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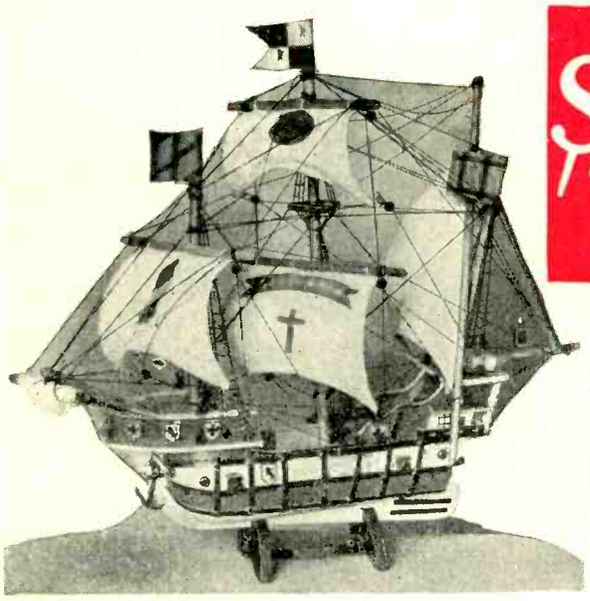

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Science and Invention

Vol. XV
Whole No.
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CONTENTS OF THIS NUMBER

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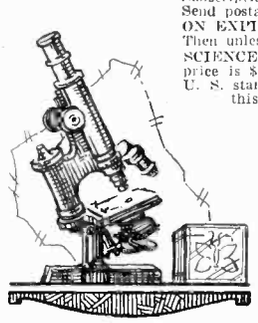

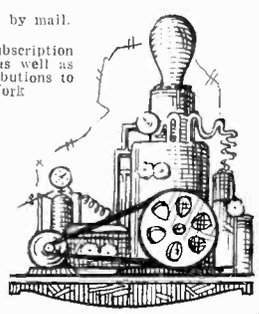

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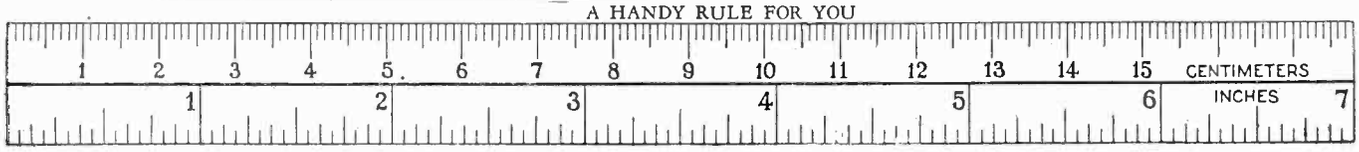

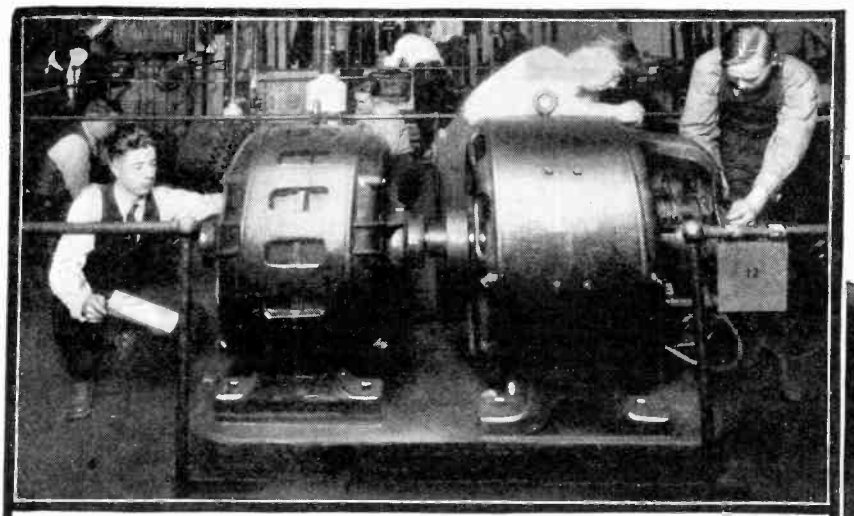

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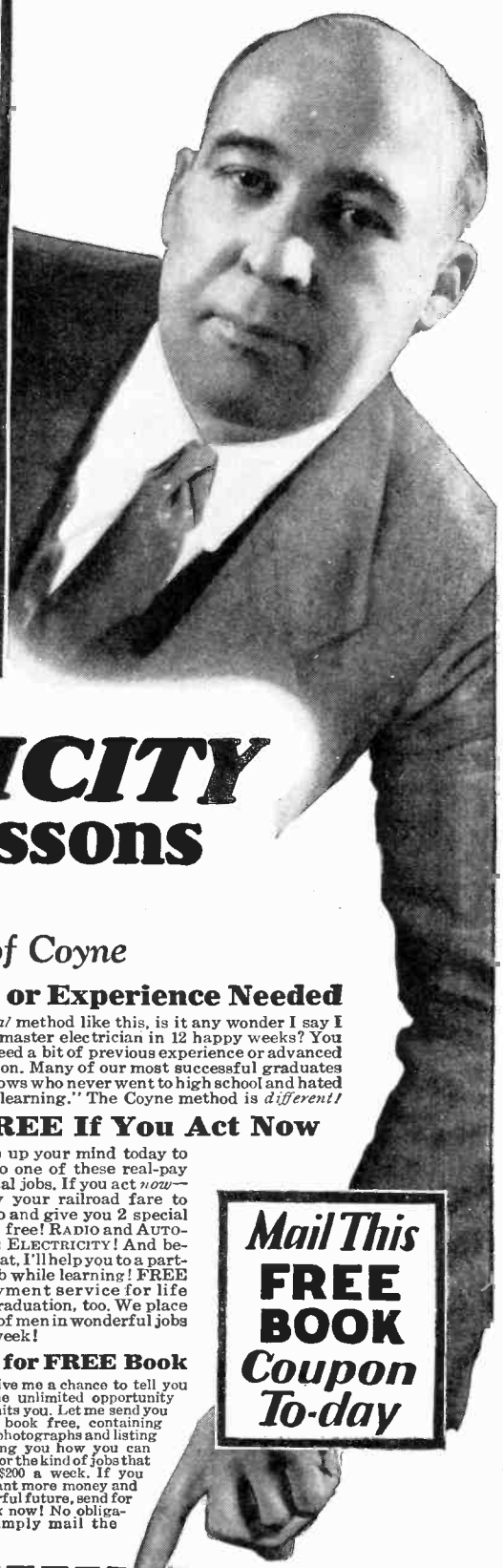

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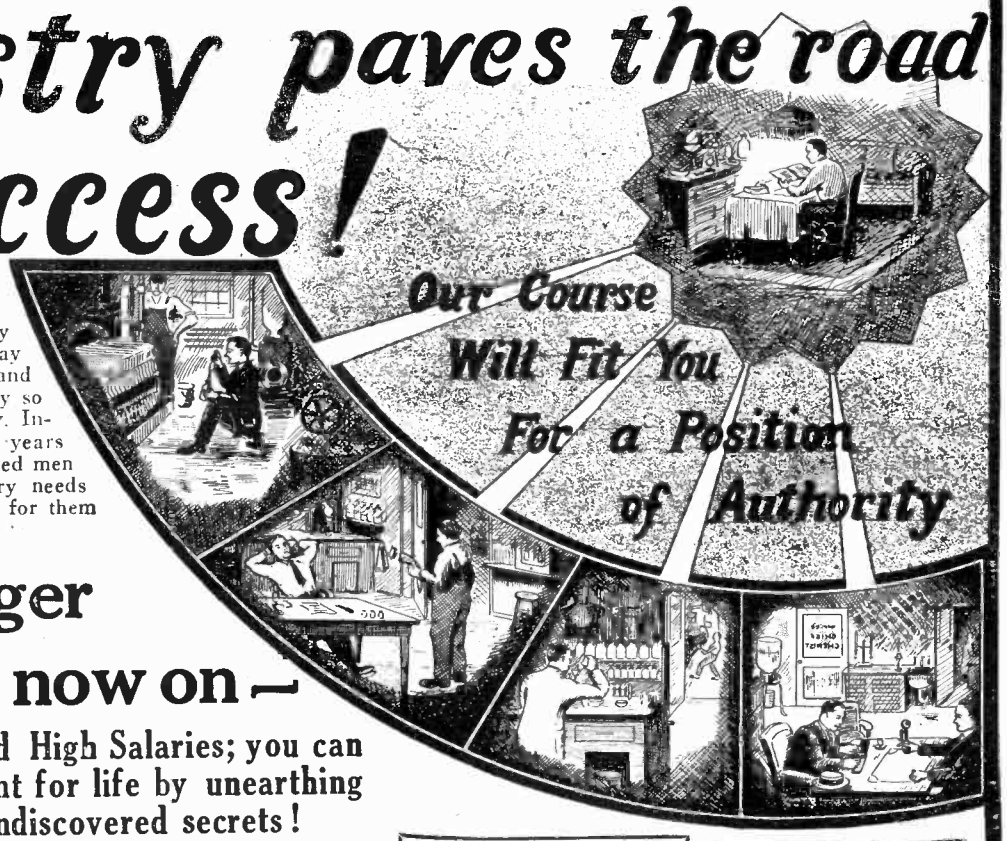

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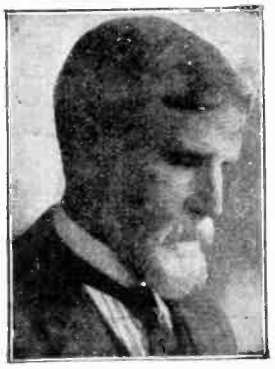

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Volume XV
Whole No. 169

Science and Invention

May, 1927
No. 1

HUGO GERNSBACK, *Editor-in-Chief*
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Editorial and General Offices, - - - 230 Fifth Avenue, New York

"Those Who Refuse to Go Beyond Fact Rarely Get As Far As Fact" - - - HUXLEY

ARE NEW SENSES POSSIBLE?

By HUGO GERNSBACK

THE human being, and most animals, for that matter, has been endowed by Nature with five senses, Sight, Touch, Hearing, Taste, and Smell. These senses vary greatly in the different species, although roughly, as far as we know today, the senses are the same. For instance, the sense of taste in man is approximately the same as that in a dog. The human tongue may be more refined and the brain may interpret different tastes in a different manner than do those of a dog, but anything that is placed on the human tongue is tasted physically, the same way as that on the animal tongue. For instance, if the French chef puts a trace of garlic in your French dressing, the connoisseur will immediately detect and correctly interpret the garlic by his taste. The dog will taste exactly the same thing, but he probably will not associate the taste with the vegetable garlic.

On the other hand, the sense of smell is very much better in the animal than in man, as is well known. Most savage animals can "wind" their enemies from miles away, whereas the human being would smell absolutely nothing. The same is the case with the sense of hearing, wherein animals greatly excel humans. On the other hand, for instance, the sense of touch is very much more refined in the human than in animals, in most cases. The sense of sight in the human being also is, in most cases, far superior to that of very many animals, although there are, of course, exceptions.

Philosophers and scientists in general have for centuries been asking themselves whether it is not possible that, outside of our five senses, there could be still higher senses. We know, and practically every entomologist knows, that many insects have senses of which we today have only the slightest notion. For instance, you may take a female moth and enclose it in an absolutely airtight container. The outside of the box and the person handling it can then be sterilized in such a way that we may say with safety that no other moth could possibly, by means of the sense of smell, communicate with the imprisoned moth. The original container can then be placed into other containers to make sure that no smell can possibly emanate through all the different walls, but, strange to say, if the container is transported to a place where male moths abound, they will immediately be attracted to the container by some sense of which we have no knowledge today. That this sense is in all probability a vibratory one is conceded today by most authorities.

In our communication with the outside world, where we get impressions of a vibratory nature, such as light and sound, we have, for this purpose, the ear and the eye. Now the ear responds to vibrations beginning at about the third octave, which is 8 vibrations per second, up to and including the 15th octave, embracing 32,768 vibrations per second. Most people, however, can not hear sounds at this high vibration, and most of them can not hear above some 25,000 vibrations per second. From the 15th octave to the 46th, man perceives nothing. The electrical octaves, from the 25th up to and including the 35th, man can not perceive by any of his senses. By means of the sense of touch man can perceive the octaves from 46 to 48, inclusive, which embraces the band of heat. Heat can not be seen, it can not be heard, and it can not be tasted, but it can be felt by the sense of touch. A hot liquid on the tongue is not tasted, but is felt through the sense of touch, also located in the tongue. The 49th octave is one of light, vibrating at the rate of 562 trillion times per second. This we perceive with the sense of sight, but there are many unknown regions in the vibration band, which we do not know today. There are, for instance, the octaves from 20 to 25, the physical effect of which we do not know. Then there are the chemical rays, embracing the 50th octave, and the 51st to the 57th octaves, which, again, are unknown. The X-rays embrace the 58th to the 61st octaves, while the 62nd, and possibly highest, is also unknown.

It will be noted from the above that between the octaves of sound and of heat there is a great gap, which our senses do not perceive. It is, however, quite possible that at some time in the future, whether this is 100 years or 100,000 years hence, makes little difference, another new sense or new senses may conceivably be born. We know so little about our own anatomy, we know so little about certain glands, and certain other component parts located in our bodies, that it is impossible at this time to say that any one of these may not be for a purpose that as yet can not even be comprehended by us. While it seems improbable, it is not impossible that at some future date human beings may be able to communicate with each other by means of some simple apparatus which is neither sound, nor heat, nor radio. That it will be by some vibratory method is not doubted by scientists today, but just how it will be brought about we are entirely too ignorant to know.

Philosophers sometimes rush to conclusions and predict that it will be possible to receive radio waves without the assistance of instruments in order to translate the waves into audible sounds. I personally do not believe that this is possible, that is, as far as radio waves as we know them today, are concerned. I do believe, however, that it is possible to communicate through some other vibratory means, over great distances. Naturally the thought will come to many that I refer to telepathy, but I most certainly do not, because I do not believe in telepathy as that term is understood. I do not believe that it is possible, at the present time, to transfer thoughts, and so far any scientific proof thereof has been lacking, although many extravagant claims have been made. If thought transference were possible, the same thought transference would be received by hundreds and thousands of others, as there is no reason to believe that two brains or minds are "tuned" differently from those of other individuals.

Outside of this higher sense, which may be termed the Sixth Sense, there may, of course, be others. For instance, the human mind is not constituted today so that it can, for instance, visualize a Fourth Dimension. You can not think about eternity for any length of time without becoming confused, or without getting an unpleasant headache. We can not understand what was before the beginning of everything, and the mind stands aghast at the idea that there could not be any beginning. Evidently these questions require another center for their interpretation, of which we are totally lacking today.

Of course in Nature there is an answer for everything and a good reason for it all, and our lack of senses to understand all this is a proof of our own incompetence. It may take thousands of generations before a new sense is developed, but it will be developed in time.

Mr. Hugo Gernsback speaks every Monday at 9 P. M. from Station WRNY on various scientific and radio subjects.

Shoes and Old Clothes are Explosives!

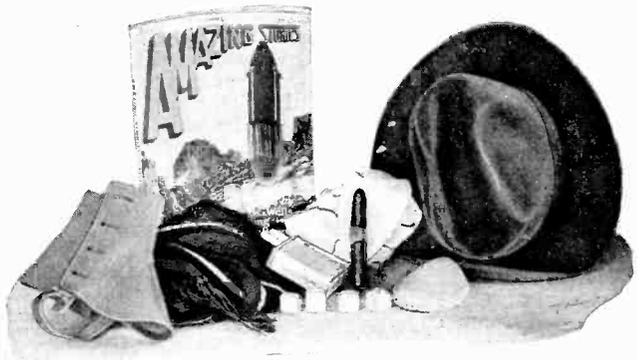
By F. W. HORTON

With all the fair sex wearing them, it is, of course, recognized that there are many inherent dangers in silk stockings, but, did you know that they can become high-powered explosives? Also, that an old straw hat or a pair of spats can be exploded with great violence.

The young man, apparently oblivious of any peril, smilingly borrows the lady's stockings for a little experiment with liquid oxygen. Watch what happens.

The stockings after being immersed in liquid oxygen contained in the thermos bottle are rammed into a short cardboard mailing tube closed at one end. Wooden pliers and a wooden ramrod are used to prevent "burning" the hands with the liquid. The tube is then stood on end and one half-a-cup of liquid oxygen poured into and over it, wetting the tube thoroughly.

The tube, connected with a piece of ordinary blasting fuse, is placed in the hole in the oak stump and the hole is rammed loosely with rags. The fuse is lit, and WHAM! See what has happened to the stump!



The spat, scarf, magazine, cigarettes, handkerchief, powder puff, cigar, lump sugar, and felt hat, are only a few of the common objects that become powerful explosives when saturated with liquid oxygen.

WHILE the blowing up of an oak stump by the explosion of a pair of silk stockings saturated with liquid oxygen as illustrated above is only a novel experiment, the commercial application of liquid oxygen as an explosive has wide possibilities due to its many advantages over ordinary explosives.

Pure liquid oxygen is a bluish liquid which boils at —183° C. (—297.4 F.). It consequently evaporates rapidly, and this is the only important deterrent to its extensive use. It is strongly magnetic and has a specific gravity of 1.118. When used for explosives it is, of course, not pure, but contains normally from 80 to 90 per cent of oxygen, the balance being largely nitrogen. It is, therefore, not to be confused with liquid air from which it is made by rectification, and which is much poorer in oxygen. Like liquid air, liquid oxygen must be handled with care, for although there is but little danger of seriously burning the hands if the liquid is accidently spilled on them, there is, nevertheless, the possibility of very painful results.

The vessels in which liquid oxygen is stored and transported must be insulated as perfectly as possible to reduce evaporation to a minimum. These vessels are made like thermos bottles with double walls and vacuum jackets. Brass or copper bottles surrounded by larger steel ones are used commercially, while glass containers are satisfactory for the laboratory. There is always some leakage of air through the metal walls of the container and in order to maintain the vacuum, hot charcoal is placed in the space between the walls before it is evacuated. After sealing, when liquid oxygen lowers the temperature, the charcoal absorbs any remaining air and produces an almost perfect vacuum. The mouth of a container must never be closed tightly as the gasification of the liquid oxygen would produce an enormous pressure. A piece of cotton wool placed loosely in the neck of the container is about the best stopper. The evaporation loss under proper conditions is less than 5 per cent in 24 hours.

If any highly carbonaceous material is saturated with liquid oxygen and ignited, the union between the two will be so rapid as to produce an explosion. The purer the carbon and the more intimate the mixture, the more violent the explosion will be. Accordingly, and also because they are inexpensive, such materials as lamp black, gas coke, soot, charcoal, sawdust, ground straw and crude petroleum are selected for commercial use. These materials, either separately or mixed and sometimes with an inert absorptive material such as diatomaceous earth, are placed in cylindrical bags of paper or cheese-cloth, usually about 6 to 9 inches long and 1 to 2 inches in diameter, while an electric detonator or a special liquid air fuse is attached to one end of the bag. The cartridge thus formed is soaked in liquid oxygen from 10 to 15 minutes and then slipped into a pasteboard container which telescopes over it, and which has also been chilled by dipping in the liquid oxygen.

The assembled cartridge is put into the drill hole and a wad of cotton placed over it. A small brass tube is then inserted in the hole and clay stemming tamped around it. The tube is withdrawn and the shot is ready to fire. The tube and the passage that it leaves through the stemming provides an escape for the evaporating oxygen until the shot is fired, while the cotton wadding over the cartridge prevents the clay from clogging this means of egress.

The rate of evaporation of the liquid oxygen in the cartridge is the most important factor in the use of the explosive. The weight of carbon in the cartridge, including its coverings, can be exactly determined as can also the amount of oxygen required to insure its complete combustion to CO_2. But this amount of oxygen will be affected by the loss by evaporation during the time between the soaking and firing. This loss can only be determined by trial. Ten minutes is allowed for loading and firing 3 shots.

As compared with dynamite and black powder, liquid oxygen explosives are both cheaper and more powerful. The table below shows the weight of different explosives required to produce a pressure of 4 kilograms per square centimeter as reported by Seider from tests made in Germany.

