soon as it was announced. It has been in operation several years now, yet there are still a great many vessels which do not receive the time signals at all, or if they are received, do not make more than a meager attempt to limit the error which occurs in their reception.

On one vessel, which I recall quite plainly, it was almost laughable to watch the horse-play, which went on when the time signals were being received. The radio shack was near the stern of the ship and the chronometer was kept in the chart house which was very near the bow. At approximately five minutes before the signals were to be received, a sailor was posted outside the radio cabin door and another outside the chart room door. When I heard the signal, I waved my hand to the sailor outside my door, who waved his hand to the other sailor outside the chart room door, who "sang out" "Time!" as the skipper watched the chronometer and compared it with the check given by the man outside the door. On some vessels this form of grandstand play is done away with by having the wireless operator blow a whistle thru a speaking tube or ring a telephone bell which connects the radio cabin and the chart house.

On modern vessels, we find that every effort is made to keep the navigating

(*Continued on page* 980)



This Collapsible Submarine Antenna Can be Operated from the Bottom of the Sea, and is Particularly Efficacious in the Event of Disaster, When for One Reason or Another, the Submersible with its Crew on Board Sinks to the Bottom of a Harbor or Other Body of Water, and Will Not Rise, as Has Been the Case in Two Important Instances in the United States Navy Since the Armistice Was Signed. Submarines Are Now Supposed to be Able to Send and Receive Radio Signals in Time of War, or When in Distress, by the New "Under-Sea" Radio System in Use by the U. S. Navy, but Judging from the Recent Accidents Which Have Occurred to this Type of Craft, Signals are not Apparently Transmitted Very Far with the Present Arrangement); Whether This is Due to the Apparatus Used or to the Arrangement and Insulation of the Antenna, is a Moot Question. With the Present Patented Arrangement Here Illustrated, There is no Doubt but that the Imprisoned Crew Can Communicate Their Distress Signals, as Well as Transmit and Receive Messages in Time of War, by Virtue of the Thoroly Insulated Antenna Supported on the Hollow Ball Floats, Which Can be Easily Released or Retrieved from the Interior of the Submarine. Electric Motor-Driven Winches Control the Cables as Well as the Lead-in Wire, in the Manner Apparent from the Picture.

Collapsible Aerial for Submarine Radio

EXPERIMENTS have shown that submarine radio-communication is possible over great distances, even when the submarine vessel lies at the bottom of a harbor or sound, and using the ordinary insulated aerial rising but a short distance above the deck and fully submerged, after the method discovered and patented by Dr. James Harris Rogers, the inventor of underground and undersea radio. There are occasions, however, when for various technical reasons it becomes desirable to send up an antenna above the surface of the water—if a submarine, for example, should become absolutely disabled. Mr. Gabriel Klem of Gardenton, Canada, has taken out a patent on a collapsible submarine antenna of the type illustrated in the accompanying figure, and he states therein that "the main object of this invention is to provide a means whereby a submarine may signal by wireless from the bottom of the sea, or at any distance under water. This is especially useful," says Mr. Klem, "in the case of a submarine which is stranded at the bottom of the sea, and which will be enabled by this means to signal for help and give its position."

As will be seen upon inspecting the illustration, there are two main float chambers or hollow balls, which can be emptied of water or flooded as desired; the water is pumped out by means of a motor-driven pump, to cause the balls to become buoyant, when they are to rise and carry the antenna surfaceward; while the valves of the balls are opened so as to allow the sea water to rush in and fill the float chambers, when the antenna is to be hauled down.

List of Articles in February "Radio News"

A Regenerative Receiver from a Double Slide Tuner. By W. F. Allston.

A Squirrel Cage Rotary Gap. By Fred. A. Burgess.

Do Insects Talk by Wireless? By Raymond F. Yates.

Breaking In With Amplified Signals.

The Development of Radio Telephone Communication Between U. S. Coast Guard Life Boats and Shore Stations. By F. W. Dunmore.

Suitably geared drums or winches are supplied, as the illustration shows, for reeling or unreeling the insulated lead-in cable, and the control ropes or steel cables connected to the inlet and outlet valves on the float chambers.

The operation of the collapsible antenna is as follows: Assuming that the floats are idle on the deck of a submarine and filled with water, and it is desired to raise them, the pump motor is started and the water is pumped from the float chambers. Next the electric motor controlling the cable drums is operated so as to release the cables, allowing the floats to rise, the valve control cable being allowed to remain slack at all times. The floats will rise to the surface of the water, when the antenna proper will take the position shown, so that messages may be transmitted and received in the usual manner. When it is desired to lower the floats, the pump motor is driven in the reverse direction, the valve control cable now being pulled taut, so as to open both valves, thus allowing water to enter the floats, which take in water and lose their buoyancy, and therefore descend.

In actual practise the design of float indicated by the inventor in his patent specifications, would prove a hindrance in attaining high speed, owing to the friction of the surface against the water, and not only this, but owing to the large area of the float projecting above the deck of the submarine, the excessive water pressure against it as the vessel sped along under the water would be liable to pull it from its moorings. This difficulty could readily be overcome, however, by designing the float in the same form as a kitchen boiler tank and arranging for this float to rest normally within a pocket, so that the top of the float would be flush with the deck of the sub-sea craft.

Radio Cheers Arctic Explorers

WHILE we amateurs and experimenters sit by our cozy fireside or steam radiator and clamp the phones to our ears, and enjoy wireless telephone music sent out by the now famous Westinghouse broadcasting station at Newark, or from one of the dozen other stations fitted with radiophone transmitters, we little think perhaps of the more practical and far-reaching aspects of radio. It is interesting at this time to read in a recent message from Capt. Donald B. MacMillan, head of a group of doughty explorers now in the far north on an Arctic expedition, of the advantages due to and the cheer occasioned by the wireless time and other

(*Continued on page* 979)

$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.

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 Company 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.

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

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.

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, by paying regular space rates, to publish all worthy ideas which did not win a prize. 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.

Receiving the Radiophone Concerts

By ROBERT E. LACAULT
LATE OF THE SIGNAL CORPS DIVISION,
FRENCH ARMY

THIS article is not intended for the radio men, who know enough about radio reception to pick up the various radiophone transmissions, which are nowadays constantly in the air, but for the uninitiated

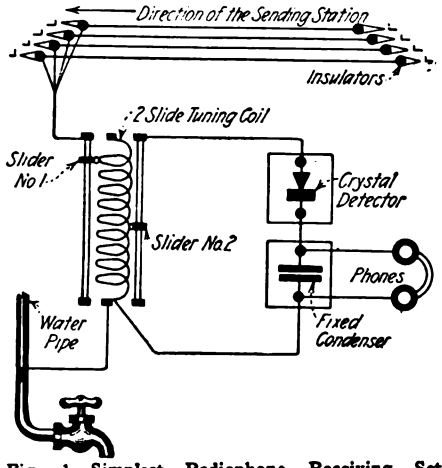


Fig. 1—Simplest Radiophone Receiving Set Comprising a Small Tuning Coil Connected With the Aerial or Antenna, Together With Crystal Detector, Fixt Condenser and Telephone Receivers. Reduced to Its Simplest Elements and Lowest Cost, the Tuning Coil May Comprise a Cardboard Tube or a Wooden Rod, Measuring 2 Inches in Diameter, and 10 Inches Long, Wound With One Layer of Spaced Bare Copper Wire, or Else Insulated Copper Wire With the Turns Touching, No. 20 Gage. The Detector May Consist of a Safety Pin Screwed to a Wooden Base, With the Point Bent at an Angle, So That It Will Bear Down on a Piece of Galena. The Fixt Condenser Is Made of Two Strips of Tinfoil Measuring About 1 Inch Wide by 20 Inches Long, Separated by a Piece of Thin Paraffined Paper, Which Are Then Rolled and Flattened. The Telephone Receiver May Be One From a Regular Telephone, or Else One Picked Up in a Radio or Electrical Supply Store. A Regular Radio Head Set Having 1,000 Ohms Resistance in Each Reciver Is Best Employed. Bell Wire or Ordinary Electric Light Wire (or Lamp Cord) May Be Used to Connect Up the Antenna, the Instruments and the Ground Connections.

who wish to install, for their own use, a simple receiving set that will give good results. The various circuits presented in this article are standard ones, which perform their functions properly, if adjusted as will be explained.

The type of receiver needed for radiophone reception depends upon the distance in an air line between the broadcasting station and the home of the amateur, it depends also upon the space available for the erection of an aerial; and lastly, the location of the receiving set will affect the intensity of the signals. In some cases it may be difficult to receive any signals if the aerial is placed just behind a building or steel structure, acting as a screen for the waves.

The Simplest Type of Receiver

If the receiving station or home of the owner is within a distance of 10 or 12 miles from a radiophone broadcasting station, the circuit Fig. 1 may be used with an indoor aerial consisting of four or five wires, 25 to 30 feet long, connected as shown. In case shorter wires are used, their number should be increased to eight or ten, spaced as far apart as possible. This type of aerial may be erected in a room, close to the ceiling, the wires being supported by small insulators of any type. The best results would be obtained if the aerial could be erected so that the lead-in wire would be in the direction of the sending station.

The receiving set itself may consist of a double slide tuning coil, a crystal detector, a phone condenser and a pair of telephone receivers having a resistance of about 2,000 ohms. Such an outfit, including the aerial, may be purchased for about fifteen dollars. Of course, the signals and radiophone transmissions received on such a set are not very loud, unless the receiver is situated, say within two or three miles of the sending station. The clearness of the speech and music will be greatly increased by the use of an outdoor aerial, which may consist of either a single wire, 100 to 150 feet long, or three or four wires, each 50 to 60 feet long, and spaced two or three feet apart.

Whether an indoor or an outdoor aerial is used, a good ground connection should be secured; this is easy, if in the country, where a zinc plate or long wires may be buried about one foot deep. For the city dweller, the only possible grounds are the water pipes, or the radiator system. If either of these are used, the pipe should be scraped so as to offer a clean surface, and a bare wire twisted tightly around it, so as to form a good contact, which should preferably be soldered.

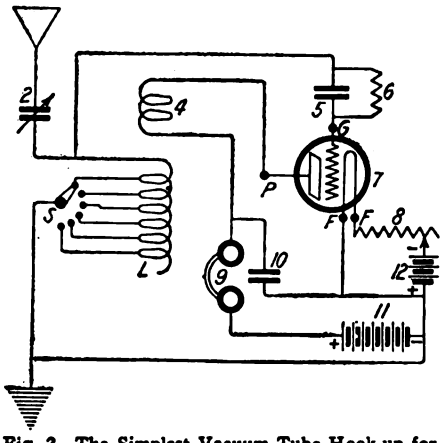


Fig. 2—The Simplest Vacuum Tube Hook-up for Receiving Radiophone and Also Radio-Telegraph Signals Is Shown Above. A "Detector" Type of Vacuum Tube Is Used for This Circuit, and the Phones Should Have 2,000 Ohms Resistance for the Two Receivers Which Are Connected in Series, and the More Sensitive the Phones Are the Louder and Clearer the Signal Will Be. 1—Aerial. 2—43 Plate Variable Condenser. 3—Ground. 4—Small Rotating Coil Inside of Inductance "L". 5—Grid Condenser. 6—Grid Leak. 7—Vacuum Tube Detector. 8—Filament Rheostat. 9—Phones. 10—Phone Condenser. 11—"B" Battery 22½ Volts. 12—6 Volt Storage Battery.

Tuning

To adjust the receiving set just mentioned, the slider No. 2, of the tuning coil, should be moved to the center of the coil, and the other one to almost the end, as shown in Fig. 1. The detector is adjusted, merely by moving the sharp point pressing on the crystal, until signals are heard, then the sliders are moved until the signals are loudest. It should be noted that slider No. 1 is to be moved slowly along the coil, while slider No. 2 is adjusted only when the signals are "tuned in."

The Regenerative Receiver

Using either type of aerial previously mentioned, very loud signals may be heard by using a vacuum tube detector (audion) and a regenerative circuit, which will give a very great amplification. We shall not describe here the functioning of this circuit, referring the reader, for this subject, to standard radio text books, or else to the wireless courses obtainable from radio dealers. This regenerative circuit, shown in Fig. 2, comprises a stationary inductance L, with taps which are connected to a switch and a small coil mounted so as to rotate one-half turn inside the other one. The connection to this small coil may consist of pieces of flexible wire attached to the detector circuit. To tune in the signals with this circuit, the small coil should be turned at right angles to the inductance L and the aerial circuit tuned by means of the variable condenser and the switch S, varying the number of turns of the coil L. The rotating coil is then turned slowly until signals are loudest, that is, just before a whistling sound is heard in the telephones. With such a receiving set, good results may be had a great distance from the broadcasting station, if an outdoor aerial is used.

If it is desired to operate a loud talker to entertain an audience with the radio

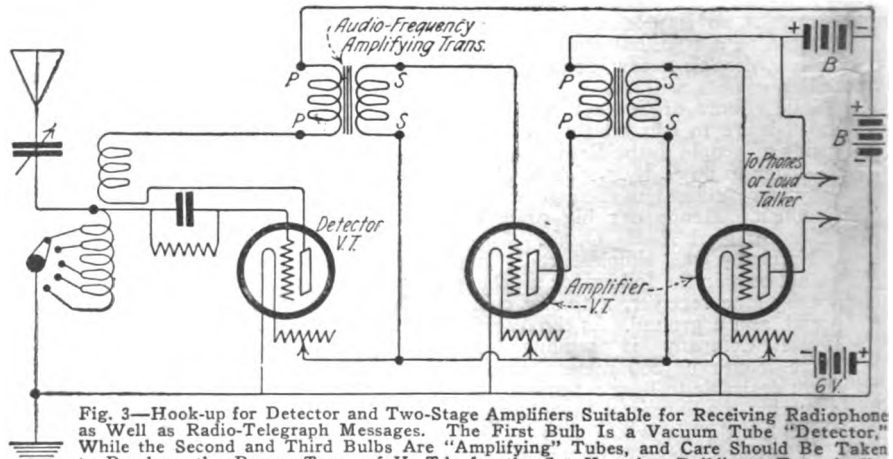


Fig. 3—Hook-up for Detector and Two-Stage Amplifiers Suitable for Receiving Radiophone as Well as Radio-Telegraph Messages. The First Bulb Is a Vacuum Tube "Detector," While the Second and Third Bulbs Are "Amplifying" Tubes, and Care Should Be Taken to Purchase the Proper Types of V. T.'s for the Set You Are Building. Two Audio-Frequency Iron Core Amplifying Transformers Are Used. The Third Vacuum Tube Connects With 2,000 Ohm Head Phones or a Loud Talker Such as a Magnavox, Fitted With Horn.

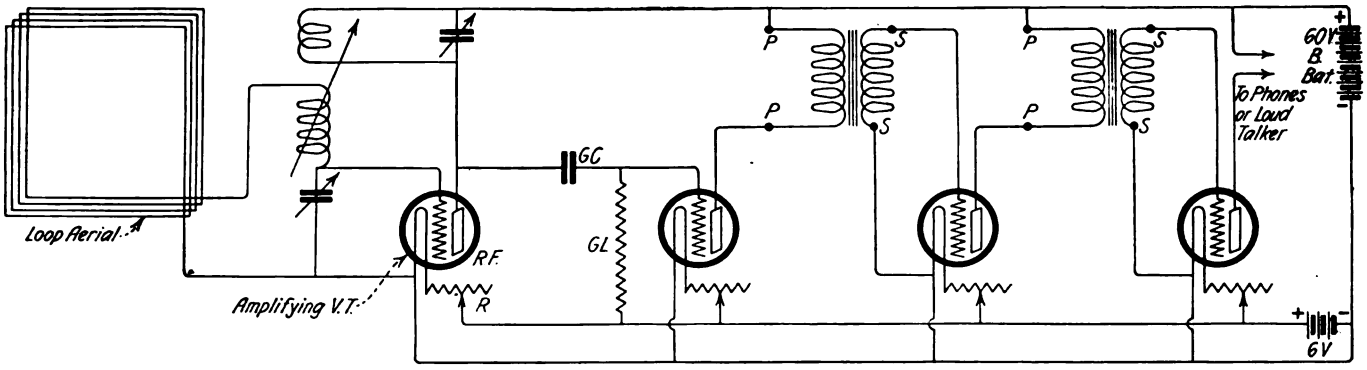


Fig. 5—Indoor Loop Aerial Connected With Regenerative Coupler, V. T. Detector and 3-Step V. T. Amplifier. The Tube Marked R. F., or the One at the Extreme Left Is an "Amplifying" Tube; the Second Tube Is a "Detector," While the Third and Fourth V. T.'s are "Amplifying" Bulbs. This Outfit Has Been Used by One of the Editors With a Single Baldwin Phone Placed at One End of a Large Tin Horn, and Radiophone Music From Cleveland, Ohio, About 758 Miles From New York, Was Amplified So Loud That It Could Be Heard Thru a Five Room Apartment. This Same Set Also Picked Up at New York the Radiophone Concert Sent From the Steamer "Paris," While 250 Miles at Sea. The Loop Used in These Experiments Was 3 Feet Square, and Was Wound With 8 Turns of Insulated Stranded Wire (Lamp Cord Is O. K.), the Turns Being Spaced ¾ Inch Apart. The Signals Are Heard the Loudest When the Plane of the Loop Lies in the Direction of the Transmitting Station.

concerts, or in case the receiving station is very far, an amplifier should be used, connected as shown in Fig. 3. A receiving apparatus of the type shown in Fig. 2 may be constructed, by buying each instrument separately, for about twenty-five to thirty dollars, while the price will rise to about sixty dollars, with the two-step amplifier, but without the loud talker.

Loop Aerial Receivers

A more practical way to receive the radio concerts and talks, without being disturbed by radio telegraphic signals sent in code, consists in using a *loop aerial*, which may be turned in the direction of the station, to receive, eliminating a great deal of interference, as the stations, which are not in the plane of the turns, do not affect it appreciably and not at all if at right angles with it. It is this type of aerial which is used in radio compass stations to ascertain the direction from which the signals are coming.

With such an aerial no ground connection is needed, but to make the signal audible it becomes necessary to use radio frequency amplification, in order to boost up the very weak current induced in the loop. If desired, a two-step amplifier may be added to the detector tube to operate a loud talker, as in the case of the receiver using an aerial, mentioned previously. A receiver of the type shown in Fig. 4 is surprisingly sensitive, and will give good, clear signals in the telephone, up to a distance of about 15 miles from the transmitter, altho this is a conservative figure.

A receiving set of this type, used by the writer in the downtown section of New York City among steel buildings, that is, in an unfavorable location, gave very strong signals, free from interference, which is experienced when an aerial is used. With a two-step amplifier, using the circuit shown in Fig. 5, and a Vocaloud speaker, signals are audible all over a very large room.

How to Build It

The loop aerial used in the circuits shown in figures 4 and 5 should be twenty inches square, and wound with ten turns of insulated wire; No. 18 or No. 20 B. S. are suitable. The regenerative coupler consists of a cardboard tube four inches in diameter, wound with 18 turns of No.

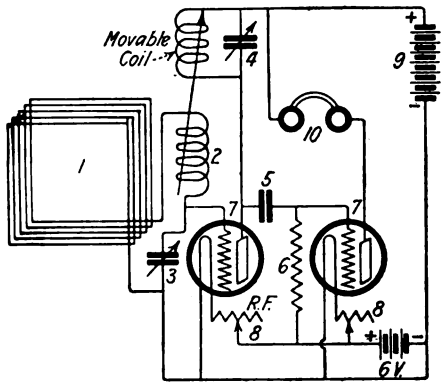


Fig. 4—How to Receive the Radiophone Concerts as Well as Radio-Telegraph Stations Without Any Out-Door Antenna, But Simply With a Loop Aerial Inside the Building. The Loop May Comprise 8 to 10 Turns of Bare or Insulated Copper Wire, Wound on a Form Built of Light Wooden Sticks About 2 Feet Square, Spacing the Turns About ¼ Inch Apart. The Bigger the Loop, the Greater the Range of the Set in Miles, and the Louder the Signals Will Be of Course. 1—Loop Aerial. 2—Regenerative Coupler. 3—43 Plate Variable Condenser. 4—23 Plate Variable Condenser. 5—.00025 M. F. Fixt Condenser. 6—Grid Leak (About 2 Megohms). 7—Amplifying Tubes. 8—Filament Rheostat. 9—60 Volt "B" Battery. 10—Phones.

14 or No. 16 B. & S. double cotton covered wire; adjustable by rotation inside it is a wooden rotor, obtainable in any radio store, wound with 60 turns of No. 28 or No. 30 insulated wire. An insulating knob, made of wood or composition, should be set on the shaft on which the rotor is mounted to insulate it from the hand of the operator.

While in the various circuits using vacuum tubes any type of detector and amplifying tubes, with any make of amplifying transformers may be used, the first tube marked RF in the circuit using a loop aerial *must* be either an AP amplifying tube, or an RAC-3 audion. A very convenient way to mount the various parts of a receiving set, in case it is not desired to build it in cabinet form, is to fix the parts on a board, making all the connections with insulated wire of large cross-section

The sets just described are only a few of those which could be employed for radiophone reception, but owing to their simplicity, easy adjustment and the good results obtainable with them, they are particularly recommended to the experimenter who has not a good knowledge of radio, nor a long experience in tuning vacuum tube circuits. The pleasure derived from listening in to the radiophone entertainments is really worth the little work of assembling a receiving set, and since new radiophone broadcasting stations are continually being installed, several of them may be heard at the same time in addition to the amateur stations sending out radiophone music for the fun of others.

In case anything is not perfectly clear to a reader desiring to make one of the radio sets described in this article, the writer will gladly furnish additional information, if addrest in care of this magazine.

Governor Radiophones Greetings

GOVERNOR EDWARD I. EDWARDS of New Jersey delivered a Christmas message over the wireless telephone at the Westinghouse plant in Newark, N. J. The Governor's voice was clearly heard at the New York *Times* radio receiving station, which "listened in." Governor Edwards said:

"To all within the sound of my voice—and I am assured by the Westinghouse Company that the number includes many millions—I extend my earnest wishes for a happy Christmas and a bright and prosperous New Year. Peace upon earth and good will toward men. The hallowed hope of the ages has never been as near realization as in this nineteen twentieth anniversary of Him whose message was that of universal peace.

"In response to the call of President Harding, representatives of great powers assembled in Washington and within a few weeks of friendly, honest conference, accomplisht more toward insuring the permanent stability and progress of the world than has heretofore been attained thru centuries of conflict and mediation by sword and pen.

"The permanency of the success thus achieved has no more potent aid than the wireless telegraph and radio telephone, which, supplemented by marvelous amplifiers, has minimized distance and will in time abolish horizons, bringing mankind in such seeming close communion that the Christmas spirit will prevail, not for a day, but for all time, and I sincerely trust it may."

Sailors in Mid-Atlantic Heard Carols in New Jersey

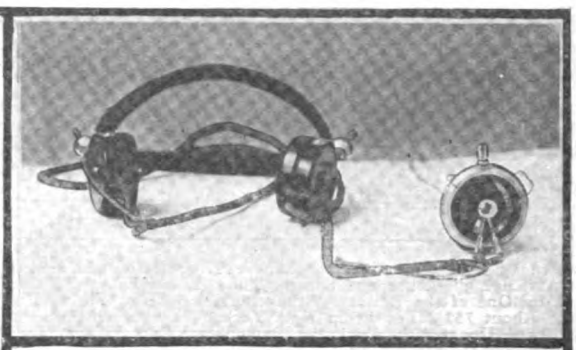
Sailors manning destroyers in mid-Atlantic listened simultaneously with doughboys stationed at posts west of the Rocky Mountains to Christmas carols sung in Newark, N. J.

The "Christmas radio concert," believed to be the first ever held, was given over the Westinghouse wireless broadcasting telephone by Julia Arthur and John Steel, songsters of the Keith circuit, as a Yuletide entertainment for service men stationed far from home.

Thousands of civilians all over the country "listened in" on the concert wherever amplifiers caught it.