Blasting powder	283 grams
Carbonite	170 grams
Gelatine dynamite	102 grams
Blasting gelatine	86 grams
Liquid oxygen with burnt cork and petroleum	58 grams

These comparisons, however, are only approximate as the purity of the liquid oxygen

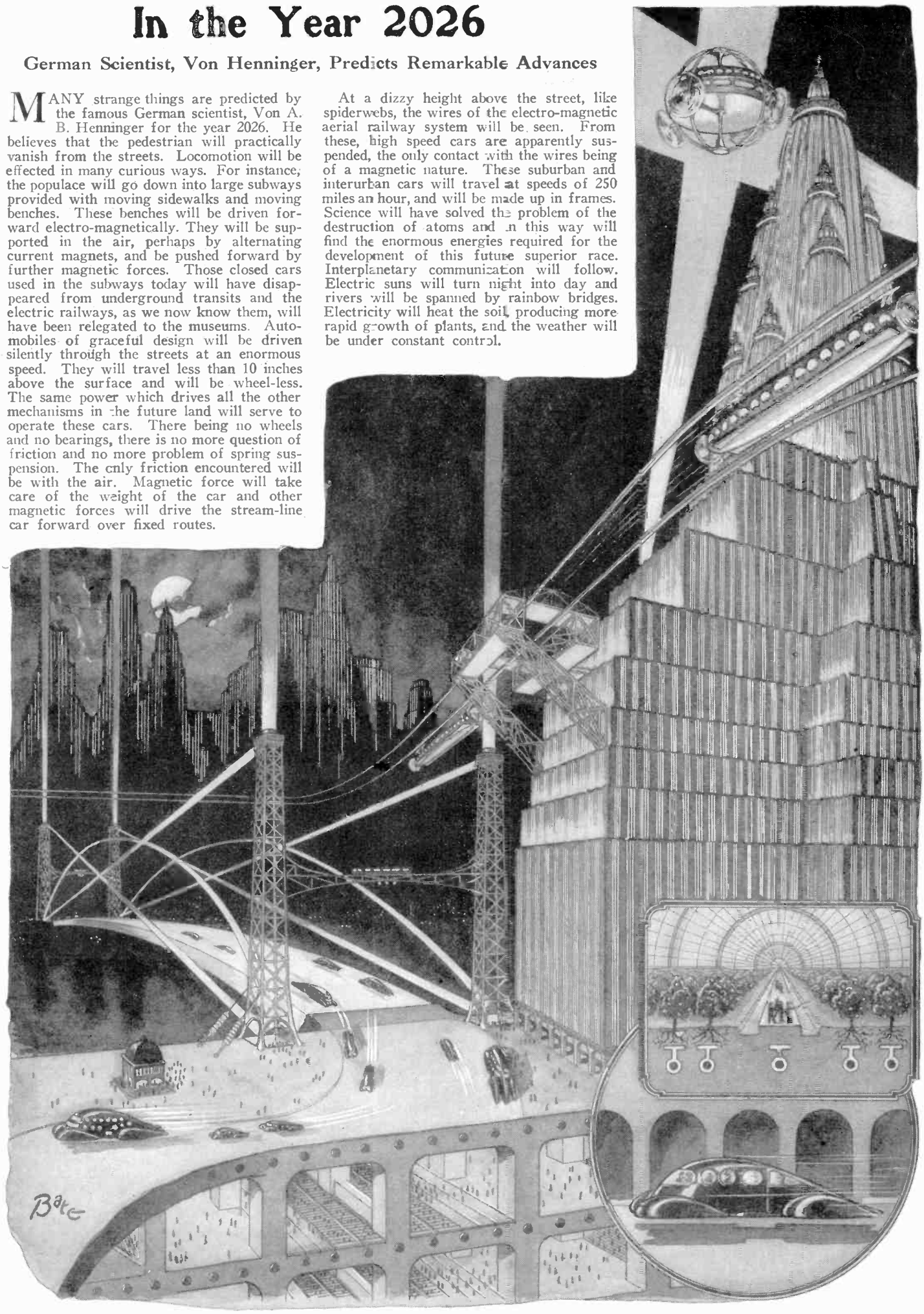
(*Continued on page* 73)

In the Year 2026

German Scientist, Von Henninger, Predicts Remarkable Advances

MANY strange things are predicted by the famous German scientist, Von A. B. Henninger for the year 2026. He believes that the pedestrian will practically vanish from the streets. Locomotion will be effected in many curious ways. For instance, the populace will go down into large subways provided with moving sidewalks and moving benches. These benches will be driven forward electro-magnetically. They will be supported in the air, perhaps by alternating current magnets, and be pushed forward by further magnetic forces. Those closed cars used in the subways today will have disappeared from underground transits and the electric railways, as we now know them, will have been relegated to the museums. Automobiles of graceful design will be driven silently through the streets at an enormous speed. They will travel less than 10 inches above the surface and will be wheel-less. The same power which drives all the other mechanisms in the future land will serve to operate these cars. There being no wheels and no bearings, there is no more question of friction and no more problem of spring suspension. The only friction encountered will be with the air. Magnetic force will take care of the weight of the car and other magnetic forces will drive the stream-line car forward over fixed routes.

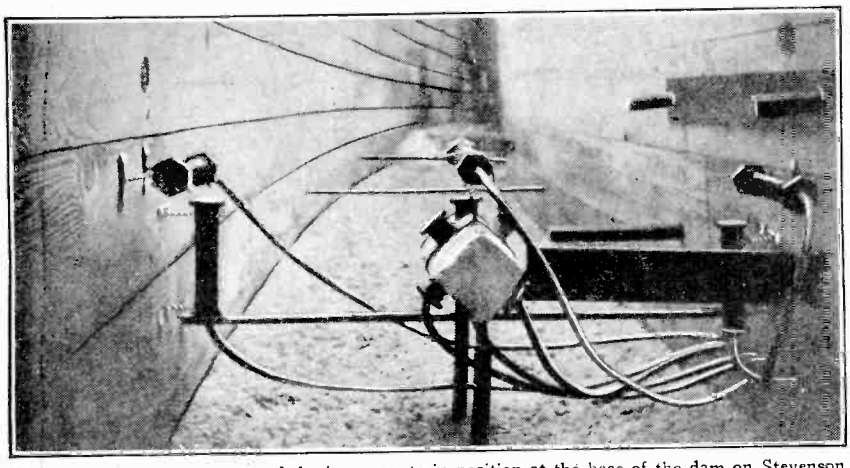
At a dizzy height above the street, like spiderwebs, the wires of the electro-magnetic aerial railway system will be seen. From these, high speed cars are apparently suspended, the only contact with the wires being of a magnetic nature. These suburban and interurban cars will travel at speeds of 250 miles an hour, and will be made up in frames. Science will have solved the problem of the destruction of atoms and in this way will find the enormous energies required for the development of this future superior race. Interplanetary communication will follow. Electric suns will turn night into day and rivers will be spanned by rainbow bridges. Electricity will heat the soil, producing more rapid growth of plants, and the weather will be under constant control.



The above illustration shows what some of our future cities will look like, the cars are wheelless, supported and driven by magnetic forces. The railways are magnetically suspended 10 inches below the overhead tracks. Rainbows form the bridges and soil is electrically stimulated.

Testing Dam to Bursting Point

By SAM BROWN

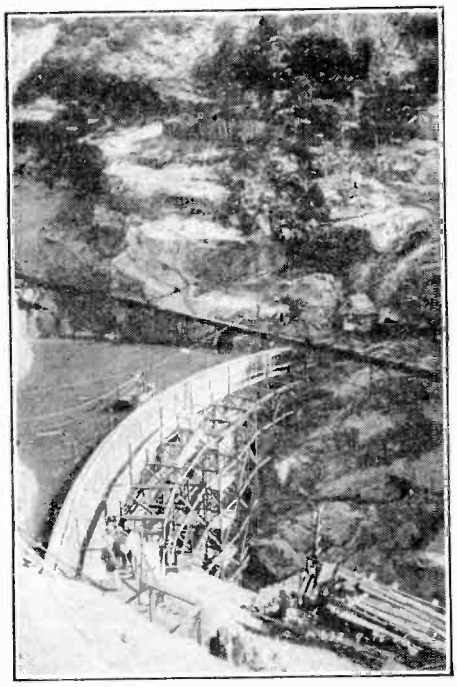


The photo above shows some of the instruments in position at the base of the dam on Stevenson Creek. The instruments determine variations in pressure.

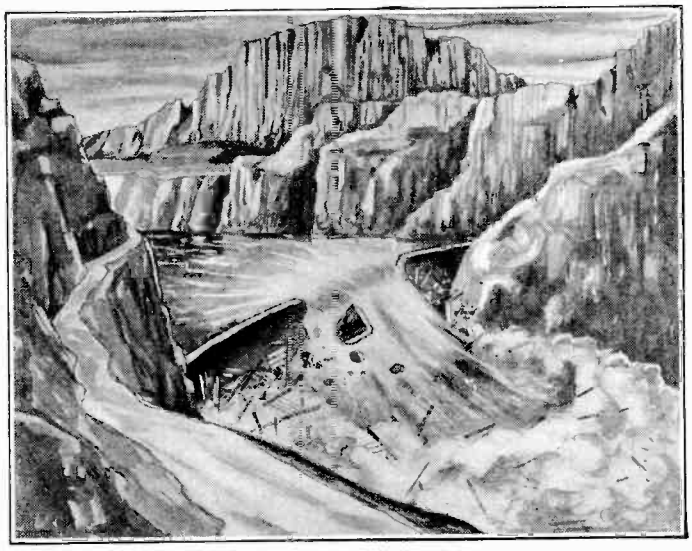
SCIENCE has turned play-boy! Her latest toy is a 100-foot arch dam, situated on Stevenson Creek, a tributary of the San Joaquin River, about sixty miles east of Fresno, Calif. The dam is being constructed by a committee of members of the American Society of Civil Engineers, under the auspices of Engineering Foundation (New York) for the purpose of settling century-old engineering problems. Eventually the dam will go into the discard, a total wreck, due to placing strains upon it beyond its capacity, but at the present time it is being subjected to hundreds of scientific tests making for the correct standardization of arch dam construction.

The dam is being built of Portland cement concrete, 100 feet high, with a vertical upstream face having a constant radius of 100 feet. The thickness of the dam at its base is seven and one-half feet. From there it is tapered back on the downstream side to a thickness of two feet at the thirty-foot level, which continues to the top of the dam —now sixty feet high.

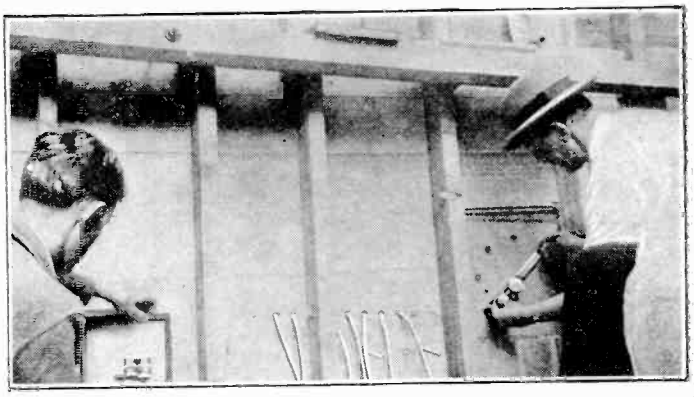
At this sixty-foot level, the dam was subjected to having a flood of 1500 second-feet pass over its crest at a maximum depth of three feet. Superficial examination indicates that the dam suffered no damage, although the scaffolding for observers and some of the instruments on the downstream side were carried away.



This shows an aerial view of the dam which will eventually be destroyed. Notice the observation towers resembling scaffolding built up on this side of the 60 foot dam.



After all possible tests have been made with the 60 foot dam now erected, provided that it still holds, the height of the concrete wall will be increased to 100 feet and the dam will then be subjected to such strains as to lead to destruction. Simultaneously this $150,000.00 plaything will be swept away to a total loss, but the engineers will have a set of fully tabulated records which should make for substantial economies in future dam constructions.



After all possible tests have been made with this sixty-foot dam, and provided it still holds, the dam will be increased to a height of 100 feet and at that height subjected to such strains as to lead to destruction.

While the concrete was being deposited, hundreds of instruments, parts of instruments and metal reference marks were very carefully set in place to be used in measuring strains, cracks and temperatures. Five wooden trestles were erected for observation purposes and for measuring dam deflections. Electric lights were installed on both faces of the dam.

Ever since the beginning of construction, the concrete has been kept wet by small streams of water, from hose or perforated pipes, trickling down the faces of the dam, excepting when test measurements were in progress and when the concrete was allowed to dry from June 25 to July 2 for special observation. By this continuous wetting undesirable shrinkage during the curing of the mass of concrete was prevented. Examination showed the dam to be a highly satisfactory specimen, accurate in shape and dimensions and free from objectionable defects.

Selecting of materials and mixing and placing of concrete were carefully controlled to get a mixture of usual characteristics, but as uniform in strength and density as was feasible. To this end there was installed a Blaw-Knox *inundator*, a device developed in recent years for controlling accurately the quantity of water and sand, taking account of the moisture in the sand as received at the mixer.

Even though all possible precautions were taken in mixing the concrete, several minute cracks have appeared on the face of the dam. Tests show that either raising or lowering the water from about a fifty-foot level caused a certain amount of contraction of these cracks. The presence of cracks in the wall are discovered by means of telemeters, which are distributed over the complete area of the dam. At the time the cracks were noted, the measured stress was about 570 pounds per square inch.

(*Continued on page 72*)

The temperature and stresses on different parts of the concrete in the test dam are electrically measured as indicated in the photo above. Pyrometers buried in the dam connect to the recording instruments.

This map shows the location of the test dam about 60 miles east of Fresno, Calif.

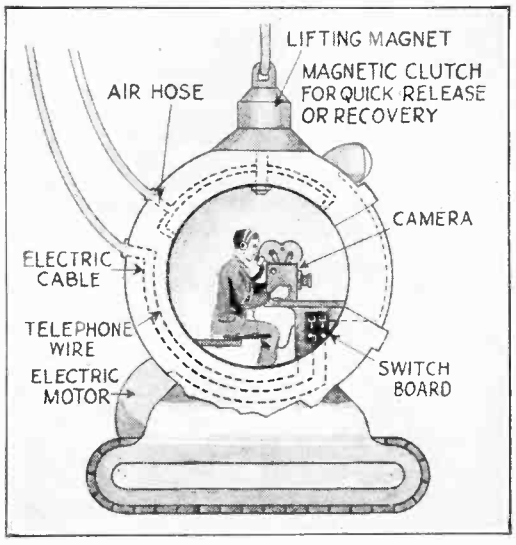
New Marine Tank

By F. O. BOYD

THE marine tank is a device here described in some detail by which it is possible for man to explore the depths of the seas. Essentially it is a globe of thick steel in which the observer sits. This globe is perforated by a window of thick glass as shown in the illustrations and it is mounted on a caterpillar tractor driven by electric motors. The power for locomotion is obtained from the mother-ship on the surface via a cable, or storage batteries, but the operator in the tank is able to control the direction of the tank by speeding up one tractor tread more than the other for steering the tank and can shut off the motors entirely. The tank is equipped with a powerful searchlight, a telephone and a motion picture camera.

Inasmuch as the walls are quite heavy, capable of withstanding the pressure of the waters at the greatest depth in which such a tank would be used, it suffices to supply a continuous stream of fresh air at atmospheric pressure through a tube, the air entering through one and leaving through another. Entrance to the tank is obtained via the window. The tank is lowered from the ship by a steel cable and when the bottom is reached, the observer operates it from the switchboard inside it. A windlass with lifting magnet hoists the tank and tractor to the mother ship.

After the tractor has been lowered to the bottom, the tank operator may cast off the ship lines and proceed "free" with self-contained oxygen apparatus.

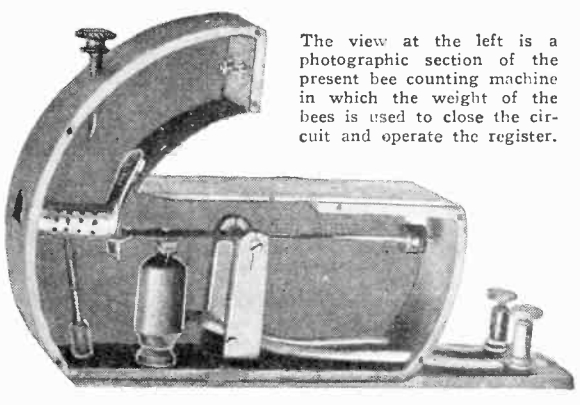


The tank for subaqueous work seen in cross-section. Note powerful construction.

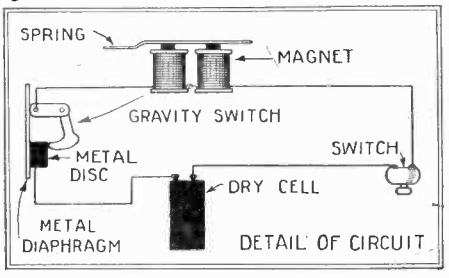
The above illustration shows the submarine tank in operation. It can either be connected to the mother ship at all times, receiving power and fuel supply or it may be cut free when desired. The illustration shows one tank being lowered into the water, and another at work.

Tuning Honey Bees

THE proposal to employ radio equipment in counting honey bees is quite spectacular. It is well known that the electric charge accumulated in a tuning condenser for a specified voltage and distance apart of the condenser plates depends upon the kind of dielectric material. When this dielectric constant is changed, as for instance, if a slab of paraffin is inserted between the plates an indication can be obtained on registering devices. It is questionable whether the method of having the bees serve as the change in dielectric and making them pass between two small plates is better than the method now employed and indicated on this page. —S. R. Winters.



The view at the left is a photographic section of the present bee counting machine in which the weight of the bees is used to close the circuit and operate the register.



It is importnt to know how many bees pass into and out of the hive and to determine the effects of weather conditions on the number of trips the bees take, consequently, counters are necessary. The above illustration shows how the mechanism at the left is operated. The mercury switch closes the circuit to the magnetically operated register.

How a Famous Phonograph Was Invented

The Human Interest Story of a Machinist With An Idea

By W. H. JENKINS

Mr. Eldridge R. Johnson, the man who invented and developed the disk phonograph best known today. His first shop in 1898 is shown in circle at right, and below it the present giant factory that grew out of it. ➤➤➤

LEGEND has it that Archimedes discovered an important principle of physics while engaged in his morning ablutions, and that Sir Isaac Newton discovered another when a falling apple rudely disturbed his slumbers.

Accidents, says the cynic. But the cynic, in arriving at his hasty conclusion, overlooks the one essential factor in all great discoveries or developments. Both Archimedes and Sir Isaac Newton were able to make logical deductions from the events and occurrences that came under their observations.

Such a man was Eldridge R. Johnson. A little more than a quarter of a century ago he was proprietor of a little machine shop, located near the banks of the Delaware River, in Camden, N. J. There was nothing imposing about the little 10 by 20 brick building. Certainly there was nothing to suggest that in a few years it would be crowded out of existence by towering factory buildings of concrete and steel, of which it was the first tiny unit.

But Mr. Johnson was a machinist with an imagination. Which is another way of saying that he was a practical inventor. Everything mechanical that passed through his hands intrigued his imagination. Therefore, when a man walked into his shop to have some minor repairs made to one of the first crude talking machines, forces were set in motion which a few years later were to exert a powerful influence upon the musical and social life of the entire world.

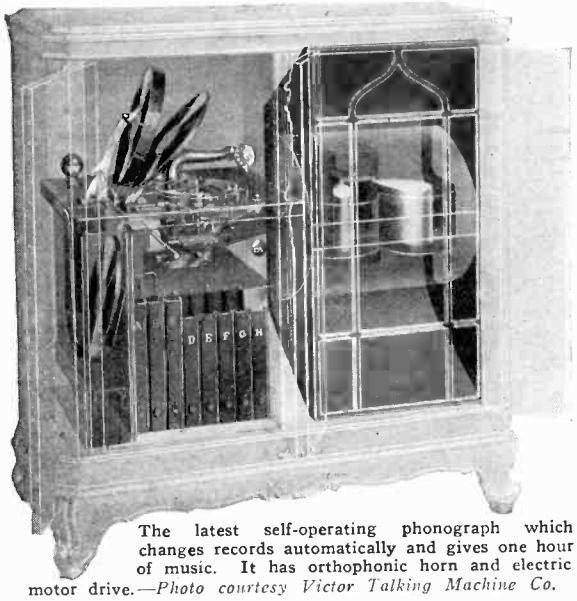
The sensitive ear of the inventor was offended by the rather grotesque sounds that came from the curious toy, but he immediately visioned its potentialities. With the inventor's enthusiasm for perfection, he set about making a machine that would really talk, and sing, and reproduce instrumental music. He saw scientific, educational, commercial possibilities, merely awaiting the development of something more nearly approaching a convincing sound quality. That, briefly, is how one of the world's greatest industrial enterprises had its birth.

With the logical procedure that was later to permeate the company which he founded, Mr. Johnson attacked the problem of recording. He saw that the first step was to put realistic sounds upon a record. His meager funds, and his time and inventive genius, were devoted to the task, and finally he produced a record that sang like a real, human voice.

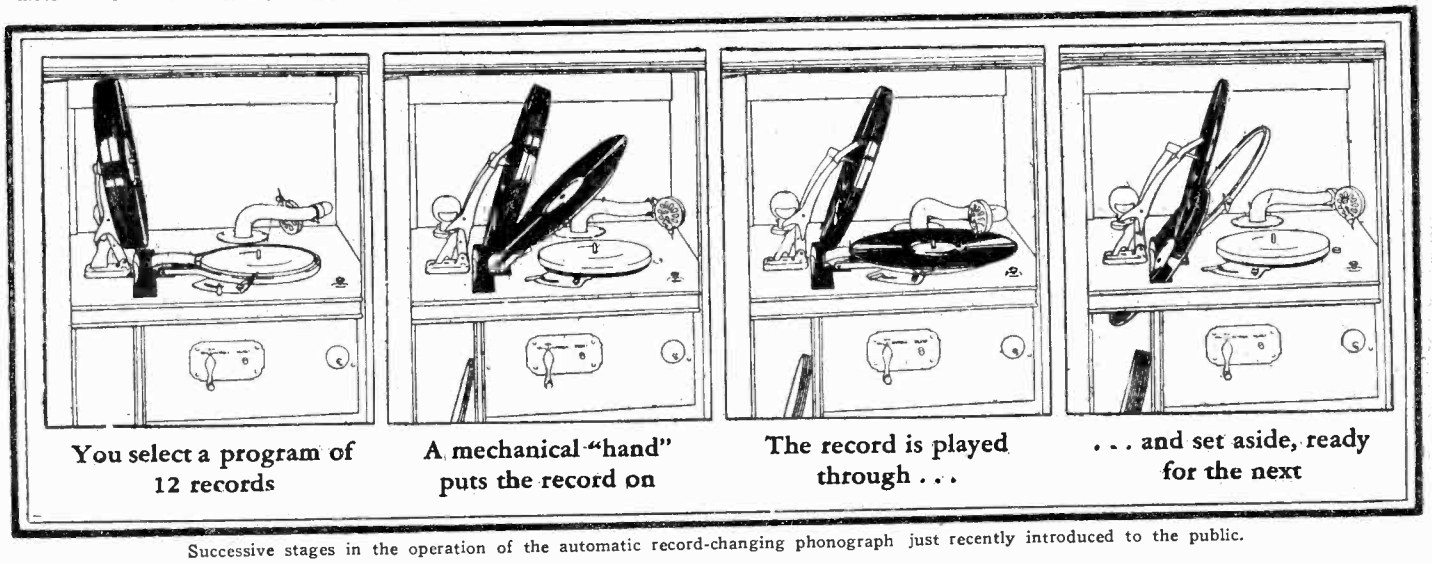
When he heard the first clear notes of "Telegraph My Baby," a popular song of the day, coming from the throat of the machine, he realized that he had completed the first lap of a long journey. It was a scientific and a business victory. Hence he named the child of his brain "Victor."

That was in 1898. But for the fact that Mr. Johnson was that unusual combination, an inventive genius and a keen business man, the story might have ended there. Restless to proceed toward his goal of great perfection, he diverted a part of his energies to the problem of organization, and in 1901 the talking machine company was incorporated.

(*Continued on page* 75)



The latest self-operating phonograph which changes records automatically and gives one hour of music. It has orthophonic horn and electric motor drive.—*Photo courtesy Victor Talking Machine Co.*



Successive stages in the operation of the automatic record-changing phonograph just recently introduced to the public.

Can I Study Engineering at Home?*

By H. WINFIELD SECOR

ONE of the great educational problems of the day is that facing the young man just finishing his high-school course, and who is beginning to consider what profession or trade he would like to learn. While there are quite a number of well-known professions today which are the goal of thousands of students, I shall tonight take up the subject of *engineering study*. Somehow or other it seems that a great many young men are attracted to the study of *engineering* as a life work, possibly due to the fact that men take naturally to mechanical ideas more generally than women, although there are quite a few women in the engineering and the architectural professions.