Radio Set in a Watch Case

By BERNARD TUCKER



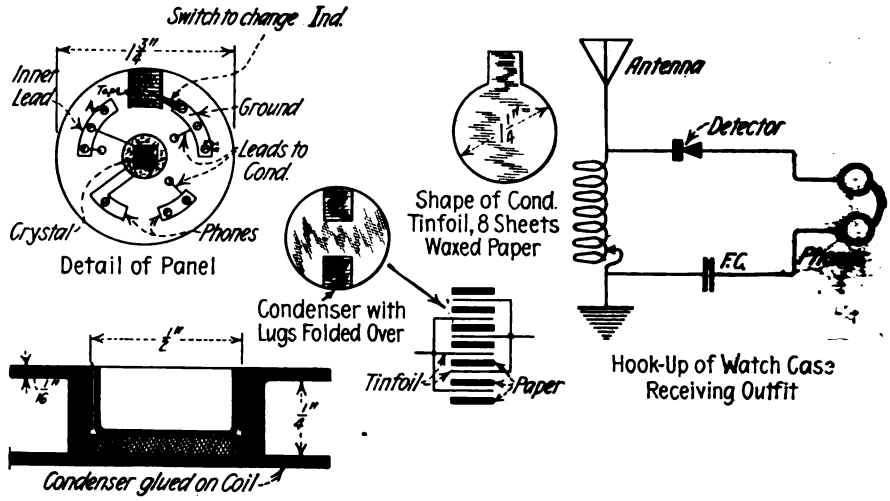
A Complete Pocket Radio Receiving Set is Illustrated Above. The Head 'Phones Take Up Considerable Space so That the Radio Receiving Set Proper, Cannot be Placed in the Vest Pocket); But When the 'Phones Are Disconnected, the Tuning Coil, Detector and Condenser, Built Into a Watch Case as Here Shown, Can be Carried Nicely in the Vest Pocket.

The Diagram Below Shows Details for Building the Various Parts of the Vest Pocket Radio Receiver as Well as Diagram of Connections. Other Hook-ups May be Employed, but the Simple One Here Shown Will Prove Efficient and Suitable for Listening to Radio Telegraph as Well as Radio Telephone Stations.

WHY not build a wireless in your watch case when your watch refuses to go? That is what I have done with my watch, a description of which is given herewith. The inductance is wound on a special bobbin made of hard rubber or fibre, which just fits the watch case. One end of the bobbin serves as a panel for the connections, and a ½" hole is drilled in the center of the panel end of the bobbin, in which the crystal for the detector is mounted. This hole should be ¼" deep. The crystal for my outfit is ½" in diameter and ¼" thick, and therefore, just fits the hole in the center of the panel. The winding consists of 475 turns of No. 28 magnet-wire. The end of the wire is made fast to the small screw in the panel thru a small hole, as shown in the drawing of the panel. Two slots are cut thru the panel ⅜" deep or down to the core of the bobbin. After the wire is fastened to the screw mentioned above, the winding may be proceeded with as follows: Wind one hundred turns, then run the wire out thru one of the slots, and back in thru the other and continue the winding. This leaves a small length of wire exposed on the panel between the two slots for the small switch to make contact with, and thus vary the inductance of the circuit for tuning. After the first 100 turns are wound on, a tap is made every 25 turns thereafter, by running the wire out and in slots.

The switch blade to vary the inductance is made of thin nickel-plated brass and is hinged to another curved strip of

(*Continued on page 978*)



A New 150 to 3,000 Meter Receiver

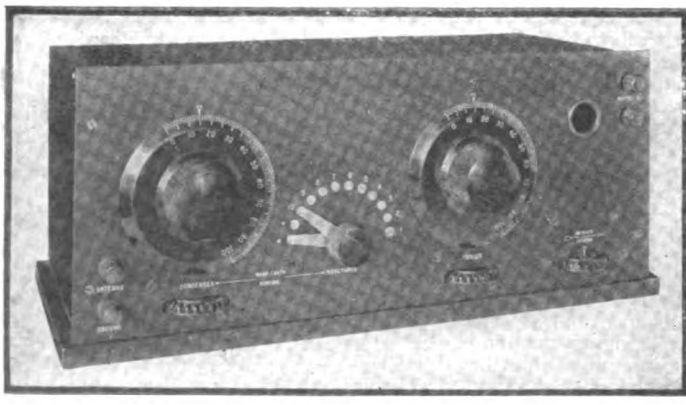
By ARTHUR H. LYNCH

FOR the reason that time signals and press are sent from the Arlington Station, on a wave length of 2,500 meters, it has always been realized that the ideal receiver for amateur use should be made to reach that wave. Since the distributing of market reports by the government has been undertaken with a system of the continuous wave type, the need for a receiver covering this wave length has been felt even more keenly, for these reports are transmitted on a wave considerably beyond the range of the receiving set which is limited to strictly amateur wave lengths.

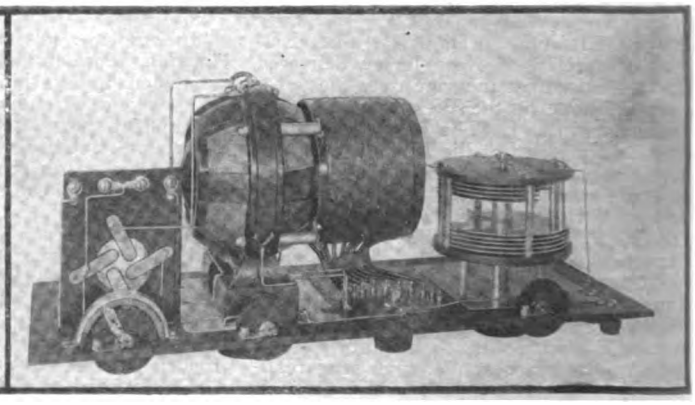
The building of a receiver which would cover the short waves as well as the comparatively longer one of N A A has been a rather difficult problem. One great reason for this was that it took many months to produce a set, which could be honestly backed by a manufacturer as being satisfactory on the entire range.

Such a receiver has now been on the market for several months and it is giving entire satisfaction, for in addition to cov-

(*Continued on page 946*)



External View of New 150 to 3,000 Meter Radio Receiving Set of the Audion Type.



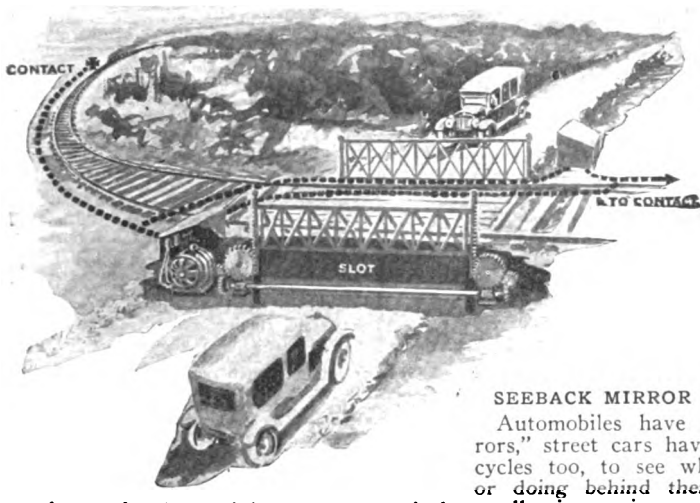
View Showing the Excellent Workmanship and Arrangement of the Apparatus on Rear of Panel.

What to Invent

By JAY G. HOBSON

SOMETHING TO THINK ABOUT

THE trouble with most of us "has-been" "would-be" inventors is the lack of sufficient vision and knowledge of what to invent, what to work on, and what is most worth-while. The purpose of these articles has been to supply the ideas or suggestions of what might prove practical and successful. Granted that the easiest part is to suggest an idea and that the hardest part is to perfect it and make it a success for all concerned; yet the fact remains that so many of us haven't the imagination, or if we have it we have failed to put it to work for our personal benefit in imagining things as they should be instead of as they are. We have neglected to observe new and useful improvements that might hold possibilities of making us independent and famous; and right there is the point about this department—the ideas and imaginations illustrated and explained here are for the sole purpose of helping the reader win something worth-while for himself. What we offer here is given in a broad spirit of co-operation with those to whom the buzz of the "inventive bee" is a constant beacon to success. With this understanding of the aim of this page the following may prove of considerable interest for your most popular indoor sport this winter.



An Automatic Electrically Operated Railroad Crossing Gate Which Would Effectively Prevent Motor Cars from Passing Over or on to Railroad Tracks When a Train is Approaching.

Mr. Hobson, Who Travels a Great Deal and Therefore Feels Privileged to Talk About Suitcases and Other Luggage, Wants to Know Why Someone Has Not Provided the Traveling Public with a Good, Cheap "Wardrobe Suit case." Yes, Why Not?

IMPROVED WATER PURIFYING SYSTEMS

If you have traveled to any extent I am sure you will appreciate the suggestion of a system of universally purifying the drinking water in these United States. There are no two towns to my knowledge having the same kind and chemical content of drinking water. A traveler going from town to town, drinking water from each place (unless he is a camel and can hold out until he reaches home each week-end), consumes a greater variety of chemicals than those contained in the average drug store. One city will have iron, sulfur and salt in the drinking water. The next will have lime, soda and copper. Another will have magnesia, and others will have a greater assortment. By the time a fellow gets home on Saturday night his old "tummy" has battled with a host of things too numerous to mention here. The big idea in this suggestion is simply this: there should be a system for furnishing the same kind of water everywhere regardless of the kind of water put thru the apparatus or water purifying device. If someone will invent a machine for this purpose there is absolutely no doubt in my mind about every city adopting it graciously, both for their own healthful consumption and that of their guests.

SEEBACK MIRROR FOR SPECTACLES

Automobiles have their "seeback mirrors," street cars have theirs and motorcycles too, to see what may be coming or doing behind them. So why not a small, inconspicuous mirror for eyeglasses, to enable a "feller" to see any stealthy "dry" snooper who might try to get too familiar with your hip-pocket? Then it would save a chap's neck heaps, when pretty chickens with up-to-date feathers happen to follow behind unconsciously or otherwise.

A small mirror of good quality could be fastened to the side rim of the spectacle frame, and the wearer could soon get used to focusing his eye to watching the rear as well as the front. In point of fact, this improvement would sort-a give the four-eyed citizen a fifth eye, which should be sufficient for the most observing pedestrian.

A WARDROBE SUITCASE

We have wardrobe trunks and wardrobes in our homes, but there is one place that we need them worse than either of the former, and as yet no one has thought to place one in reach of those who must patronize the hotels in their stately travels.

If you will closely observe the best suitcase on the market you will forthwith agree that it is about the most inconvenient piece of cow's hide and brass you ever looked at. There is no place for anything. Everything goes in like a beef stew. When you finally arrive at your destination and attempt to open your temporary home, you disgustedly find a maze of toothpaste, sox, handkerchiefs, B.V.D.'s, comb and brush, etc. Now why on earth can't some kind gentleman or lady design a suitcase on the plan illustrated herewith? One with compartments for collars, ties, sox, shirts, handkerchiefs, etc. Honest to goodness, I will thank the stars for your blessed invention if you do, for one of the seven worries of my young life is told above.

A Suggestion is Here Given for Improved Spectacles or Eye-glasses, on the Side of Which There is Attached a Small See-back Mirror. The Size of the Mirror is Exaggerated in the Illustration in Order to Show it Clearly. This Could be Made as a Removable Attachment.

ANOTHER RAILROAD CROSSING GUARD

Friends, have you been noticing the large number of ghastly crossing accidents this past summer? I havn't the exact statistics at hand, but scores and scores of good people have lost their lives because there is no guard at country crossings to prevent them from running in front of trains with their automobiles. There are several reasons for these catastrophes. Either it is because they misjudged the speed of the on-rushing "flyer," or their engine went dead on the crossing. But there is no reason for their engine having a chance to die at the wrong time on the crossing, or for them to be concerned about judging the train's speed. Guards working automatically by the approach of the train should think for them, which would prevent so many deaths. The sketch shows another idea for this purpose.

The only way to prevent the speed-crazy motorist from flying across railroad tracks just in front of an on-rushing express, and thus providing an excellent opportunity for a grand smash-up and the loss of several lives in many cases, is to block off the crossing by means of a strong barrier, such as a steel gate. It would seem desirable from many points of view to have this gate rise up out of a slot somewhat in the fashion here shown, an electric motor raising or lowering the gate by means of a rack-and-pinion gear. The electric contact to be operated by the engine of the oncoming train is placed up the track several hundred feet. The gates could be raised and lowered by comprest air, or by other means, and when they are properly balanced, as are the present rising and falling wooden gates, only a small motor will be necessary to operate them.

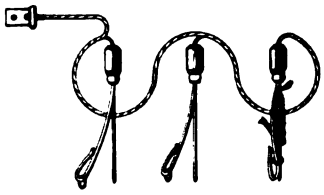
Of course special means would have to be provided to close the slot as soon as the gate disappeared beneath the surface.

LATEST PATENTS

Electric Hair Curler

(No 1,387,785 issued to Elin M. Lindberg)

This system is best described by viewing the drawings herewith.

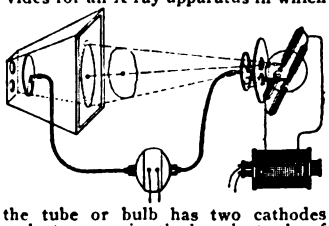


The circuit wires are all of a length only sufficient to conveniently support the heating units, spaced the desired distance apart. The heating units comprise an active member containing the heating element and a resilient coöperatively engaged clamping appliance. This clamping appliance normally remains open, and is securely attached to one end of the heater. A small molded ring is added, so as to permit holding this member adjacent to the heating element.

X-Ray Apparatus

(No. 1,390,250 issued to Matias Balsera Rodriguez)

The inventor of this system provides for an X-ray apparatus in which

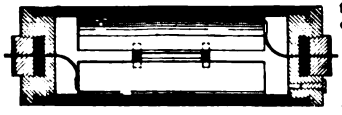


the tube or bulb has two cathodes and two anti-cathodes instead of one. These are connected to the usual transformer. Rays from these can pass only thru openings cut out of a lead plate, in front of which is another disk also made of lead having two or more openings in it. This disk is rotably mounted and its rotation is in synchronism with the alternations of current in the secondary circuit supplying the tubes. Thus whenever there is an obturation of the openings, a corresponding issue of current passes into the X-ray tube. In this manner, it is claimed that stereoscopic vision of X-ray objects is possible, using the ordinary fluoroscope.

Storage Battery

(No. 1,388,850 issued to Thomas R. Cook)

There have been many attempts made at providing storage batteries

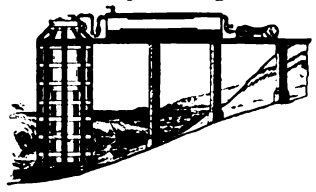


for portable flashlights. In this invention, the style is changed slightly. The battery itself comprises a tubular container of hard rubber, glass, or other non-conducting material. This houses the regular pasted plates made as usual, including grid and active material. These plates have a curvature nearly coresponding to the curvature of the inside of the tube, and are practically semi-cylindrical in shape. The plates are separated from each other by means of a bridge of hard rubber in the shape of an "H," or by means of asbestos wool mixed with silicate of soda, water glass, to which sulphuric acid of the proper density has been added.

Ocean Compress Air Power

(No. 1,389,445 issued to Charles M. Hare)

Utilizing wave motion for power purposes is not new, but many and varied are the methods which have been used in attaining this end. In the present apparatus two long steel cylinders, the upper one of which is rigidly secured to a pier or abutment, while the lower one is permitted to move vertically in roller guides, act as the compressing elements. These tubes telescope into each other in such a manner that a water seal separates the air within the cylinders from the external atmosphere. Taking advantage of the waves, the inventor believes that the cylinder will move up because of the buoyant effect of water and drop down again due to

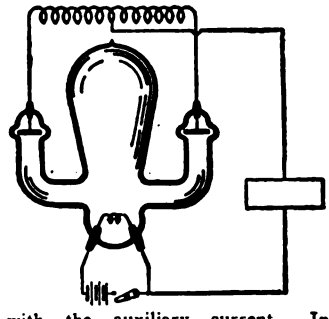


gravitation. These movements are to cause compression of a large quantity of air. The downward movements on the other hand, permit a valve to open and the cylinders to fill with atmospheric air again.

Vacuum Type Converter

(No. 1,388,793 issued to Wilfred T. Birdsall)

In the usual form of vacuum type converters or rectifiers, a cathode in the form of a filament has been employed. This cathode was generally made incandescent by drawing current from an auxiliary current source, in order to render it suitable for electronic emissions. The inventor of this system has done away

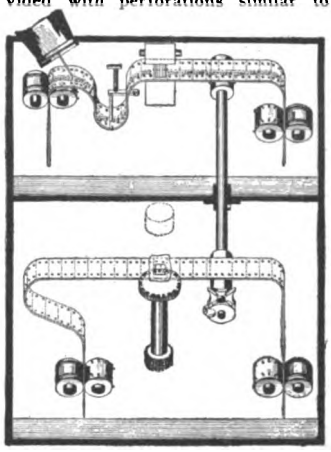


with the auxiliary current. In alternating current apparatus, he provides for two electrodes. These are provided likewise with suitable heating means. The electrodes are then raised to an electron-emitting temperature, whereupon bilateral current flow takes place.

Coördinating Sound and Motion Picture Records

(No. 1,389,407 issued to William Erastus Williams)

This method of coördinating sound and motion picture films is very simple. For the reception of sound the inventor prefers to employ a thin strip of suitable material coated with gum, wax or other substance. This strip is provided with perforations similar to

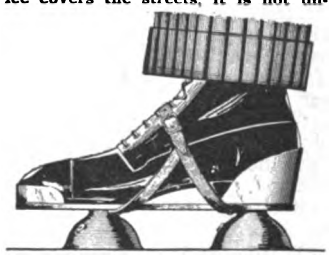


the perforations found upon ordinary motion picture films. The motion picture and sound recording film strips are driven in synchronism with each other. Thus, whenever the motion picture machine is actuated the sound recording machine also works in exact accord with it. An additional feature is, that each corresponding frame of a motion picture is numbered by means of a perforating and numbering device. It will thus be seen that in projecting, it is merely necessary to line up both films

Non-Slip Device

(No. 1,389,416 issued to José Garza Zertuche)

In the dreary winter months when ice covers the streets, it is not un-

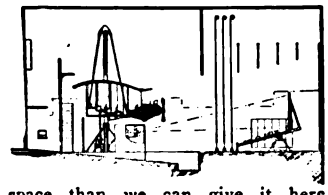


usual to find both pedestrians and animals skidding over the surface of the ice and vainly trying to regain their footing. In this device, the inventor has provided for one or two suction cups, which can be attached to the footwear. These are so arranged, that pressure on the foot causes the open cup to be closed, and incidentally closes a vent, thus establishing a partial vacuum or suction. On subsequently releasing pressure on the cup-shaped devices, the vent opens, permitting the air to flow into the cups, hence relieving the suction.

Amusement Apparatus

(No. 1,388,130 issued to Frederick William Thompson)

This is a very clever illusion device and deserves a good deal more

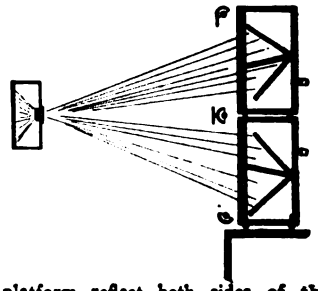


space than we can give it here. Passengers are permitted to embark upon an imitation airplane, so mounted that it is free to swing for a few feet. This airplane is suddenly released when its motor starts the propeller spinning, drawing the plane a little forward of its center of suspension. This motor incidentally drives a compressor, the air from which is allowed to escape interruptedly, giving the effect of an engine exhaust. Meanwhile scenery painted on drops is gradually lowered, making it seem that the airplane is flying up into the air. The wind from the propeller and the vibrations of the motor greatly enhance the effect, a miniature city is lowered into view on a sort of rocker platform.

Image Recording Apparatus

(No. 1,391,807 issued to William E. Swalm and William C. Bryan)

Many times banks and other institutions send thru the mails or by means of messengers, checks, notes or contracts of which they have no further record, unless, of course, they have legally protected the note. In order to facilitate retention of such record, and in order to make a protection of this nature easy to secure, the inventors have devised a glass plate which holds the check or note. Mirrors in angular relation with this note-holding

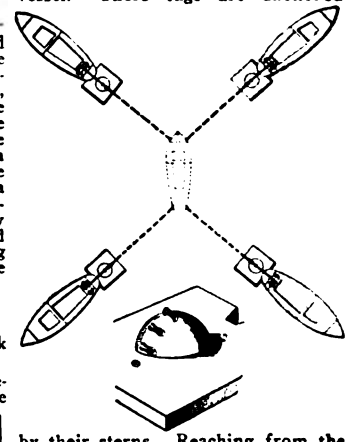


platform reflect both sides of the note or check, so that it may be photographed by one camera at the same time.

Raising Sunken Vessels

(No. 1,390,097 issued to Pedro Donaire)

Whether or not the following invention will actually raise sunken ships remains to be seen; the device is merely a pontoon secured to the bow of a wrecking tug or similar vessel. These tugs are anchored



by their sterns. Reaching from the sunken vessel to the tug are two chains attached to the bow and stern of the sunken vessel, or in case the vessel is very large, four chains are arranged upon it. These chains are to be heavy enough to sustain the weight of the vessel. Their inboard extremities communicate with windlasses by passing over the rollers of the pontoon. It is thought by the inventor that this device will work.

Scientific Humor

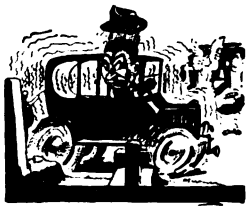
Fors-hootch.—Out in Tulara county, California, an enterprising citizen has discovered a process of curing grapes. They are put up in cartons of several pounds each. Directions as follows:

Place the contents of this package in open jars and add three gallons of water. Let stand three days. Strain and boil one hour, then seal or bottle. This makes an excellent grape juice. IMPORTANT—Do not forget to boil on the third day or the mixture will ferment and turn to whiskey.

It is needless to add that the buyers of said packages are exceedingly forgetful.

Soon.—Aviator (on being led to court): "But, officer, I was only doing 160 miles an hour."

Aero Cop: "Why, you were delaying the traffic."



The Rattlesnake.—One of Bossworth's young sprouts was coming home about 12 o'clock the other night on the south road, and just as he got even with the graveyard the engine went dead. But he said he got so scared when he saw where he was that he shook the car so badly the durned old Ford thought the motor was running, and came clear to town before it discovered its mistake.

—*Frank Durivage.*

Past Her.—"I do hope that you keep your cows in a pasture," said Mrs. Newlywed, as she paid the milkman.

"Yes'm," replied the milkman. "Of course we keep them in a pasture."

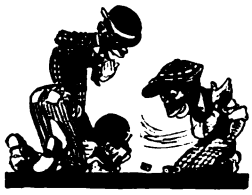
"I'm so glad," gushed she. "I have been told that pasteurized milk is much the best."—*Frank Durivage.*

With Lightning Speed.—Poor: "What made Vulcan lame?"

Sim: "Why, he slipped on a thunder peal."—*Abraham Budovsky.*

Did They Switch Her On?—Old Lady: "Oh, Conductor, please stop the train. I dropped my wig out of the window."

Conductor: "Never mind, Madame, there is a switch just this side of the next station."—*Abraham Budovsky.*



No Bonehead, He. — Rastus: "Feller, why for you all dabblin' wid dis here oysteropathy?"

Sambo: "'Cause Ah done read in a book dis oysteropathy treat ob de manipulation of de bones, and de onliest partiality Ah's got is humorin' de gallopin' dominoes to pass in review."

—*Frank Durivage.*

Electrically Speaking.—"Hey, Edison, wire they conducting those two Poles to the electric chair?"

"Because they were burning juice at the Battery, and a copp-er two doing their cores discovered and captured them. At the terminal, the cops gave up their charges, and after placing the juice burners safely in cells, they were discharged, and sent ohm."—*Morris Diamond.*

A Long Needed Invention.—An old colored minister announced that he had invented an automatic collection basket, which would be past around by the deacons of his church. "It is arranged, my brethern," said he, "dat if you drop in a quartah or half dollah it falls noiselessly on a red plush cushion; if you drop in a nickel, it will ring a bell dat can be distinctually heard by de entiah congregation but if you let fall a suspender button, my brethern, it will fiah off a pistol."

—*L. W. Moore.*

Plane Truth.—Mose: "Dis here flyin' business am a mighty ole venture."

Rastus: "How come you say dat?"

Mose: "Didn't de parson say dat Esau sold his 'heirship' to Jacob?"

—*Kerness Chapman.*

No Decent Descent.—A man had just made a successful descent in a parachute and the crowd of spectators that had gathered were asking questions.

"Say, what if the parachute didn't open?" one inquired.

"Oh, that wouldn't bother me. I'd just come on down anyhow," was the reply.—*Bernice Bray.*

WE receive daily from one to two hundred contributions to this department. Of these only one or two are available. We desire to publish only scientific humor and all contributions should be original if possible. Do not copy jokes from old books or other publications as they have little or no chance here. By scientific humor we mean only such jokes as contain something of a scientific nature. Note our prize winners. Write each joke on a separate sheet and sign your name and address to it. Write only on one side of sheet. No letters acknowledged unless postage is included.

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

Warning! Last Time We Print This Joke.—Once there was a conductor who was not satisfied with his wages, and left. The next day, while looking for a job, he happened to step on the third rail. Did he get killed? No. He was a non-conductor.—*Max Abramson.*

High Resistance. — Flubb: "What is the line of least resistance?"

Dubb: "Well, it certainly isn't the telephone line."

—*Edward H. Dreschnack.*

Oh! Water on the Brain!—Professor: "What proof have you to show that alcohol is lighter than water?"

Student: "It goes to your head when you drink it."—*Thomas Tynan.*

Gassed.—

Percy studied chemistry;
He studied long and late.
Percy breathed some chlorine gas—
He'll not *graduate!*

—*William Poizner.*

Dayrate is High Enough.—"I see by your sign that you now charge 10 cents extra on all drinks served at the fountain after midnight."

"Yes, in the future a quarter will be what I may call the Nightrate of Soda."

—*W. S. McLean.*

Better Than Making Gold.—"What fo', Rastus, you got dat chemist workin' fo' yuh?" inquired Snowball Johnson.

"I'se seein' if he can't take de wood outa de alcohol," replied Rastus.

—*Lyle Heintz.*

A Lightning Change.—The class in chemistry were discussing chemical and physical changes, the professor went on to explain that, for instance, when a piece of wood warps, that is a physical change, and when a piece of iron rusts, that is a chemical change.

Then one of the students, somewhat perplexed, inquired, "What kind of a change would you call a peroxide blonde?"—*Rudolph Wensko.*

Slow Movies.—An old darky had bought a pressure cooker and was back talking to the merchant he bought it from.

"Well," said the merchant, "can your wife work that cooker all right, Sambo?"

"Naw, sah," Sambo replied. "Not much."

"Well, you don't have to miss any meals, do you, Sambo?"

"Naw, boss, I don't have to do dat," Sambo said. "But I shore has postponed a lot of 'em."—*Bernice Bray.*

Relativity.—Mr. John Smith had got his auto stuck in the mud, so his wife watched the wheels to see if they were spinning.

"Why, John," she said, "the back ones are spinning, but the front ones are getting a good hold."

—*Edward Highes.*

Hard Water.—Teacher: "And now, can anyone tell me what an icicle is?"

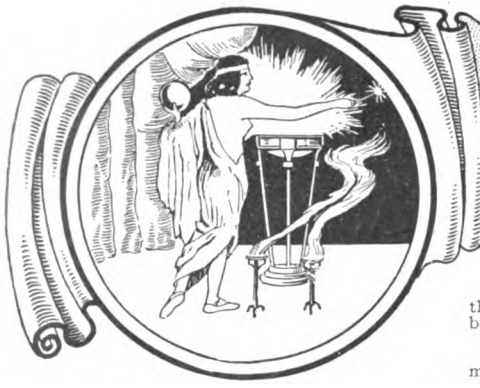
Tommy (after a profound silence): "Please, Ma'am, it's a stiff piece of water."—*Julia Howland.*

Both Come High.—Dum: "What's the difference between a giant steamship and a dirigible airplane?"

Bell: "I don't know. What is it?"

Dum: "The one has wonderful power and the other is a powerful wonder."

—*Theodore Keller.*



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.

Is Wet Coal More Efficient Than Dry Coal in Steam Production?

(1177) James M. Murphy, Pittsburgh, writes:

Q. 1. I have heard so many different opinions as to the advisability of wetting coal before firing it in a furnace or boiler, that I would appreciate some data if you have any available, as to the relative efficiency of dry and wet coal. Some chemists claim that there is no gain whatever, while boiler experts whom I have spoken to on the subject say that it is best to wet the coal, especially if it is very dry, and that there is an appreciable gain in the amount of steam produced, or water evaporated.

A. 1. We are glad to give you herewith the tabulated data on an actual test made with both dry and wet coal by Mr. W. H. Wakeman and recently reported in *Power Plant Engineering*. These tests were conducted by Mr. Wakeman, as he states, under the same firing conditions and the coal in both cases was taken from the same lot. The rate of combustion was maintained as nearly alike as possible in both cases. During these tests a forced draft of about one-half inch of water was maintained under the grates by an Argand blower. The increased evaporation of water due to wetting the coal was found to be over 8 per cent, as shown in the final tabulation in test No. 2.

Test No. 1. Dry Coal

Duration of test	10 hr.
Pea and dust	4181 lb.
Soft coal	1000 lb.
Total	5181 lb.
Proportion of mixture	4.18 to 1
Coal per square foot per hour	17.3 lb.
Power developed	134.4 h. p.
Water evaporated	43,020 lb.
Water evaporated per pound of coal	8.3 lb.

Test No. 2

Stated weight is of dry coal. It was then wet down with all of the water that it would absorb.

Duration of test	10 hr.
Pea and dust	3666 lb.
Soft coal	780 lb.
Total	4446 lb.
Less 3 per cent moisture	133 lb.
Net weight	4313 lb.
Proportion of mixture	4.7 to 1
Coal per square foot per hour	14.4 lb.
Power developed	121.5 h. p.
Water evaporated	38,880 lb.
Water evaporated per pound of coal	9 lb.
Increased evaporation due to wet coal	8.4 per cent

Chemicals Producing Heat in Water

(1178) Arthur Hacburn, Wyandotte, Mich., asks:

Q. 1. For a chemical which will produce heat if added to water.

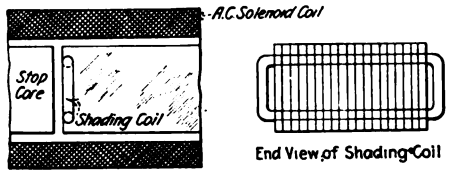
A. 1. We suggest some chemicals which, when placed in contact with each other develop considerable heat, sufficient to vaporize the gasoline. They are cheap and will not offer any difficulty in handling.

One is quick lime mixed with water, the simple process otherwise known as slaking. Water and sulfuric acid will also produce heat but we do not recommend them; the acid is liable to do harm by its corrosive power. In any case add the acid to the water, not the water to the acid. Calcium chlorid, caustic soda and many other chemicals produce considerable heat when added to water.

Q. 2. Please explain the use of a shading coil for single phase electromagnets to improve the lifting power and also to reduce the humming.

A. 2. The following data is given from the *American Handbook for Electrical Engineers*, by Pender. The humming of single phase magnets may be greatly reduced by introducing a so-called *shading coil* in the pole face. This shading coil is nothing more than a short-circuited secondary winding, consisting of one or more turns, which encloses only part of the total flux passing thru the plunger. Due to the leakage reactance of this turn, the current induced in it is out of phase with the inducing flux, so that at the moment when the inducing flux, due to the main winding, is zero, there still remains a flux due to the current in the shading coil which flux produces a pull. Thus the combined pull from the main flux and the shading coil flux never becomes zero. The illustration shows the arrangement of the shading coil. This coil is mounted in the plunger or in the plug close to the pole-face, in order to reduce the length of the path for the magnetic lines which are interlinked with the shading coil. Naturally the shading coil has no effect with long air-gaps, and it is therefore imperative that a good magnetic contact be obtained when the plunger is in the sealed position, to get the greatest possible effect of the shading coil.

Incidentally the shading coil also increases considerably the maximum pull for a given imprest voltage, as the minimum pull is also due to the combined main and local flux. As an example, a plunger magnet without shading coil, which gave a minimum pull of zero and a maximum pull of 28 pounds, had, after the introduction of the shading coil, a minimum pull of 18 pounds and a maximum pull of 143 pounds.



The Use of a "Shading Coil" Like That Shown Will Increase the Pull of A. C. Magnets Considerably.

Problems in Physics

(1179) C. C. Stervette, Rockfield, Ind., writes:

Q. Asking several questions in physics.

A. Your questions contain a number of peculiar paradoxes. If a weight is dropt from its roof to the floor of a moving train, the weight will strike the floor at a point directly beneath its starting point, with reference to the car, the reason being that all bodies within the train are in motion at a speed equal to the train. If the front door of the train were open so that air were permitted to rush thru the cars, the air would have some slight effect on the weight, and the weight would fall behind its starting point.

With reference to your second query, there are several interesting points which have to be considerd. As you know, the earth is ellipsoidal being of greater diameter at the equator than at the poles, and, therefore, the gravitational pull at the poles would be greater than that at the equator, provided that the earth remained in its same shape when it ceased rotation. It is quite possible, however, that the earth would become perfectly spherical, in which event the weight at the equator would be identical with that at the poles.

Two persons together in the center of an absolutely frictionless pond could get off that pond. The fact that the pond is frictionless excludes the possibility of a gravitational pull. If, therefore, both individuals exerted pressure upon each other, or one pushed the other, the force exerted by him would be exerted in the opposite direction in an equal manner, and both would go sliding off to the edge of the pond regardless of its size because they had been started into motion and friction does not further affect them.

Transformer Winding Data

(1180) G. Stevenson, Detroit, Mich., writes asking for:

Q. Data on 12-volt, 120 ampere transformer.

A. The nearest data we have to the transformer you request data on, having a secondary output of 12 volts and 120 amperes, is that for a transformer giving 13 volts and 150 amperes, and intended for operation on 110-120-volt, 60 cycle A. C. circuit.

The data for constructing this transformer is as follows: The laminated sheet iron core measures 17½x8¼ inches with a cross-section of 2¼x2¼ inches.

The primary coil is wound on one of the longer legs, first insulating the leg with several layers of oiled linen or empire cloth, and for 110 volts, 60 cycle A. C., this winding comprises 224 turns No. 8 B. & S. gauge D. C. C. copper magnet wire.

The secondary winding comprises 31 turns of No. O. B. & S. gauge D. C. C. magnet wire, or several other conductors of small size, but equivalent to this size conductor, may be wound on, owing to the difficulty of winding on such heavy wire as No. 0. The secondary voltage will be dependent upon the number of turns tapped off from this coil. If you tap off at 15 turns, you will get approximately one-half the normal secondary voltage or 6½ volts, so that you can easily figure out by direct proportion where to tap off.

Transparency of Different Materials to X-Rays

(1181) Henry D. Thompson, New York City, N. Y., writes:

Q. 1. How do different materials compare with water with respect to their comparative transparency to X-rays, taking the transparency of water as equal to 1?

A. 1. The table below gives the values cited by Batelli and Garbasso:

MATERIAL	Specific Gravity. Water = 1	Transparency. Water = 1
SOLIDS		
Pinewood	0.56	2.21
Walnut	0.66	1.50
Paraffin	0.874	1.12
Rubber	0.93	1.10
Wax	0.97	1.10
Stearine	0.97	0.94
Cardboard	....	0.80
Ebonite	1.14	0.80
Woolcloth	....	0.76
Celluloid	....	0.76
Whalebone	....	0.74
Silk	....	0.74
Cotton	....	0.70
Charcoal	....	0.63
Starch	....	0.63
Sugar	1.61	0.60
Bone	1.9	0.56
Magnesium	1.74	0.50
Coke	....	0.48
Glue	....	0.48
Sulfur	1.98	0.47
Lead Ointment	....	0.40
Aluminum	2.67	0.38
Talcum	2.6	0.35
Glass	2.6	0.34
Chalk	2.7	0.33
Antimony	6.7	0.126
Tin	7.28	0.118
Zinc	7.20	0.116
Iron	7.87	0.101
Nickel	8.67	0.095
Brass	8.70	0.093
Cadmium	8.69	0.090
Copper	8.96	0.084
Bismuth	9.82	0.075
Silver	10.5	0.070
Lead	11.38	0.055
Palladium	11.3	0.053
Mercury	13.59	0.044
Gold	19.36	0.030
Platinum	22.07	0.020
LIQUIDS		
Ether	0.713	1.37
Petroleum	0.836	1.28
Alcohol	0.793	1.22
Amyl Alcohol	....	1.20
Olive Oil	0.915	1.12
Benzol	0.868	1.00
Water	1.000	1.00
Hydrochloric Acid	1.240	0.86
Glycerine	1.260	0.76
Bisulfite of Carbon	1.293	0.74
Nitric Acid	1.420	0.70
Chloroform	1.525	0.69
Sulfuric Acid	1.841	0.50

Books on "Perpetual Motion"

(1182) J. Smith, Florida, asks:

Q. Where can I procure books on perpetual motion machines?

A. There are several books on the subject of perpetual motion. We can recommend a very good book by Percy Verance, entitled "Perpetual Motion," which our Book Department can supply at $2.00.

You might also find useful the book entitled, "Seven Follies of Science," by Phin.

Try Their Way

of teeth cleaning—make this test

You see white teeth everywhere today—teeth that show perfect care. Millions of people have adopted a new method of teeth cleaning.

You should learn what that method means. Accept this offer, make this test, see the changes that occur.

Remove the film

To keep teeth whiter and cleaner and safer you must remove the film. Old ways of brushing fail to do that effectively.

Film is that viscous coat you feel. It clings to teeth, gets between the teeth and stays. It absorbs stains, so the teeth look discolored. Then it often forms the basis of a fixed and dingy coat.

That film is what discolors, not the teeth. Film is the basis of tartar. It holds food substance which ferments and forms acids. It holds the acids in contact with the teeth to cause decay.

Germs breed by millions in it. They, with tartar, are the chief cause of pyorrhea. Thus most tooth troubles are now traced to film. Under old methods, those troubles have been constantly increasing.

How to combat it

Dental science, after long research, has found two ways to fight film. Many careful tests have amply proved their efficiency. Now authorities endorse them, and leading dentists everywhere are urging their daily use.

A new-day tooth paste has been created, called Pepsodent. Those two film combatants are embodied in it. That is what those millions are using today. That is what we urge you to try.

Teeth Glisten

when the film goes

Teeth show their natural luster when the film-coats are removed. That is why so many teeth now glisten — teeth which once were dingy.

But dental research has found other essentials. And this modern tooth paste—Pepsodent—meets the new requirements.

Other new effects

Starch deposits also cling to teeth. In fermenting they form acids.

Nature fights those enemies by two factors in saliva. One is a starch digestant—to digest the deposits. The other is alkalis—to neutralize the acids. But, with modern diet these defenses are usually too weak.

So Pepsodent is made to stimulate those forces. It multiplies the starch digestant in the saliva, multiplies its alkalinity. So every use increases markedly those natural protective forces. Starch deposits or their acids are combated with many-fold effect.

Watch the changes

The results of Pepsodent are quick and convincing. The effects can be seen and felt. This ten-day test will be a revelation.

Send the coupon for the 10-Day Tube. Note how clean the teeth feel after using. Mark the absence of the viscous film. See how teeth whiten as the film-coats disappear. Note the refreshing after-taste. The mouth is left in alkaline condition.

In a week you will realize that this method means a new dental era. You will want those benefits continued. Cut out the coupon now and see.

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The New-Day Dentifrice

A scientific film combatant, bringing five desired effects. Approved by authorities and now advised by leading dentists everywhere. Supplied by druggists in large tubes.

10-Day Tube Free 780

THE PEPSODENT COMPANY,
Dept. 650, 1104 S. Wabash Ave., Chicago, Ill.
Mail 10-Day Tube of Pepsodent to

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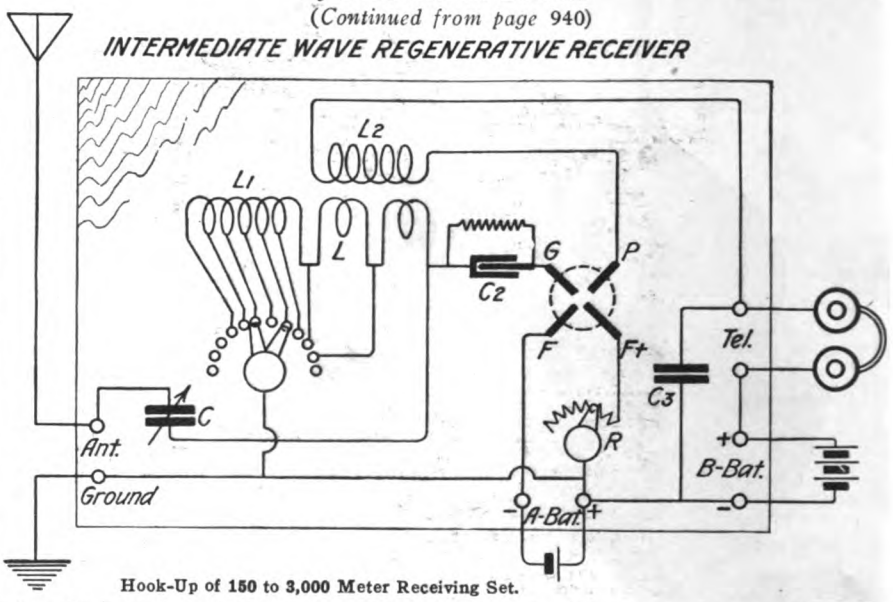
Only one tube to a family.

A New 150 to 3,000 Meter Receiver

By ARTHUR H. LYNCH

(Continued from page 940)

INTERMEDIATE WAVE REGENERATIVE RECEIVER



Hook-Up of 150 to 3,000 Meter Receiving Set.

ering the wave length range, it is particularly easy to operate.

The set includes a vacuum tube socket and control system, which was previously of an entirely different design. It was originally necessary to insert the tube thru the front panel and it was held in a horizontal position and projected beyond the panel. In the newer type receiver the tube socket has been mounted in a vertical position which prevents the tube filament from sagging.

The control of the filament battery is now carried out by means of a rheostat, mounted at right angles to the front panel, with the control knob passing thru it. The control knob is marked directly in ohms and runs beneath a pointer on the front panel. There are two other knobs, similar to the rheostat control, which are used for verniers. One operates on the antenna series condenser and the other on the tickler variometer.

The control knobs for the two verniers are mounted on the shafts, which carry little rubber tires, which press against the rear surface of the dials for a friction drive.

New Subway Turnstile

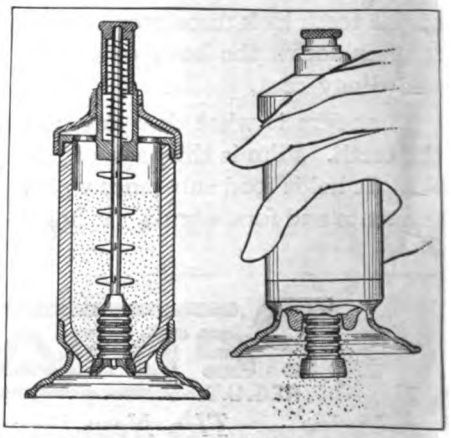
(Continued from page 917)

the subway, comes provided with a nickel, he can rush thru these gates without waiting in line for his ticket. Obviously the ticket chopper is no longer needed. These gates turn freely for any person going out and the gate does not have to be unlocked for this purpose. Inherently their construction is simple, the coin, having been dropt thru a slot, if of the proper size and weight, closes an electrical contact. This contact operates a solenoid which admits a quantity of air into the unlocking mechanism and releases the gate for the distance of one quadrant or 90 degrees. The passenger having past thru the gate is securely locked until the next nickel is dropt into the box. Should a person desire to leave the train he passes thru the same gate. This turns freely in the exit direction.

Nor do incomers and outgoers interfere with each other. Supposing that a passenger should be passing in and another coming out of the station, they both meet at the same gate. Then the passenger entering has the right of way, and when once his nickel has been dropt in the slot, it is impossible for the outgoing individual to pass thru the gate, regardless of how strong he may be. Inasmuch, however, as the great flow of traffic in the morning is downtown and uptown in the evening, a downtown passenger meets very few entering the station as he is leaving it, and in the evening when going uptown he is with the greater amount of traffic. One of these gates can pass 40 passengers thru every minute.

A NON-STICKING SALT SHAKER

The accompanying illustration shows a salt shaker patented by a New York inventor, which, he claims, will absolutely prevent the caking of table salt, one of the nuisances we have with us on our rainy days. As will be seen this salt shaker embodies in its make-up a movable center stem or shaft, which is normally held in its upper position by a spiral spring. Along the shaft is placed a series of blades, and at the bottom of the shaft a plunger is secured which has grooves turned on its surface. Whenever the plunger is deprest, therefore, the salt is broken up by the moving blades and a quantity of the salt is positively ejected by the grooved piston, which moves thru the opening at the bottom of the dispenser.



A Non-Caking Salt Shaker, Illustrated above, Has Been Patented By a New York Inventor. He Provides a Spring-Actuating Central Plunger, Carrying With It a Series of Blades as Well as a Grooved Piston-Like Lower Member, so That When the Center Shaft is Deprest, the Salt is Broken Up and a Quantity of it Positivly Ejected By Virtue of the Grooved Piston.

Actual photo of one of our rebuilt Underwood Typewriters

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Rebuilt like new. Every typewriter is factory rebuilt by typewriter experts. New enamel—new nickeling—new lettering—new platen—new key rings—new parts wherever needed—making it impossible for you to tell it from a brand new Underwood. An up-to-date machine with two-color ribbon, back spacer, stencil device, automatic ribbon reverse, tabulator, etc. In addition, we furnish FREE waterproof cover and a special Touch Typewriter Instruction Book. You can learn to operate the Underwood in one day.

From Factory to You

Yes, only $3 brings you this genuine Rebuilt Standard Visible Underwood direct from our factory, and then only small monthly payments while you are using it make it yours; or, if convenient, pay cash. Either way, there is a big, very much worth-while saving, too. Genuine, new Underwood parts wherever the wear comes—genuine standard, four-row, single-shift keyboard—thoroughly tested—guaranteed for five years.

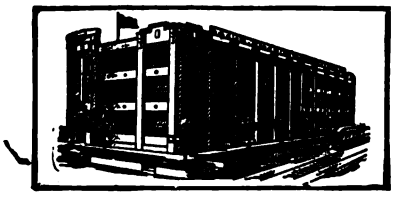
$3 Puts It in Your Home

You don't even have to scrimp and save to pay cash. Instead, you pay only a little each month in amounts so conveniently small that you will hardly notice them, while all the time you are paying you will be enjoying the use of and the profits from the machine.

10 Days' Free Trial

Remember, you don't even have to buy the machine until you get it and have used it on 10 days' free trial so that you can see for yourself how new it is and how well it writes. You must be satisfied or else the entire transaction will not cost you a single penny.

Act NOW! Mail TODAY!



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Send by return mail Bargain Offer No. 2162 of a Standard Visible Writing Underwood. This is not an order and does not obligate me to buy.

Name.....

Street or R. F. D. No......

Post Office.....*State*.....

If a 250-Mile Gale Struck New York

By C. S. CORRIGAN, C. E.

(Continued from page 906)

storm was more than five hours getting here after the barometer lowered enough to give warning, so that all the superfluous particles of air in a building had plenty of time to get in line and march out at the cracks around the doors and windows, then the storm only had its force of 50 pounds per square foot to use against buildings, and only succeeded in damaging the weaker ones.

If such a storm should increase to a 250-mile gale, the barometer would fall, say to 24" or a 12 pound pressure, but the decrease coming slowly would not damage any building. The force of the wind, however, increases as the square of the increase in velocity, so in this case it would amount to 320 pounds per square foot or about six times as much as the Woolworth building was built to stand, and if out on a prairie it would surely be toppled over and broken to pieces, but as it is surrounded by many other tall buildings, on each of which the storm would have to expend and lose considerable of its energy, it might happen that the lower and better braced part would stand the strain. The tower, however, rising so much above its surroundings, would be snapt off as the tallest forest trees have their tops broken off in severe storms. If the storm came from the west, and the steel uprights on the Broadway front only bent over instead of breaking off, the tower would describe a half circle, strike the pavement or possibly the Post Office building and so support itself upside down as shown in the picture.

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Through This Wonderful New Method You Can Now Learn to Play Your Favorite Instrument in a Few Short Months

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"HOW did you ever do it? Where in the wide world did you ever learn to play so quickly?"