There are in general just about two choices open to the prospective engineering student, the first being to take a course of study at one of the many colleges or universities affording courses in engineering, and the second opportunity is to take up the study of engineering at home with one of the several well-known correspondence schools.

The speaker has been asked the question as to whether or not an engineering course by correspondence is satisfactory, so many times that he hesitates to answer in many cases. This is so not for the reason that the lessons as given by our best correspondence schools are particularly deficient in any way, but because the big problem in this

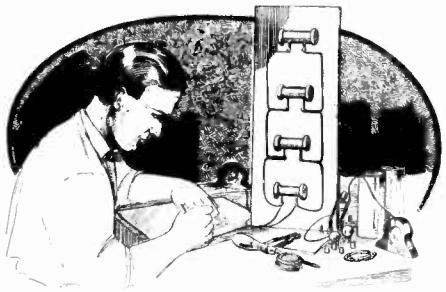
The author of this article says "One of the chief things to watch out for in taking a correspondence course is to obtain good practical experience."

case lies with the individual student himself. I have always been a warm advocate of the courses given by our correspondence schools, but in a number of cases failure is likely to result instead of success for several reasons.

It will probably be well, before going further, to point out what these reasons for failure are, although there may be numerous others which are sometimes beyond the control of the student. One of the main defects of any correspondence course, particularly that embracing engineering, where the student should by all means have practical experience in the laboratory and shop, is that the student is quite likely to rely too greatly on the pure *theoretical* study from the lesson books.

After an engineer graduates from school no matter what sort of school it may be, and has found himself a job in the commercial world, he will invariably find his shop and laboratory experience most valuable indeed.

As I said before, this is one of the principal points to be watched out for in taking a correspondence course in engineering. The way to overcome this is to procure a job in some electrical or machineshop, even if this is for only part time during the week, so as to get actual experience in handling tools and machinery. For instance, one of the best ways in which to take an electrical engineering, correspondence school course is to spend three years in the electrical trade, either at house wiring, or electrical shop work, and preferably both. Then when you are through studying your course, which will take about from two and one-half to three years on an average, you will have the practical experience along with the theoretical study, which will make you infinitely more valuable in the engineering field than if you had just relied on the theory given in the course itself. This also holds for many of the college graduates in engineering, although it must be said that most of the universities and colleges who give engineering studies, have seen to it that the students of these subjects spend a certain amount of time each week in the machine-shop and laboratory.



Some of the leading engineering schools provide an elaborate experimental outfit with their electrical course, and a student is here shown with some of this apparatus in his home laboratory.

It takes four years to complete the average engineering course at college at a cost of a thousand dollars or more per year, while a good correspondence school course in engineering can be purchased for about $150.00 or so.

Upon completion of the correspondence course in engineering, a diploma or certificate is awarded, certifying that the student has finished the course of studies prescribed, but at present it is not possible to obtain from a correspondence school a degree such as electrical engineer or chemical engineer. In many cases, however, part of the work for a *degree* may be taken by correspondence, and where financial and other considerations require it, this is a great help to many ambitious students.

In taking a correspondence course in electrical or mechanical engineering, several of the schools provide quite an elaborate experimental outfit consisting of volt and ammeters for carrying out tests, besides magnets, batteries and other paraphernalia which students certainly should have. Some prospective students have often asked the speaker why they could not procure books at the public library and purchase some engineering books themselves and study at home, without taking a regular course with a correspondence school or with the extension department of one of our universities, such as Columbia. The answer to this question is obvious, and in a few words it amounts to this. The student would study those subjects which he liked best, and even if he did spend three or fours years of patient

Here we see a home-study student checking up the electrical energy input and the output in heat of an electric stove. Practice must be coupled with theory.

study in this way with himself as the director of the course, he would find that he had many weak spots in his education.

For this reason particularly, and providing you are not going to take an engineering course at a university, you had best consider taking a correspondence school course. The men who have prepared these courses and who direct the examination of the students' answers to each lesson and the correction of these answers, know what subjects the student should study as experience has shown. In looking over the catalogs listing the subjects taught in these engineering courses by correspondence, we find that they are pretty thorough. The wise student taking a correspondence course, will also procure catalogs and outlines of the subjects taught in universities giving a similar course, and he then can elaborate on those studies given in his home course which seem to be weak in vital spots, such as "foreign languages, biology, physics," etc. Several of the schools teach languages by means of the phonograph and this is a very capital way in which to learn a foreign language. The principal languages which an engineer should study are French and German. German engineering literature is very valuable, especially to the engineer who takes up design, and who, therefore, has to do a great deal of research work in the study of what has been done previously by other engineers.

In taking a home study course in any branch of engineering or other professions, it is a very wise thing to subscribe to at least two or three monthly magazines carrying articles pertaining to the subject in hand. The speaker has written a number of times on engineering as a career, which articles have appeared in the columns of SCIENCE & INVENTION Magazine. Several excellent schools teaching engineering by home study advertise regularly in SCIENCE & INVENTION Magazine. One of the most valuable subjects which every engineering student should master is *mechanical drawing* and *sketching*. Until one has graduated and entered the commercial engineering field, he cannot appreciate how important this branch of the work really is. An engineer should be able to sit down in front of a machine or part of a machine and sketch the apparatus before him quickly, and with due regard to proportions. Many times on a rush job, these sketches made on the spot by an engineer are handed directly to a machinist or to a pattern maker, and he will have to make up the part wanted or the machine itself from these sketches. The speaker has had quite a little experience with both classes of engineers, those who studied correspondence courses, and those who have had the benefit of a college education. Strange as it may seem, the correspondence school graduate who is conscientious and anxious to learn at every turn, has in many instances stood side by side with the college trained man.

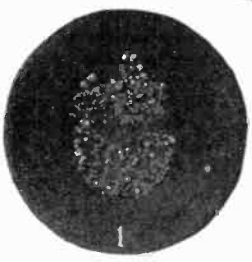
While a considerable part of an engineering course can be learned from the theory given in text-books, the worth-while engineer must have good sound practical experience in electrical measurements and testing.

This of course is often a puzzle to the man who belongs to half a dozen fraternities, and who has spent from four to six years at a university, but the answer is more of a problem of general philosophy than it is one of engineering. The correspondence school graduate is usually a man who certainly has the *courage of his convictions* to say the least. If he has the persistence to carry out the studies without the aid of a

(*Continued on page* 81)

* *Radio Talk given at WRNY, Tuesday evening, March 1st, 1927, at 7:45 P. M.*

40,000 GERMS IN A KISS



The above photograph shows a pair of natural ips, unadulterated by lipstick. Left, germ culture from such lips.

There are approximately 500 germs on the lips in the photograph above. Right, another culture from unpainted lips.

By JOSEPH H. KRAUS

THERE is in Paris an organization known as the Anti-Kissing League which is seeking to impose the decree, "Thou shalt not kiss." They argue that in every kiss no fewer than 40,000 disease germs are transferred. They say that if every person before kissing would pause for a moment and consider the possible consequences of a transfer of 40,000 germs the practice would die out.

Why is it, this league demands, that American or European motion films when edited for Japanese consumption show no kissing scenes? In Japan there is no inclination to learn the art of kissing.

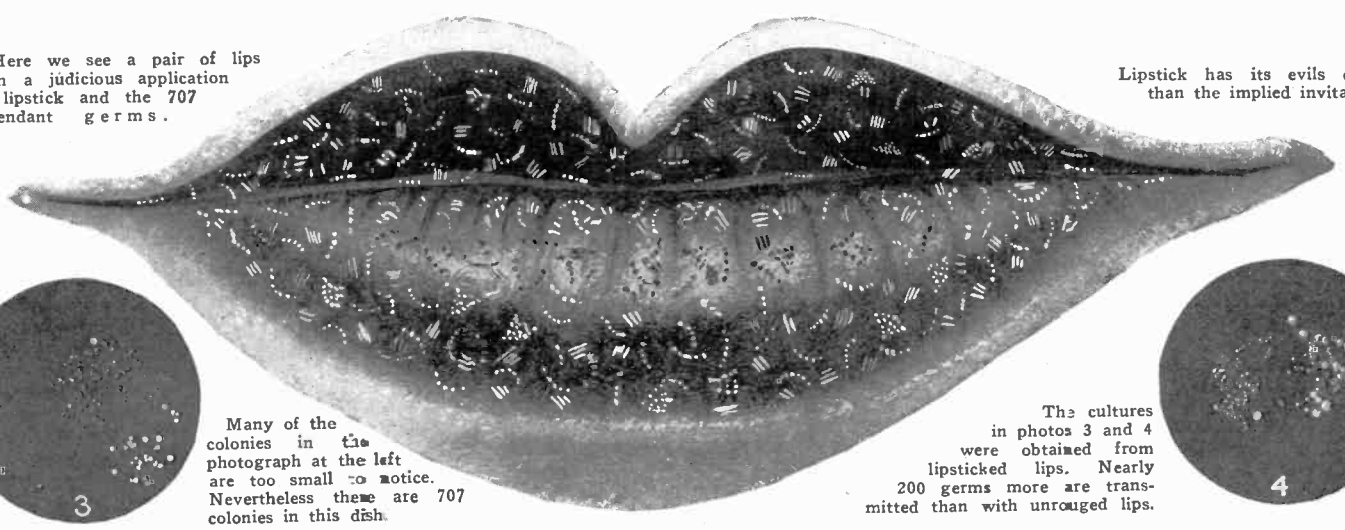
In order to test the truth of the claims made by the Anti-Kissing League, this publication decided to actually breed germs. The results of the laboratory test showed that there were a surprising number of micro-organisms transferred during every kiss, but the number was nowhere near the amount claimed. But the experiments showed one very important and startling fact to which very little attention has been paid.

No longer need the boy friend be a conscientious objector to a kiss coming from his enamored, garnished with a plentiful application of lipstick. He now has a reason — a scientific reason for such refusal. The average number of germs transferred in a kiss from untainted lips; by that is meant lips that were not shaped with the red pencil, was 534. The average number of micro-organisms trans-

(*Cont. on page* 84)

Gilda Gray and Tom Moore posed in this very entrancing manner expressly for SCIENCE AND INVENTION Magazine through the courtesy of Paramount Pictures. This same scene appears on the cover of this issue. Our own researches revealed that the scientist who claimed 40,000 germs were transmitted while kissing either grossly exaggerated or had particularly unhealthy subjects.

Here we see a pair of lips with a judicious application of lipstick and the 707 attendant germs.



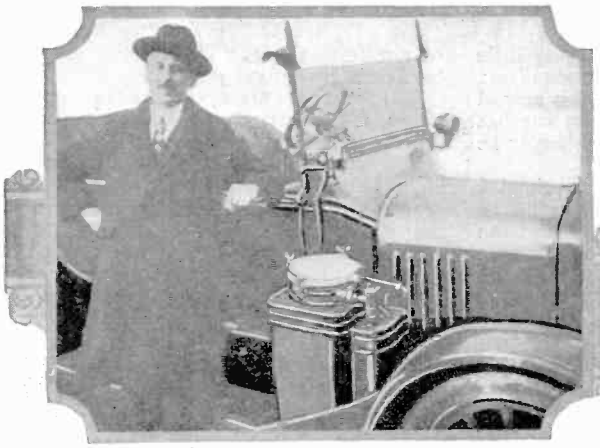
Lipstick has its evils other than the implied invitation.

Many of the colonies in the photograph at the left are too small to notice. Nevertheless there are 707 colonies in this dish.

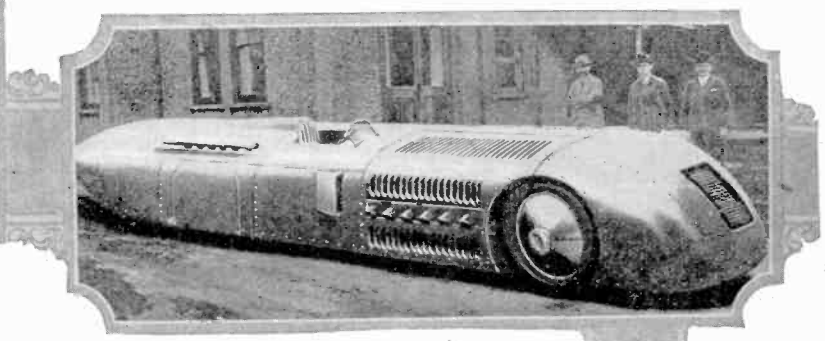
The cultures in photos 3 and 4 were obtained from lipsticked lips. Nearly 200 germs more are transmitted than with unrouged lips.

Scientific Curiosities

On this page are illustrated some of the recent scientific novelties and curiosities as caught by the camera's eye in various parts of the world



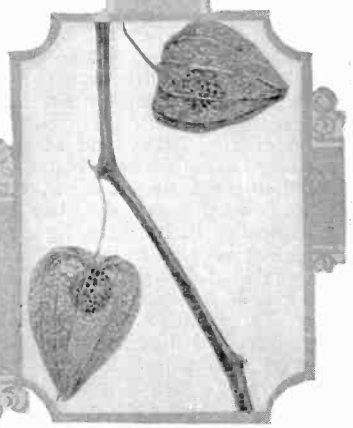
A French engineer, M. Jacquelin, standing beside his Ford that employs acetylene gas instead of gasoline as a fuel. The generator is on the running board. The gas is produced here and then forced into a special carburetor. It is claimed that the cost of operation is lower than with ordinary gasoline.



Will this car break the world's speed record in the coming races at Daytona, Fla.? It is to be piloted by Major Seagrave of England and is equipped with two engines capable of generating 1000 horsepower. In a road test, it has made an average of 172 miles per hour.

With a bellows, an organ pipe and his hands, Sir Richard Paget of England, shown above, has been able to say "Hello, London, are you there?" The bellows takes the place of the lungs, the reed of the organ pipe the vocal cords and the hands duplicate the mouth.

The home-made incubator constructed by Mrs. Gartner of New York saved the life of her prematurely born baby. Note hot water bottles and electric heater.

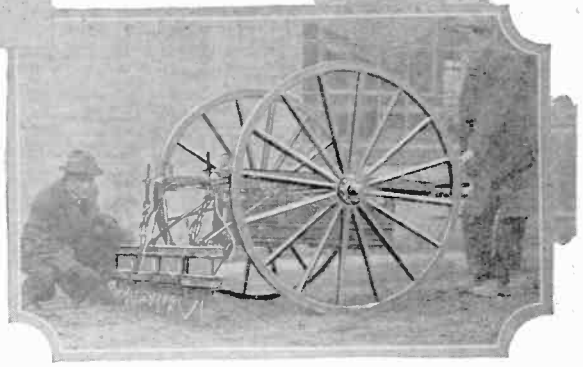


The curious Alkekengi, popularly called "Love in a cage." It is an edible red fruit, growing in a natural vegetable network to protect it from many of the insects of the locality in which it grows. The plant is found in the French colonies in Africa.

The photograph at the right shows a noted German inventor, Alexander Von Kryha, who has just invented a system which can be used for the transmission of secret messages and which can likewise be employed to decode those messages.

An instrument for measuring musical sounds and their synchronization has been invented by Carl Robert Blum of Berlin, Germany. The music film permits any rhythmic phenomenon, whether expressed in music, dance, or speech, to be recorded.

Parisian dressmakers are now displaying the latest gowns on wax models which move hands, arms, head, and feet in realism. The photo above shows a mechanic inspecting the electric motor which is installed within the model and which operates the various parts of its body.



The photo at the right shows a magnetic trailer which is used to pick nails and other pieces of iron from the roads in the District of Columbia. There is a string of magnets attached in front of the cart energized by a storage battery from axle.

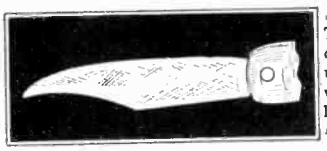
Wood Whittling

By M. POTVIN, Master Whittler

THIS afternoon I was asked to write an article on whittling. Now, had the gentleman asked me to cut a likeness of himself in wood it would have been easier for me than to write about it.

First let me tell you how I became a whittler.

I was born on a farm adjoining a small town in Canada, and at the age of three never having heard of artists of any kind I

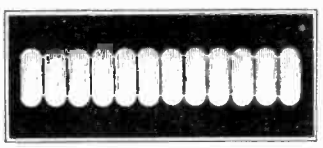


The best form of knife to be used for wood whittling is illustrated here.

showed artistic talent. My first efforts at that age were cutting silhouettes of all kinds of animals, fowls, etc., which I pasted on the window panes for the neighbors to see as they went by. When a little older, instead of cutting silhouettes out of paper, I made my subjects of wood, because wood was about the only material I could use under the existing circumstances. As I grew older it developed into a hobby and at this hobby I have spent many pleasant hours. Of course, I do not mean by whittling, converting a stick of wood into chips, but I mean the production of little pieces, figurines and the like, which people admire.

I would advise young boys that have a good idea of form, to try their hand at whittling. They will find that there is no limit to the beautiful things that can be made out of wood with a jack knife. For whittling I always use a two-bladed knife of medium size, having a plain round handle so as not to hurt the hand. The large blade should be of the shape shown above.

This is the best shape for a blade for turning sharp corners and cutting in deep, narrow places. After experimenting with several kinds of wood I like plain gum wood the best as it is not too hard, cuts nicely across the grain and does not split too easily, except when nailing. Of course a beginner should not attempt too much at first but should try his hand at some simple piece, like a little chair or other piece of furniture of any desired style, but should make it artistic, and according to scale. For instance if your chair is to go into a little bed room set and you have adopted one inch to the foot



How beaded molding is produced is shown in the illustration at the right.

as the scale, take time to measure a real chair and make all parts of your little chair accordingly, in the exact proportions of the original full sized one.

If you need rope or beaded mouldings here is how to make them. Take a stick and round it as perfectly as you can, being careful to have it of the same thickness for its entire length, then if you want the beads on it to be ¼-inch in length mark your stick at every quarter inch and then cut in all around at each mark and smooth with sand paper and you will have a piece like the illustration.

If you want ½-inch round moulding, with fine saw cut this piece in two the long way, if you want ¼-round moulding, cut in four. If you want rope moulding cut your stick spirally, using a bit of real rope as pattern.

Probably you will say all this takes a lot of patience, I agree with you, but if you have the ability you will most likely have the patience, because the two qualities usually go together.

Some will be fairly good at making little houses all furnished, and similar inanimate things, but making figures of living animal nature is another story, and unless one has natural artistic ability success can hardly be expected.

In cutting out a horse or other animal I always make it in two pieces, lengthwise. After cutting the profile or silhouette of the body and two legs on one side, I cut the silhouette of the other side with legs and then remove enough wood off legs so that I can reach anywhere with the knife after the two pieces are glued together. After gluing the two together, I finish as if it was one piece.

Don't expect to do things in a few minutes, good things are hard to produce. Visualize your work in advance, it will give you courage. Also estimate how long it will take you to make a certain set of furniture perhaps. Allow enough time so you will not be disappointed.

I planned my "Home Sweet Home" for two weeks. This I did at night before going to sleep. I planned every piece of furniture and every article before starting but I never put anything on paper. I calculated that it would take me two and a half years; it actually took me a little over two. It is quite a long time to spend on a little home, but I have been well repaid.

My blacksmith shop is the first mechanical piece I made. I worked on it for a year. It is quite complicated, and is run by motor, and by a system of cams, gears, springs, clutches and belts, the nine figures are put in motion. You will say it took a lot of patience and thinking. Well, of course, these things cannot be done in a few minutes; it takes time and you cannot expect that every piece of machinery will be right the first time. So you often have to start over again, but when you know you will succeed, you enjoy your labor. To anyone who wishes to do any whittling, I would say "do something worthwhile, something that tells a story." A little house with all the furniture is all right in a way, but it tells nothing, a human figure added to it in a certain pose may tell a lot. That is why thousands of people who would hardly pay any attention to a $50,000 painting or a beautiful piece of sculpture said upon seeing my little miniatures, "I never saw anything so interesting in my life." It's not that they are perfect, but they seem to appeal to everyone.

To approach such a degree of excellence, you must be very careful in the selection of your subject, study your details, and especially pay great attention to your proportions. For figures, have someone pose for you for a few minutes in the position you want to copy. Study folds and wrinkles in clothing, etc. If you wish to cut a coat hanging on the wall, simply take one and hang it up, then copy it with all its folds and you will be surprised to see how realistic it can be made, especially after it is painted.

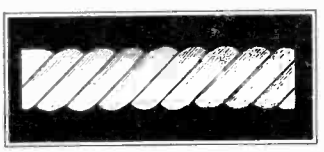
Now as to painting, some may be able to do their carving fairly well but may not be able to do a good job of painting. In that case they should seek the advice of a painter for finishing their furniture and ask someone with artistic talent to paint their figures. There is much in the painting to get desired expressions in faces and artistic effect for paintings on walls. These should be well done, for a poorly painted picture would certainly spoil the appearance of the whole.

As for myself I do all the painting and every thing that I need, and I honestly think that anyone who can do their carving, can also do their painting after a little practice.

When carving figures it is a good idea to glue several pieces together so as to avoid taking big pieces of wood and doing a lot of needless cutting. This applies especially to figures in sitting positions.

The arms I always make of separate pieces, it is much easier to work them and also to adjust them to the position wanted. After careful joining and gluing the figure looks like one piece.

If after carving a head on a figure you find it has not the position desired, you can remedy the condition by sawing the head off with a very fine saw. Then you can try it in any position you like. Sometimes you may have to make a wedge-shaped piece of



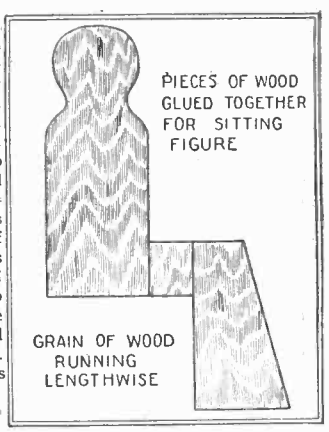
Imitation rope molding is made as indicated in this figure. It may be cut in half longitudinally.

wood and by placing the thick side in different directions you can bring your head to the desired position. You will be surprised to see the different results that can be obtained.

When carving a figure begin by diminishing gradually all over, being careful not to take too big chips, for which you may later be sorry for it is always much easier to take off wood than to add some, although in some cases even this must be done.

In making a chimney as in my blacksmith shop where the bricks are visible I used a solid piece of wood and cut the bricks with the point of a knife, then to make it appear not too regular I chipped off some of the bricks here and there so that some stick out a little more than others. When it came to the painting, a little difference in the shades of the bricks, one a little darker, one a little lighter do the trick. It looks like a chimney that seems to be made of small bricks put together and laid up by a Lilliputian mason, while it is only one piece. The same can be done for a stone wall.