This is the question that thousands of my students have been asked and are being asked daily.

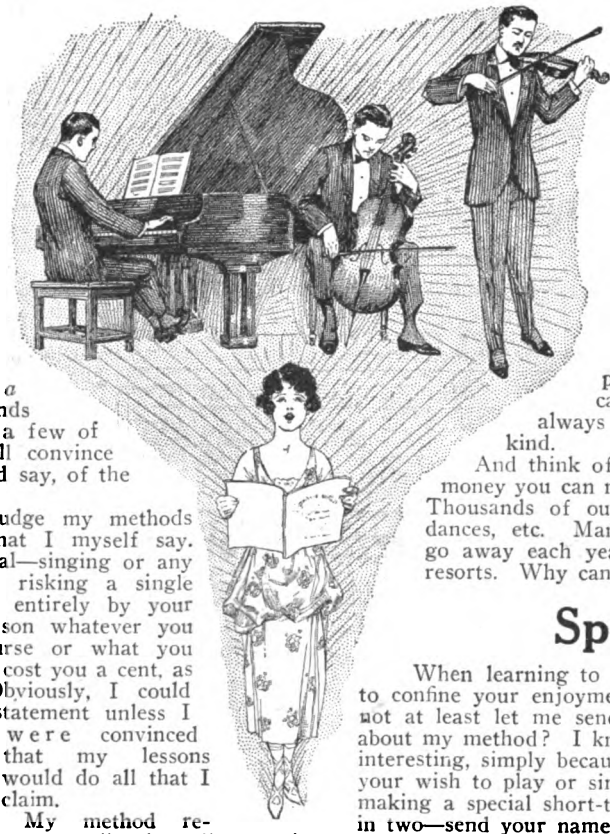
With my wonderful easy print and picture lessons for beginners, their progress has been nothing short of astonishing. Not only their friends, but they themselves were amazed at their sudden ability to play or sing. With this accomplishment they have been able to achieve greater popularity than they ever thought possible. And you can do the same.

Even if you don't know the first thing about music, don't know one note from another—with this new method you can easily and quickly learn to sing or to play your favorite musical instrument. *And all in your spare time at home—without a teacher!*

To those who are not acquainted with my system this may sound like a pretty strong statement. Yet I stand ready and willing to back up every word of it.

I have taught music to over 250,000 men, women and children in all parts of the world. Just think!—over a *quarter of a million graduates.* Their thousands of grateful letters to me, only a few of which are reproduced here, will convince you better than anything I could say, of the true merit of my system.

But I don't ask you to judge my methods by what others say or by what I myself say. You can take any course on trial—singing or any instrument you prefer—without risking a single penny. I want you to judge entirely by your own progress. If for any reason whatever you are not satisfied with the course or what you can learn from it—then it won't cost you a cent, as outlined in our guarantee. Obviously, I could never make such a sweeping statement unless I were convinced that my lessons would do all that I claim.



My method removes all the discouraging drawbacks and entangling hindrances of the old way of learning music.

There are no dull and uninteresting exercises, no agonizing scales, no tortuous finger gymnastics, no reprimands from a cross or impatient teacher. Nor is there any need of joining a class, pinning yourself down to certain hours of practice, paying a dollar or more per lesson to a private teacher.

All these obstacles have been eliminated entirely. In their place you are given delightfully clear, easy and interesting lessons, which make every step as simple as A, B, C. You take lessons in the privacy of your own home with no strangers around to embarrass you. And you may practice whenever it is most convenient for you.

So easy is my method that children only 10 to 12 years old have quickly become accomplished singers or players. Also thousands of men and women 50 to 60 years old—including many who have never before taken a lesson—have found this method equally easy.

And my lessons are just as thorough as they are easy—no "trick" music, no "numbers," no makeshifts of any kind. I teach you the only right way—teach you to play or sing by note.

Think of the pleasure and happiness you can add to your own daily life once you know how to play! Think of the popularity you can gain—for players and singers are always in demand at social gatherings of every kind.

And think of the good times you can have and the money you can make.

Thousands of our students now play in orchestras, at dances, etc. Many have orchestras of their own and go away each year to play at the seaside or mountain resorts. Why can't you do the same?

LEARN TO PLAY ANY INSTRUMENT

Piano	'Cello
Organ	Harmony and Composition
Violin	
Drums and Traps	Sight Singing
Banjo	Guitar
Tenor Banjo	Ukulele
Mandolin	Hawaiian Steel Guitar
Clarinet	Harp
Flute	Cornet
Saxophone	Piccolo
Voice and Speech Culture	Trombone
Automatic Finger Control	

Special Offer

When learning to play or sing is so easy, why continue to confine your enjoyment of music to mere listening? Why not at least let me send you my free book that tells you all about my method? I know you will find this book absorbingly interesting, simply because it shows you how easy it is to turn your wish to play or sing into an actual fact. Just now I am making a special short-time offer that cuts the cost per lesson in two—send your name now, before this special offer is withdrawn. Instruments supplied when needed, cash or credit. No obligation—simply use the coupon or send your name and address in a letter or on a post-card.

U. S. SCHOOL OF MUSIC, 1332 Brunswick Bldg., N. Y. City

Mr. David F. Kemp, U. S. School of Music,
1332 Brunswick Bldg., New York City.

Please send me your free book, "Music Lessons in Your Own Home," and particulars of your special offer. I am interested in the following course:

.....
(Name of Instrument or course)

Name.....
Please Write Plainly

Address.....

City.....State.....

THE VERDICT!

Since I've been taking your lessons I've made over $200 with my violin. Your lessons surely are fine.—Melvin Freeland, Macopin, N. J.

My friends all think it wonderful how I learned to play in such a short time. I regret that I didn't hear of your school long ago.—Mrs. W. Carter, 22 Cass Ave., St. Louis.

I want to tell you how delighted I am to have found a way to learn music. I shall sing the praises of your school to everyone I meet.—Susan J. Almy, 500 W. 144th St., New York.

I am more than satisfied with the lessons. They are much better than a private teacher. I certainly admire the way you take pains to explain everything in them. I wouldn't go back to my private teacher if I were paid to.—Julian L. Piccat, Stepney, Conn.

REAL SYNTHETIC SILK DISCOVERED

A process for making silk artificially, which has every characteristic of the natural process, and in some respects is superior to the natural silk, has been discovered, by research chemists, as an adjunct to the dye industry which was developed in the United States during the war.

According to the chemists the new process laboratory silk will have all the silkiness of the original article spun by the Asiatic silk-worm, will be more durable, and can be produced at a lower price. They assert that not even an expert will be able to determine whether the ballgown of the future came from the mulberry tree silk farms of Japan or China or out of the test tubes of the chemists. The synthetic fabric will even have the silken *rustle and swish* that characterize the true silk garment.

The new American chemical industry, which has been experimenting for several years with synthetic fabrics, will at once begin the manufacture of the new process silk on a commercial scale. Factories have already taken over the process and a mill capacity of several million yards annually will soon be in actual competition with the silk worm.

10,000 Years Hence

By H. GERNSBACK

(Continued from page 904)

pressure will perhaps not be more than four or five pounds per square inch, instead of 14.7, as we have it today. That means that humanity will have to accustom itself to such a change, and there is no question that it is possible to do so if the change is made gradually, as it probably will be. It means that the future humanity will have larger chests than they have now.

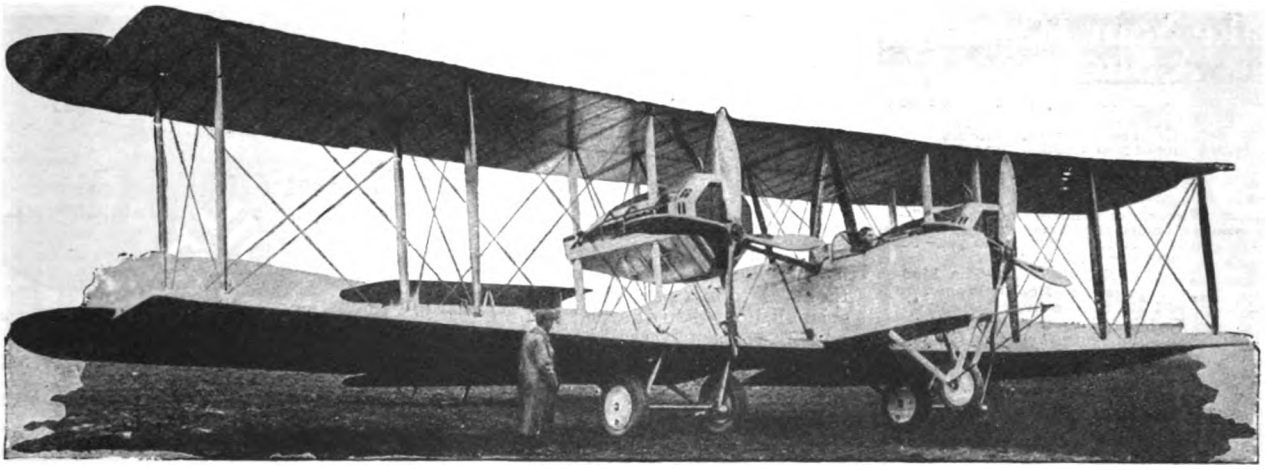
Naturally it would not do for the future city to descend upon the surface of the earth, as this would be disastrous, not only to the inhabitants, but to the machinery as well. For one thing, the human beings would probably suffocate as they could not stand the high pressure of the present atmosphere. This need not worry us any more than does the present ocean steamer, which is not expected to land on the floor of the ocean, because when it does, all is lost. The steamship has been designed and constructed to stay upon the surface of the ocean, and the future floating city will be designed in the like manner, to stay up; not to go down.

As for flying in 10,000 years, the aeroplane and the flying machine will have disappeared. We will have the individual flyer, as depicted on our front cover. The future flying man will be encased in warm fabrics electrically heated and kept hot comfortably. Upon his head he will have a sort of a diver's helmet made of flexible glass, unbreakable. The little atmosphere that he needs—remember he only needs five pounds per square inch—is carried by him in a few small tanks that do not contain air, but chemicals, which are slowly converted into air when required. The power is derived directly from the atmosphere—static electricity converted directly into electro-energy. No wings are used by him, but he propels himself just exactly as the city of the future is propelled, namely, by power rays, as shown. As before mentioned, the energy for these rays is obtained from static electricity reconverted into suitable high potential force, by means of a small converter strapped around the body.

If the flying man wishes to rise, he operates his future "joy" stick in such a way that the rays point downward. He then rises upward with a speed all dependent on how much energy he furnishes his ray generator. If he wishes to go sideways, or laterally, the ray projector shown on top of his head is put into operation, which moves him sideways at any speed desired. If he wishes to descend, all he needs to do is to reduce the power. The more he reduces it the quicker his descent will be.

Thus the future flying man will be able to travel at prodigious speed without the necessity of using ponderous machinery or heavy apparatus. The future man will also be in touch with his friends or his office, or whatever it may be called then, by means of radio. He will be able to converse with them just as he can do today in a more modest manner, as when speaking to his friends from aboard a ship, or in his auto of today. That, however, is not all. He will even be able to eat and drink, not from food which he has brought with him, but from food and drink sent to him through space. It will be possible to de-materialize and re-materialize matter, sending it at any distance desired with the speed of light.

We admit that all of this sounds extremely fantastic, but the truths of tomorrow will surpass our wildest fiction.



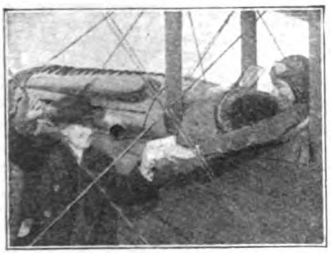
Go as High as You Like

No Limit to Salaries in Aviation

No other industry offers the wonderful chances for big money-making that the Airplane Industry offers to ambitious men. Many more trained men will be needed to fill big paying jobs. The airplane has come to stay—it will soon be a part of our everyday life. The men who get in now are the ones that will cash in big. Look at the "big fellows" in the automobile game today. They represent power and wealth because they got in early—you can do the same in Aviation and you have an advantage because you can be trained before you start.

Delivering Newspaper "Extras" by Airplane

A New Seven-Passenger Airplane



A New Job—The Aerial Postman

View in an Airplane Factory

Thousands of Airplane Mechanics Will Be Needed

The airplane industry is going forward by leaps and bounds. Transportation—passenger carrying and mail carrying lines are being opened up everywhere. This means men—men—men! Trained men only are wanted—men who know what's what. Get ready now to make big money. The industry is calling for real red-blooded fellows—heed the call—*now* is the time to get started—while the industry is still in its infancy.

Here Are a Few Jobs That Will Pay $50.00 to $250.00 a Week:

Aeronautical Instructor Aeronautical Engineer Aeronautical Contractor Airplane Repairman Airplane Mechanician Airplane Inspector Airplane Salesman Airplane Assembler Airplane Builder

Learn at Home In Your Spare Time

Keep right on with the work you are doing now. A little of your spare time is all you need. Our Special Course is simplified for home instruction and is endorsed by airplane manufacturers, aeronautical experts, aviators and the leading aero clubs. Any man who can read English can understand it. The Lessons are self-explanatory and are made plain as day with Blueprints, Diagrams, etc. Our Advisory Council and Instructors are behind you all the time giving you everything you must know. The entire field of Practical Aeronautics and Science of Aviation is laid right before your eyes. You are bound to succeed with this training. This means for you a man's size job with a man's size pay.

Big Book of Opportunities FREE!

Send for our big free book showing just what is going on in the Airplane Industry. It also shows what other men have done in this fascinating field and what you can do, too. It gives a list of some large manufacturers and dealers in airplanes and some of the jobs that are open to trained men. With the book we will send you a special offer that you will be glad to know about. This special offer may be withdrawn at any time without notice. *Send the coupon now and take advantage of this offer.*

American School of Aviation
Dept. 7442 3601 Michigan Ave., Chicago

Mail This Coupon For FREE BOOK

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Dept. 7442
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Without obligation on my part you may send me your book entitled "Opportunities in the Airplane Industry" and your SPECIAL Limited offer.

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*Address*_____

*City*_____ *State*_____

Motor Hints

(*Continued from page 928*)

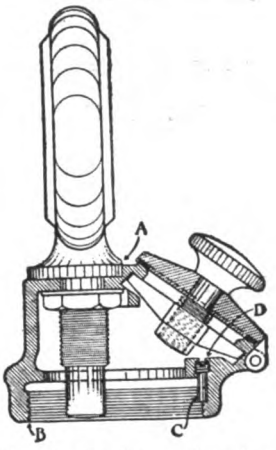
A TIME SAVER FOR YOUR FREE AIR TANK

As known, the dust caps on tires are always tight. I arranged this means for having something handy for loosening them. I took a pair of pliers and drilled a small hole thru the end of one handle and fastened a small chain about 18 inches long to the pliers and the other end to the air hose. You never have to hunt for that pair of pliers.

Contributed by W. R. EVANS.

MOTOMETER LOCK

The activity of a certain class of thieves has led to the disappearance of many motometers from radiator taps. They have a certain value and can be removed by anyone by hand.



This Motometer Cap Secures It on the Radiator of An Automobile, so That It Cannot Be Removed Without Special Tools. It Also Provides a Hinged Lid Instantly Opening for the Purpose of Pouring in Water for the Regular Supply.

The attachment we illustrate, which is clearly explained in the section, shows how a motometer can be so securely attached, that it cannot be removed, except by the use of a screw-driver, screw-wrench or spanner.

The motometer is held by a special cap and is secured therein by a jam nut on the inside. The motometer and cap are screwed upon the radiator nozzle and by a one-eighth inch set screw, C, with slotted head, D, in the cap, B, is held so that it cannot be unscrewed. A fine screw-driver is required to remove the set screw, so that the activities of the dishonest or mischievous person are curbed.

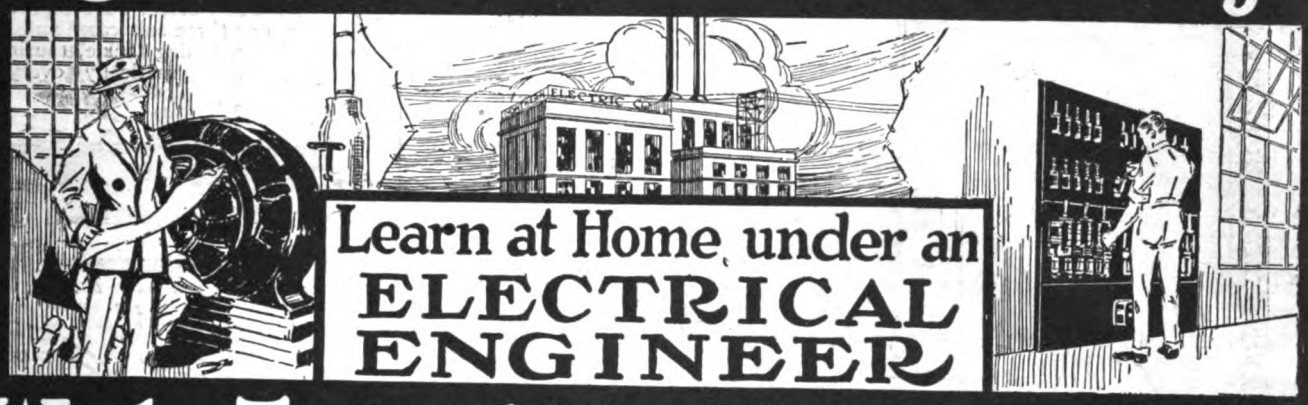
A hinged-lid opens toward the front of the machine, so that water can be poured in when necessary, and the lid is held closed by a latch catching under the flange of the motometer at A.

AUTO LUGGAGE CARRIER—FOLDS UP

The left-hand side of the running board may be utilized to its full extent and area due to the fact that it is enough if the right-hand side doors are free to be used for pas-

(*Continued on page 954*)

Quick Success in Electricity!



Learn at Home under an ELECTRICAL ENGINEER

Wicks Trained Men Make Big Money

A. W. WICKS
Elec. Engineer
Formerly with the General Electric Co. Former General Manager of company manufacturing Jenney Electric Motors, also formerly with Fairbanks, Morse & Co. Now Consulting Engineer, also Director, of the Wicks Electrical Institute.

Electricity, the greatest force in the world—offers you "Big Money" and "Quick Money" if you have the ambition to go and get it. Let me train you in electricity—at home—in your spare time—no matter where you live. I can quickly fit you to qualify as an expert electrician earning $2000.00 to $4000.00 a year. You don't have to go to school. You don't have to serve time as an apprentice. You start drawing the big pay as soon as you are qualified.

I am an authorized Electrical Engineer. So far as I know I am the only man with the degree Electrical Engineer to offer a Home Study Course in Electricity. My Electrical Engineering experience has covered a period of twenty-five years with some of the leading engineering and industrial corporations in this country. This wide and varied experience is the secret back of the success of my students.

Qualify to Fill One of These Big Paying Positions

Chief Electrician
$300 per month and up
Sub-Station Operator
$200 per month and up
Electrical Contractor
Unlimited
Maintenance Electrician
$250 per month and up
Power Plant Supt.
$200 to $1000 per month
Electrical Wireman
$150 to $200 per month
Meter Tester
$150 to $200 per month
Electrical Sales Engineer
Unlimited
Supt. Elec. Installation
$250 to $500 per month
Traveling Elec. Inspector
$200 per month and up

Why Wicks Trained Men Are Successful

Wicks trained men succeed where other men fail because they are trained thoroughly from the ground up. They have been trained under an Electrical Engineer. They have the knowledge gained of 25 years of experience behind them. Wicks trained men can't go wrong—they know only one way to do things—the right way.

New Easy Method

My new easy method knocks out all the unnecessary frills and gives you **real, practical electricity** — the money-making facts that you can cash in on. I teach **both why and how** through practical problems—the kind of problems you will meet later in your everyday work.

FREE Electrical Outfit and Tools

Big outfit containing material, apparatus and tools FREE. I know the value of the right kind of tools, so I want my students to start out with the very tools they will need on the job. This outfit contains everything—there are no extras for you to buy.

Great Opportunities In the Electrical Industry

Just stop and think what electricity means to us in our everyday life and you will realize why there is such a big demand for electrically trained men. The whole world depends on the electrician. Electric Light Companies, Municipalities, Manufacturers and Contractors are paying bigger wages than ever and still need more men to fill big jobs.

A. W. Wicks, E. E., Pres., WICKS ELECTRICAL INSTITUTE
3601 Michigan Avenue, Dept. 7442, Chicago, Ill.

Mail Coupon for FREE Book

Send the coupon to me today—it will bring you my new big book "Opportunities in the Electrical Field." If you are interested in your own future you will want this book. I will also send you full particulars of my method of training—show you why Wicks training brings quick success. You will also find out about my Special Tuition Rate now in force. Act at once.

Get the Special Rate

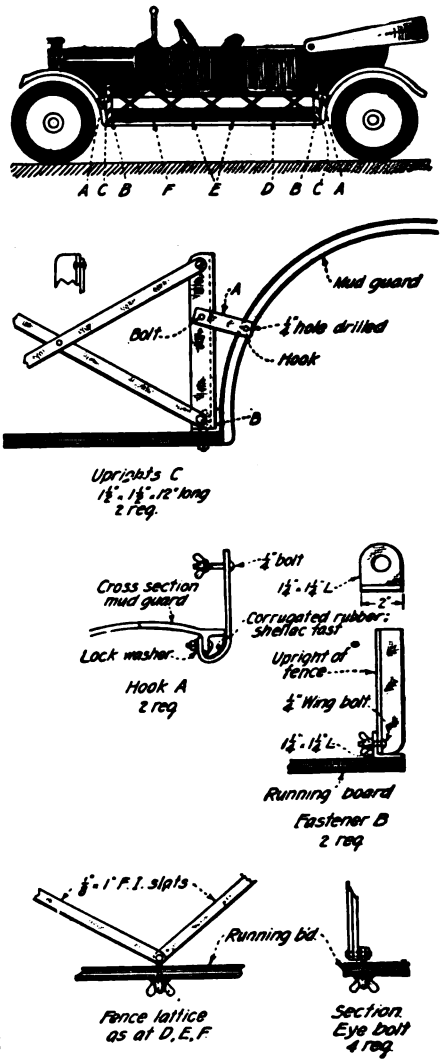
A. W. Wicks, E. E., Pres., WICKS ELECTRICAL INSTITUTE
3601 Michigan Ave., Dept. 7442, Chicago, Ill.
Without any obligation send me your Big New Book, "Opportunities in the Electrical Field," and full particulars regarding your method of training.

Name.....
Address.....
City..... State.....

Motor Hints

(*Continued from page 952*)

sengers to get in or out, and as most cars cars are left-hand drive, no complications occur. Two or three suit cases and many packages, tents, fishing tackle, touring, or camping articles, practically everything



Here Is a Simple Home-Made Luggage Carrier Which Fits Along the Running Board and Clamps Fast to the Mud Guard. When Not in Use It Folds Up Very Compactly So as to Fit Under the Seat.

needed, can be carried in this way, leaving the interior of the car free and its occupants comfortable. A few dollars buy all the parts which any machine shop will cut for you at once, even drilling the holes. Use good quality bolts and extra fine soft rivets, hammered up just tight enough to allow movement, so that the lattice fence may be taken off or put on readily. When folded up, it makes but a small package under the rear seat, when not in use. Give two coats best black enamel.

Contributed by P. P. AVERY, M. E.

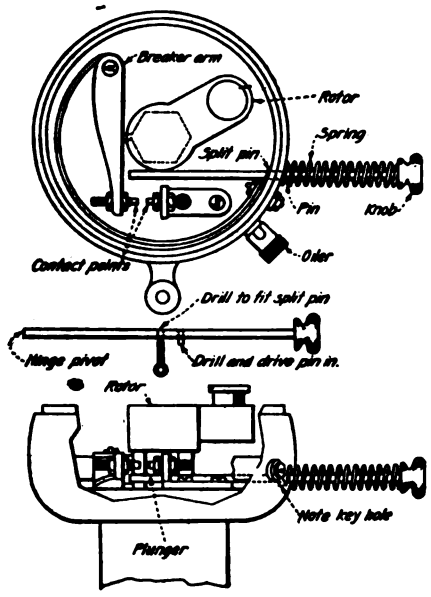
SIMPLE IGNITION LOCK.