Many have asked me upon seeing the carpets in my "Home, Sweet Home" how wood can be made to appear so like a textile fabric. Well, here is how I do it. After gluing a piece of white wood (veneer) on the floor I take about 10 pointed wire nails, all of the same length, I cut out off the heads and then tie the nails together all the points at the same end. Then with a hammer I pound



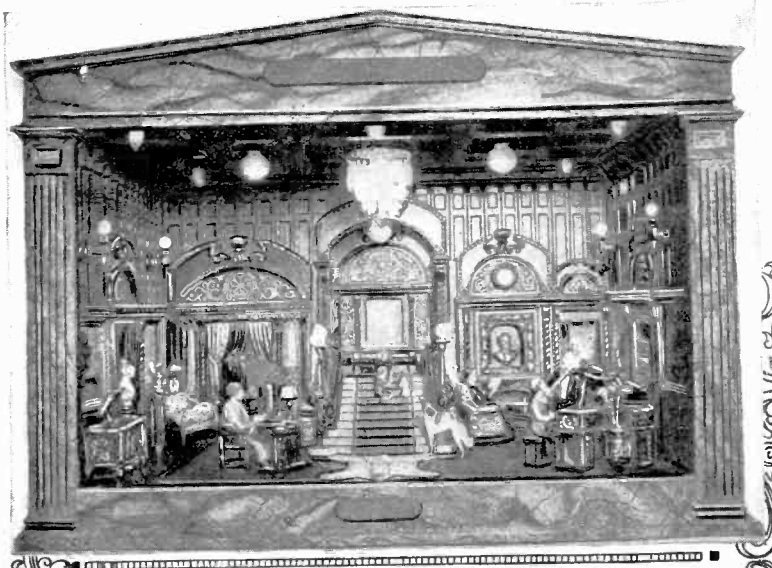
In carving a figure in a sitting position it is a good idea to glue several pieces of wood together so as to avoid needless cutting. The arms are made of separate pieces of wood and then glued to the figure. The grain should run lengthwise. The head is added later.

lightly on those nails while holding them on the veneer and prick the whole surface of the carpet and then paint the design wanted on it. It looks like the real thing.

In the same cabinet there is a bear-rug on the floor. Many have asked how I could put the tongue and teeth in so small a mouth. The method is to cut an opening for the mouth, then split the head open, and put in the tongue and teeth then glue the parts together again. As the wit has said there is a little trick to everything.

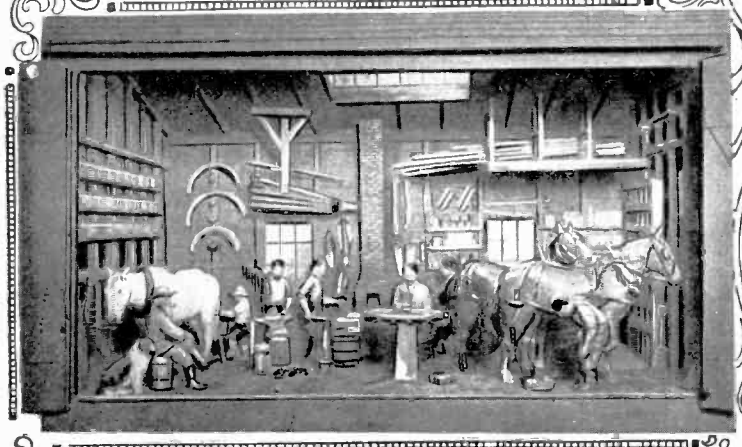
Whittling with a Jack-Knife

THERE are very few people who would question Moise Potvin's claim to the title of the champion wood whittler. On this page we show a few of the remarkably ingenious scenes whittled entirely out of wood by Mr. Potvin. Three of the scenes are animated; that is, the characters move in life-like actions. The other three are stationary. Nearly all of the work has been accomplished by just the aid of a jack-knife. Such small accessories as clamps, glue, paints, brushes, wire, electric light bulbs, and electric motors facilitate the work, and serve to animate the scenes. Carpets, draperies, coats, clothes, flowers, rugs, and every other decoration is made entirely of wood. The movements of the various characters are not continuous. One individual will perform a certain amount of work and then stop. Meanwhile, others will continue with their duties.



In the scene above there is a lady reading a letter, sitting at a table and the light from the lamp illuminates the letter itself. Immediately in back of this lady is a reception hall. The draperies in the doorway are of wood and the overstuffed furniture, even to the upholstery is also of wood. The floor is inlaid, the bear rug, dog and in fact, every character and every object with the exception of the electric light bulbs and chandeliers is made of wood. The walls are carved and the pictures painted.

Neither the scene at the upper lefthand corner of this page or the one immediately above is animated, but in both of them there are so many interesting features that one never becomes tired while looking at the scene. Above: Picturization of "The Face on the Bar Room Floor."

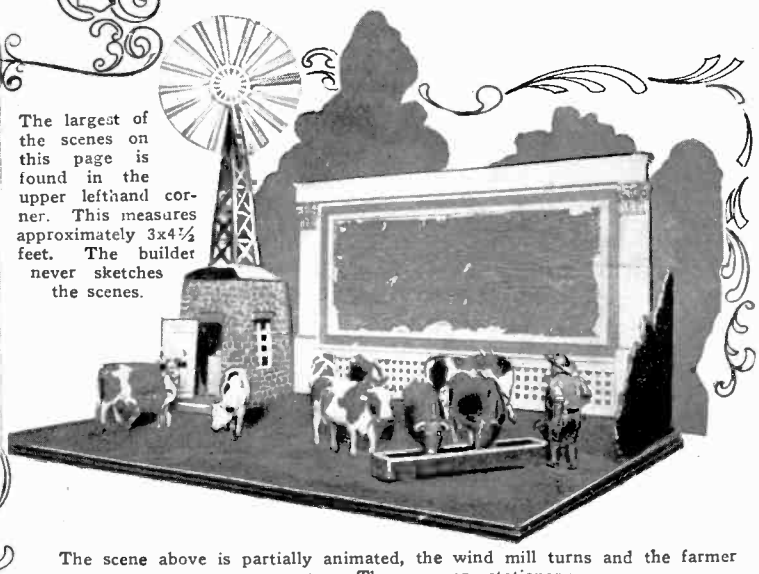


An animated scene of the Village Blacksmith in which the farmer in the foreground at the left swings his foot and shakes his head. The dog pants, the blacksmith operates the blower, holes are drilled in the edge of the wheel and the horses move.

In the scene above the clothes on the line are of wood. The man in the foreground drinks from the bottle, sets it down on the table, then hangs his head and falls asleep. The dog scratches itself and shakes its head; the mother rocks her babe; a girl wrings the wash and an elderly woman washes clothes.

By trade Mr. Potvin is a violin maker and this is a scene of himself in his own workshop. Everything is to scale. The wooden figure of Mr. Potvin is only 6 inches high. Note the wooden coat hanging on the rack; the wood radiator and the umbrella.

The largest of the scenes on this page is found in the upper lefthand corner. This measures approximately 3x4½ feet. The builder never sketches the scenes.



The scene above is partially animated, the wind mill turns and the farmer pumps water. The cows are stationary.

Mechanical Devices Animals Use

By DR. ERNEST BADE

ALTHOUGH the importance of the physical sciences is admitted, few realize through what difficulties and setbacks it had to pass before it became an exact science. Years passed and although the gain in knowledge was steady, it was slow. Even some of the principles were little understood and much time had to elapse before they could be employed. All this was in spite of the fact that numerous examples of the laws of physics were and still are being used by all kinds of animals under all sorts of conditions.

Nature is peculiar in this respect. Things most often seen are little noticed and seldom studied. Therefore, it is but natural that such simple machines as the lever, the inclined plane, and such devices as the pump, the valve, suction cups, springs and many others, were overlooked by the early men of science.

Take such a simple thing as the borer, represented in mechanics by the drill and auger. Nature made it long ago. An example is the stinger of various insects such as the wasp, while the borer of the thalessa, a thread-waisted wasp, is one of the longest and it bores right into solid wood to a depth of two and sometimes even three inches. The saw, too, is an instrument which some insects use, as, for instance, the gooseberry wasp.

Levers are some of the more common devices found almost everywhere under many various conditions. Often they are accompanied with springs, in the form of muscles. These are usually levers of the third class. Take the fore-arm of a man. The fulcrum is at the elbow joint, the biceps muscle, descending from the upper part of the arm and inserted near the elbow, operates as the power or tension spring. An object placed in the palm of the hand acts as the weight. Small weights can be held quite readily when the arm is extended, but when the weights are increased a much greater effort or muscle power must be exerted to compensate for the slight addition of weight and this is due to the fact that the muscles do not act perpendicularly to the bone, but at an oblique angle. This accounts for the difficulty of holding out a heavy weight at arm's length. In proportion as power is lost, quickness of motion is gained.

A lever of the first class is found on the foot. Here the power is exerted at the heel, the fulcrum is found at the ankle joint. The strong muscles at the calf exert such power that they are able to lift man every time he walks around.

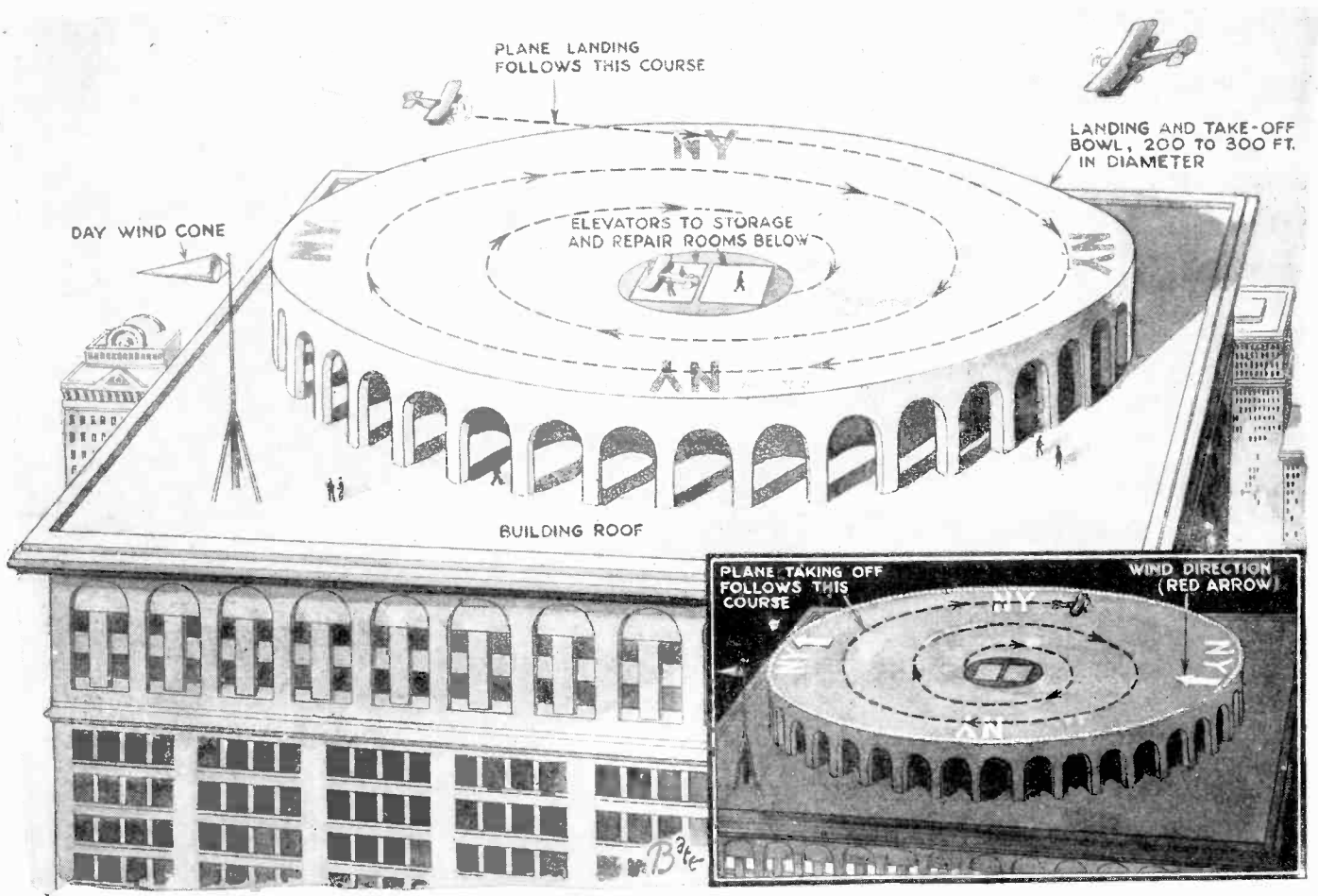
The speed of the snakes while gliding is astonishing, and their method of locomotion is peculiar. The scales with which they are covered, especially those on their abdomen, are provided with a set of muscles connecting to scale and rib and these, by means of contraction and expansion, move the scales backward and forward. Each individual scale is also connected to its neighbor by means of muscles which tilt the scales at an angle. When the scale is placed at an angle it catches some outside material such as a pebble and as the scales are brought parallel to the body, the creature moves forward. It is nature's example of a ratchet and pawl.

The lightning-like speed with which the tongue of the chameleon is hurled from the mouth also necessitates certain mechanical arrangements of levers whereby a small original motion is converted into a rapid and extensive one. Since the tongue of the chameleon is almost as long as its body, some method must be arrived at to make it take its place in the mouth, and this is accomplished by making the extending tongue hollow and folding it. The tip of the tongue is provided with a clubbed thickening. At rest the tongue takes position 1-2-3, when suddenly extended, lever 2, which is at an acute angle to the tongue, is brought almost parallel with it and throws the tip 3 with considerable force outward, the folded part of the tongue at 1 then taking position "1."

The hinged joint requires only two muscles, a bender and a stretcher, and the resulting joint bends only in one plane like the blade of a pocket knife, the ball joint, on the other hand, usually demands more than four muscles. The latter are also very common. Besides being found in the more advanced orders of the animal kingdom, they are present in the jointed heads of many insects, such as the flies and darning needles.

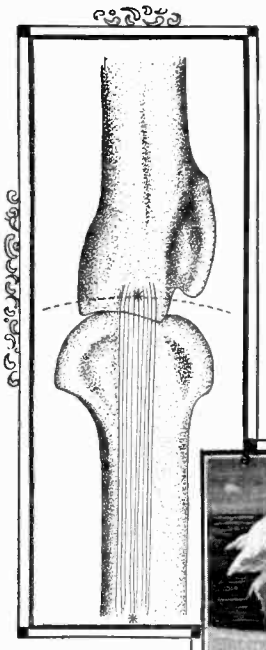
(*Continued on page 76*)

Bowl-shaped Landing Place for Airplanes



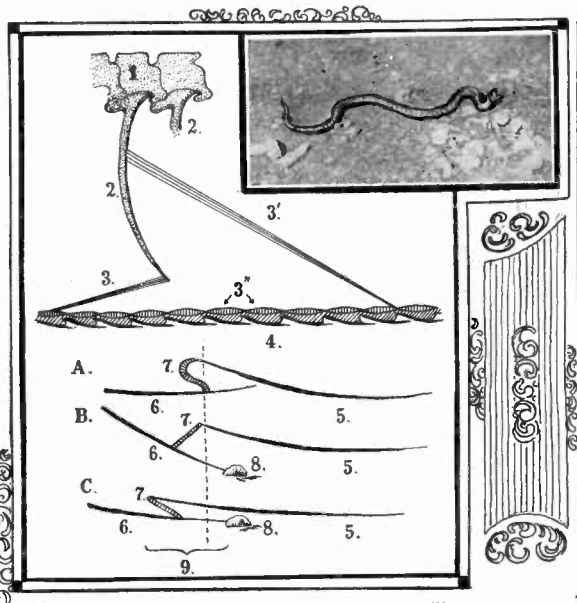
The problem of finding sufficient space for landing fields in large cities meets a proposed solution in the suggestion of using a modified motordrome upon which the planes may land and from which they may take off without difficulty. It is known that a plane can spiral or turn in a one hundred foot circle while in the air, and therefore, theoretically one could land in a saucer of that size. To allow for more maneuverability, it was decided that a saucer two or three hundred feet in diameter should be used. After landing at the edge of this bowl, the plane would be able to taxi indefinitely, being protected from the side winds by the edge of the bowl.—Walter X. Brennan. Staff illustration drawn by Mr. Bate.

Mechanical Devices that Animals Use

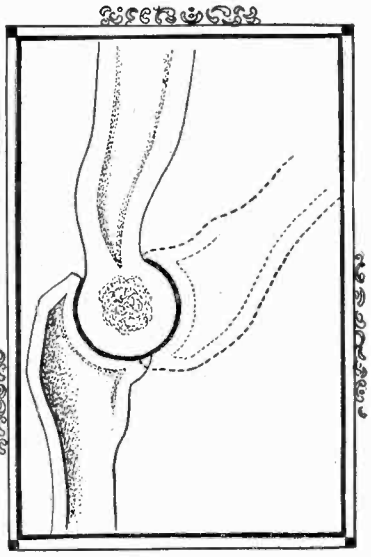


The bones of some birds, like the crane, which often stand on one leg, have a locking device on the knee whereby the bones of the foot and leg are made to act like a continuous column, permitting the creature to stand motionless for hours, without fatigue. The illustration at the left shows how this mechanism operates.

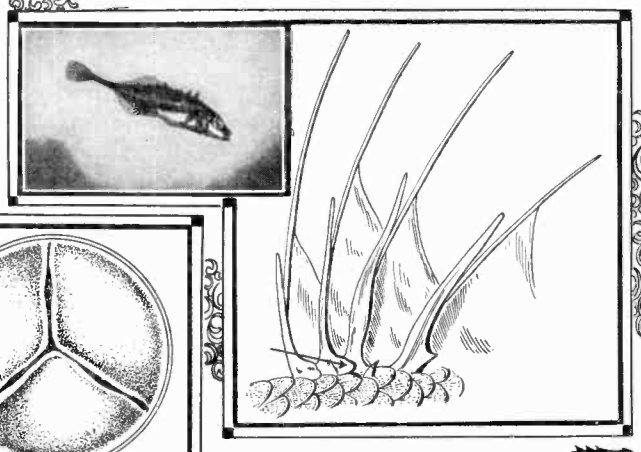
Locking devices are also found on the dorsal fins of certain fish. Here the mechanism spreads the spinelike fins and holds them in position, even after death. This is a sort of protective device whereby larger fish are prevented from eating the smaller. As a usual thing, these dorsal fins are actuated by muscles, only when the fish dies a natural death the fins relax. The illustrations at the right show how the fins interlock.

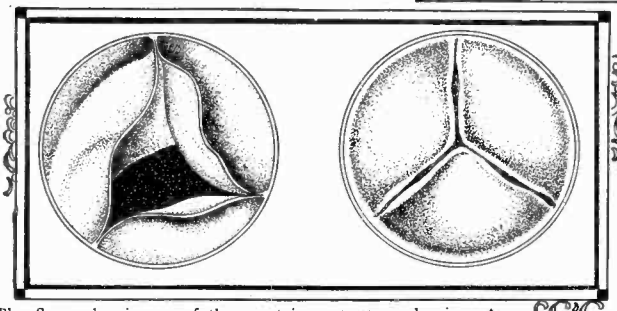


The locomotive apparatus of a snake is illustrated above. 1 is the spinal column, 2 is a rib, 3 is a muscle attached to the top of a rib, 3′ muscle attached to scale and upper center of rib, 3″ muscles attached to the scales, 4 the scale. A, B and C show how the mechanism works. See text.



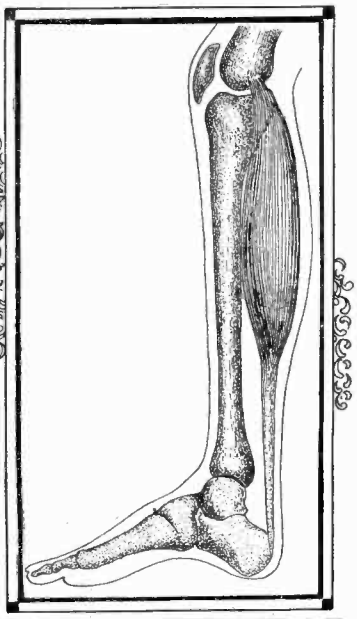
The drawing above shows a typical ball-and-socket joint, such as the joint found in the arms and legs of a human being. The direction of motion is practically unlimited in all directions except forward, in which direction motion is controlled by the "stop."

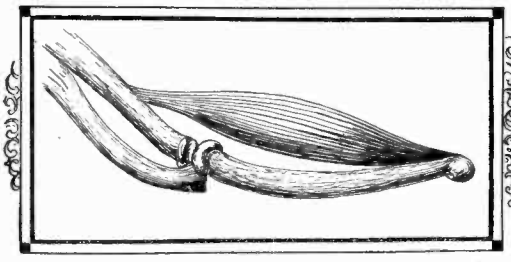




The flap valve is one of the most important mechanisms in the body of an animal. An adaptation of the mechanical check valve is illustrated in the valves of the heart, used by nature to permit the blood to flow in one direction only. If the flow tries to reverse, the valves close automatically, preventing the liquid from passing.

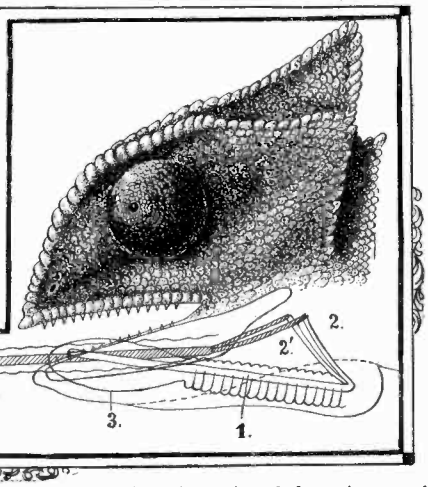
The muscles of the leg, together with the bony structure, are an excellent illustration of an adaptation of a lever of the first order to the purposes of nature. The fulcrum is at the ankle, the load at the toe, and the muscle furnishes the power.





The illustration above shows how the biceps with the muscles of the arm constitute a lever of the second class. The fulcrum is at the elbow, the force is applied at the insertion of the muscle in the forearm, while the weight is represented by the end of the forearm or the hand. The biceps is the contracting muscle of the arm, while the triceps—not shown in this illustration—is the extensory muscle. This same mechanism is duplicated in a number of parts of the human anatomy.

The chameleon is one of the most interesting of all creatures, due to the fact that he is so unusually constituted.



The lightning-like speed with which the tongue of the chameleon is projected from its mouth necessitates the mechanical arrangement illustrated above, whereby a small original motion is converted into a rapid and extensive one. The tongue is hollow, and it folds up within the mouth of the animal. See the text for further comments.

A New Talking Motion Picture

Light Rays Record Voice and Picture on Same Film by New Process

By JAMES FRANCIS CLEMENGER

The method of photographing the actor or singer on moving picture film, as well as the recording of the voice, in the latest talking motion-picture known as the Movietone is illustrated in the picture above. The voice is recorded on the same film with the picture, as the other illustrations and accompanying text make clear.

AT various times in the past few years, SCIENCE AND INVENTION has published articles explaining the mechanism used by several processes for recording sound simultaneously with motion pictures. The first process of which we have any certain knowledge is that developed by Thomas A. Edison in the early days of motion pictures, and it consisted simply of a phonograph synchronized to operate with a motion picture projector. This device soon proved inadequate to the requirements of the art, due to the fact that it was impossible to resynchronize if the film happened to break in the middle of a program. Other developments came along later, culminating recently in the development of the De Forest "Phonofilm" and the well known "Vitaphone," which was described in a recent issue of SCIENCE AND INVENTION. The general trend has been toward simplification without sacrifice of efficiency, and in this direction we are glad to present to our readers a new device, recently exhibited for the first time, which appears to possess many of the advantages hoped for in other processes.

This new type of recording, called the "Movietone," is due to a group of engineers connected with the Fox Case Laboratory and Studios in New York City.

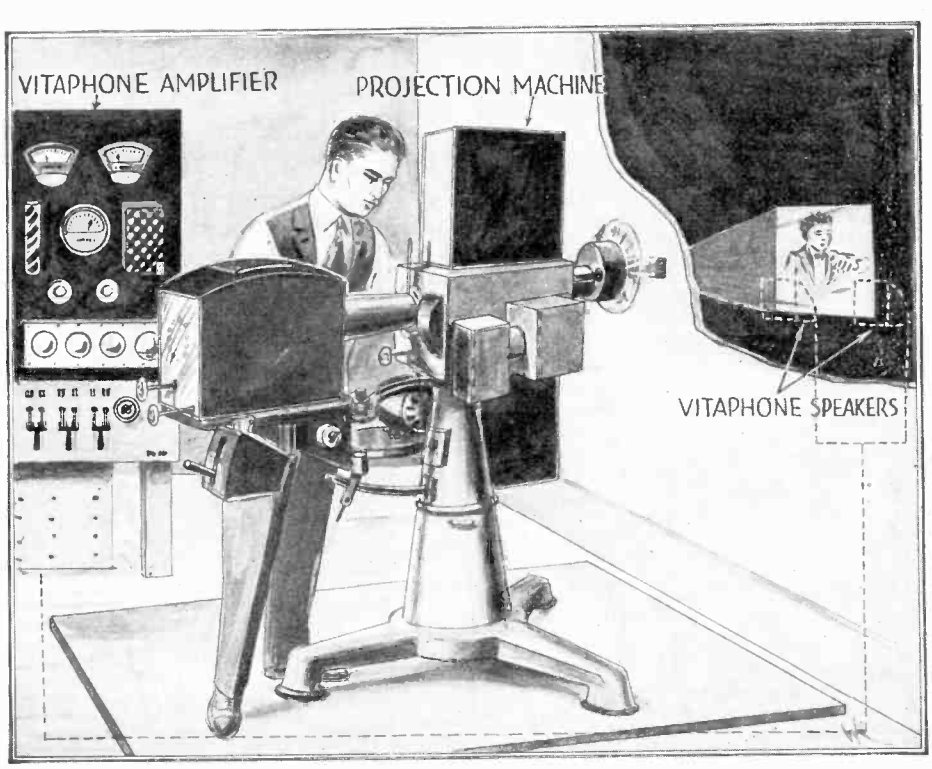
These studios are of special construction and are said to embody the finest engineering practice of today from the standpoint of acoustical conditions, ventilation, and adaptability to the purpose for which they are built. There are two rooms or studio stages in which production can go on either separately or simultaneously as necessary. Both studios are ample in size to allow for elaborate settings or large orchestral accompaniment; both studios have the usual equipment of lights used in motion picture production as well as the special apparatus required by the Movietone process.

The walls of these rooms are absolutely sound proof, so that it is never possible for outside noises to penetrate either room while a picture is being taken. In order to insure this complete isolation, each of the studios is wholly enclosed within a double wall. These walls are slightly over one foot in thickness, including an interior space of six inches. On either side of this air space are three-inch walls of gypsum blocks and on the outside of each of these layers is an additional thickness of a patented material of cellular texture. On the inside of the studio walls this material is covered with heavy draperies of a sound-absorbing nature. Other similar draperies are hung about the studios. By this means, perfect acoustic conditions are obtained.

The air in these rooms is changed every three minutes, purified by a washing process, heated in the winter, refrigerated in the summer, so that a constant temperature is always maintained. This equipment places Movietone in a position to immediately produce pictures in large quantities, and it is undoubtedly one of the most essential and valuable contributions to the successful production of talking pictures.

Aside from the fact that absolute silence is enjoined on all present, the production of a Movietone picture does not greatly differ from that of the ordinary motion picture of a similar subject. The settings are constructed and lighted in the same way. A rehearsal is held before the actual picture-taking is carried on, such as is often done in ordinary picture-making. While the action in a Movietone rehearsal is being checked up by the director sitting behind the camera, in another room the vocal director checks up the tonal quality through the simple device of a loud speaker connected with a microphone in the studio.

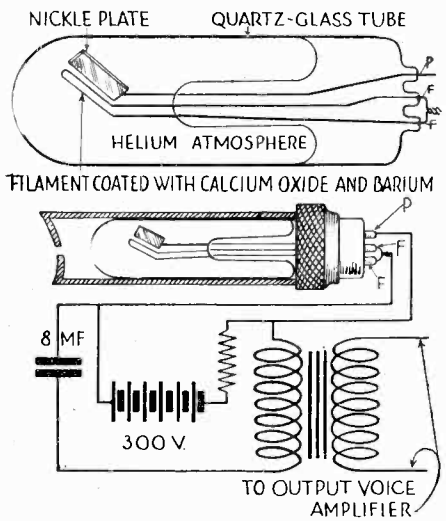
Aside from the fact that the camera is motor driven and that it is connected by wire with the telephonic apparatus, there is little difference between the recording of picture



Here we see the inside of the motion picture projection booth in the theatre where the Movietone talking movies are shown. The main difference between this system and the Vitaphone talking movies, lies in the use of a new vacuum tube for recording and a new photo-electric cell for reproducing the voice.

and voice by a Movietone camera and the ordinary picture recording in a motion picture studio.

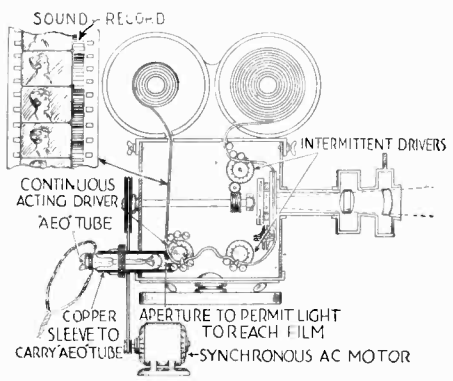
In the Movietone process standard motion picture film is employed. On this film is recorded both the moving picture and its sound accompaniment, whether the latter be vocal or instrumental. In its basic elements the process is simplicity itself. It consists, briefly, in photographing variations in light intensity on moving picture film. This is accomplished by collecting the sounds to be recorded through the use of a microphone, which has the property of changing sound variations into electrical variations. These electrical variations are amplified, and in turn vary the intensity of the recording light. This recording, or "AEO" light, so called because of an alkaline earth oxide deposit on the filament, is high in actinic values.



Details of the new "Aeo" tube used in recording the voice on the same film with the picture in the Movietone process of producing talking motion pictures, is shown above. Voice current fluctuations cause the tube glow to vary correspondingly.

It is contained in a glass tube which is inserted in the back of the camera in such a manner that the variations in light intensity fall directly upon a narrow edge of the negative film on which the motion picture is also simultaneously being recorded. An illustration of the recording device will be seen on the opposite page.

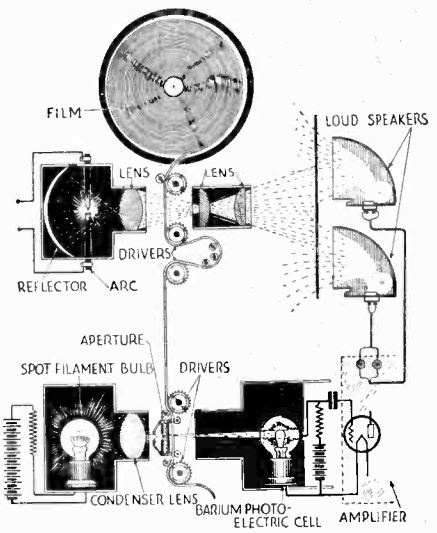
The presentation of a Movietone subject to the audience in the theatre or auditorium is in effect a reversal of this process. The standard film, containing both picture and sound in a photographic record, is run through a standard moving picture projection machine, to which has been attached a sound reproducing unit, also illustrated opposite. This sound reproducing unit includes a light which is focused by a lens system through a narrow slit on the sound record of the film. As the sound record on the film passes by the slit, it interrupts the constant light shining through it, and sets up light variations corresponding directly to those photographed. These changes in light variation then fall on a photoelectric cell, which changes the light variations back to electrical variations. These electrical variations are then amplified and carried by wire from the projection booth to the screen and reproduced back of the screen through loud speakers.



The diagram above shows schematic arrangement of the Movietone camera. The sound record is made photographically alongside of the picture record on the same film. The new "Aeo" tube, which records the voice current fluctuations (by corresponding light pulsations) as they come from the pick-up microphone, is shown in place before this film slot. The picture images pass through the usual lenses and are recorded on the film as it intermittently moves by the lens and shutter opening. The film moves in a continuous manner before the sound recording vacuum tube.

The process employed in making movietone pictures is claimed by Fox Case Corporation as its individual process. It is the result of many years of experimentation and study conducted by the Case Research Laboratories in Auburn, N. Y.

In the Fox Case process, aside from its own various particular patents, such, for instance, as the "AEO" tube, certain telephonic apparatus is necessary. This embraces the use of such devices as amplifiers, microphones, loud speakers, both in recording and reproducing. Since the telephonic equipment is common to both Vitaphone and Movietone, reproducing attachments for these two systems are now being so designed that both can be put on the one projection machine. This enables the exhibitor to reproduce both Vitaphone and Movietone pictures over the same machines.

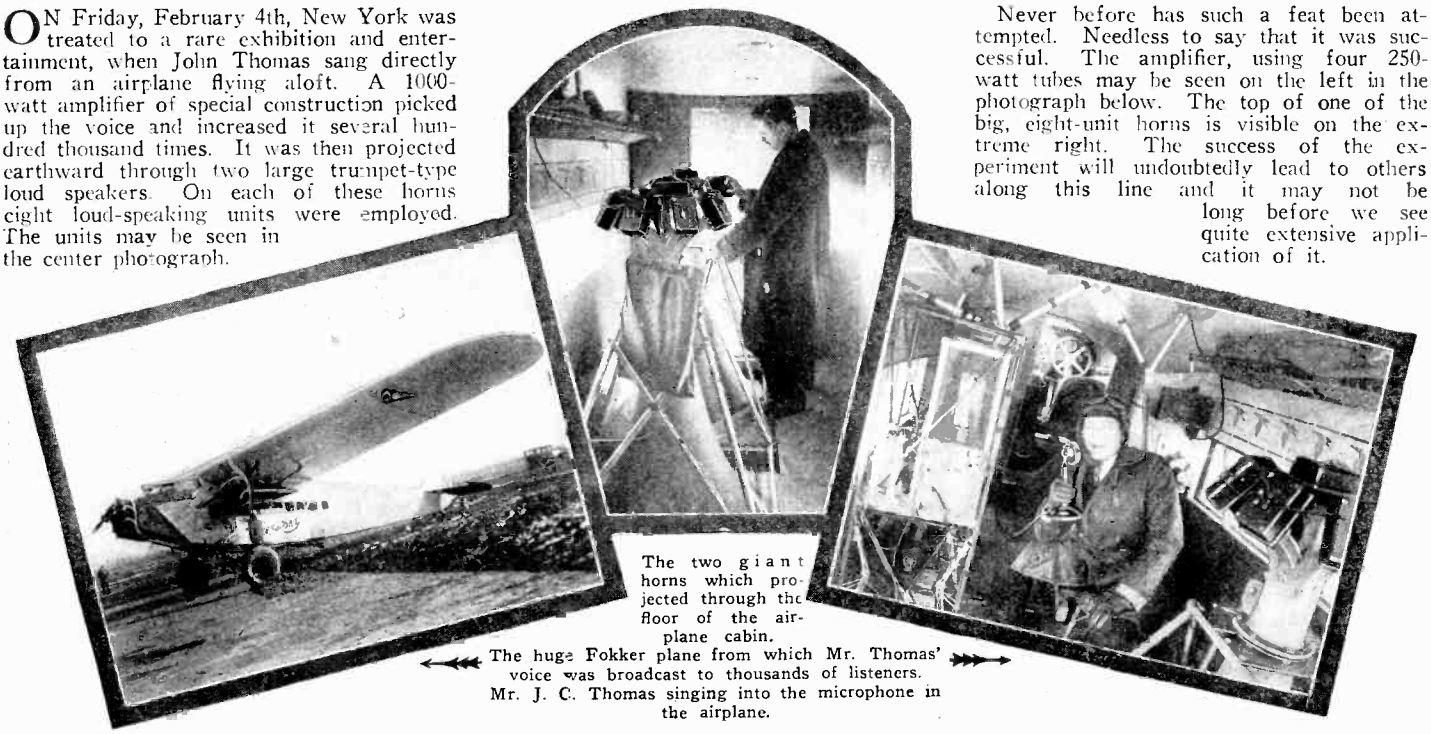


The diagram above shows the path of the single standard film through the motion picture projector in the theater. Also we see the secondary action resulting, as the film with its "voice record" passes before the new Movietone photo-electric cell, which causes variations of current in a loud-speaker circuit as shown.

Talking from the Sky

ON Friday, February 4th, New York was treated to a rare exhibition and entertainment, when John Thomas sang directly from an airplane flying aloft. A 1000-watt amplifier of special construction picked up the voice and increased it several hundred thousand times. It was then projected earthward through two large trumpet-type loud speakers. On each of these horns eight loud-speaking units were employed. The units may be seen in the center photograph.

Never before has such a feat been attempted. Needless to say that it was successful. The amplifier, using four 250-watt tubes may be seen on the left in the photograph below. The top of one of the big, eight-unit horns is visible on the extreme right. The success of the experiment will undoubtedly lead to others along this line and it may not be long before we see quite extensive application of it.



The two giant horns which projected through the floor of the airplane cabin.

The huge Fokker plane from which Mr. Thomas' voice was broadcast to thousands of listeners.

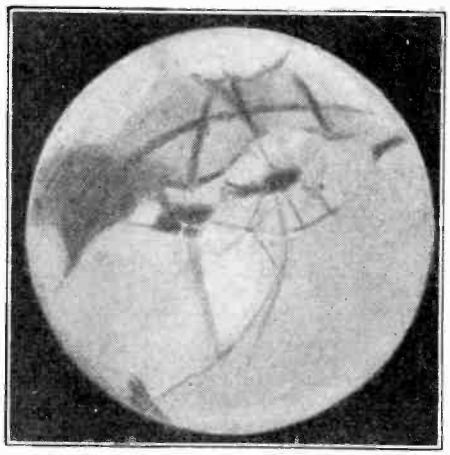
Mr. J. C. Thomas singing into the microphone in the airplane.

The Canal-Geometers of Mars

By DONALD P. BEARD
OF THE U. S. WEATHER BUREAU, KANSAS CITY, MO.

WIDESPREAD shifting of certain major canals, "migration" through many miles of green vegetal areas and other similar phenomena have appeared of late upon the planet Mars.

Besides the enigmatic "canals"—a vast system of fine dark lines hundreds of miles in length enmeshing the planet from pole to pole—the disk of Mars presents an arrangement of dark green areas of similar geometric aspect. Apparently the shallow beds of ancient seas which ages ago evaporated, today they are filled with sparse vegetation cultivated in areas with artificially created boundaries.



It seems that the public never tires of hearing the latest news from our astronomical observatories as to the mysteries of Mars, and whether it is possibly inhabited or not. This photo from a drawing by Hamilton shows the Solis Lacus Region of Mars.

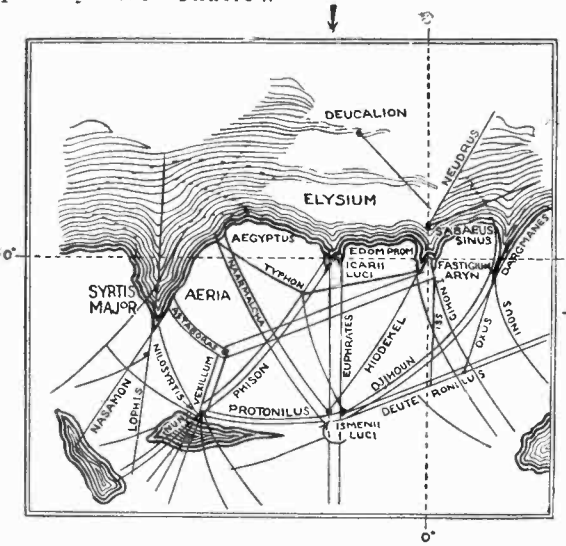


Fig. 2. Martian map reproduced at right shows a close-up study of the Solis Lacus Region of Mars.

Fig. 3. The Martian map at left shows that region known to astronomers as the "Star of Elysium." The marginal arrows converge on matrix of star.

The behavior of the canals is the most inexplicable of all the mysteries that brood over the red neighbor planet. In recent years Prof. W. H. Pickering has thrust the great Harvard telescope through the palms and banyan fronds about his observatory at Mandeville, Jamaica (B. W. I.) and observed startling changes that march across the yellow-marl disk which hangs like a signal lantern in that lucid tropical firmament.

Prof. Pickering has sketched the shifting of certain major canals like Phison and Tartarus and has discovered that nearly all the canals either shift their positions, vary in width, or otherwise change their appearance.

An instance of major change is furnished by the Hellas region of Mars. The "Cross of Hellas" first appeared to Schiaparelli in 1879 and at the next close appearance in 1892 was observed by Lowell, Thollon, Schiaparelli, Cellori and others. At the latter approach of Mars a regular pentagon figure with several radiating canals was seen from the Harvard station near Arequipa, Peru.

Several canals in this Hellas area have altered visibly their places and directions at recent Martian approaches. In 1909 M. Jarry-Desloges of Nice on September 26th drew the arrangement shown in Fig. 1, which is a quite significant figure, since large four-sided constructions are most unusual on Mars. The central meridional canal is Laestrigion; the two lower ones Tartarus and Cerberus.

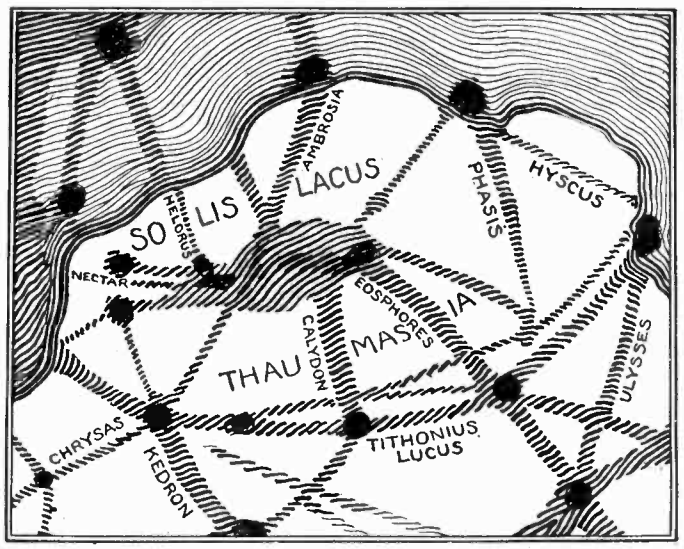
At the opposition of 1924 Mars came to a close approach of 34 million miles and in that year an unusually large and complicated figure appeared. "Again it was pentagonal, apparently a favorite figure with the Martians, but in a different place."

The great "Solis Lacus" or *Lake of the Sun,* is the supreme enigma of Mars, its oval shape and location rendering it the dominant feature upon its hemisphere. Suggestive of a huge dark "eye" of some world-monster looking out calmly into space, it has defied rational explanation since its discovery in the pioneer days of Maedler and Schmidt's studies. It may possibly house some such Utopia on Mars as Hauptmann or Wells would describe in one of their fantasies!

On the night of August 23rd, 1924, at the last close approach of Mars, this strange "eye" of the Martian planet looked directly down upon those regions on the earth from which our great observatories had focussed their telescopes upon it,—a rather significant fact, remarked G. D. Hamilton of the Harvard observatory at Mandeville.

On that particular night the Solis Lacus exhibited a most unusual shape, as shown in the accompanying sketch made by Dr. Hamilton at the British West Indies observatory. The canal Nectar, as shown in the key map, did not meet the Mare Erythraeum as usual, but was an extension of the Solis and ended in two of the four "oases" or lakes shown in the drawing, Fig. 2. A rift cut the Nectar transversely, close to these oases, and was itself crossed by a triple Nectar canal, the central member of which passed through the whole length of the Solis and continued on across the outer plain of Thaumasia—a structure of most amazing complexity!

Furthermore, a cross-shaped *white canal* appeared in the dark region of the Aurorae Sinus, with a continuation leading off to the small oases of Fons Juventae and Pseudo Fons. Perhaps the Martians have cultivated the borders of their vegetation into cross forms such as this and may occasionally illuminate them with powerful incandescent lights in efforts at signalling. Indeed, the arrangement of the great canals of Naarmalcha, Hiddekel, Phison and Euphrates into the cosmic symbol of the masonic square and compass is strikingly shown in Fig. 3.



Concerning this "pentagon of Elysium" (out of which the Masonic symbol mentioned is formed) some startling discoveries were made by Pickering recently. The pentagon area measures 1600 miles in diameter, or twice that of Hellas. Moreover, it is not a true pentagon, although roughly of that shape, but a five-pointed star, more nearly, Conceivably it is a universal, cosmic symbol flashed to us across 40 million miles of space to reveal the presence of reasoning mind upon that distant planet.

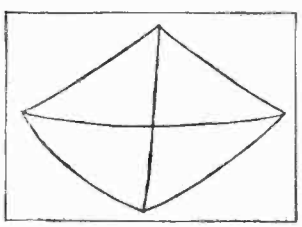


Fig. 1. Arrangement of canals drawn at Nice. The central canal is Laestrigion; the two lower ones Tartarus and Cerberus.