One of the simplest and yet one of the most defying locks for the prevention of automobile theft is shown in the accompanying illustrations. It consists chiefly of a rod or plunger which when pushed in and turned as a key so as to remain in that position, holds the breaker arm of the distributor in such a position that the contact points cannot touch, thus preventing the ignition system from functioning.

Referring to the illustrations, it is seen that a plunger with a knob attached to it is needed. An old hinge spindle will answer the purpose very nicely. Drill a hole in the side of the distributor case as shown and file a slot in it similar to that of a keyhole. Place the plunger in position so that it does not touch the distributor arm when the points are closed, and mark the positions of the holes to be drilled. To hold the small pin in place it is best to shrink the plunger around it.

To operate the lock, push the plunger in so that the small pin enters the keyhole, and turn. The breaker arm will now be held open and starting of the car is impossible until the plunger is withdrawn to its normal position. When the distributor head is in position, the device is very inconspicuous and to an observer who didn't know, it would appear to be nothing more than an adjustment of some sort.

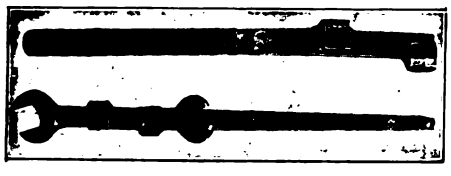
Contributed by NATHANIEL BREWER.



Here Is a Simple Locking Device Which Prevents the Interrupter On the Magneto From Functioning. When the Projecting Rod and Button Is Pushed in and Turned It Locks in Position So as to Hold the Breaker Arm Open; Releasing the Pin Permits the Car to Be Started.

LEVER INCREASES POWER OF WRENCH

The use of a piece of gas pipe to increase the leverage of spanner wrenches for work on heavy bolts is an old story. In the cut we show an extension handle adapted to large size spanners. In a most efficient way it increases the leverage so that rusty joints between bolt and nut can be broken, after kerosening and pounding if necessary. For new work it enables a nut to be set up with very great power and by eliminating the temptation to which all workmen are subjected of using a sledge upon the handle of a spanner, saves the latter from being bent, twisted or perhaps broken. It works right or left for screwing or unscrewing a nut by being placed with one or the other side uppermost.



Don't Use a Piece of Gas Pipe to Lengthen the Wrench Handle. Here's a New Extension Handle That Increases the Leverage of Any Flat Wrench.

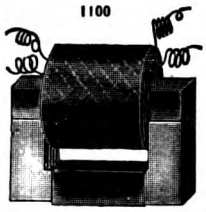
(*Continued on page* 960)

"RASCO HAS IT!"

THE Radio Specialty Co.—"Rasco" for short—is probably the most unique supply house in the United States, if not in the world to-day. This company makes a specialty of small orders, no order being too small to get immediate and prompt attention for the simple reason that most of our orders are small.
The reputation of this house was built upon service. Ask any of your acquaintances what they think of Rasco goods, Rasco service, Rasco promptness!. Thousands of unsolicited testimonials on file to prove that we serve the public best!
Be sure to get our great catalogue, containing several hundred different parts, which is illustrated below.

ORDER DIRECT FROM THIS PAGE. ALL GOODS SENT PREPAID IN 24 HOURS

1100



"RASCO" AUDIO FREQUENCY TRANSFORMER

We have compared many of the present transformers on the market but have finally decided upon a type that is the most efficient one we have seen so far. The best amplifying transformer is that in which the impedance of its primary is equal to or exceeds the impedance of the plate-to-filament circuit of the tube in which it is connected.
We guarantee this transformer to equal any one on the market.
No. 1100 "Rasco" Audio Frequency Transformer (not assembled) each prepaid.....$2.65

ANTENNA CONNECTOR

This antenna connector is made entirely of aluminum, is light and will not rust. The only connector of its kind. The 4 antenna wires go to the upper holes; the lower hole takes the lead-in. Don't solder your aerial, don't have loose connections. Dimensions 2" high, 1¾" wide, ⅝" thick.
No. 999, Connector, each..$0.35

999

PANEL KNOBS


6241


838

No. 6241 is well made and has a good corrugation. Its dia. is 1", height is ½", hole 5/32". The shank is ¼" high.
No. 6241, Knob, each.....$0.06

MARCONI KNOB

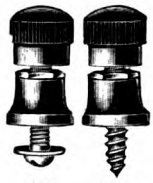
Has a central hole of 5/32" and seat to hold the screw, dia. is 1¼", height ¾".
No. 838, Marconi Knob, each.....$0.15

RASCO POSTS


202 201


(3) 029

These are our very own patterns, from our own designs and look mighty handsome on any instrument. The top knobs are of composition, the bottom parts brass nickel plated polish.


650 651

No. 202 is nickel plated at bottom part.
"Rasco" Binding Post, 8/32 thread, each, $0.10; doz., $1.00.
No. 202, Post, each, ...$0.08
Nos. 650 and **651** made entirely in composition with a hexagonal brass nut in center.
No. 650 has 8/32 machine screw.
No. 651 has bottom wood screw.
No. 650, Post, each.....$0.08
No. 651, Post, each.....$0.08
Dozen, each style.....$0.90

BRASS NICKEL POSTS

No. C29, Binding Post, each.....$0.05
No. C30, Binding Post, each.....$0.04

RASCO SWITCH POINTS


75 1 2 3 4 5 6 7 77 76

Nickel plated and polished. The following have been found the most popular.
No. 1 ¼"x¼", 6/32 thread, ea., $0.03; doz., 35c
No. 2, 3/16" high, ⅛" dia., 6/32 thread, ea., $0.03; doz., 35c.
No. 3, 3/16" x 3/16", 4-36 thread, ea., $0.03; doz., 35c.
No. 4, ¼" dia.; ⅛" thick; stem 6/32, ea., $0.03½; doz., 40c.
No. 5, ¼" dia., 3/16" thick; stem 4-36, ea., $0.03½; doz., 40c
No. 6, 3/16" dia.; 3/16" thick; stem 4-36, ea., $0.03½; doz., 40c.
No. 7, 3/16" dia.; ⅛" thick; stem 4-36, ea., $0.03½; doz., 40c.
No. 75, Switch Stop, ⅞" long, 4-36 thread, complete with nut, ea., $0.05; doz., 50c.
No. 76, New style Switch Point, to be pressed into bakelite panels with forced fit. Wire is soldered to pin end. Head ¼"; dia., 1/16" thick, ea., $0.03½; doz., 40c.
No. 77, same as above, but head is ¼" dia. x 3/16" thick, ea., $0.03½, doz., 40c.

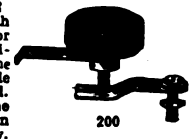
THE RASCO BABY DETECTOR


1898

In presenting this little Detector, we feel sure that it fills a place never taken before by any small detector. It does a variety of things and does them all well and better than many $5.00 detectors. The base is solid, black composition. Mounted on same is a nickel holder and binding post which holds a fluted hard rubber knob with its sliding rod member.
The outstanding part of the Detector, is the patented nickel detector cup and binding post. The knurled cap unscrews and you place the Galena Crystal in the cup, then replace the knurled cap and the galena crystal is held secure. The circular hole in the cap exposes enough of the crystal for ordinary purposes.
No. 1898, Rasco Baby Galena Detector. Price, prepaid.....$0.50
No. 1899, Rasco Baby Detector with Galena and Radiocite Crystals. Price, prepaid.....$0.75

PANEL SWITCH LEVER

New style switch lever with lock fork. It is impossible for this lever not to make positive contact at all times. The blade radius is 1¼". Blade is nickel plated and polished. Fork is phosphor bronze. The lock fork holds the screw (in which it rotates), securely. A loose contact is impossible.
No. 200, Switch Lever, complete as illustrated..$0.30


200

LITZ WIRE


323

This wire is recognised as the only thing for winding coils for Radio instruments. Particularly recommended with our **No. 343** Variocoupler Rotor, for vario-couplers, banked windings, etc.
No. 323, Litz Wire, 20 No. 38 strands, enameled double silk wire, per foot, $0.02; per 100 feet, $1.15
No. 890, Litz Wire, 10 strands No. 38 wire, per foot, $0.01; per 100 feet, $0.75.
No. 891, Litz Wire, 16 cables of three strands No. 38 wire, per foot, $0.03; per 100 feet, $2.25.

NOTE: This page contains only a few of our 300 specialties.

PANEL KNOB

This is a very distinctive knob and can be used on dials, panels, switches, condensers, etc. It is exceptional and well made. Dia. 1 1/16"; height 11/16"; comes with 8/32" bushing.
No. 815, Knob, each.....$0.18


815

VARIOCOUPLER ROTOR


343

This rotor is used by all up-to-date amateurs. Is accurately turned of hard wood and is used as a secondary coil. It takes any finish, either shellac or stain and can be drilled readily for any size hole. Large hole 2" dia. Width of spool is 2". Total dia. 3¾".
No. 343 Variocoupler Rotor, each $0.75

827

"RASCO" NAME PLATES


839

Our name plates are of brass with a black background. Letters are polished nickel. Order by name and number.

	Each		Each
807 "Phones"	$0.05	810 "Ground"	$0.05
809 "Aerial"	$0.05	812 "Primary"	$0.05
811 "Secondary"	$0.05	814 "Detector"	$0.05
813 "Audion"	$0.05	866 "On"	$0.05
865 "Off"	$0.05	840 "Increase Current" (Left)	$0.10
839 "Increase Current (Right)	$0.10	834 "Series"	$0.05
813 "Vacuum Tube"	$0.05	830 "Receive"	$0.05
831 "Transmit	$0.05	820 "2nd Step"	$0.05
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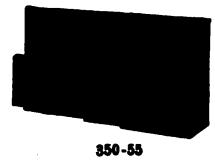
818 "Input"	$0.05	828 "Parallel"	$0.05
829 "Telephone"	$0.05	837 "+ —"	$0.05
833 "Detector Tube"	$0.0	841 "(Blank)" (takes pen or pencil writing)	$0.05
822 "Coupling"	$0.0		
806 "Load'g Coil	$0.0		

Price of all of our name plates in dozen lots, 50c, with the exception of the two "Increase Current"

BAKELITE PANELS


350-55

We list below six panels, the sizes of which have been selected after carefully checking up many dimensions of the most popular radio apparatus on the market.
Note particularly that our prices are anywhere from 25 to 50% lower than those quoted by most other concerns. The reason is that we buy these panels in very large quantities, and we do not cut sheets to order. Remember always that when sheets are cut to order they cost you at least 50% more than our prices, because you must pay for the cutting and the necessary waste.
Note also that we ship these panels prepaid. This alone amounts to a considerable saving.

No. 350	6"	x 12"	x 3/16"	thick,	each	$1.30
No. 351	6"	x 18"	x 3/16"	"	"	2.25
No. 352	9"	x 12"	x 3/16"	"	"	2.00
No. 353	12"	x 18"	x 3/16"	"	"	5.65
No. 354	6½"	x 19½"	x 3/16"	"	"	3.50
No. 355	6"	x 7½"	x 3/16"	"	"	1.20

"RASCO" LUBRICATED PANEL SWITCH

A radio switch that has two nuts at the end is a monstrosity, for the reason that it will never stay put. Our patent spring fork holds the switch handle always under uniform tension, at the same time it insures the best contact possible. New wiping contact, which covers every point of the switch point. Another new improvement is the lock fork, which can assume three different positions to accommodate the switch to various thicknesses of panels.


1921

No. 1921 "Rasco" Switch, as illustrated, each $0.50

KNOBS


199

These knobs are favorites with all experimenters. The size of both is: dia. 1⅛", height ⅝". No. 4451 comes with 8/32 and 10/32 bushing.


4451

No. 4451, Knob, each...$0.25
No. 199 (screw length ⅝") Knob, each $0.15

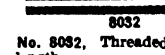
NAVY KEY KNOB

This navy key knob is now used on all standard wireless keys. It gives the right swinging mation and rests the fingers. It is a favorite with all advanced amateurs. Once used always used. The screw is 8/32 and will fit all keys.


748

No. 748, Key Knob, each.....$0.25

THREADED BRASS ROD


8032

We carry two styles, 6/32 and 8/32 thread. Only 6" lengths sold. No others.
No. 8032, Threaded Brass Rod 8/32 thread, per 6" length $0.06
No. 6032, Threaded Brass Rod, 6/32 thread, per 6" length $0.06

THE "RASCO" CATALOG

CONTAINS 50 VACUUM TUBE HOOK-UPS

Complete hook-ups of all important vacuum tube circuits are given in clear diagrams with complete explanation. Just to name a few,—The V.T. as a detector and one-step amplifier; regenerative circuit; De Forest ultraudion; V.T. to receive undamped and spark signals; Armstrong circuits; one step radio frequency amplifier and detector; three stage audio-frequency amplifier; short wave regenerative circuits; V.T. radio telephone; 4-stage radio frequency amplifiers; radio and audio frequency amplifier, inductively coupled amplifier; Armstrong superautodyne; radio frequency amplifier and crystal detector; etc., etc. The catalog contains 200 illustrations. On account of its great cost, it cannot be distributed free of charge. Mailed only upon receipt of
The catalog contains 200 illustrations. On account of its great cost, it cannot be distributed free of charge. Mailed only upon receipt of
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An Interview With Nikola Tesla

By H. WINFIELD SECOR

(*Continued from page* 913)

years has been proceeding at a bewildering pace, the future offers incomparably greater possibilities. Especially bright appear to be the prospects for wireless experts if the art is permitted to expand freely and the enterprises are raised to a higher level and dignity.

The Edison Questionnaire

Q. With especial regard to the Edison questionnaire, do you believe this to be a good way to select an employe? How do you select employes?

A. I regret to state that I cannot agree with Edison. I may say, in fact, that my views are diametrically opposite. A young man with a good college education will always have an overwhelming advantage in working out the problems of his life. Edison attaches too great a value to mere memory. The imitative gift, altho useful, is not of very high order. Some monkeys, for instance, which are possest of but rudimentary intelligence, exhibit it to an astonishing degree. Encyclopedias are now within the reach of every employe and there is no necessity for surcharging the mind with virtually useless knowledge. I prefer to test the worth of an employe by giving him some problems to solve. This involves the exercise of his highest faculties. An assistant who can solve problems is worth a hundred of those who are able to tell what *has been done*. But, perhaps, the best is the method followed by the great J. Pierpont Morgan, who placed character above all and never made a mistake. Character implies intelligence, devotion to the task, loyalty, honesty, good sense, and other qualities which are especially valuable in an associate.

Spiritualism

Q. Do you believe in spiritualism to any degree? Do you really believe that a full life-size materialization of a human body has ever been produced at a spiritualistic séance?

A. Most certainly I do not believe in any such manifestation, but I have no prejudice against anyone who gives himself to these illusions, except those who are cunningly exploiting the public. I have proved to my complete satisfaction, thru continuous observation, that we are automatic engines, the actions of which are governed from the outside chiefly by rays of light. Being of identical construction and subject to the same influences, we respond in like manner. This concordance of action makes possible mutual understanding, and is the basis of what we term "reason." Our minds are blank, there is no stored knowledge, and memory is simply the increased facility of response to repeated impressions. It is like an echo in a forest which only occurs in answer to a call.

Will Radiophone Supplant Present Wire System?

Q. Do you think that radio telephones will supplant the wire telephone in the near future? Do you believe that several hundred thousand radiophone stations could operate in an area no larger than that covered by New York, all using differen wave lengths, without troublesome interference?

A. I do not think that the development of the wireless telephone will be hurtful to intelligence transmission thru wires.

On the contrary, it will be extremely helpful. This is precisely one of the advantages of my World System to which I have referred. As to multiplex wireless telephony, there are means available which will make it possible to operate as many telephones as there are human beings on the globe, entirely without mutual interference.

Q. Do you think that the high frequency alternator, the Poulsen arc, or the vacuum tube will survive the test of time, and which one of these will be used in future radio transmitters?

A. It affords me great gratification to observe that the frequencies of alternators, which I built and exhibited in 1891, have been universally adopted as the most effective. The so-called "Poulsen arc" and de Forest "Oscillion" are, if I understand correctly, nothing but my oscillatory transformers in which a hydrogen gap or vacuum tube is employed instead of an air space. In my early work I have described and used such means. Certain defects are inherent to all of these devices, and I have satisfied myself that another method of generating electrical oscillations, which I have invented, will prove the best. I expect to disclose it in the near future.

Will Electric Auto Supplant Gasoline Type?

Q. Is the gasoline motor car here to stay or do you thing it possible that a revolutionary discovery will be made in the near future of a storage battery which will re-establish the popularity of the electrically propelled automobile?

A. The internal combustion motor has very nearly attained the limit of perfection under the immense stimulus of the war. Thru careful study of the prime-mover problems, during the past six or seven years, I have come to the conclusion that a novel type of gas turbine, brought out by me some years ago, will be the next commercial type. Its characteristics are such that it is bound to find extensive use. It is so simple and effective that it is likely to displace even the electric drive. Fuel efficiencies, approximately equal to those of the Diesel engine, are obtainable, while at the same time an enormous saving in weight, space and cost of first installment results. It is doubtful that anything revolutionary in storage batteries will be produced as long as we use metals, but a successful oxy-hydrogen battery is possible.

Q. In the October, 1921, number of Radio News there appeared a description of a new direct current transformer. If the interviewer recollects correctly you intimated some years ago that you had devised a D.C. transformer working on a very simple principle. Could you give a diagram of your arrangement, and what do you think of such apparatus as to operation and efficiency, all things considered?

A. I have not had the time to peruse the article referred to, but understand that it deals with a new kind of rectifier. We can now obtain in several ways direct from alternating currents, but, of course, there is always room for further improvement. Many years ago I exhibited before engineers an alternator which was excited without a commutator. I have never had the opportunity to give a description of the invention in detail, but may state, in a general way, that currents of one direction can be obtained from it without commutation, and I have not given up hope that it may yet be put to some practical use.

The Future Phonograph

Q. It is agreed, it seems, in a general way, that the present-day talking machine, of no matter what make, is not the phonograph that we will expect to see tomorrow. In what way and along what lines do you believe that the future phonograph will be designed and built? Do you think the Poulsen telegraphone principle a good one to follow in further research toward perfecting a more perfect and scratchless talking machine, which will absolutely reproduce the human voice with true fidelity?

A. I have devoted considerable thought to improving the rendition of the voice in a phonograph, and sometime ago I produced an apparatus which is capable of making much longer records, at the same time yielding a better quality of tone. Owing to unfavorable conditions, nothing has yet been done with it in a commercial way. There will be in the future opportunities for use of the mechanical as well as the magnetic method. When it is desired to preserve the impressions for considerable periods of time the mechanical record will have to be employed, but when speed is the main object the magnetic will be generally more preferable.

If President Harding Spoke to 120,000,000 People

(*Continued from page* 909)

them to audibility for the New York audience. The other million million amplifications were used to carry the President's voice to the Arlington crowd. By providing a few more scores of thousands of miles of wire, some thousands of loud-speaking devices and a few foolscap sheets filled with tiny ciphers indicating more amplifications, the entire country might hear future public ceremonies, Mr. King said. It would be relatively simple, he declared, to set up equipment in the capitals of the forty-eight States thru which 150,000 persons in each city—a total of 7,200,000—could hear a ceremony in Washington or elsewhere as distinctly as if they were seated within a few yards of the speaker. A long distance call from New York to San Francisco involves 400,000,000,000,000 amplifications. Similar amplifications occur when the human voice is transmitted by radiophone and amplified sufficiently at the receiving stations to be heard by an audience or audiences of this magnitude.

Blackwell and Espenchied of the American Telephone and Telegraph Company give the horsepower rating of the human voice as 2 to the 10 minus 8th power (2×10^{-8}) in ordinary conversation. This is about 1/50th of a millionth of a horsepower, or 15 millionths of a watt.

Crandall and Arnold of the Western Electric Company give this figure as about 100 millionths of a horsepower for ordinary conversation. A man (soap-box orator) can talk to about 1,000 people at a time, and even those at the outskirts of the thousand will have difficulty in hearing distinctly. In such oratory the voice is strained from 100 to 1,000 times. In a well designed hall about 5,000 people may hear his speech at one time. Trying to cover a hall seating about 15,000, such as Madison Square Garden, which Crandall characterized as being "an old pot," is impossible, and for this reason amplifiers must be used.

Motor Hints

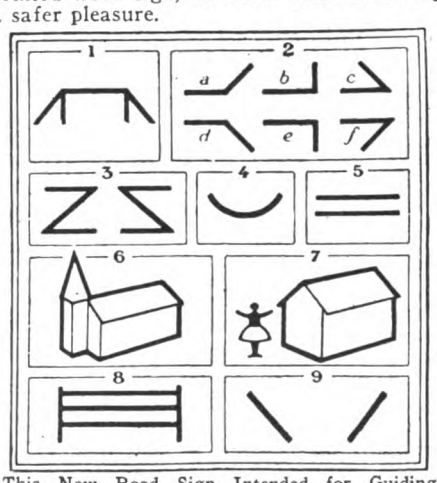
(Continued from page 955

PERFECTLY LEGIBLE ROAD SIGNS.

The Italian Touring Club has recently devised and adopted a series of new indicator posts for the purpose of replacing the old system of marking danger points such as railroad crossings, grades, school streets, etc.

Instead of signs being printed in ordinary word form, this new method consists merely of pictures drawn in a simple manner, and the meaning of which are conveyed at a glance to the reader.

By observing the illustration herewith, the idea of this system will be at once evident, and it will not fail to convince one of its extreme simplicity and legibility. For this reason, it is hoped that these picture-signs will prevent many accidents due to the failure to grasp at once the meaning of a printed word sign, and thus make motoring a safer pleasure.

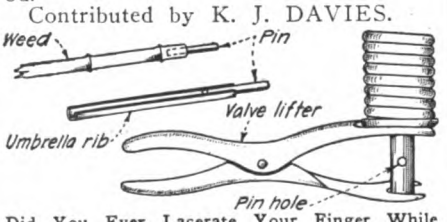


This New Road Sign Intended for Guiding Motorists on Italian Highways, Has Been Arranged So as to Show in Simple Signs the Angles at Which Roads Meet Highways, Schools, Churches, Bridges, Etc. It would Seem a Very Good Idea for American Highway Engineers to Work Out a Scheme Something Like This One, as There are too Few Signs Along the Principal Motor Highways in America.

VALVE PIN INSERTER

On several makes of cars the valve pin underneath the valve spring is a great source of trouble to insert (I speak from experience). The best and only way I have found practical is the use of a segment of an umbrella rib or any weed stem that has a pulpy center. The pin is forced into the center of the pulp and with one hand manipulating the pin-holder while the other is employed holding the valve lifter. The umbrella rib is pinched slightly at one end, but not too far so that the pin cannot come out easily. This arrangement does away with the removal of the carburetor and exhaust manifolds on a Ford car. The common casualties such as broken finger nails and smashed hands are few and far between since the adoption of this method.

Contributed by K. J. DAVIES.



Did You Ever Lacerate Your Finger While Replacing Valve Pins? Here Is a Simple Valve Pin Inserter Which Will Save Much Time and Labor, as Well as a Pinched or Injured Finger. Inserting Valve Pins Is a Simple Job When You Go About It in the Right Way.

Saving Some of the Annoyances of Tire Troubles

By F. H. SWEET

TROUBLE and annoyance is saved the motorist if he will examine his casings after a puncture, before inserting a new tube. A nail, fragment of glass, or rough and broken fabric, remaining over from the first puncture, will often quickly ruin a new tube.

After a careful inspection of the casing, the tubes should be slightly inflated before being inserted, in order to prevent its being twisted. Where the tube is inserted flat, there is danger that, due to a twisted condition, it will tear under high air pressure.

Another good rule is never to place the tube on the ground. A porous condition is often a direct result of the dirt and sand which adhere to the tube that has been laid on the road beside the car.

A fourth principle of tube conservation is to lightly dust the inside of the casing with soapstone or talc. This prevents chafing and sticking of tube and casing. Excessive use of either talc or soapstone, however, causes blisters.

Using a blow-out patch for too long a period is a common mistake and a costly one to motorists. This patch is a car owner's first and best remedy for a blow-out on the road, but it is a temporary and not a permanent repair.

A blow-out patch is only to assist in the road-side emergency. After the emergency is past, it should be removed and a permanent section built into the tire to enable it to give the balance of the mileage of which it is capable.