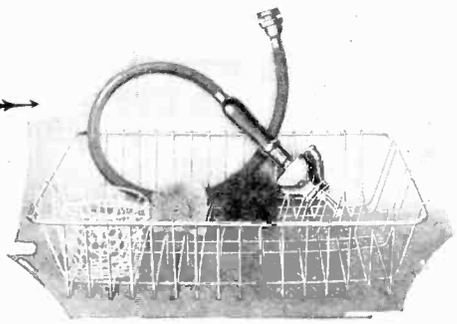
Obviously so large a figure, formed out of the hedgerows of Martian vegetation, similar to the symmetrical box-elder hedges of our own gardens, and projected upon the globose surface of Mars, can only appear in its true character during a certain presentment of that region to the earth. That position was precisely assumed at the opposition in 1924, when the planet approached nearer than for the preceding century-and-a-half, and the centre of the disk was in Martian latitude 16°, and rotation had brought the central meridian to its zero point of longitude.

(*Continued on page* 76)

The Home Scientific

DISH-WASHING AID

An aid to dish washing is indicated in the photograph at the left where it is being used by Miss Sid Heffler. It will be observed that the hose couples directly to the water faucet and that the boiling hot water is shot out in a powerful spray through the flat nozzle.

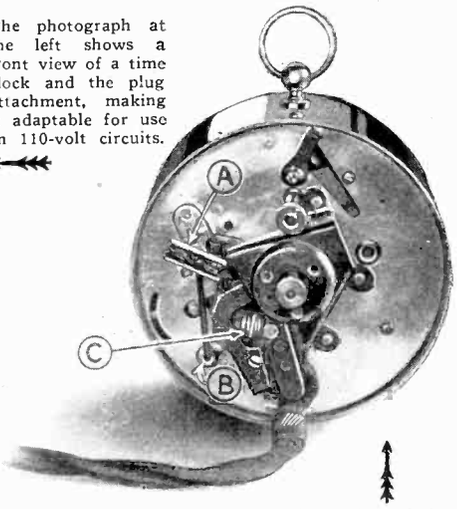


The enlarged portion in the shape of a metal cup near the end of the nozzle on this dish-washing machine is a receptacle for soap. The water rushing from the faucet mixes with the soap and hot soapy solution is sprayed upon the dishes with great force. This stream is sufficient to cut any dirt and grease which may be on the dishes and then by a slight change in the nozzle condition, the dishes are flushed off with hot water. Two brushes are provided with this outfit for the cleaning of pots and pans. A tray also accompanies the article.

—Courtesy of Dishwashette Co.

ELECTRIC TIME SWITCH

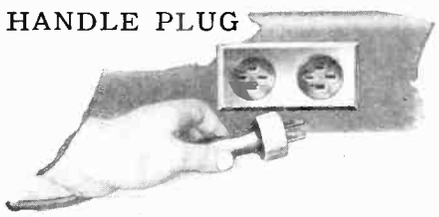
The photograph at the left shows a front view of a time clock and the plug attachment, making it adaptable for use on 110-volt circuits.



The photograph above shows a close-up back view of the clock which can be employed for controlling the radio set or for controlling any apparatus operating on 110-volt circuits. A, turns on the current through switch C via toggle B. The owner of an article of this nature can go to bed leaving his radio turned on and know that the clock will perform its duty, shutting off the set.

—Courtesy G. & S. Research Laboratory.

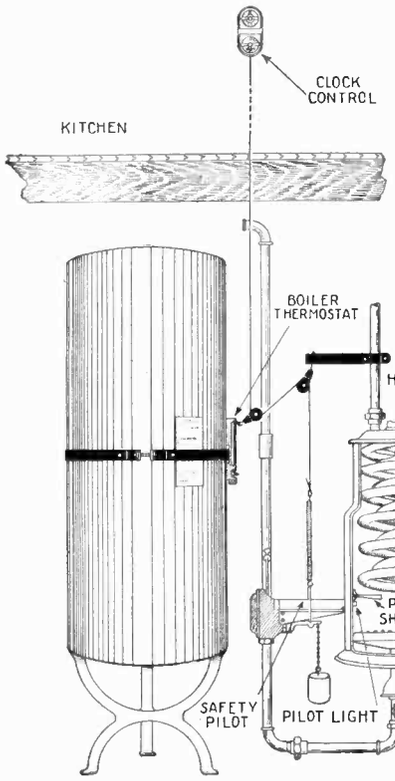
HANDLE PLUG



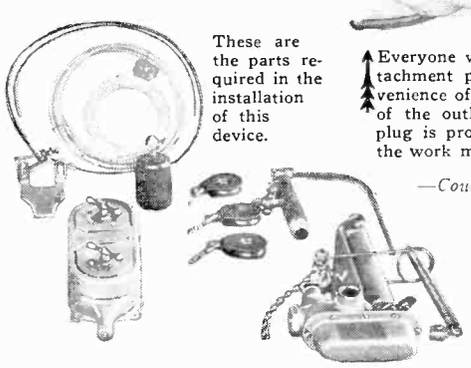
Everyone who has used the regular style of attachment plug realizes the difficulty and inconvenience of inserting the brass blades in the slots of the outlet. In the article shown above the plug is provided with a handle which facilitates the work making an ideal article for the toaster, percolator or lamp.

—Courtesy Beaver Machine & Tool Co.

DISTANT HOT-WATER CONTROL



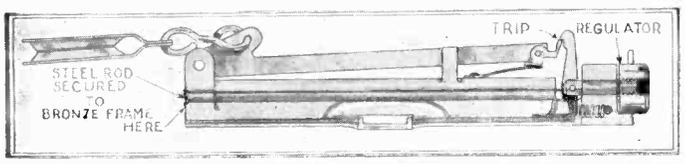
The diagram at the left indicates the method of turning on the gas supply from the kitchen with the apparatus here shown.

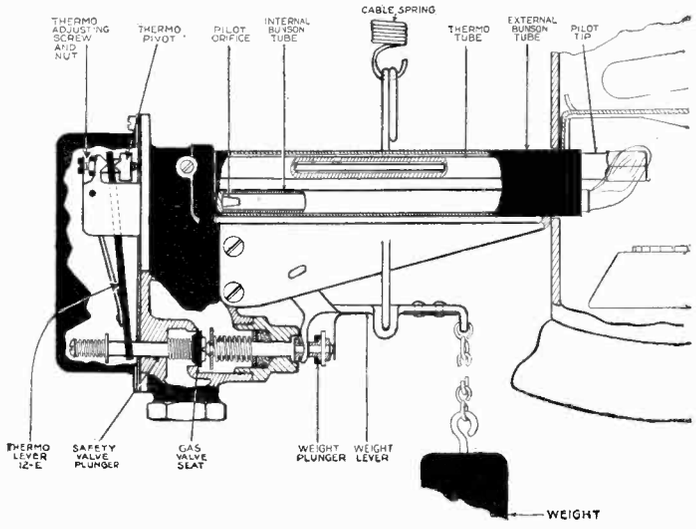


These are the parts required in the installation of this device.

The safety pilot used in the system for turning on the gas from the kitchen. The pilot heats a rod, permitting the gas to be turned on when the cable spring is raised. If the pilot goes out, gas cannot be turned on.

Several months ago in The Home Scientific department was shown an electrical installation for turning on the gas of cellar water heaters from either the kitchen or the bathroom. The device here described is not electrical. The time-clock on the wall permits the water to be heated for from five minutes to two hours by simply setting the hand. A boiler thermostat prevents overheating. This thermostat is indicated in the diagram below; it operates because of difference of expansion of the two metals of which it is composed.



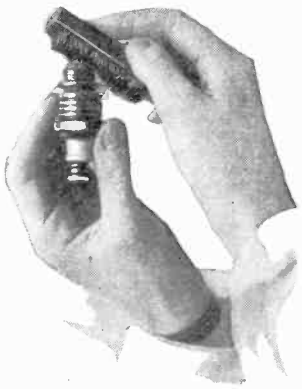


Names and addresses of manufacturers furnished on request.

The Lady Motorist

After washing the body of a car it should be thoroughly dried with a well wrung chamois leather of fine texture.

A wire brush cleans spark-plugs easily and quickly.



Supplying the motor with too much oil generally causes the spark-plugs to become very dirty. A stiff wire brush is ideal for cleaning them.

Plenty of water should be used when sponging off the mud accumulating on a car. At the same time the water should pour forth from the open end of a hose as a high pressure stream might injure the surface.

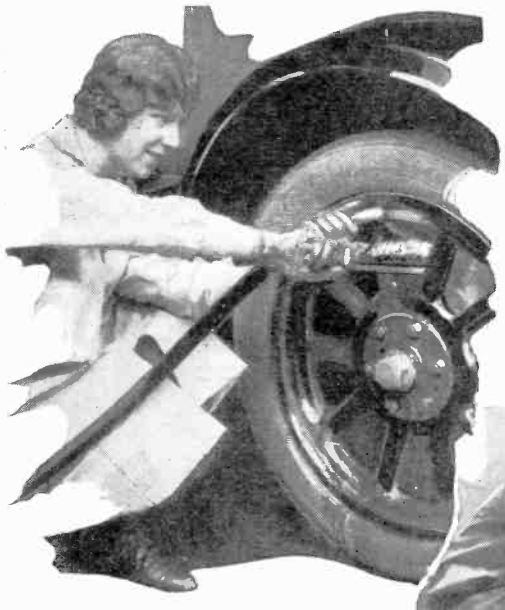
On this page are given some helpful hints for the lady motorist. The man of the house might also profit by some of the suggestions illustrated.

The specially shaped funnel here illustrated enables one to fill the sump if the filler opening is awkwardly placed. Suitable rubber gloves, boots and clothes are essential in washing a car right.

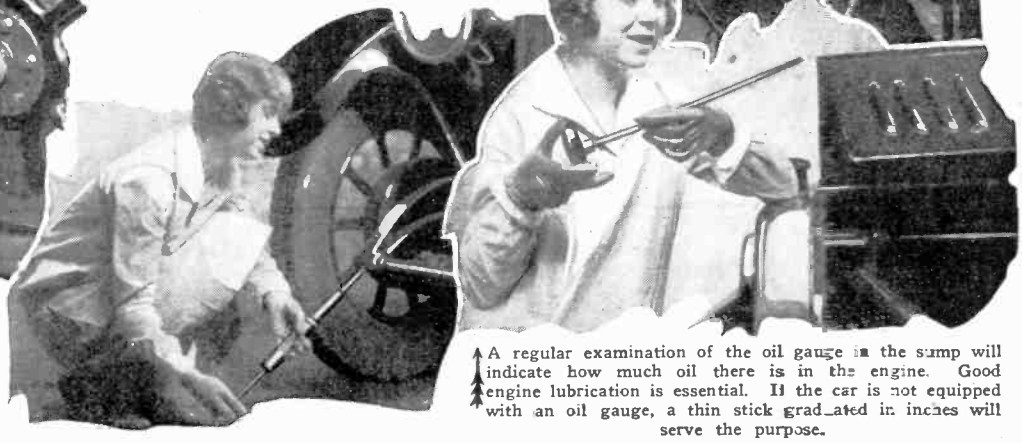
Every time you wash a car, look for flints and tacks in the tire and remove them. This prolongs tire life.

The finishing touch may be applied to the car with a good wax polish and plenty of elbow grease. A surface of 4 square feet, 2 feet by 2 feet, is about the average space which can be covered by the fair motorist at any one time.

Below the grease gun is in use. Don't forget that the car needs plenty of grease. The better lubricated it is, the longer it will run without wearing.



The photo above illustrates the use of an under-carriage brush for reaching awkward places. The gear box and back axles of the car should be taken care of every 500 miles and oiling and greasing should be done bi-monthly.



A regular examination of the oil gauge in the sump will indicate how much oil there is in the engine. Good engine lubrication is essential. If the car is not equipped with an oil gauge, a thin stick graduated in inches will serve the purpose.

Our Spiritualistic Investigations

By Dunninger.

NO. 10 OF A SERIES

"Ghostly words, apparently from the mouths of different subjects, were distinctly heard. Suddenly, from out the darkness, came a ghostly vision. A head was seen. Nearer and nearer came the face and floated through space about the room in uncanny fashion. . . . And so the ghostly business proceeded. The heads would become visible and invisible. . . . Now they were here. . . . Then they were there. Finally they vanished altogether. The closing hymn was sung and the elderly gentleman arose from his chair, and proceeded to relight the lamps."

ONE of the most daring and bewildering séances I have ever attended, transpired but a few weeks ago, in the city of Milwaukee, Wisconsin. Several newspaper men gave me the address of Madam Beiderman, who was said to be a trance medium, of unusual ability. The medium, who, according to reports, originally created her reputation in one of the smaller neighboring towns, and had become so popular that her many admirers and believers persuaded her to make her residence in Milwaukee. This enabled them to attend her séances more frequently. The lady, as gossip had it, was an uncanny individual, who possessed a unique and extraordinary power, so as to be able to produce the spirits of the departed in so complete a form, that they were actually recognized by their loved ones. It was hard for me to conceive that these newspaper friends of mine were actually serious, their descriptions of this woman's manifestations seemed absolutely far-fatched. It was only after a period of time, and after a great deal of discussion had transpired, that I fully realized their earnestness and sincerity. They had heard of the fakir, and the bogus medium, but Madam Beiderman was different. She was positively genuine. Of this they were assured.

For fully an hour I listened to the ravings of the two, as they showered bouquets upon the exceptional talent of the mystic. Dozens of names they mentioned, of people who had attended these séances. All of these were fully convinced of the uncanny genuineness of the lady's demonstrations, and I was invited to visit any and all of those, whom they had quoted, should I be the least skeptical of their assertions. The tales that they unfolded sounded like the readings of a choice lot of stories, taken from the "Arabian Nights."

I could readily understand how an average person, ignorant of the methods employed by fraudulent mediums, could be deceived. I could not, however, conceive that these two fellows could have become possible subjects to the hocus-pocus of a medium, unless she was far above the average in her chosen line of deception. I was further told that these séances were conducted twice a week, regularly, Wednesday night and Friday nights. On Wednesday evenings the medium would go into a trance, and would converse with the dead. The information that she would produce was nothing short of miraculous. This was all done in brilliant light, and lasted until a message was received for all of the many present. The Friday night séances, however, were quite different. These were conducted in a dead-black room, and upon this night, the ghosts would walk. (For two reasons, thought I . . . the one, that her deceived believers would see apparent apparitions . . . the other, that the ghost would he glad to walk for the medium, as her fees this night were twice those asked for the usual Wednesday evening séances.)

It was, of course, the Friday night séance, that I was interested in, and I was naturally instructed, as in all my other previous experiences, that an introduction would be necessary, before I would be permitted to enter the mystic circle.

So enveloped in the interest of this medium were my two associates, that they both volunteered to take me to her, at the next sitting, and would stay with me, throughout the séance, to await my opinion of the mystic doings of this super-spiritualist. And thus, upon the following evening, at 9 P. M. my 'phone rang at the hotel where I was stopping, and I was informed that my friends awaited me in the lobby. Into a taxi, and on our way, through some of the darker and desolated parts of town, we drove. A heavy snowfall, and a dismal night, helped things considerably. The taxi driver seemed to have been chosen by my friends, as a picturesque background for this venture. His bony countenance, and ghost-like features, would have been accepted by any and all, as a vision from the great beyond, upon a night like this. All this time, amid the screeching of his car, which had long ago seen a better day, I listened to further assurance that I was to see the doings of the one real medium, at last. A sudden stop, and our ghastly chauffeur hastened from off his seat, and opened the door of his cab.

Before us stood a house of ancient type, which formed rather a picturesque silhouette of spirited vision, with its lone lamp burning in the window, its dim flicker sending forth rays of uncanny invitation. After the door bell had sounded, footsteps were heard, and soon the door stood open before us.

A little lady greeted us in a squeaky voice. Unless my imagination deceived me, as imaginations often do, she must have been a near relative of our cab-driver, her ghost-like appearance and ashen white face bore him a strange resemblance.

(*Continued on page 72*)

$21,000.00 for Spirits

Dunninger, who writes exclusively for SCIENCE AND INVENTION Magazine and who is the Chairman of our PSYCHICAL INVESTIGATION Committee will personally pay $10,000.00 to any medium or spiritualist who can present any psychical manifestation in so-called spiritualism, that he will not explain or that he cannot reproduce by natural means.

More than two years ago SCIENCE AND INVENTION Magazine offered a prize of $11,000.00 to anyone who could demonstrate his or her ability to communicate with the spirits or to give some definite form of a psychical demonstration which in itself was not trickery.

The result has been that mediums and spiritual organizations have been afraid to place proofs before us. Those weak attempts which have been made to demonstrate psychical phenomena were almost instantly proven fraudulent, and no medium has dared to contradict our findings.

In view of these facts, should we not consider all mediums fraudulent?

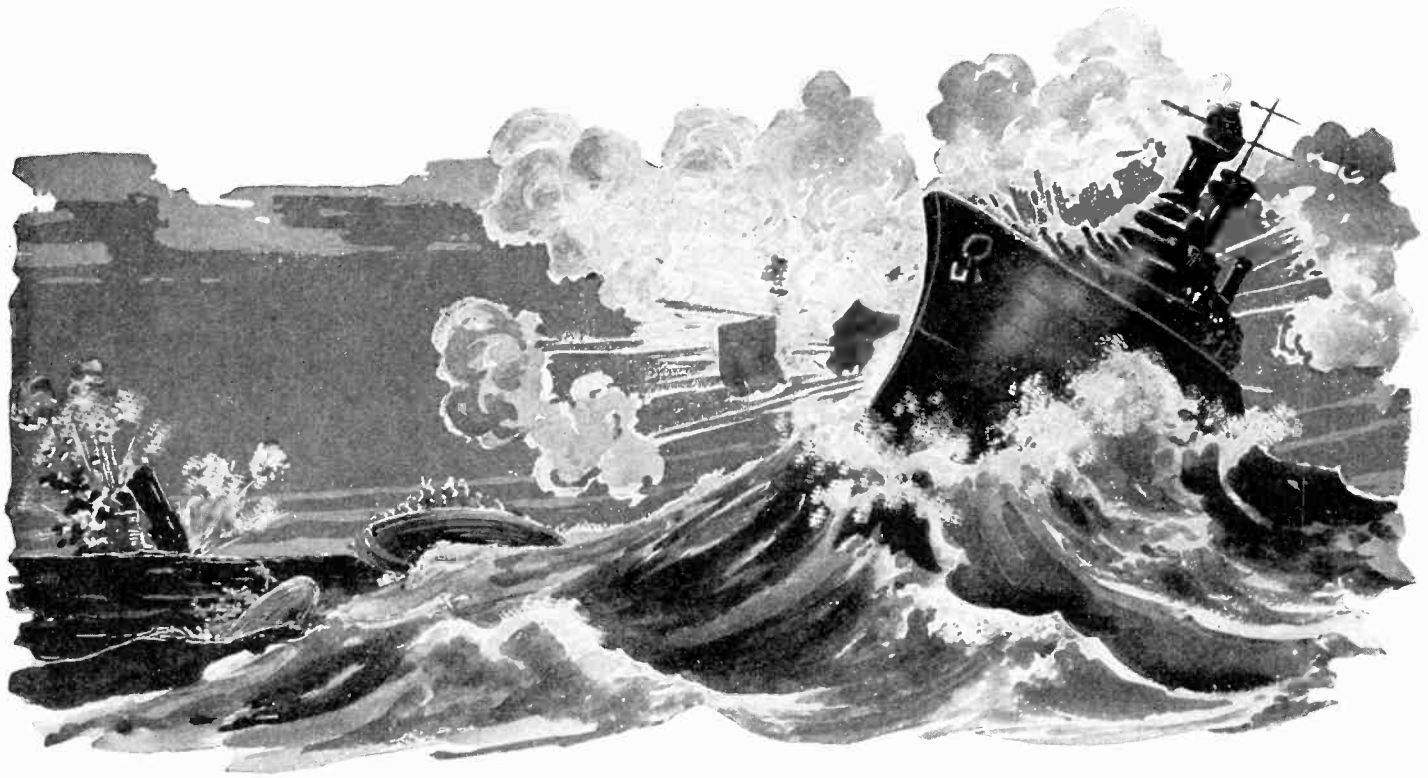
To the $10,000.00 which has been offered by Joseph F. Rinn through this publication for Spiritual proofs and the $1.000.00 in addition offered by SCIENCE AND INVENTION Magazine we now add Dunninger's $10,000.00.

So now we have a total of $21,000.00 offered for proofs of Psychical Manifestations. Spiritualists—get busy.

Into the Fourth Dimension

NINTH INSTALLMENT (Conclusion)

By RAY CUMMINGS



A warship lay in the upper harbor. Small boats were clustered around it. Over its decks and within its structure, men were frantically rushing. . . . Then there came a surge of its giant bulk upward—a torrent waterspout as of a great mine exploding beside it. Bow down, it began to sink. Slid cracked and broken into its shadowy grave. . . . The swirling water was a mass of wreckage. . . . With death and destruction everywhere.

CHAPTER XVII

THE RESCUING ARMY

I STOOD gaping, every sense within me shuddering at that soundless scene of ruin and death. And then it came upon me that now I could escape. Brutar had turned triumphantly to his underlings. I heard his voice: "The first success! Now let us try the others!"

No one seemed noticing me. I turned and swept myself away into the darkness. . .

I was aware of the grey outlines of New York floating by above me. . . . A dim idea was in my mind that I must rejoin Will and Thone. . .

Out there beneath the Westchester hills the silent mob of Brutar's ghostly followers still waited. Near them was the main body of his army, inactive, waiting here while he with his chosen few were experimenting upon New York!

Experimenting! This little experimental test, and it had brought down the Woolworth Building! What then would they do with a general attack?

I passed around the mob—silent, fleeing spectres—and sped again into darkness. With no conscious thought of passing time, or direction to my flight. Yet there must have been some instinct to guide me. The thought of Bee came strong. A growing triumph, a relief, told me I was nearing her; and I think now that it was her thought of me which guided my flight.

Darkness. But overhead lay the shadows of my own world. Winding grey hills; towns that lay like grey, colorless pictures in a book, queerly distorted as I looked, upward and through them. . .

Shadows like myself were advancing from the gloom in front of me! A little group; behind them a vague sweep of shapes stretching out to seem a throng, a multitude.

Synopsis

Robert Manse, a correspondent in the New York Office of a Latin-American export house, in company with Wilton Grant and his sister Beatrice, saw the first of the ghosts in February, 1946, a few miles from Rutland, Vermont. These ghosts were semi-transparent, glowing figures much resembling human beings. Attempts to destroy them with bullets or clubs had no effect on the shadows.

Some time later, Will calls Rob on the telephone, saying that his sister Bee is quite ill and asking Rob to pay them a visit. During the visit Will mentions that the ghosts have already arrived in the Borderland lying between their world and ours, and that they were on the point of coming into our world. Will himself has discovered a means of entering into this borderland, and declares that even though he is being watched by many of the ghosts he will make an attempt to enter their realm and turn the spirit-like creatures back into their former paths. While he makes the journey, Rob is to stay behind with Will's sister, Beatrice.

The preparations for the experiment are made, and Will clasps upon his arm a connection to the vibration-transformer which, by altering the vibrations of his body, is to transform it from normal substance to the wraith-like material of the other world. They see a ghostly form watching them as Will's body becomes transparent. Finally the apparatus is disconnected and they wait for his return. Five hours later, Will returns saying that they must go back with him to save the world from an invasion of the ghostly hordes.

Robert and Beatrice, though face-to-face with the unknown, succeed in suppressing their fear, and agree to accompany Will across the border. The three adventurers don their metallic garments, attach the batteries, and swallow the acrid compound which is to transform their tissues. In a few minutes they find themselves transposed into the Borderland.

They meet Ahla who takes them to the big city. The triplet is told that Brutar is inducing his followers to enter our world. A battle of thoughts takes place among the ghosts. Brutar captures Rob and Bee with thought waves, and tells them that he can use them for his conquest of the earth. Will and Ahla go to the rescue.

Brutar brings a young man, Eo, on the scene and they both listen to descriptions concerning earthly life. Brutar shows how material things are made from thought waves. He also shows Rob and Bee the lolos plant which has a conscious mind. The blood from this plant enables the ghosts to enter our realm. During the demonstration Bee and Eo escape.

Eo is stricken by Brutar by an evil power of mind and becomes insane, passes to the realm of death and leaves a ghostly body behind. This dissolves like a fog. Thone describes to Bee and Will how thoughts create new life. He also states that his own men are preparing to attack Brutar if they can locate him. Suddenly Ahla exclaims she knows of Brutar's encampment. On reaching the place, they find everything dissolving. Brutar, taking Rob with him, starts his invasion of the earth.

Brutar brings his men into our world, each armed with a weapon in the form of a scintillating brick. They pass through the earth and peer as if with X-ray eyes through buildings. Some penetrate the girders and bricks of the Woolworth Building, where they drop their weapons on one side of the building. These bricks pass into the structural steel work and begin to materialize. Because the bricks require space of their own within the confines of the steel girders, the building collapses, dealing death and destruction.

Now continue with the story.

Thone! Will and Bee—with the rescuing army of the Big-City behind them!

The rescuing army. . .

CHAPTER XVIII

THE DEADLOCK

THERE came upon me with that meeting a great surging knowledge of my love for Bee. My love, born up there in my own world. And then, in the realm of the Egos, stricken of the physical, a changed love which had faded to a vague affection—a knowledge that she was dear to me, but nothing more.

Now—in the Borderland once more, at least of half material substance, a very human love descended in a torrent. My arms went around her.

"Bee, my darling." And she responded to my caresses, kissing me with an eagerness, a longing undisguised. "Rob! I've been so frightened, not having you——" Murmured then that she loved me; and clung to me. . . The threshold of our own world.

But it was no time for love-making. I told Thone and Will what was transpiring, what already had come to pass, down there in New York. And with them we presently swept forward to the rescue.

Thone's army was at least as large as Brutar's; and it was not, like his, burdened by those who could not fight. In orderly array it advanced, and soon ahead of us we saw the shapes of Brutar's forces.

Strange ghostly battle into which now we plunged! I did not, could not fully understand it at the time—but now I think I do. The very essence of it a physical inactivity. Fighting! The word to our Earthly minds is so full of movement! Yet a man battling with himself, pitting the good against the evil within himself, may sit in his easy chair and fight a fiercer fight.

So it was here; unleashed forces of the mind, grappling silently—a struggle without rules of combat in which no quarter could be given, and which could only end by complete annihilation of one side or the other.

I knew all this, and standing with Bee, Thone and Will on a dark eminence above the scene, I watched, breathlessly.

We were under that same little Westchester town. Its streets and houses lay shadowy above us. Ghostly people were up there—thronging the streets—gazing down with fear and awe at those flowing masses of ghosts advancing to battle.

The mob of Brutar's followers, frightened now, were huddled compactly. In area, they spread under perhaps half the village. And around them in a great concentric ring, Brutar's fighters massed. This movement Thone did not disturb.

"Let them," he said. "It is what I wish, to have them massed like that."

From our eminence—we were poised not very far beneath the ground level—we could see over the whole area of the battle which was proceeding below us. The central mob who could not fight; the ring of Brutar's soldiers; and surrounding that, at a distance of some five hundred feet, another ring, Thone's fighters who now were massing to the attack.

"What will they do?" I murmured. But no one answered me, and soon I was answered by the scene itself. From both sides —Thone's army and Brutar's—little waves of the Thought-substance were flowing out over that segment between the opposing rings. Like slow-floating wisps of grey smoke from the heads of the fighters. Flowing across the space between the lines. Materializing steadily. Solidifying until I could almost imagine it might become a grey wall. But this was an illusion. It was merely thought-antagonistic which would grip and hold like a net, no more.

The two opposing streams met in the center of that circular No-man's-land between the lines. A chaos of blurred formless color was there. Not grey now. An angry red. The visible substances holding each other immovable. A boiling cauldron of red, with livid, lurid tongues like flame darting from it.

No sound. But I could feel it. A mental distress, as even at this distance its influence swept me. An uneasiness; a depression; a vague sense within me of a growing panic.

It seemed a deadlock. And then began movement; strategic movement. From one portion of his line Thone suddenly withdrew a number of his thinkers. They came sweeping around to our side. With this reenforcement we became stronger over here, and the red chaos surged inward. I saw it flow almost to engulf the crouching Brutar fighters who were here opposing it. Saw a few of them fall—ghostly shells lying inert —and above them a something luminous, the Ego-mind deranged, unhinged, hovering, then winging away into death. . .

A shape hurriedly approached us; a man with harried, anxious face. "Thone! We are too weak now upon the other side. The Red Death is almost upon us there! They want the thinkers back."

Thone ordered them back. He turned to me. "We will win, Rob."

But I could not see it so.

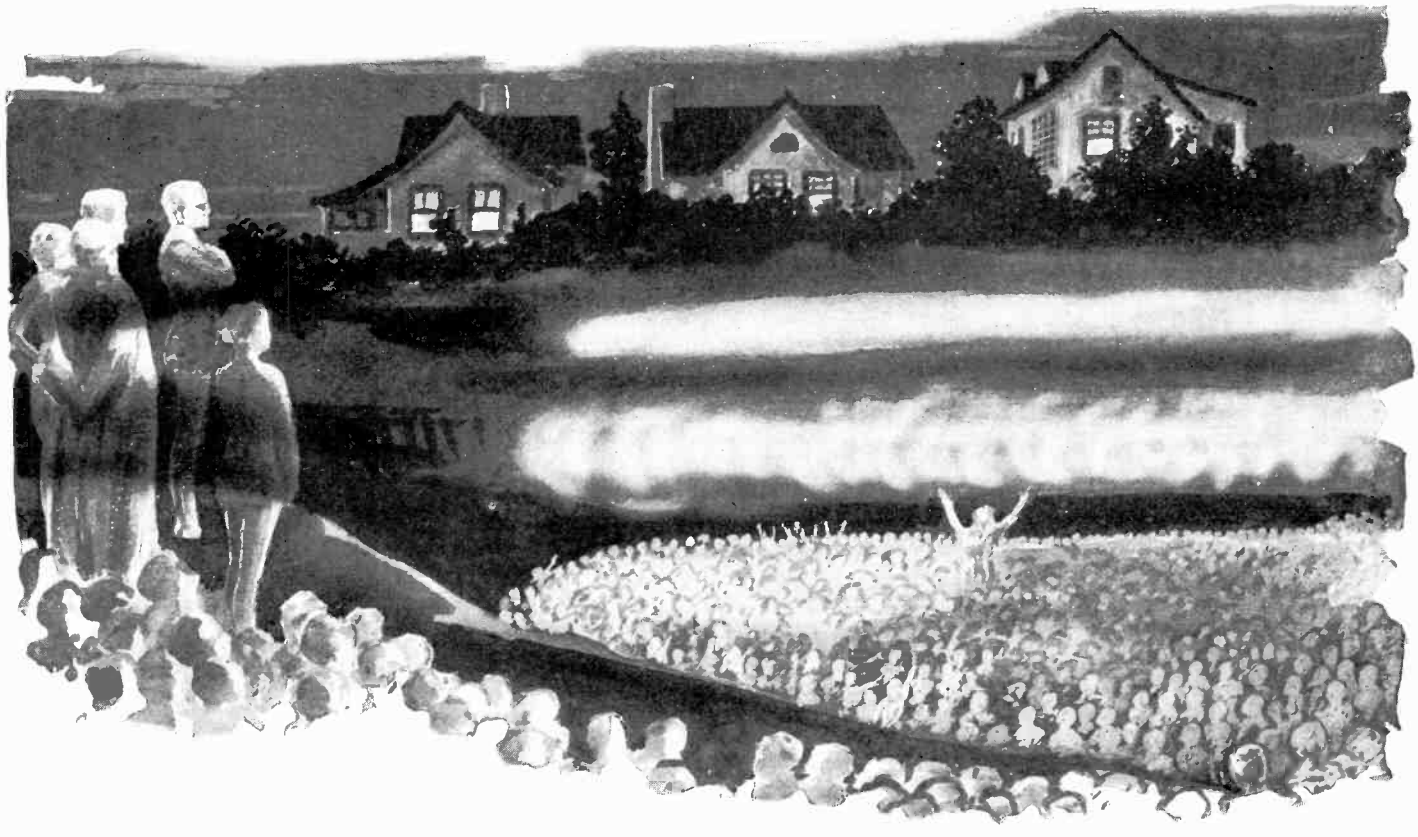
"Look!" He gestured. "There is a haze above the red. It passes inward—can't you see that? And they cannot stop it. They have not been trained, for they do not know what it is."

Above the red seething ring, where the opposing thoughts were meeting, I saw as he said, a haze. It seemed a dim purple. It was floating up and inward. Very tenuous, hardly to be noticed. An imponderable something.

Thone said, "A quality of our thought which they cannot combat since they do not know what it is—or realize perhaps its presence. But its influence will reach them in time."

He swung upon the attentive shapes near us. "Oh!—give orders not to hasten. Hold the deadlock. Keep them there. Do not hasten. We must drive up the others if we can. Brutar and the others——"

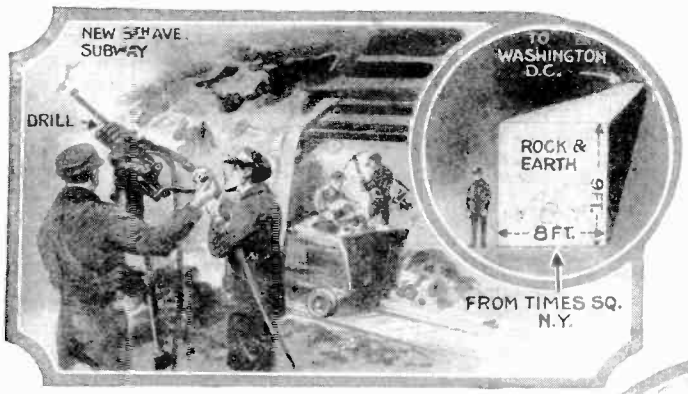
(*Continued on page* 66)



I could see Brutar, or at least a shape I assumed to be he, raised upon a height in the center of his forces; his arms waving; his soundless voice doubtless exhorting his fighters to greater effort. The fog of purple haze swirled about him, tinting, but not obscuring, for it seemed utterly transparent. Was it my fancy that Brutar's shape was of changing aspect? And then I was aware of an uneasiness growing in the mob. . . .

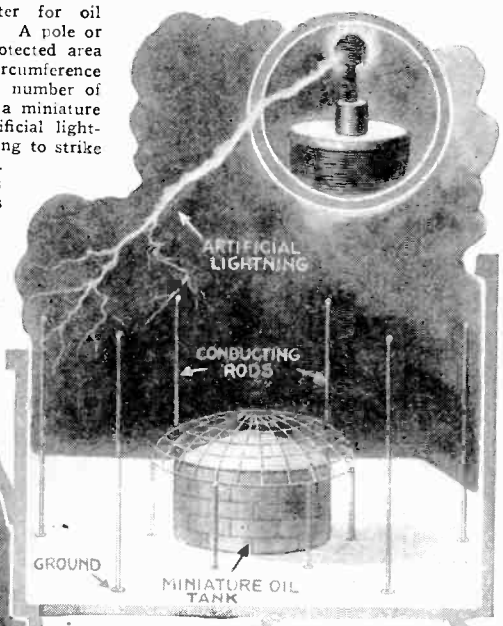
The Month's Scientific News Illustrated

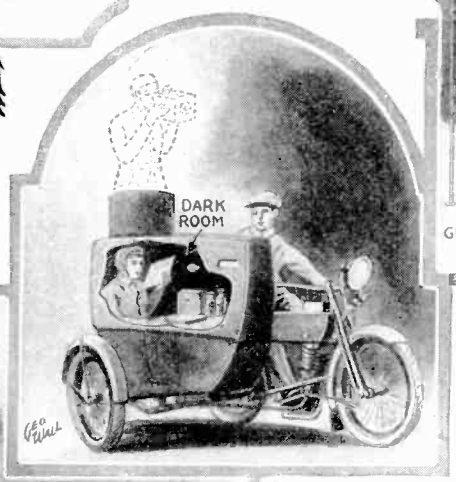
By GEORGE WALL



More than 6,400,000 cubic feet of rock and earth, enough to form a solid wall, 8 ft. wide, and 9 ft. high, from Times Square to the capitol at Washington, has been excavated from the new Eighth Avenue Subway. During the last year, a daily average of nearly a quarter of a million tons of earth and rock has been removed. This is said to exceed all previous records of subway excavation. More than 40% of the drilling has been through hard rock and the drilling now in progress is 61% completed.

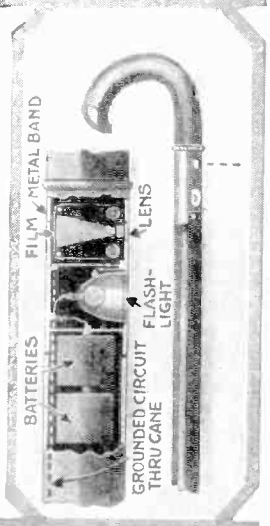
A new lightning arrester for oil tanks has been perfected. A pole or conducting rod has a protected area from lightning within a circumference four times its height. A number of such rods placed outside a miniature tank were struck by artificial lightning or caused the lightning to strike at a distance from the tank. Next, a wire screen was placed over the top. Thus induced voltages which might cause sparks igniting explosive gases were prevented.

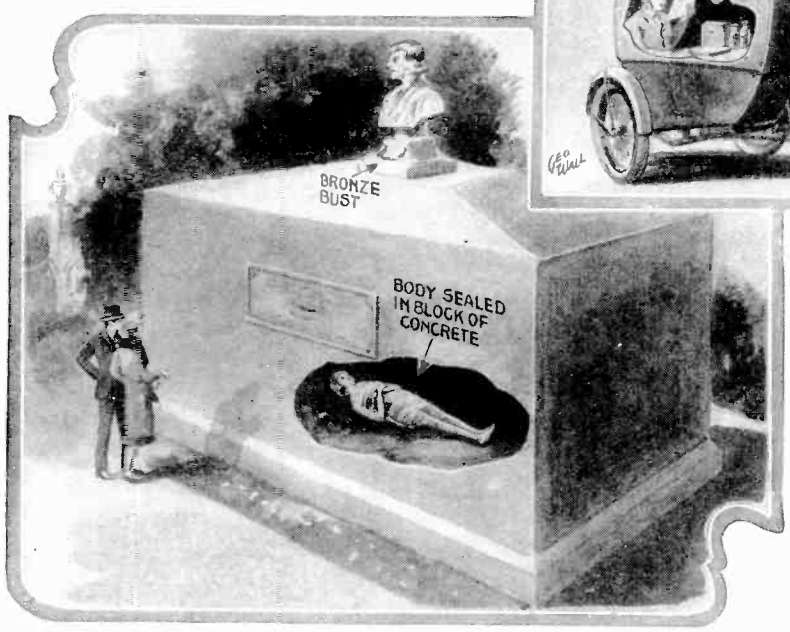




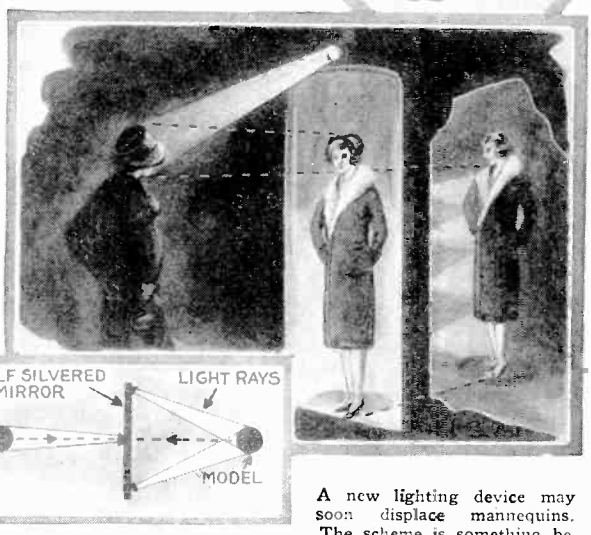
Berlin has developed the latest in speed photography; a small dark room is attached to a motorcycle car, the photographer takes the picture from the conning tower, develops and prints the photographs in the dark room while the motorcycle speeds to the central office, and has the pictures ready upon arrival. This new method of speed photography makes it possible to have "extras" on the street a few hours after the event has taken place.

Turning a metal band below the handle of a new walking stick switches on a flashlight and uncovers camera lens.





The body of Mrs. W. F. Miller was recently entombed in a solid block of concrete, without a coffin. The monolith, eight feet wide, twelve feet long, and eight feet high, now stands in the city cemetery, surmounted by a bust of the deceased. The body was placed on a slab of concrete and concrete poured over it until the huge block was formed. Even if the body turns to dust the form will remain the same in the center of the block.



A new lighting device may soon displace mannequins. The scheme is something between a ghost mannequin and electricity. The customer enters a small room and stands in front of a mirror. Her body is made to "fade-out" by special lighting, leaving the head in the mirror. Then a headless model dressed in a particular costume "comes through" and fits exactly under the head of the purchaser. If this means is successful several gowns may be tried on without the removal of the outdoor garment or the use of a mannequin.

Two lights placed on either side of a half-silvered mirror are focused on the model. Another light placed on the other side of the mirror illuminates the prospective customer. By referring to the small diagram above it will be readily seen just how this unique device operates. The inconvenience and bother usually associated with buying a new costume is eliminated.

The future sidewalks recently tried out in Germany have met with approval. The problems of street congestion have been solved to a certain extent by these unique elevated sidewalks.

Hamburg, Germany, is the scene of a new type of office building, which has sidewalks around the entire structure, where office workers can spend their noon hour in the open air, free from the crush and dust of the traffic on the streets. A New York architect is planning to introduce this new building sidewalk in America. So, in the near future we may expect a complete revolution in modern architecture.

MAGIC By "DUNNINGER"

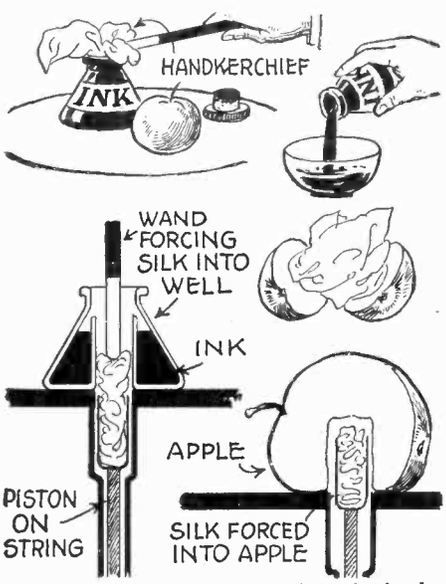
THE MAN WHO MYSTIFIED

Pres. Coolidge
Prince of Wales, Ex-President Harding, Taft, Roosevelt, and other celebrities
Writes Exclusively for
SCIENCE AND INVENTION

No. 50 OF A SERIES

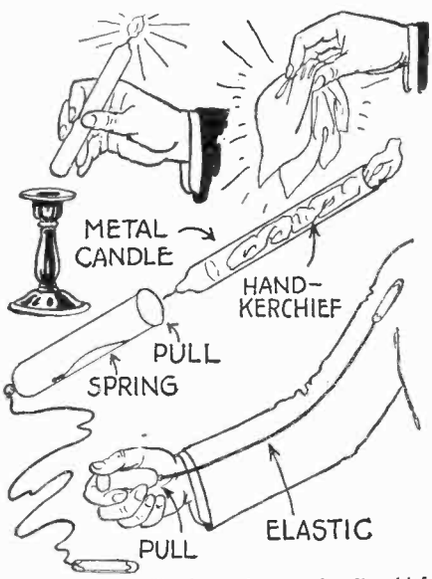
The Diabolic Handkerchief

A HANDKERCHIEF which has been marked for identification is forced into the mouth of an ink bottle with a wand as illustrated. A moment later the ink is emptied from the bottle and the handkerchief is found to have mysteriously vanished. It is later located at the center of a large apple. In reality the kerchief is pushed into a small receptacle which is hidden in the table leg, making its entrance via the special opening in the bottle. When an apple with a prepared cavity is placed over the piston arrangement, the reverse action takes place.



The diagram above illustrates how the handkerchief is pushed through the well in a special ink bottle and is later forced into a prepared apple by the piston-like arrangement in the table.

A Candle Transformation

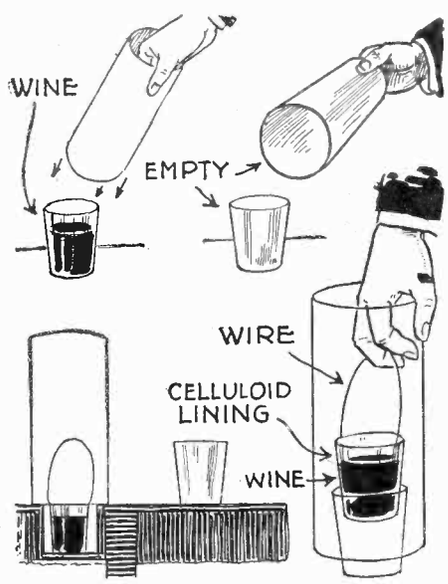


This diagram illustrates how a handkerchief concealed in a candle can be made to appear in the performer's hand, the candle itself vanishing by means of a special pull which grips the metal candle.