When the patch is made to answer the purpose of a permanent repair, the warping of the tire incident to contact with the road causes the patch to seriously chafe the inside of the carcass. The result is that where a small and inexpensive repair would have been sufficient if taken in hand at once, an expensive repair is now needed. And often the damage is beyond cure.

The fact that a blow-out patch is not built into the carcass, but is separate from it, increases its tendency to wear the fabric, creating friction, if a permanent repair is too long neglected.

The blow-out caused by a tread cut is usually a clean cut hole. If it is ragged looking, a severe bruise is probably the cause. If the fabric is badly raveled and torn apart, fabric separation is often the reason.

The motorist, who would escape this form of tire trouble, should try to avoid running over broken glass, should guard against driving into curbs, into holes along the road and against rocks; and above all should have his tires regularly inspected by a competent tire surgeon. Even neglected punctures may be the direct cause of sand blisters and mud boils which eventually cause a blow-out.

A surprising fact in tire conservation is that it is better to run over a rock in the roadway than to hit a sharp glancing blow. Of course such obstacles should be avoided if possible, but when the dilemma of a choice is forced upon the motorist, this decision is best.

To hit a rock head-on may cause a severe jolt, and furthermore is likely to stone bruise the tire, but it causes less damage in the end to the tire properly inflated than a sharp blow against the side wall and rim. The reason for this is that the tread of a tire is the thickest part and best able to absorb shock incident to normal operating conditions.

Side walls are not intended to be shock

absorbers, but to give the carcass of the tire strength and shape. Rubber on the side wall is laid on to protect the tire fabric from the destructive action of the elements, while the tread of a tire is thick and resilient, and made to withstand the abrasive action of the road. A layer of cords, heavily imbedded in cushion rubber, is specially designed to neutralize and distribute blows.

TOO HEAVY OIL FOR COLD WEATHER

By F. H. SWEET

You say you can hardly turn your motor over on cold mornings. That reminds me of some experience I had a number of years ago. I had a four-cylinder car that had been in use some time. One morning a cold snap came. We had fairly heavy oil in the motor. There were only two of us, out of five, that could turn the motor over, and before we got the engine started, we two were rather dizzy and shaky on our feet. My arm was sore for more than a week. We changed to lighter, lower cold-point oil and had no more trouble. The heavy oil is all right after it has warmed, but it is a terrific friction drag in starting. It might easily be possible that the oil-pump could not handle this solid feed oil, and damage would be done to the bearings.

Table of Vibrations, Whose Effects are Recognized and Studied

1st	Octave	2
2nd	"	4
3rd	"	8
4th	"	16
5th	"	32
6th	"	64
7th	"	128
8th	"	256
9th	"	512
10th	"	1.024
11th	"	2.048
12th	"	4.096
13th	"	8.192
14th	"	16.384
15th	"	32.768
16th	"	65.536
17th	"	131.072
18th	"	262.144
19th	"	524.288
20th	"	1.048.576
21st	"	2.097.152
22nd	"	4.194.304
23rd	"	8.388.608
24th	"	16.777.216
25th	"	33.554.432
26th	"	67.108.864
27th	"	134.217.728
28th	"	268.435.456
29th	"	536.870.912
30th	"	1.973.741.824
31st	"	2.147.483.648
32nd	"	4.294.967.296
33rd	"	8.589.934.592
34th	"	17.179.869.184
35th	"	34.359.738.368
36th	"	68.719.476.736
37th	"	137.438.953.472
38th	"	274.877.906.944
39th	"	549.755.813.888
40th	"	1.099.511.627.776
41st	"	2.199.023.255.552
42nd	"	4.398.046.511.104
43rd	"	8.796.093.022.208
44th	"	17.592.186.044.416
45th	"	35.184.372.088.832
46th	"	70.368.744.177.664
47th	"	140.737.488.355.328
48th	"	281.474.976.710.656
49th	"	562.949.953.421.312
50th	"	1.125.899.906.842.624
51st	"	2.251.799.813.685.248
52nd	"	4.503.599.627.370.496
53rd	"	9.007.199.354.740.992
54th	"	18.014.398.709.481.984
55th	"	36.028.797.418.963.968
56th	"	72.057.594.837.927.936
57th	"	144.115.189.675.855.872
58th	"	288.230.379.351.711.744
59th	"	576.460.758.703.423.488
60th	"	1.152.921.517.406.846.976
61st	"	2.305.843.034.813.693.952
62nd	"	4.611.686.069.627.387.904

Compiled by Dr. Stanislav M. Kolar. AB, BS, PhD, OD. RPH.

A National Association of Inventors

By JAY G. HOBSON

"Say, Hobby." It was Mr. Edison speaking. "Have you heard the good news?"

"Good news? No," I replied, wondering what epoch-making discovery Uncle Thomas had up his sleeve this time.

"You haven't heard a word about it?" he pleasantly persisted. "You must have been with the Mt. Everest expedition not to have heard."

"Nope, don't know a thing," I confest, somewhat ashamed at my ignorance of the subject. "But let's have it, please."

"Well, I should say so!" the wizard of West Orange emphatically remarked. "It's too bad that you haven't heard of the organization of the 'National Association of Inventors' and their magazine called *The Inventor's Companion*, say, young man, this is the greatest individual event since the 'Declaration of Independence!'"

"Is that so? My! I certainly have mist something," said I with intense interest, for a protective association of inventors had long been one of my pet hobbies, and to hear that this great achievement was really a settled fact prompted me to ask for complete details. Handing Mr. Edison one of the two stogies in my possession, I inquired:

"Just who is responsible for the success of this great movement. Undoubtedly you had a great deal to do with it?"

"Yes, and no," he replied. "You see, it is this way. There has been a crying need for unity in the inventive-world for many years. In the past, the free-lance inventor was handicapt because of his lack of knowledge of patent procedure, of manufacturing requirements and commercial law. Many of those to whom he repaired for information and instruction took advantage of his ignorance and profited accordingly. Even after a patent had been secured these pirates often tried to steal it by fair means or foul. So you see what this mutual organization will mean to the inventors of the country."

"I see," was my response. "But how are the affairs of the association handled to make it fully coöperative and beneficial to each member?"

"That's just what I was going to tell you," the learned inventor replied between methodical puffs on his Pittsburgh stogie. "According to the charter of the association there must be a president, vice-president and a secretary-treasurer. Each member pays $5.00 yearly dues, which entitles him to one year's subscription to *The Inventor's Companion*, to five questions on legal matters, Patent Office procedure, manufacturing problems and the like; and to one year's legal protection against theft of his patent rights, against infringement attempts and royalty violations. Then the official magazine will have a 'Scientific Research Department,' a 'What to Invent Department,' a 'Legal Department,' a 'Personal Exchange Department,' and many special articles from successful inventors for the purpose of assisting the members in every possible manner. At present the membership has reached the powerful number of 100,000—all inventors and potential inventors of good standing. At the first meeting Mr. Gernsback, editor of SCIENCE AND INVENTION, was unanimously elected president of the association and editor of *The Inventor's Companion*. I was honored with the vice-presidency, and you were voted the office of secretary-treasurer. I'll tell you it was a——"

Just then my alarm clock went off, awakening me from one of the sweetest dreams ever. I wonder if dreams really come true?

HEALTH FACTS, 5¼x7½", 200 pages, cloth covers. Publish by George Callahan & Co., New York City.

This attractive little book is devoted to hygiene, or medical practise without medicine, if this contradictory expression may be allowed by the modern indulgent reader.

It gives directions for various exercises; it gives hints for health; it gives the result of partial and total fasting as a tonic and remedy for troubles of the system. It tells of how to treat the hair, how to fill up hollow places in the face and neck, and ever so many other interesting little notes on health and simple treatment are contained in its pages. It seems that garlic is highly to be recommended, altho it is probably better for the consumer than for his friends and neighbors.

As a sort of appendix, Walter Camp's speech before Congress on "Health," and notes from other sources are given. There is considerable psychology in the last sections of the book, on education, on success, down to such things as penmanship.

We certainly recommend the book to our readers.

EINSTEIN'S THEORIES OF RELATIVITY AND GRAVITATION. By J. Malcolm Bird. Cloth covers, 5" x 7½", 359 pages, with diagrams. Publisht by Munn & Co., New York.

This book is a selection of material from the essays submitted in the $5,000 competition for the Eugene Higgins prize for the best essay on Einstein. It is rather interesting in the preface to look over the list of names of the authors whose work it has seemed proper for the editor of the book to embody in this collection.

The editor states that merely the reading of all the essays has given him many ideas of such a complex origin that he could not assign credit if he would. It is certainly open to conjecture whether the ideas themselves, after reading so many essays, will not partake of considerable complexity.

STANDARD WIRING—For Electric Light and Power. New 1921 edition. By H. C. Cushing, Jr. 446 pages, fully illustrated. Flexible covers, 4⅜" x 6¾". Publisht by the Author, New York City, N. Y.

This new edition of a well-known handbook has many features to commend it to electricians, engineers, and architects. It not only follows and explains the various rules adopted by the Fire Underwriters of the United States for the installation of electrical wiring for light and power, but many valuable and indispensable tables and formulae are given therein. The tables on direct current and alternating current wiring, giving directly the size of wire to be used for any desired voltage drop, current in amperes, and any distance in feet, are alone worth the price of the book. All forms of wiring are thoroly described and discust, including molding, both rigid and flexible metal conduits, knob and tube work, wiring for electric stoves, bells, motors, dynamos, etc. Very complete wire tables are included which give such valuable data as the greatest number of wires of different size which will go in a certain conduit, dimensions of rubber covered insulated wire both solid and stranded, data on iron and steel wire, descriptive data on pole line construction, wiring plans and typical layouts for all the different rooms in a modern home, symbols used in wiring plans and blueprints, etc.

Some of the special subjects covered are wiring for garages, theater and moving picture houses, including switchboards, wiring for organs, marine work and transformers. A very good section is given on the care and operation including the charging of lead plate, storage batteries, as well as of Edison batteries. A useful section is included on illumination, which includes tables of tungsten lamp data, mercury vapor lamps, etc. At the end of the volume there is a glossary of technical electrical terms explained in plain language, and electrical and mechanical formulas covering calculation of belts for different horsepowers, as well as the calculation of the size of pulleys and gears for different speed ratios between the driver and driven pulleys. Lightning rod protection is also discust, as well as resuscitation from electric shock.

THE BOYS' HOME BOOK OF SCIENCE AND CONSTRUCTION. By Alfred P. Morgan, 469 pages, cloth covers 5⅞ by 8 inches. Publisht by Lothrop, Lee & Shepard Co., Boston, Mass.

This book, with its liberal illustrations—nearly 400 in number—with a very full index, is cer-

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LIGHTING UP THE GAS GAGE

Your motor stops. You make all the necessary investigations, and find that everything seems all right. You then turn to your gas tank. It is night time and very dark. In order to look at the gas gage, you light a match. The next thing you see is the face of the hospital nurse bending over you, while the doctor says: "I think we will pull him through all right." And the nurse answers: "It certainly was foolish to light a match with all those gas fumes around." That may have happened to the other man. It is much pleasanter to think that it will not happen to you, for you have a gas gage which is just as visible at night as it is in the daytime, because its lettering has been treated with undark radium luminous materials.

Now when you want to see how your gas stands in the tank, your radium illuminated gage will tell you at night without the use of any other illumination. In the same way, the modern motor car has its dash-board dials and its clock faces illuminated with radium. And this is not the only advantage of a radium illuminated gage or dial.

DEODORIZED GARBAGE

Dr. P. A. Maignen of Philadelphia, an inventor, has an invention which he says will render garbage odorless and germless by simply sprinkling a pinch in the housewife's garbage can. Dr. Maignen proposed that the city promote a competition to discover the best means of deodorizing garbage. The inventor also displayed a powder, another of his inventions, which is good for many ills, including hay fever and cancer.

Book Review

(Continued from page 964)

tainly a concession to the boy of this generation, for to the writer a scientific book without an index is very defective. The first thing the reviewer did was to turn to electricity to see what the author said it is, and he really takes it in a very proper way, practically saying that we can hardly define it at all.

It is interesting to find in the pages of the book such classic apparatus as the Voltaic pile. We are glad to see, too, that the author makes a bid for accuracy in telling his young readers to distinguish between a cell and a battery. We are a little surprised not to find the amalgamation of the zinc plates described in the Voltaic battery, for certainly unamalgamated commercial zinc plates are very unsatisfactory.

Now we can turn to the contents, and we find that in nine chapters chemistry, mechanics and physics are given in considerable detail. All through the book there is an atmosphere of the practical, and the illustrations are most attractive and elucidating.

A very nice example of how the author treats his subject is found at the end of the chapter on chemistry. He describes clay and its nature and then very sensibly gives an illustration of how to make a potter's wheel with illustrated examples of making a cup and saucer. This sort of thing delights the ingenious boy. We are inclined to say that if he would have given a little bit more detail the book would have appealed more to us, but quite possibly it is well to spare the young mind too much of this. Some excellent examples of the author's method with graphic illustrations are given in the chapter on gravity, where the man on the moon can jump over a house as easily as a champion jumper on the earth can hurdle six feet; on the moon he would be able to lift an automobile at arm's length, the force of gravity is so little there. All this is nicely illustrated.

A typical piece of apparatus which is described is the harmonograph, which is so well presented that it makes one feel like getting to work and constructing one at once. We quite commend the section on soap-bubbles, which subject is very cleverly presented. Under heat, he says that savages kindle fire by rapidly twirling a dry stick on a second dry piece of wood. It is a pity he did not give the full details of the experiment, as they are given in the Boy Scout's Hand Book, for this is a thing which has to be done rightly.

In general, we can do nothing but commend the book.

PRACTICAL ELECTRIC WIRING. By John M. Sharp. Fully illustrated, 247 pages. Stiff covers, size 4¼" by 6¾". Publisht by D. Appleton and Co., New York City.

This is a very good manual, quite liberally illustrated and touching on all phases of house-wiring and of wiring for motors and telephone systems. The illustrations to which we refer are very clear, the lines being strongly drawn, which is rather a tendency of the present day, as the old system of hair line diagrams is being given up. All we can say about the book is, that it seems to contain all that can be said on the subject. All thru the book there are little series of questions to be answered by the student, each one for a different section, and this system of intercalating questions seems to the writer to be a particularly good one, as compared with the catechism system sometimes indulged in. We are also glad to see in it an entirely adequate index.

AUTOMOTIVE WIRING MANUAL. By Harry Lorin Wells. 768 pages. Stiff covers, size 7¾" by 10¾". Publisht by Automotive Publishing Co., Chicago, Ill.

This book is really a remarkable compilation. It begins with some forty introductory pages on the general handling of ignition systems and the starting systems on motor cars. It also has a full contents which is very useful and an absolutely essential part of the book, and necessary for its use. The preliminary part makes very nice reading, short as it is, and then we come to the real body of the book, and this is really quite a remarkable production. It gives in white line on blue, so as to represent blueprints, no less than 768 diagrams of the electric wiring of cars, for starting systems, ignition systems, for the lighting and the horn connections. As a technical publication alone, it is a very remarkable production, and it is something which the advanced automobile engineer cannot dispense with. It looks simple enough in many cases, but we all know that the owner, which is another name for amateur, often have very sad times in attempting to work with his electric connections. In this book will be found all the wiring given for his car, because it does not seem possible, that anything should be omitted by these wiring diagrams, nearly 800 in number. There is

one thing they suggest, which is that the wiring of cars might by some joint action be standardized. Those who have driven cars for many years realize how the construction of cars, their transmission gear and the like have taken a definite form at last. It does seem a pity that the electric installation on cars cannot follow the same rule, so that when one car's installation is understood, that of all cars will be.

CASH FROM YOUR CAMERA. By Frank R. Fraprie, S.M., F.R.P.S., 87 pages. Cloth covers, size 5¼"x7½". Publisht by the American Photographic Publishing Co., Boston, Mass.

This seems to be a very excellent little book. It is devoted to advocating a more practical use of a camera. Thus it alludes to a competition under the auspices of the publishers of the "Photo Miniature" open only to women photographers, and in the course of this it was found that 75 per cent of the entrants had adopted the profession of photography in the home for portraits of customers, because of their experiences as amateurs. The book is eminently practical, touching on pretty nearly everything in the line of the many technical varieties of photography where remuneration is paid for such work.

ASBESTOS. By A. Leonard Summers. Profusely illustrated, 107 pages. Hard covers, size 4½" by 7¼". Publisht by Bath Melbourne Co., New York, N. Y.

The Pitman Company, of England, who now have a branch in this city, in addition to short-hand books, have publisht a great quantity of commercial hand-books. The present one, devoted to asbestos, with its liberal illustrations makes a very interesting little manual. Asbestos is of growing importance. It gives a fire-proof roofing material which will prevent conflagrations; it enters into many other building fabrics, and is even used to make fire-proof garments for emergency use in conflagrations. Its employment in electricity is also to be noted, and for engine packing, its intrinsic absence of friction makes it most valuable. In America a good deal of work has been done in the development of the many applications of asbestos in engineering and technology. This little English manual makes it perfectly clear that our cousins across the ocean are alive to its varied uses.

INDUSTRIAL MATHEMATICS. By Paul V. Farnsworth. 250 illustrations, 272 pages. Hard covers, size 4¾" by 7¾". Publisht by D. Van Nostrand Co., of New York City.

This book contains such a mass of information, so well arranged and in such compact form, that it cannot be said to lend itself to a review within the limits of our space. The text starts at the very foundation, with definitions of the signs, symbols and abbreviations used in mathematics in general, each definition being followed by an example of the use of the symbol. It is the writer's experience that one of the indications of a good book is when it begins at the beginning of things, and this book certainly does so begin. It is arranged in many sections and the subject of each paragraph is printed in special bold face type. After the arithmetical and algebraic portion of the book, the more concrete part comes in, where calculations applying to engineering and machinery, gear wheels, and screws are introduced, and where all such subjects are very fully treated with numerous illustrations. At the end of the book there is an interesting section devoted to mechanics. The book has no index, but it is hard to see how one could be constructed, as the book is really its own index.

GERMINATION. By A. E. Baines. 185 pages, fully illustrated. Stiff covers, size 5½" by 8¾". Publisht by E. P. Dutton & Co., New York City.

Much attention has of late years been given to the effects of the electric current and of electric excitation on the growth of plants. Mr. Baines in this book goes very fully into the subject, giving examples of the effect of electricity on plants, on the germination of their seeds, and in the second section takes up the effect of electricity on the auditory apparatus of a human being and on cancer. Much other ground is covered in the second half of the text. Numerous illustrations are given and the author certainly has convictions which he expresses very well and clearly in his treatise.

STORAGE BATTERY MANUAL. By Lucius C. Dunn. Profusely illustrated. 391 pages. Stiff covers, size 6" by 9¼". Publisht by United States Naval Institute, Annapolis, Maryland.

Nearly 400 pages, text and illustrations, compose this excellent manual on the storage battery, its theory, uses, various connections and all the minutiae of its construction. The liberal illustrations form a most valuable part of the book. It is pretty nearly or entirely restricted to lead plate batteries. Commander Dunn, however, unfortunately does not realize the importance of an adequate contents and

index to books of this class especially. The great quantity of text so satisfactorily presenting the details of his subject and describing all the different parts of the battery, testing apparatus, details of manufacture, and generally allied subjects, certainly deserve two things: One is an adequate contents which the book does not possess, as a very brief one is given. The other is an adequate index, and of this there is absolutely none. It is a most valuable manual, seriously written, and covering the most interesting and practical details of battery construction, without too much speculating, as to the exact theory of its electrolytic action.

NAVAL CONSULTING BOARD. By Lloyd N. Scott, 288 pages. Illustrated. Cloth covers, size 5½" by 9". Publisht by the Government Printing Office, Washington, D. C.

So much and such varied description of the work and investigation of this board are contained in this book, that we find it really is quite interesting from the descriptive and literary standpoint, particularly is the account of Mr. Edison's work attractive. It has been written by a very appreciative hand. Meritorious inventions received by the government from outside inventors are given space. The inventive accomplishments of members of the Board are also told, and it is here that Mr. Edison's work is given most space. It really seems that if the ideas of the great inventor had been utilized as they deserved, much good might have been done. Following the unfortunate government practise, the book has an inadequate contents, and is devoid of an index, both of which would add greatly to its value.

THE STORIES EDITORS BUY AND WHY. By Jean Wick, 362 pages. Cloth covers, size 4¾" by 7¼". Publisht by Small, Maynard & Company, Boston, Mass.

Thirteen short stories from leading story papers form the bulk of this work and they certainly give a good presentation of what the public wants. Many distinguished names appear among the authors. The editress of the book in her prefatory note speaks of the status of the short story among American publishers. The book, from the standpoint of the magazine writer, will have a technical value, as it certainly will show what the public wants, and from the literary standpoint the stories, by authors such as Booth Tarkington and Samuel Hopkins Adams and others of almost equal fame, promise a high literary value. At the end is quite an interesting section, a collection of letters from members of the editorial staff on different magazines, explaining "why editors buy."

MARVELS OF MECHANICAL INVENTION. By Thomas W. Corbin. 248 pages, 79 illustrations. Stiff covers, size 5" by 8". Publisht by J. B. Lippincott Co., Philadelphia, Pa.

The present work is exceedingly attractive. It has very clear print and excellent illustrations, the idea being to treat the subject of modern inventions from a very simple and elementary standpoint and to make mechanics of this description interesting to the layman. Today the boy knows more about mechanics than his adult predecessors did, because the trend of modern life is in the direction of general utilization of small machines. The text is in excellent literary style and the book is really good reading for anyone, but we are inclined to strongly recommend it to young people, for we know much that is in it, will be very acceptable to the young reader. It is written from an English standpoint. In it the coal mine is a colliery; the manufacture of a boiler is described and this is the famous Lancashire boiler, a typically English construction. We think, however, that the book would be much improved by an adequate index. It has none. A fuller table of contents might have been made to take the place of an index.

It is a portion of a larger work by the same author entitled "Mechanical Inventions of Today."

HAWKINS ELECTRICAL DICTIONARY. By N. Hawkins, M. E. and Associates. Leather covers, 5½" by 8", 513 pages. Publisht by Theo. Audel & Co., New York.

The preface of this book names some of the author's scientific assistants who helped him with his work. There are several electrical dictionaries publisht, and this one, which is really quite attractive in appearance, is rather of the portable order.

It is a thankless job to pick out omissions, but we cannot but mention the fact, that the dictionary contains the term "Lumen Meter" defined, the term "Lux" defined (the latter the intensity of illumination produced by a Lumen at one meter distance from the source of light), but the author never takes the trouble to state what the original "Lumen" is.

The definitions are short, the book is very clearly printed, with heavy type for the terms defined, and we certainly feel it will be a useful addition to the electrician's library.

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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 address 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.

Mold for Toys

(542) E. N. Lundgren, of Downey, Idaho, submits a drawing of a mold for toys and the like and requests our opinion.

A. You have discovered nothing new in the particular style of mold you have designed, as molds of this nature can be secured upon the open market anywhere in the United States.

Battery-Less Omnigraph

(543) Clarence H. Miller, Denver, Colo., sends a description of a battery-less omnigraph. He requests our advice.

A. Undoubtedly the idea advanced by you is patentable, but is just a little more costly in our opinion than the ordinary instruments. Omnigraphs do not sell by the million, however, and we would advise that you should not base too high hopes on the ultimate outcome of such a device, unless made more cheaply than the present day instruments.

Race Track Annunicator

(544) C. H. Lackinau, Detroit, Mich., asks our opinion on a race track annunciator.

A. We hardly think that there would be enough call for a contrivance of the nature you describe, and therefore do not believe that a patent upon the same will be a profitable one for the inventor. All patents, of course, in order to pay, should be of a commercial value, and there are not enough race tracks in this world, many of which would not consider installing the device you have suggested, to make the scheme worth the time, research and money involved.

Automatic Phonograph Stop

(545) E. A. Lavalle, Southbridge, Mass., asks our opinion of a patent he has obtained for automatically stopping a phonograph.

A. Altho the automatic phonograph stop which you have patented is very ingenious, it seems to us that it is entirely too complicated to perform this very simple function. The main trouble, however, is that it will be very difficult to have a spiral gear travel so as to conform with the groove on a record.

If you would have a model built of this device and try it out and find that it works just as you have described, and if this model would be so arranged that you could place it on any machine whatsoever, and yet if it should be small enough and neat enough so that it would not mar the appearance of a phonograph, we believe that a very good sale for such a contrivance would be realized. In other words, in a patent of this nature try first to make the device small and neat; secondly, make it attachable to *any* form of phonograph whatever, and thirdly, have the price low enough so as to warrant a ready sale. In our opinion the device is patentable.

Pre-Patent Protection

(546) T. R. Martinek, New York City, wants to know how to protect his invention.

A. Under ordinary circumstances a reliable patent attorney will take your device and patent the same, and you need not worry lest the device be stolen.

Should you desire to safeguard yourself more fully, place your idea in an envelope so sealed that it will be impossible to open the envelope without breaking the seal, and mail a duplicate of the idea which you sent to the patent attorney to yourself. When this letter comes, do not open the same nor break any seal, unless court action in the future necessitates it, when the envelope should be open in the court room. Have another set of papers in your files for attorney's record, should you need it. The device should be further protected by having each paper of the quadruplicate signed and sworn to by a Notary Public.

Rotary Spark Gap

(547) Ch. H. Miller, New York City, submits a sketch of a very ingenious rotary spark gap and asks our opinion.

A. We have in the past published a suggestion for rotary gaps in our magazine, but today rotary gaps are little used, and probably will not be more used in the immediate future.

Altho your idea creates a favorable impression, we would hesitate at advising a patent upon the same just at present.

Phonograph Record Idea

(548) W. B. McDonald, London, Ark., asks whether he can secure a patent on printing on a phonographic record the number of revolutions per minute the turntable is to make.

A. Modern phonographic records are all made at one speed, dependent on the particular machine for which they are designed. Thus all Victor records for example are made at a speed of 76 R.P.M. Therefore, if the speed of the phonograph is adjusted, which can be easily done by turning the speed control knob to correspond with 76 R.P.M., the reproduction will be reproduced at exactly the same speed as when the voice was recorded.

Some machines operate on a speed of 68 R.P.M. and adjustments are easily made in the same way. Thus one can determine exactly the number of R.P.M. that the turn-table is giving. Your regulator, therefore, will of course not be anything new, and novelty is essential to patentability.

You can hardly obtain a patent for printing upon the record the number of revolutions per minute for which the record is designed.

Perpetual Motion Machine

(549) William Noble, Rensselaer, N. Y., submits an idea upon which he would like to obtain letters patent, comprising a machine composed of two fans belted or geared to a line of shafting driven by an electric motor, suitable clutches being interposed in the line shaft. His idea is to start one fan by driving the line shaft with an electric motor, and after this propeller or fan has reached high speed, the motor is shut off, and a second fan will be driven by the first fan, and thus serve to drive the line shaft upon which an additional pulley is secured for driving a dynamo. From this dynamo, the inventor proposes to supply electrical energy for lighting lamps and operating various other machines.

A. You cannot possibly secure a patent upon your idea, as it is merely an attempt at perpetual motion. Under no circumstances would the device work, except if the motor were kept in continuous operation, in which case the losses of power are so great as to make the system decidedly unprofitable.

Rotary Steam Engine

(550) Guy Oldstad, Vancouver, B. C., sends drawing and description of a rotary steam engine, which he states he believes to be different from any other type so far devised. He wishes our criticism on this design of steam engine.

A. The drawing of the rotary steam engine which you have forwarded is quite clever, but it lacks those qualities which would make it a real worth-while invention for several reasons.

In the first place, the steam used by such an engine is almost equal that used by turbines. Your engine, however, occupies a much greater space than the turbine. Its speed would not be as high and the wear upon the parts would be quite great. This same idea has been used in explosive gas turbines and has been practically discarded, because it was found that these gas engines would not answer the purpose commercially.

Altho we do not condemn your idea entirely, we do not believe that you have worked it up into its most efficient form, and, therefore, we would hesitate to advise a patent in its present stage. It would probably be advisable for you to have a model constructed and from this model determine definitely just how your engine will function and how it compares with the ordinary turbines with regard to the consumption of steam, the H. P. developed, and the amount of wear.

Spring Auto Wheel

(551) Arthur Monfile, Ottawa, Ont., Canada, submits an idea for a spring wheel for use on automobiles, and wishes to know further if there are any similar wheels on the market.

A. Unless your idea on a spring wheel for automobiles is exceptionally good, we would not advise a patent on the same. There are hundreds of spring wheels which have been patented recently and not one perhaps will ever see the light of a successful market.

Pressure Feed for Auto Gasoline Line

(552) L. H. Magee, Novelty, Mo., writes:

Q. My idea is this: There are several popular cars which "stall" when going up-hill with several quarts or even several gallons of gasoline in the tank, owing to their inability under the gravity feed system to force the gasoline up into the carburetor. I am using successfully at the present time a gas tank cap fitted with a simple valve, so that I can connect my tire pump to it, and thus force air into the tank and cause even a very small residual amount of gasoline to be fed to the carburetor. What I want to know is can I protect my idea by a patent covering the attachment of this valve to automobile gas tanks, and patent it in such a way as to prevent other manufacturers from using similar valves for the same purpose?

A. In our opinion a patent upon the device which you believe to be efficient would not be granted, for the simple reason that air pressure forced into both oil and gas tanks so as to feed more gas or oil to the machine is a very old idea, and can scarcely be protected by a basic patent. It has incidentally produced much trouble, because of the fact that the greater the pressure within the gas tank, the more detrimental would an explosion be, should one occur.

Auto Appliance

(553) Oliver D. McAdams submits an idea of a push-rod silencer.

A. This idea is certainly clever and if it does as you claim we can foresee quite a sale for such a steel push-rod silencer, but why limit your contrivance to Chevrolets? Why not also make it attachable to other forms of cars, for instance, the Ford? These devices could be punched out and bent, then tempered, making them very easy to manufacture.

Gasoline Economizer

(554) Antonio Munoz, of Bradford, Pa., sends us his idea of a gasoline economizer for automobiles, which employs comprest air in such a fashion that the gasoline and air mixture, will supposedly be accomplisht in such a thoro manner that very little gasoline will be used in operating the engine.

A. Your scheme has been carefully looked over, and we fail to see anything in the idea whatsoever. In the first place, you go to the trouble of constructing a very difficult mechanical wheel, which will wear very rapidly and along every portion of which leaks will occur, regardless of how accurately it is made. In addition, the air comprest will not be of any advantage in carburetion whatsoever. There are small air compressors measuring about 6"x6", which will give you more air than your device and are more compact.

Book Review

(*Continued from page 968*)

THE RIDDLE OF THE RHINE. By Victor Lefebure. Cloth covers, size 8½" by 5½". Publisht by W. Collins Sons & Co., Ltd., London, England.

This book hardly lends itself to a brief review. In it a description is given in great detail of the beginnings of the gas warfare when the cloud of chlorine gas was seen by the Allied troops rolling over the ground towards them. Then it goes on to tell how the gas warfare was met, for there was no time to be lost and masks had to be improvised until proper ones were devised to take care of the different gases. It was quite a chemical problem to solve, the selection of a material which was both practical and effectual. The author is no lover of German methods, and to some of us it seems as if there is a danger in the early forgetting of the iniquities of warfare carried on by chemical gases, in direct violation of the Hague covenant. This book is a good study in the technique of modern war, and to the chemist it is most interesting reading, as the composition of the different gases is given in great detail. The author certainly suggests a dreadful future for coming wars.

We strongly recommend it to our readers.

YOUR PSYCHIC POWERS AND HOW TO DEVELOP THEM. By Hereward Carrington, Ph. D. 358 pages, no illustrations, stiff covers, size 8¼" by 5½" by 1½". Publisht by Dodd Mead and Co., New York.

In his preface, Dr. Carrington gives his excuse for the findings contained in the book, by stating that those who would criticise certain views advanced are deprived of that privilege, because he does not present "his own views," but the traditional ones accepted by some. The book is intended for individuals already convinced that psychic phenomena are actual facts.

Altho the chapters on hypnotism, mesmerism, haunted houses, apparitions, and what happens after death, are interesting reading matter, many of the ideas advanced in the work are farfetched, and even a careful attempt to follow the work results in very few, or one may say, practically no additional development of psychic powers. But perhaps, the reviewer is not psychically inclined, and therefore, he could not develop those powers, even if he tried. The work is well edited, and carefully written.

MODERN PSYCHICAL PHENOMENA. By Hereward Carrington, Ph. D. 331 pages, stiff cover, size 5½" by 8¼" by 1½". Publisht by Dodd, Mead and Company, New York.

Generalities occupy the first part of this work, which is divided into three parts. As reading matter, they are interesting, and an attempt is made to outline a few of the relationships bearing upon psychical phenomena, as developed by science and thought.

Part two details some of the newer researches, and part three enters into the discussion of crystal gazing, and crystal vision, conducted by Drs. Carrington and Bates.

Much of the old shopworn freaks are incorporated into this book, but they do make interesting reading matter; we may cite for instance, the "Talking Horses of Elberfeld," "Where the Plants Have Souls," "Obsessions," etc.,

Members of the Psychical Research Society of New York claim that many of the illustrations in this work are not authenticated, but the book as a whole is quite interesting, more from the reading standpoint, than from its educational value.

The chapter detailing the work of Eusapia Palladino, whose frauds were exposed several years ago, is interesting, but not as a practical addition to the work.

EXPERIMENTS IN PSYCHICAL SCIENCE. By W. J. Crawford, D. Sc., 201 pages, illustrated, stiff cover, size 5½" by 7½" by 1⅛", publisht by E. P. Dutton and Co., New York.

Another of the very interesting works by Crawford is this one on psychical problems. Dr. Crawford goes about his research in a clear cut style, using instruments wherever possible, and giving the results of his experiments. As a general rule, instruments cannot be defrauded, and when a scale gives a reading of ten pounds, ten pounds is the weight applied to the balance, if the scale is known to give actual and correct readings.

His cantilever principles are again given space in this work, which forms a valuable adjunct to his book, "The Realities of Psychical Science." The experiments outlined are written in such a manner that the reader will feel tempted to duplicate them if possible.

THE REALITY OF PSYCHIC PHENOMENA. By W. J. Crawford, D. Sc., 246 pages, illustrated, stiff cover, size 5" by 7½" by 1¼". Publisht by E. P. Dutton and Company, New York.

In this book on psychical phenomena, Dr. Crawford gives a list of experiments and deductions obtained by him while operating in conjunction with a family of mediums. His actual observations and his theories are interesting, even tho it would seem that duplicate results, similar to those described in his experiments would be rather difficult to obtain. He advances a theory of the cantilever action of table levitations, and other weight lifting efforts; spring balance readings and other miscellaneous experiments. He theorizes on the results obtained in the numerous experiments listed in his general conclusions.

The book is written from the apparent standpoint that Dr. Crawford is perfectly satisfied that we can communicate with spirits of human beings who have past into the Great Beyond.

HEART TROUBLES, THEIR PREVENTION AND RELIEF. By Louis Fougeres Bishop, M. D., 414 pages, 38 illustrations, stiff cover, size 5½" by 8¼" by 1½". Publisht by Funk & Wagnalls, New York.

This very interesting treatise and authoritative discussion on the subject of heart troubles is written for the guidance and help of the layman, his family, or their immediate relatives, and for nurses in charge of such a patient. It enters into the question of the palliative treatment of heart troubles by drugs, by exercise, and by the Neuheim bath methods.

It is written so that the layman can understand it; it is printed in clear bold type; and the text is profuse with sane counsel, and cheery optimism. It is, without a doubt, the finest non-technical book on heart troubles which has yet come to our attention.

At first the work enters into the discussion of the heart, describing exactly how it works, and how the various disorders would affect it. It then takes into consideration the non-existent relationship between the pulse and the heart. The course of the blood in the heart and the methods of reading electro-cardiograms, and the irregular heart, are next entered into in such a plain, clear, concise manner that the words "auricular fibrillation" become very easy to understand by anyone who has read this work conscientiously. The effect of tea, coffee and tobacco, as well as anti-fats are then considered and a comparison of dietaries for corpulence and obesity is listed. Nursing of the patient is given reasonable space.

The book is of exceptional value to the physician, and just as much or more so to the layman. It is well indexed.

HIGHER PSYCHICAL DEVELOPMENT AND YOGA PHILOSOPHY. By Hereward Carrington, Ph. D. 291 pages, besides an additional index, illustrated, size 5¼" by 8¼". Publisht by Dodd, Mead & Company, New York.

Not knowing much about the Yoga philosophy or the Yoga terms it is rather difficult to believe everything that is told in this work, but here again in the preface, Dr. Carrington shifts the responsibility to others, who claim to know more about Yoga philosophy that he does, and thruout the work says, "It is claimed," or "It is thought that." Nevertheless, the secrets seemingly exposed are interesting to read, and if carefully followed would, perhaps, result in a further development of psychic powers, as outlined by these Hindu philosophic instructors. That the book does teach a very fine religious truth, cannot be doubted, and the Hindu belief in God surpasses to a great extent some other more modern beliefs. Neither can one doubt that the Hindus are capable of performing various stunts, as they could, perhaps, be called which shame our attempts at psychical research.

The book carries the student into the very deepest recesses of his being, and is, perhaps, the best of the series on psychical science by Carrington; maybe because Yoga philosophy is not so well understood. From each and every one of these works the grain must be sifted from the chaff. They are all valuable in their own way, even tho much of the works are filled with generalities.

THE PHILOSOPHY OF DREAMS. By William S. Walsh, M. D. 349 pages, size 5½" by 8¼" by 1". Publisht by Dodd, Mead & Co., New York.

Dream analysts have attracted a great deal of attention both among the medical fraternities and among the lay readers. This is a very interesting work for those who believe in psychoanalysis, or Freudism, and also for those who do not believe in Freud's theories.

The work is well edited, well written, and quite complete. Whether or not the reader will believe it in its entirety, depends entirely upon his particular trend of mind. Whatever benefit the work may have is greatly enhanced by the excellent manner in which the writer presents his views.

Popular Astronomy

By ISABEL M. LEWIS, M. A.

(*Continued from page* 911)

(called the line of aspides), is shifting slowly eastward in the plane of the earth's orbit, at a rate that causes it to make a complete revolution in a period of about 108,000 years. Also the line of the equinoxes, which is the line of intersection of the plane of the earth's equator with the plane of the earth's orbit, or the line connecting the vernal and autumnal equinoxes, the points where the sun crosses the equator in the spring and fall is shifting slowly westward along the ecliptic at a rate that will cause it to make a complete revolution of the earth's orbit in about 25,800 years. This is the well-known "precession of the equinoxes," and this action is due to the attraction of the sun and moon for the equatorial bulge of the earth, which leaves the obliquity of the ecliptic and the tilt of the earth's axis unchanged, but causes the line of intersection of the planes of the equator and ecliptic—the line of the equinoxes—to shift slowly westward. As a result the celestial pole, which is the direction in which the earth's axis points, makes a slow, conical revolution around the pole of the ecliptic and the position of the earth's axis with respect to the stars gradually changes so that, in the course of time, we will have a new pole star. As the tilt of the axis to the ecliptic remains unaffected by the precession, it has no direct effect on the seasons.

This precession of the equinoxes, and revolution of the line connecting perihelion and aphelion, bring the earth alternately, after the lapse of a number of centuries, in perihelion and aphelion in different seasons. It follows that for many centuries the earth will be nearest the sun in winter and, therefore, especially when the eccentricity is high, for long periods the winters will be hotter and shorter than the average, and the summers longer and colder than the average. Then there will come a time when the precession of the equinoxes and the revolution of the line of aspides brings the *aphelion* point in conjunction with the winter solstice, and there will be a long period in which the earth will be farthest from the sun in winter and nearest to the sun in summer. At such a time, some believe, more snow would form in winter than could be melted in the short summer, which would also be made colder by the presence of the unmelted snow of the preceding winter. An ice age would then follow, during which the polar cap would extend far down into the temperate zone. Changes in ocean and air currents would take place which would have an even greater effect upon the climate. In the course of centuries the precession of the equinoxes would again bring the earth nearest to the sun in winter and an intervening warm epoch would follow.

At the present time the eccentricity of the earth's orbit is much smaller than it was in the past, and is decreasing, as we have seen, so such pronounced changes are not to be expected in the future, at least not for fifty thousand years or more. On the whole, we may expect to experience a comparatively mild climate for many centuries to come. The earth is now in perihelion in winter, and so the winters of the northern hemisphere are warmer than the average. We have

seen that a small decrease in the obliquity, which will continue for about fifteen thousand years, also has the effect of making the winters warmer in *both* hemispheres, but this effect is small compared to the climatic effects produced by the precession of the equinoxes and the change in the eccentricity of the earth's orbit.

In about ten thousand years, as a result of precession, the present conditions will be reversed so that the earth will be farthest from the sun in winter. At that time the winters of the northern hemisphere will be longer and colder than they are at present, but the contrast between the winters of today and the winters of that future day will not be as great as in past ages, since the eccentricity of the earth's orbit is becoming less.

There are, then, two factors to be considered—the slowly decreasing tilt of the earth's axis, which will cause the winters to become slightly but increasingly warmer for the next fifteen thousand years, and the precession of the equinoxes which will cause our winters to become increasingly colder and longer for the next ten thousand years. Of the two causes the latter will probably prove the more effective tho it will be considerably offset by the fact that the eccentricity is growing less during the same period, reaching its smallest value in twenty-four thousand years, so that the heat received from the sun will vary but little between perihelion and aphelion.

We would conclude, then, that considering all the factors the *winters of the northern hemisphere are growing slightly colder instead of warmer*, tho the change is so slight that we may expect to enjoy a mild and equable climate in the northern hemisphere for many centuries to come with no prospect of another glacial epoch for one hundred thousand years or more.

The winters of the southern hemisphere, on the other hand, should grow considerably warmer within the next ten thousand years, for in ten thousand years from now the earth will be nearest the sun in the winter of the southern hemisphere, instead of in the winter of the northern hemisphere, as it is today. The winters of the southern hemisphere will therefore, for that reason, be much warmer than they are today and will be still warmer for the additional reason that the obliquity of the ecliptic will be less than it is today. These long-period temperature changes in the two hemispheres, arising from variations in the form and position of the earth's orbit, will probably produce changes in the direction and temperature of ocean and air currents also, which will be even more effective in changing the climate in high latitudes than the original causes that we have considered.

PREVENTS PICKING UP OF MESSAGES

Discovery of a method whereby wireless messages may be sent to a definite receiving station without the danger of being "picked up" by other stations is claimed in an announcement by the Official Press Bureau at Moscow.

A Ukranian electrical engineer named Chayko is responsible for the discovery, and it is stated that, by means of a simple apparatus, Chayko straightens out and groups what are termed the "locked power lines" of the magnetic field into parallel rays. These rays, he says, can penetrate mountains, thereby avoiding the necessity of high antennae.

It is also asserted that the discovery will enable the location from the surface of metal deposits in the earth.

Automatic Control of Motor Boats or Aircraft

(*Continued from page* 919)

The axis of the gyroscope remains constantly in one direction so long as the flywheel is kept revolving. The data secured as a result of the allowances made for the craft, the effects of winds, tides, currents, etc., used in dead reckoning, are then applied to the timing apparatus at predetermined intervals as indicated for it to pursue successfully its course. This has been done many times already. With the Winkley apparatus it is merely a question of accuracy in *dead reckoning* and accuracy in mathematics. The mechanical control has proved itself to be 100 per cent. efficient, leaving any errors wholly to the human side of the problem.

The Winkley steering and stabilizing devices can fly unmanned aircraft to given points and there let loose poisonous gases or explode several hundred pounds of T. N. T. or other high explosives; can guide tanks filled with tons of T. N. T. or other explosives across the ground into enemy territory, there to explode; can direct unmanned minesweepers into mine-infested areas and sweep them up without losing a man.

Home Mechanics

Conducted by WM. M. BUTTERFIELD

(*Continued from page* 926)

first of a heater of some portable variety, either electric or gas, and of a metal stove with two compartments, in either of which the heater may be placed in the manner shown in the drawing. When placed in the upper chamber, the heater provides heat for boiling or frying, and when in the lower one, heat for baking—the upper chamber with its lid and door closed forming the required oven. When not in use as a cook stove, the device may be used as a stand for the heater and a storage place for cooking implements. The one precaution in the use of such a device is to have the electric wire or gas pipe connections properly insulated against heat at the place where either comes in contact with the stove, when it is used for cooking.

Buying a Second-hand Car

By EDNA PURDY

(*Continued from page* 903)

the bearings are filled with heavy cedarwood grafite grease, and plenty of it, to absorb as much lost motion as possible in the shaft bearings and between the gear teeth and you will really be surprised when you have been "thru the mill" as to how much noise can be gotten rid of in a transmission or a differential by packing it well with such a wood-grafite mixture. Some old cars squeak quite a little and some timorous "would-be purchasers" are often scared away by such squeaks after riding in the car, but this is frequently due only to dry springs and spring bolts. The writer recently experienced this trouble with a new car and thought that something was askew, but after oiling the springs and the bolts at either end of the springs, the noise entirely disappeared and the car, a heavy sedan model, runs as sweetly as could be desired. Dry springs are liable to cause severe rusting and eventual breakage also, as one expert pointed out.

Editor's Mail Bag

(*Continued from page 927*)

us all to see alike, but surely it is time that all should carefully consider the ideas of others and respect their views.

I am going to suggest the addition of a new department to your publication, one which I think would be very appropriate and in harmony with the pulse of our time; it is one of theoretical science—a sort of gathering place where the thinkers of the land could meet to exchange and discuss their opinions; a place where such topics of interest as life, motion, electricity, matter, space, etc., could be gone over—not just a mere statement of what one thinks on this or that subject, but all the evidence, devoid of technicalities and in a condensed form, which one has to cause him to think as he does. If this new addition was placed on a par, financially, with other parts of the magazine it would soon be drawing the most advanced ideas of the day.

Of course, such a department to be a success would take up, perhaps, a half dozen pages; but I think it would be worth the price many times over. No one would deny for a moment that it would be very interesting to all classes of people. Man is very curious; he is over-anxious to learn just what his neighbor is thinking. It would bring many thousand readers who care nothing for other branches of science. It would bring to the classes a glimpse of the minds of the foremost men in every realm of thought; and it would be creating a new source of information for the people. Far better than all, it would soon be reaching around the earth, carrying a wealth of inspiration to a great throng of students scattered thruout the world.

I think that humanity is looking for just such a fountain—unconsciously perhaps; and the scientific publication (no other would answer), which realizes it first, will undoubtedly reap a rich reward.

With best wishes for your future, and the future of SCIENCE AND INVENTION, I am,

M. REED.

Bowie, Texas, Route No. 7.

Fortunes from Little Things

By CHARLES FREDERICK CARTER

(*Continued from page 925*)

and 1,931,611 dozen blades. Factories in Boston and Montreal have an aggregate floor space of 390,000 square feet and turn out razors at the rate of 20,000 a day and blades at the rate of 1,100,000 a day. Dividends are paid regularly at increasing rates, 12 per cent being the latest reported in reference books.

Explosives to Be Fired by Music

By ARTHUR KAYE

(*Continued from page 917*)

are presumed to separate from their own particular molecule, and in mixing with the same atoms of other molecules cause the phenomena of explosion. In order to cause the disintegration of the molecule a detonating wave is necessary, and this is usually caused by the explosion of a charge of fulminate within or into the mass of high explosives.

Radio Set in a Watch Case

By BERNARD TUCKER

(*Continued from page* 940)

brass. One terminal of the condenser is connected to the center screw of this curved strip; the ground wire is connected to the other screw in this strip, which is shown on the right hand side of the panel in the drawing. The other terminal of the condenser is connected to the other strip of brass on the upper screw, as shown in the drawing of the panel. The other screw in this strip of brass is for one terminal of the phones, and the second terminal for the phones is shown at the bottom of the panel at the left. The brass of this makes connection with the metal which the crystal is mounted in. Another curved strip of brass is shown at the left side of the panel near the top. The aerial is connected to the top screw, the cat-whisker to the center screw, and the end of the inductance to the lower screw in this curved strip. All screws are ⅛" long, No. two-fifty-six.

The condenser is glued to the back of the bobbin, and two short lengths of wire run from the screws in panel, thru the core of the bobbin to rear, where they are connected to the condenser. The dimensions of the bobbin will be determined by the size of the watch in which it is to be mounted.

New Self-Lubricating Bearing

(*Continued from page* 921)

close a fit, all that is necessary is to reassemble it with the proper fit, no damage being done to either the shaft or bearing. Fig. 3 shows the crank pins and main bearings of a well-known make of automobile after 20,000 miles' service, the crank pins being equipt with genelite bearings. The main bearings are badly worn, as is shown by the grooves in the shaft and the deteriorated appearance of the babbitt, while the crank pins are barely polished, and the genelite bearings in the big ends of the connecting rods have not yet come to a full seat.

Genelite is made by reducing a mixture of the oxides of lead, tin and copper, so as to obtain a high grade bronze, intimately mixed with grafite, all the materials being in a finely divided state. Grafite is added in sufficient quantity to reduce a part of the oxides to the metallic state and leave enough grafite to give the required grafite-content in the finished material; the oxides are partially reduced by heating the mixture.

The mixture, still in powdered form, is then prest as nearly as possible to the required shape in massive metal molds. In this prest form it will not stand much handling, so it is given a final baking, which fuses the metals together into a homogeneous, firm solid, holding the grafite uniformly distributed thruout its mass. The baking serves to clamp or grip the grafite particles securely within the mass of bronze, so that they cannot be washed out or detached, save by dissolving away the surrounding metal with acids. The material has the general appearance and body of bronze, but the characteristics are different. It does not machine readily by ordinary methods, but can easily be ground, which has been found to be the best method of handling it in quantity.

—*Photos courtesy General Electric Co.*

Radio Cheers Arctic Explorers

(*Continued from page 937*)

signals picked up every day by the portable set carried with the expedition. Captain MacMillan does not state in his dispatch, which is dated August 15th, 1921, "On Board the Arctic Schooner Bowdoin, Longitude 67:35:10; Latitude 62:22," whether or not any wireless music has been heard, but probably none was heard, as the stations sending out radio music and other features such as weather reports, football scores, etc., have not a very great power as yet. Undoubtedly, in the very near future, the power of the radiophone broadcasting stations will be greatly increased and possibly some of the high-powered government stations may take over some of this work, and then everyone in the smallest hamlet will be able to enjoy wireless concerts, with a simple and inexpensive receiving set. We quote below two extremely interesting passages from Captain MacMillan's letter:

"Upon our arrival today 1,224 geographical miles north of Boston, we tested our wireless and were delighted to hear at least a dozen stations. The Annapolis station we hear every day at noon and at 10 p.m., when time signals are sent broadcast. I think we are the first Arctic expedition ever to keep in touch with home, bringing to our minds, possibly, the fact that while we are apparently in a world unfinished or now long dead, there is another world to the south of us progressive and throbbing with activity. The musical little note that reaches our ears nearly every minute of the day is a constant reminder that we are a part of that world and not forgotten.

"Our wireless, installed by Prof. Pierce of Harvard, is still with us. Yesterday we heard the time signal sent out by Annapolis. When in winter quarters we shall put up a larger antenna and undoubtedly keep in touch with home thru the year.

"As yet we have seen no polar bear or walrus, but seals, ducks and snow geese are very numerous all along this shore. To supplement our supply on the Bowdoin we hope to secure a goodly number of the latter before their departure for the south, about the middle of September."

IS THE HEN SUPERIOR TO THE INCUBATOR?

No incubator can compare with a hen is an old phrase of the farmer, but is the hen really more reliable than the incubator after all?

When the eggs under the hen begin to hatch, she will generally continue to wait for a day, but then the desire to show her family to the rest of the inhabitants of the barnyard gets the upper hand, and she gathers her incomplete brood together and proceeds to strut proudly around with her children, continually calling attention to her little ones.

The eggs left in the nest are said to be infertile and are thrown away.

If these eggs, supposed to be useless, are taken from the nest before they are too cold, and placed in an incubator, in almost every instance some of them will hatch, and in some cases all of them produce chicks.

The hen in her excitement, leaves the nest too soon, whereas the incubator, which has no maternal desire to show off like the hen, keeps up a steady warmth, whether the eggs take the supposed twenty-one days or more to hatch.—*William Reinich.*

Recording and Amplifying Radio Time Signals

By ARTHUR H. LYNCH

(*Continued from page* 935)

equipment as near perfect as possible. Skippers very seldom agree on anything, but it is hard to find one of them who will not tell you that an *accurate chronometer* is his best friend. Considering this important adjunct to safety at sea, we wonder why no effort has been made heretofore to bring about some better method of letting the observer in the chart room know of the reception of the radio signal. A very satisfactory method has now been devised.

Instead of having the signals come into the radio room and actuate a pair of receivers, such as we ordinarily find to be the practice, the radio signal is made to operate a highly sensitive relay, which, in turn operates a second relay, which is connected in series with a line running from the radio room to the pilot house or chart room. In the chart room we can use any one of a number of sound producing instruments and practice indicates that the best results are obtained by using a third relay which operates a telegraph sounder, from a local battery. The plan of the entire layout is shown in the accompanying diagram.

There are very few sailing vessels which boast radio outfits, so they are very much at a disadvantage, as far as accuracy of their chronometers is concerned, and radio engineers have gone to the trouble of producing a simple receiving outfit, which requires practically no knowledge of radio for them. The original cost of the entire equipment is approximately twenty-five dollars, and there is absolutely no upkeep cost. The aerial may be put up in any convenient place aboard the vessel and the receiving set, which is actually smaller than the ordinary ship's clock, can be placed right in the same room with the chronometer. The set requires no attention and when the skipper wants to pick up time signals all he has to do is to put the receiver to his ear.

For Jewelers

There are many jewelers thruout the country who make a specialty of watch repairing and adjusting, especially where they are situated in the locality of important railway terminals, for railroad men require accurate watches. Many of these jewelers are using radio time signals to check their "standard" chronometers. None of them, as far as I have been able to learn, have made any attempt to use the incoming radio signals for an advertising feature, tho they will spend all kinds of money for signs and gold letters for their windows.

By using the sensitive relay previously described, a jeweler could even go so far as to connect up an electric horn, which would enable every person within a block to set his watch by radio signals directly from Washington. Of course such equipment is more or less elaborate, but it may well be modified by the jeweler to suit his own requirements. At any rate there is an opportunity for us all to profit by the signals sent out from Washington, be we merely laymen or skippers of the largest ocean liners afloat.

OUR OWN WIRELESS

A wave of thought takes a minute to travel a mile of nerve.

A touch on the face is registered on the brain and responded to in the seventh of a second. It takes a sixth of a second for the brain to respond to the sense of sight.

Vibration—The Energy Waster

(*Continued from page* 921)

end of each *heavy* blade until the entire assembly of armature, shaft and fan will remain in any position in which they are placed or turned on the knife edges.

Mr. N. W. Akimoff, mechanical engineer, of Philadelphia, Pa., has gone very exhaustively into the study of vibration as applied not only to automobile engines and other smaller machinery, but also with respect to the balancing and elimination of the wasteful vibration in large steam engines, ship propelling machinery, and all sorts of other machinery having a loss of power inherent in it due to undesirable vibration, or a state of *unbalance* of the rotating parts.

The photograph at the left of the accompanying group shows a combination static and dynamic balancing machine. *Static Balance* means that the center of gravity of the body lies exactly on the axis of rotation. *Dynamic Balance* means that there is no centrifugal couple in the body, *i.e.*, no two "heavy points" on opposite sides of the shaft and not in the same transverse plane. It can be instantly set for either determination, and gives results of the greatest accuracy. It can be used to accurately balance crankshafts, flywheels, armatures, pulleys, etc.

It gives the plane and the amount of correction to be applied to the body to make it operate smoothly. It is furnished in two sizes, small and medium. For large rotors special equipment is designed, light and sensitive.

The engine shaft here shown was well made and accurately ground; yet the engine shook even at moderate speeds, while it was not possible to reach high speeds, no matter how wide one opened the throttle. Examination showed that the shaft was badly out of balance, dynamically.

The indicated corrective weights were introduced and the increase in power was remarkable. All vibration stopt and a certain hill which could only be taken in *second gear* became mere play on *high*.

The diameter of the propeller of the right-hand illustration was 18 feet, and the weight approximately 24,000 pounds. Irregular bodies of this kind are extremely difficult to correct for balance. Many engineers feel that good balance is not absolutely necessary for slow speeds (about 300 r. p. m.). "I can only suggest that we have never seen a case of *too much balance*, especially in an overhanging body," says Mr. Akimoff.

There are other factors, however, which also may cause the propeller to vibrate even if in perfect balance; for instance, insufficient tip-clearance (tips too close to the hull), or lack of uniformity in pitch may cause vibrations in the propeller shaft. The effect will be very similar to that of unbalance, to all outside appearances, yet the remedy will, naturally, be quite different from balancing the propeller.

LIQUID AIR FOR TIGHTENING BOLTS.

We all know that metals are contracted in size by cooling. A wonderfully simple and efficacious way of securing a rigidly fitting metal bolt has been experimented with by the Bureau of Standards.

But the new method is simplicity itself; the bolt or shaft is made of slightly larger diameter than the hole; it is cooled by immersion in liquid air and is inserted in the hole, which it readily enters. As it returns to normal temperature it expands and is strongly gript by the metal thru which it is thrust.

Practical Chemical Experiments

By Prof. FLOYD L. DARROW

(*Continued from page 929*)

small flask containing about 25 to 50 cc. of water so arranged that the water can be heated almost to boiling just previously to blowing the air thru.

Now start the nitric oxid generator and fill the large flask or bottle, which serves as the lead chamber, with nitric oxid. Immediately the nitric oxid unites with the oxygen of the air in the flask to form the dense brown fumes of nitrogen peroxid. To stop the action in the generator pour in water.

When the flask is full of the red fumes of nitrogen peroxid start the sulfur dioxid generator. As the sulfur dioxid enters the flask it immediately reduces the peroxid, causing the red color to disappear, and at the same time forming on the walls of the flask the *chamber crystals* previously described. Now blow a stream of air thru the small flask of hot water. The vapor carried into the flask will unite with the chamber crystals to form sulfuric acid, while the air will gradually regenerate the nitrogen peroxid, so that the process may be repeated until a fairly strong solution of sulfuric acid has been formed.

If this experiment is properly carried out you will seldom find a more beautiful demonstration.

Test for Sulfuric Acid: To a little dilute acid in a test tube add a few drops of a solution of barium chlorid. Immediately a heavy white precipitate of barium sulfate forms. As a confirmatory test add a little dilute hydrochloric acid. Note that the precipitate does not dissolve.

To learn the reason for the confirmatory test apply the same test adding barium chlorid solution to solutions of sodium carbonate, sodium phosfate, and ammonium oxalate. It will be observed that while in each case a white precipitate forms, it immediately dissolves if hydrochloric acid is added. If you used sulfuric acid or any soluble sulfate, however, the barium sulfate would not dissolve.

Affinity of Sulfuric Acid for Water: To a test-tube half full of water, add very slowly a few cubic centimeters of concentrated sulfuric acid. Note the heat that is developed and the fact that you can scarcely hold your hand on the outside of the tube.

Carbohydrates are compounds containing carbon with hydrogen and oxygen, the latter two in proportion to form water. So great is the affinity of sulfuric acid for water that it will separate it from such compounds. Place a drop of the concentrated acid upon a piece of cotton fabric and note the charring effect, as well as the fact that a hole soon appears. This action accounts for many of the holes that are burned in the clothing of a laboratory worker.

Thrust a piece of wood into a test tube of concentrated sulfuric acid and allow it to remain for a few hours. The acid immediately chars the surface and after a time changes the wood to a black pulp.

Prepare a very concentrated solution of cane sugar. Place about 50 cc. of this in a beaker placed in a large shallow glass jar or basin. Then pour into it about an equal quantity of concentrated sulfuric acid. Immediately a black color appears, the contents boil up, the odor of burnt sugar appears and a frothy residue of black carbon remains.

In all of these cases the acid has been uniting with hydrogen and oxygen to form water and leaving carbon. Because of this great affinity sulfuric acid is important in the laboratory as a drying agent for gases. The gas to be dried is past thru a wash bottle containing some of the concentrated acid.

An Excursion Into the Past

By ERNEST K. CHAPIN

(*Continued from page 907*)

"And if you call 60 miles an hour *speeding*, what might this be?" I asks, getting a bit sarcastic.

"Painfully slow," says he. "You forget that speeding all depends on circumstances. On earth it is well to keep down to 20 or 25 miles an hour and then be on a sharp lookout for trouble. But here in space—why there is almost nothing between the earth and the stars, and the stars are so far away we could keep on at our present rate for three or four years before we reached the nearest one and then, unless we steered right for it, there wouldn't be a chance in a billion of hitting it. Once one is clear of the solar system, there is nothing substantial to meet for some 20 trillion miles."

"Are we clear of it yet?" I queries.

"Nowhere near," says he. "The orbit of Neptune, the farthest planet, is nearly two billion, eight hundred million miles from the sun. It would take us about four hours at the speed of light to cover this distance."

"You can't mean it!" I explodes, dumbfounded. "Surely we are not going to travel at this unheard-of rate all the time, are we?"

"No indeed," he smiles. "We should be a million years reaching heaven if we did. As it is, the car is capable of making any speed I see fit. Very shortly I shall increase the speed to over a million times that of light and even at that rate it would take us the rest of the day to pass the farthest star visible to your most powerful earthly telescopes and thus to reach the outskirts of this universe. Now as there are many more universes to cross besides this one, at times I shall increase the speed to a billion times that of light."

Well, if I hadn't been a ghost I'd have fainted then and there. And to think I ever thot I knew what speed was. All my notions about speed were plumb foolishness alongside of what he was going to show me. One thing was certain, and that was, I was in for speeding with a vengeance. In fact, I knew I was in for a fill of it that would last me for all time. However, at the present rate we didn't seem to make headway at all, for the stars appeared no fainter nor brighter tho we were leaving some at the speed of light and approaching others at the same rate. Stopping to figure a minute, I could see that at this rate one could zip around old Mother Earth crossing every continent and ocean seven times in one second. The thot made me kinda mum for a while. Presently the angel spoke up again.

"Perhaps you would like to see the earth again before you leave it forever?"

I confessed I would be very grateful for the chance if it were possible now that we were so far away. At once he slowed the car down a notch until the meter read exactly "1." Then he begun to turn some knobs and things on a panel in front of him and in a moment a light appeared on the windshield as though cast from some reflector in back of us.

"The light that reaches us from the earth is too faint to affect mortal eyes," says he, turning some more knobs and dials, "but by suitable amplifiers it can be intensified to any extent desired. Then by proper focusing, you can see your old home.

"You now see a reflection of the earth," he explained, "which I shall next proceed to magnify and intensify." As he again turned the knobs, I saw the spot become a disk, grow bigger and brighter and soon take on the shape of a ball, with traces of mountains, continents, and oceans all layed out on it like a map. A moment later he

had the apparatus focust on the precise spot where the accident happened. The scene looked very much like a photo taken from an aeroplane about a hundred feet from the ground. There I could see the crossing where the Limited bumped into me. A freight train stood on the track, motionless, altho there was plenty of smoke above the engine. A man in a nearby field was loading potatoes into a wagon and stood with a basketful half raised to his partner who was reaching for them from the wagon. Both men remained stock still as tho they were petrified, one holding and the other reaching. In a pond by the track a couple of kids were in swimming. One must have just dove off the spring-board for he was stuck head first in the water with feet in air. The other was in the very act of diving. He was headed straight down for the water and his toes had not yet left the plank but not a move did either make tho I watched them for several minutes.

"What's the matter down there?" I asks in an awed whisper. "Why don't things move? Or is this just a picture you are showing me?"

The angel smiled at my astonishment. "No indeed," he said. "Everything you now see happened about twenty minutes ago as it has taken the reflected light about that long to reach us from that scene. The boys have dressed and gone home, the train is on the siding at the next station and the farmers have loaded the wagon and driven off with the load."

"But we still see the same thing and nothing seems to move," I exclaims.

"Yes," says he, "and we will continue to see the same thing as long as we travel as fast as light. At present we are just keeping up with the light waves reflected from that spot twenty minutes ago. As long as we continue at this rate no new waves can reach us and we overtake no old ones, so everything must seem at a standstill."

"What would happen if we slowed down a bit so the light waves could overtake us?" I asks, beginning to get excited.

"No sooner said than done," he replies, turning a control lever. We are now idling along at a little less than the speed of light. Looking on the shield, the figures so motionless before now seemed to come to life. They moved—but oh, so slowly! The kid's legs gradually disappeared in the water. The diver released his toes from the spring-board and slipped in after him. The smoke from the smokestack began to curl upward and the man with the potatoes after a painfully long time succeeded in handing his load to his companion on the wagon.

"The light waves are catching up with us now," says the angel, "but they are not catching up with us as fast as they are reflected. We should have to come to a full stop for that to happen. Watch the scene change as I slow the car down some more."

Immediately the figures began to move faster altho still too slow for real life. The slower he made the car move, the faster everything on earth seemed to go until by the time the meter read zero things appeared to move at natural rates again. Suddenly an idea pops into my head. I asks him to turn the car about and head us for the earth once, just to see how things would go then.

"We have very little time to waste," he objects, "but possibly we can return on our course for a few minutes." So saying he turns the car around and in a jiffy we are headed for Mother Earth again. Of course he had to shift the hickeys around until he had the scene focust again, but just as soon as he did I took another slant at the picture and how things did move! The boys were scrambling onto the bank, jumping into their clothes and more than beating it for home. The freight was flying down the track like the Limited when she struck me, while the horses with the load of potatoes were galloping along as if they were on a race course. Everything was zip, zip,

zip,—people legging it here and there for all they were worth and autos scooting around as though there wasn't any danger or any law agin it. It was like a movie in which the operator speeds up the fillum.

"As long as we are directed toward the earth," says my conductor, "we are meeting the reflected rays from that scene faster than they were produced. If we continued moving toward the earth we should find events progressing at this accelerated rate so that by the time we reached the earth again we would have seen not only all that happened while we were leaving the earth, but also all that occurred while we returned. Watching events from this distance puts us in the past, but, by the time we reached the earth again, we would have caught up with time, and again find ourselves in the present. But we must not continue in the wrong direction any longer." So saying, he frisked the car about and we were again headed for the stars. Then I asked him to show me how to focus the apparatus on any particular spot and intensify the image properly. He consented and soon I was looking at this city and that city and skipping around all over. While looking at New York I remembered that the world series was being played between the Yanks and the Giants and soon I was watching the game. It wasn't very exciting, however, for the action was slowed down considerably on account of our own motion. The faster we went the slower the players moved, until by the time we were going as fast as light everything was at a standstill. This happened just as Babe Ruth was about to slam out a homer. I saw the ball pitched to him. It seemed to travel very slowly, in fact no faster than a slow walk, then stuck to the bat for a moment as Babe was poised in the very act of giving it an awful wallop. But, can you believe it, instead of sailing out over the outfield, the ball gradually returned to the hands of the pitcher. The pitcher was all wound up when he caught the ball but at once he began to slowly unwind and by the time he was all unwound the ball passed to the catcher. I was too amazed to speak, but the angel seeing it explained in this way.

"At the instant the ball seemed to strike the bat we were going at the speed of light. Everything was then at a standstill. But the next moment we were going faster than light, and, consequently overtaking some of the waves that had previously passed us. As long as we travel faster than 186,000 miles a second, then, events should appear reversed."

And I should say they did! The faster we went, the faster everything we saw took place only it was all the wrong way to. I was watching the game take place backwards and getting a lot of fun for nothing out of it for a while when an idea came to me that it would be great sport to see what happened when I was wrecked. What a sensation it would be to see myself killed, from a safe distance and half an hour after my death had occurred! The next moment I had the scene of the accident back into focus.

As soon as I had the picture sharp and clear, I saw the old freight returning along the track with wheels going the wrong way and smoke pouring down into the stack from the cloud above. As I watched, who should I see coming but the kids walking backwards toward the pond. Pretty soon they were in the water and swimming around backwards. It was killing to see them dive. Instead of striking the water head first, they rose feet first from the water to the spring board and then ran backwards off the plank to the ground.

After a while I saw an ambulance back up to the crossing where I was wrecked. Two men got out and then I was dumbfounded to see them pull my body out of the car and dump it on the ground. Then they got in and drove off backwards. It nearly made me swear to see them treat me rough like

that. There were a lot of people around when the ambulance drove up but one by one they ran away backwards and left me lying there alone. Suddenly the limited backed lickety-cut across the road and just as the cow-catcher reached the middle I saw my mangled remains fly off the ground into the air and into my wrecked car which at the same time was leaping for the front of that engine. Together we hit it an awful wallop and it backed off down the track and around the bend pushing the coaches behind it, while my car was carrying me at breakneck speed backwards along the gravel road to the clubhouse and secret hootch that started the whole business.

Well, by this time the angel had speeded the car up to many times the speed of light. Everything was now going backwards so fast I couldn't follow it. Sometimes, however, he would consent to slow down a bit or even stop awhile and let me watch some particular past event that interested me. All I had to do was to give him the exact date when it happened. The angel would then speed up the car to a thousand or a million times the speed of light and we would burn the ether for a few trillion miles until we could overtake the waves reflected from that scene. Then he would stop the car and we would let the waves catch up with us. In this way we could see everything that happened a month, a year, or even several years back and see them happen in the natural order.

I saw myself in this way, going to school back in the grades, later to the kindergarten and still later as a youngster toddling about my father's farm. "Slow down," I says one time, "when you catch up with June 3rd, 1871. I'd like to see my mother's wedding." "All right," says he, and we tear thru a quadrillion or so miles of space while stars flash by like comets. "By jove, there's the charivari!" I exclaims, seeing a crowd of people with torches and cowbells outside the door. "If they would only hold the wedding outdoors I could see it too." Well, the funny thing about this was, that after the wedding was all over, the next time we stopped to look I saw my pa and ma as kids going skating together!

After watching my folks grow younger and younger toward babyhood, I decided to watch my grandparents for a while and later my great grandparents whom I had never before seen. It seemed kinda mean at first to spy on them like this, but I had to do it. It was too good a chance to pass up. Then when the sixties came rolling along I resolved to watch some of the battles of the Civil War. I wasn't much at book learning but if there was anything I liked it was history. Here was a chance to check up on some of the yarns they told in that history book of mine.

I can't tell all the things I saw and we didn't have time to stop for everything, but I managed to get the angel to slow down or stop for the real big things. Napoleon and the battle of Waterloo, Washington crossing the Delaware, the Pilgrims coming over in the Mayflower, and Columbus crossing the ocean to America are only a few of the things I saw with my own eyes.

My constant fear was that the light from the scenes that took place a few thousand years ago would have passed so far away by this time that we should never catch up with it. But the angel shook his head when I asked him.

"The light that was reflected from the earth when the pyramids were built has not yet passed many of the stars you could see with your naked eyes," he assured me. "We shall soon overtake it," and on we went. It was a great pageant I saw. Every king and emperor of Europe appeared at one time or another, growing from old age to childhood, to be succeeded then by a father or an uncle who in turn would lead another backward reign and again be superseded by one of his parents.

Suddenly the windshield cracked, the picture disappeared. Somebody was trying to pull the laprobe that protected me from the cold of infinite space, a hand gript my wrist and try as I would I could not shake it off. Then a voice:

"He has been just like that ever since they brought him, doctor. He simply won't let me get his pulse and I can't do anything with him. And of all the nonsensical jabberings you ever heard his beats all hands down. It runs something like this:

"'Slow down again, angel, when you catch up with the first century. I simply must have a slant at Cleopatra and Caesar —there—there—now I have it focused. Keep her steady now on Number 1. 186,000 miles a second is just O.K. for this scene."

Geometrical Paper Folding

(*Continued from page* 932)

the apex of the pentagon, and complete it by folding R Q and Q P.

To make a hexagon by the employment of a square, the square is first folded to give the two lines at right angles to each other, A B and C D. A O and O B make the bases for four equilateral triangles, two above and two below as shown in the drawing, the combination when the apexes of the triangles are joined by folding gives the hexagon.

For these very interesting demonstrations, we are indebted to a work entitled "Geometric Exercises in Paper Folding," by T. Sundara Row, which has been edited and revised by Professors Wooster Woodruff Beman and David Eugene Smith.

Science Wrinkles

(*Continued from page* 924)

tions along the frame. Mr. J. E. Lemoine, the inventor, places the explanation in a very few words as follows: "I claim a three axial motion discovery in the gyroscope causing the phenomenon of the gyroscope." He then goes on to explain the phenomenon of the structure of matter by saying that the gyroscope will explain this also and adds that "three forces working in harmony form a three axial mechanism involving four principles." Can you follow him, boys?

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