IN this stunt a lighted candle is removed from its holder and visibly disappears leaving in its place a handkerchief that may have been previously vanished. The candle in this particular trick is made of a piece of metal tubing, in the end of which a real piece of candle is placed. The handkerchief itself is concealed in the metal tube. The performer drawing the pull down into his hand pushes the lighted end of the candle into it. At the same time he grasps hold of a handkerchief and releases the pull, retaining the handkerchief in his hand.

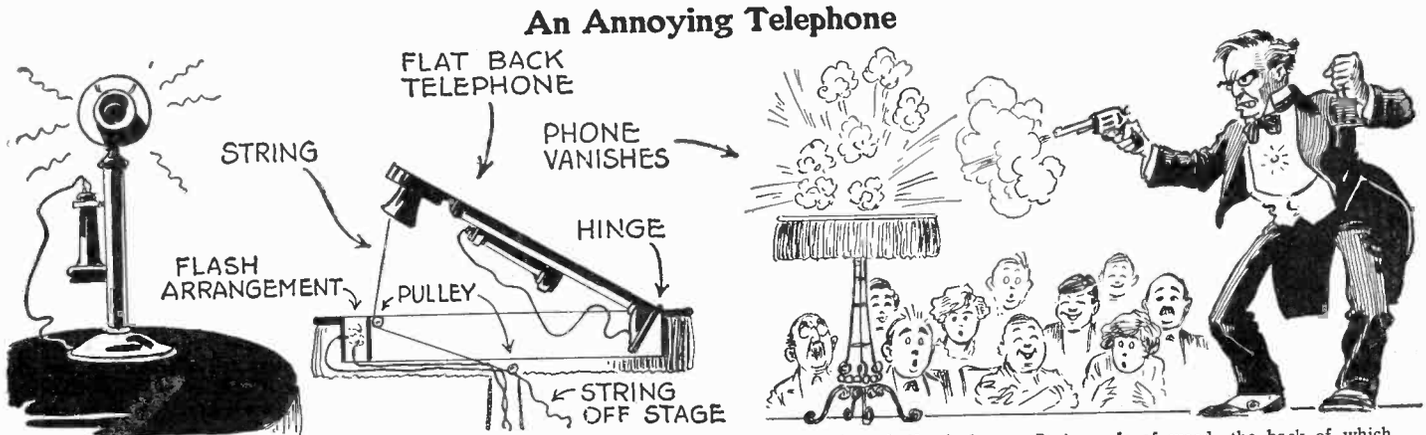
A Tumbler Trick

A LARGE glass tumbler is visibly filled with wine and then a gummed label is attached to it marked by some spectator for identification. A cylinder is now passed for examination and is then placed over the glass. A moment later it is removed and the glass is found empty. The secret lies in the fact that the liquid is actually poured into a celluloid lining in the glass. When the cover is placed over the glass filled with wine, the celluloid lining is lifted out of it by the aid of a wire loop and is carried off.



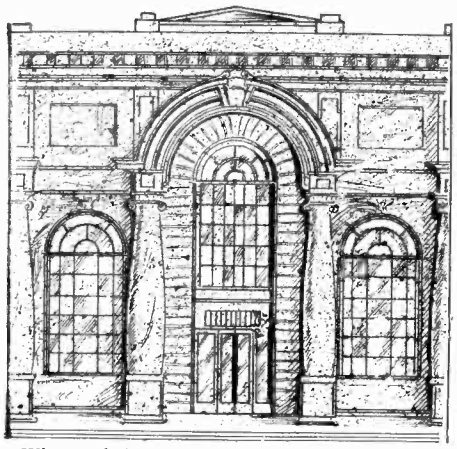
Here we see how the celluloid lining filled with wine is lifted out of the glass and carried away to be deposited in a table receptacle. The celluloid is invisible when placed in the glass.

An Annoying Telephone

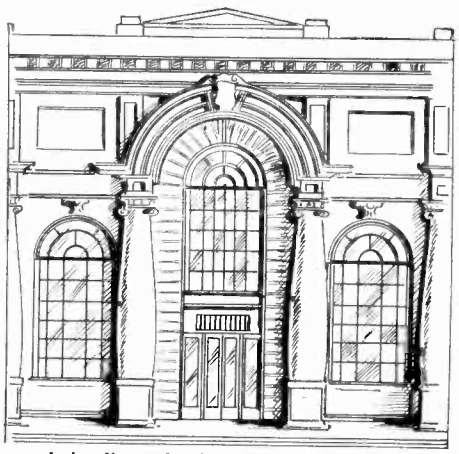


Upon the performer's entrance at the opening of his act, he is repeatedly annoyed by the ringing of the telephone, but gets no answer when he lifts the receiver. While addressing his audience, the telephone bell again sounds. Enraged, he removes a revolver from his pocket, fires at the telephone, which vanishes with a flash and puff of smoke. The telephone itself is really a half telephone. It is made of wood, the back of which is covered with black velvet. The inside of a table is similarly lined. Both the telephone and the flash powder are operated by an assistant offstage. He pulls on a string, pulling the telephone down into the table, and operates the spark coil which ignites the flashlight powder.

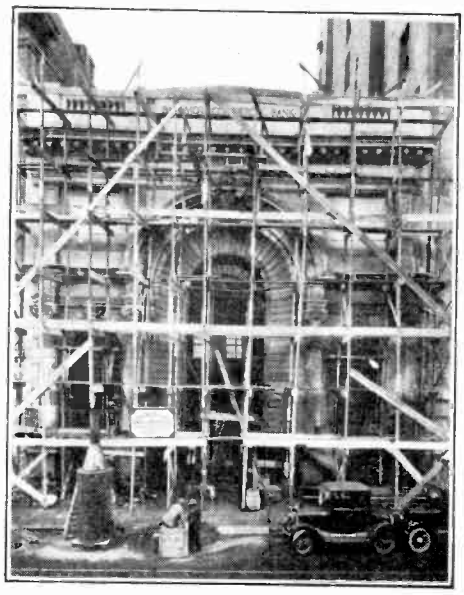
Cleaning Buildings by Steam Restores Surface



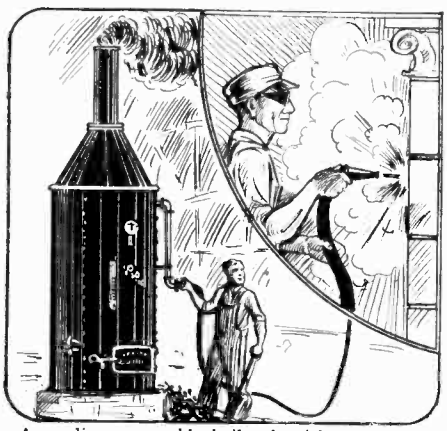
When a building begins to look like the one above, it is high time to "wash its face." The renovator turns on the steam



and the dirt and grim soon disappear. Unlike sand-blast cleaning, this method does not detract from the appearance of age.



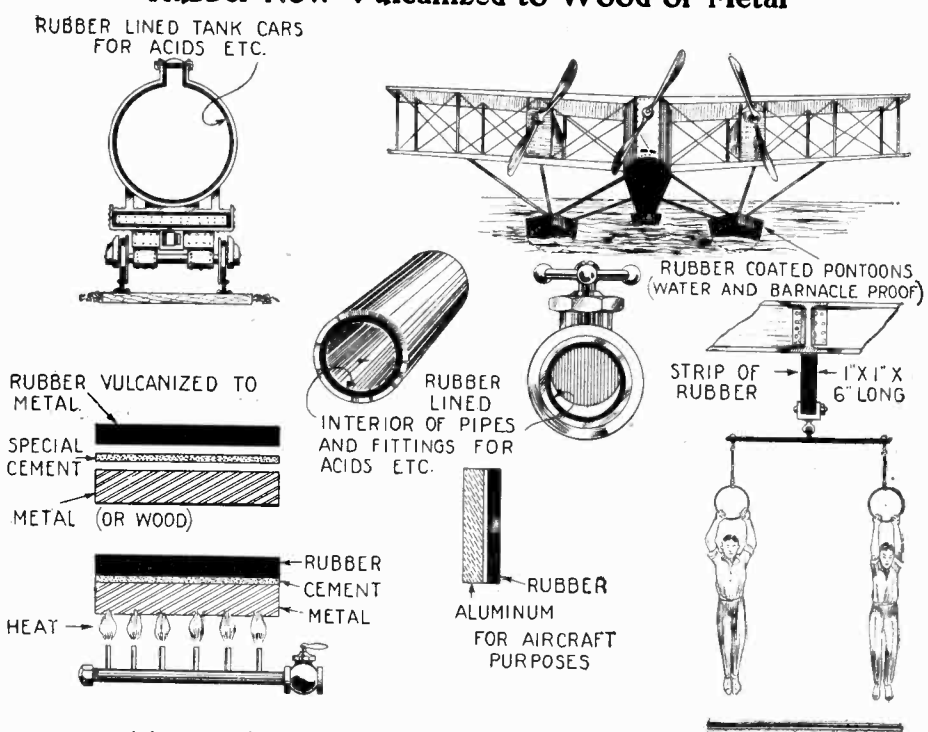
A bank in Baltimore was renovated by the new steam cleaning process.



An ordinary portable boiler furnishes sufficient pressure to remove the grime, and the only attachments needed are standard hose and nozzles made of galvanized pipe.

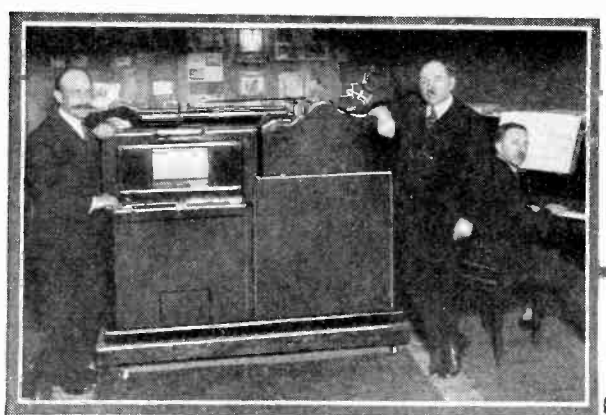
THE use of steam from a boiler blown directly against the stone through a simple nozzle has been found by the Bureau of Standards, Department of Commerce, to be a very effective way to remove dirt from the walls of a stone building. Steam at 80 pounds per square inch, the pressure ordinarily used in small portable boilers, was found very effective in removing 20 years' dirt from the bank building here shown. The desirable appearance of age still remains after treatment.

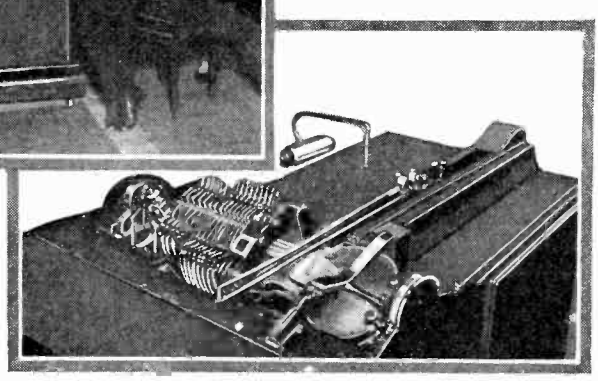
Rubber Now Vulcanized to Wood or Metal



A large manufacturer of tires and rubber goods has developed a new method of vulcanizing rubber of which some applications are shown in the illustrations above. Its usefulness is limited only by the ingenuity of the inventor.

THE engineers of a large rubber concern have evolved, through a series of researches, a new process which permits rubber to be vulcanized to practically any surface desired. A very strong, coherent cement is used between the rubber and the base, and the junction is practically as strong as the rubber itself. An idea of the strength of the vulcanized coat may be inferred from the sketch above, which shows two men suspended from an I-beam, with their weight pulling on a 1 square inch patch which is anchored by the newly-discovered process.





Two European engineers have perfected a device for mechanically reproducing, through the medium of player-rolls, the artistry of the finest violinists. The device is entirely pneumatic, and functions in a manner very similar to that of the automatic player piano. The results are said to be entirely satisfactory, even the bowing being perfect.

"Violonista" Plays from Perforated Roll

MESSRS. Emile Aubry and Gabriel Boreau, distinguished French engineers, have after fifteen years' of painstaking research succeeded in developing a machine which plays the violin with almost human intelligence. It is doubtful if the machine will be received by the musical world, but its very ingenuity and its marvelous reproduction will make it an object of much interest to inventors and musicians interested in mechanical art.

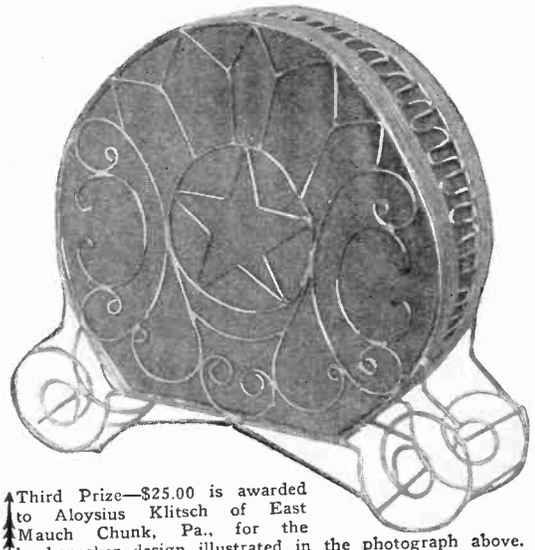
WIREKRAFT $3000.00 IN PRIZES

This photograph shows Miss Renie Hart demonstrating the first prize award in this month's contest. Silk lines the shade, which is held in place by the prong-like arrangement fastened to the top of the bulb.

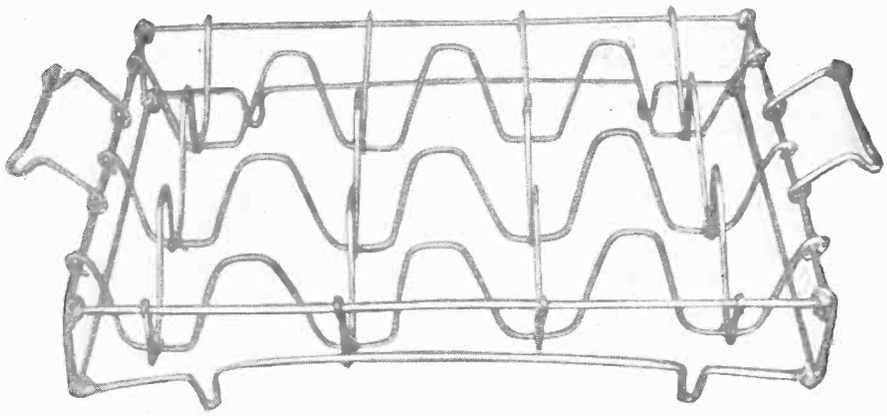
FIRST PRIZE

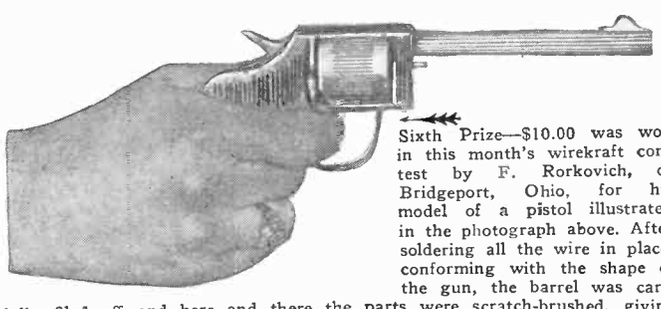
FIRST Prize—$100.00 was awarded in this month's contest to A. Ujihara, of San Francisco, Calif., for the lamp shown in the photograph at the right and also at the left. It will be observed that the wire forming the frame of the lamp has artistic scrolls interposed between alternate pairs of uprights. The same suggestion is carried out in decorating the vase around which the base of the lamp is built. Brass wire was used throughout. This forms an interesting contrast with the opalescent blue green color of the vase. Observe how the base has been extended so as to guarantee sturdiness of construction. The shade itself is affixed to the lamp by means of a four-toothed clasp.

Rather heavy wire was used in the construction of this article and consequently a very rigid lamp is built which will not tip easily and which preserves the artistic value of the vase augmented by the individual touch resulting from the wire scrolls. The article itself is 20 inches high.

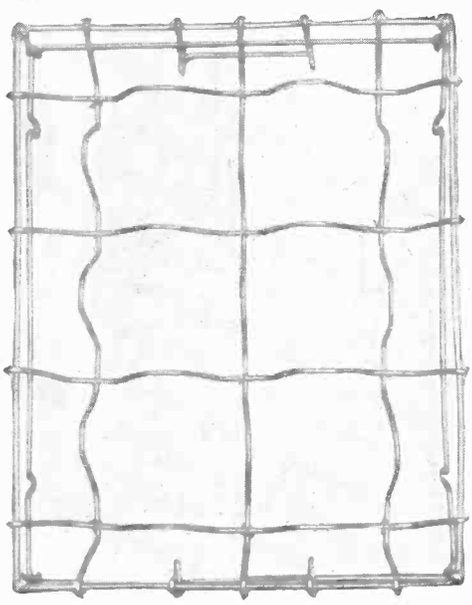


Third Prize—$25.00 is awarded to Aloysius Klitsch of East Mauch Chunk, Pa., for the loud-speaker design illustrated in the photograph above. This consists of a wire drum decorated on both front and back with two surrounding bands of closely soldered wire and a wire lacing between. A receptacle is provided on the rear surface into which the loud-speaking unit may be affixed. The inside of the entire article is lined with silk sewed to the wire framework. The device is a little more than seven inches in diameter.





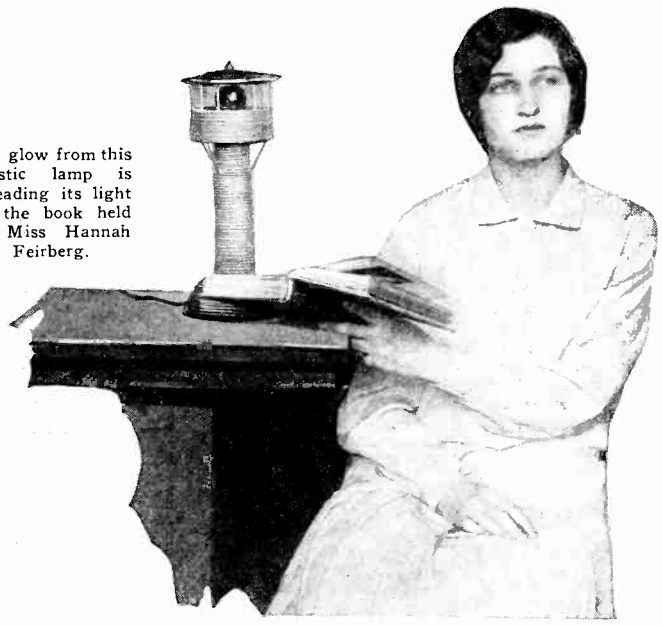
Sixth Prize—$10.00 was won in this month's wirekraft contest by F. Rorkovich, of Bridgeport, Ohio, for his model of a pistol illustrated in the photograph above. After soldering all the wire in place, conforming with the shape of the gun, the barrel was carefully filed off and here and there the parts were scratch-brushed, giving the article a very smooth finish. The trigger of this pistol is not made to operate, the barrel is hollow and spaces are provided for the cartridges.



Fourth Prize — $20.00 was issued to William Caleda, of Vauxhall, N. J., for the potato rack indicated in the photo above and at the left. This potato rack is for use in the cooking of baked potatoes. The potatoes are inserted in the squares formed by the upright wires, and are maintained in such a position that they cannot touch the bottom of the stove, and consequently the danger of burning them is considerably lessened. If it is desired to cut the potatoes, then add the proper quantity of butter, salt, cayenne pepper or other garnishment to the potato, the work may be done in this rack and served directly from it. The article is easily constructed from heavy wire.

More awards on following pages—Rules of Contest on page 82

Further Awards in $3,000.00 Wirekraft Contest



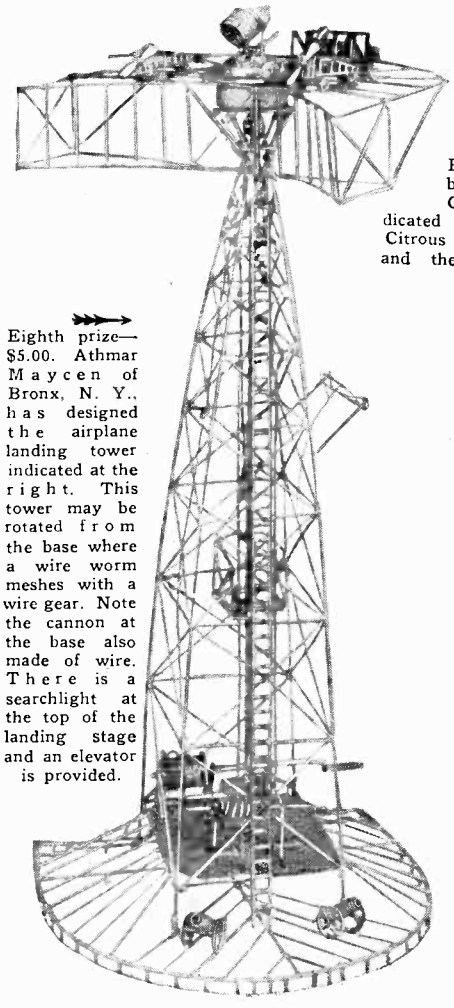
The glow from this artistic lamp is spreading its light on the book held by Miss Hannah Feirberg.

The comparative size of the second prize-winning model may be obtained by examining the photograph above. This is a splendid piece of workmanship, very accurately made. An enlarged view appears at the right.

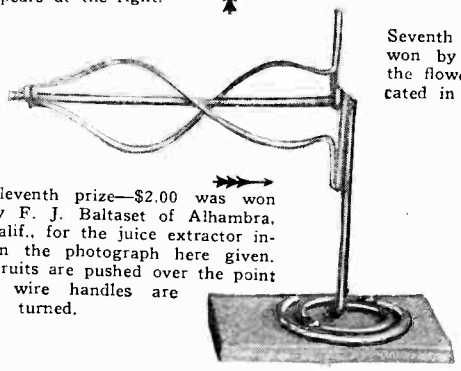
SECOND PRIZE WINNER

Second prize—$50.00 is awarded in this month's contest to Harold Vogt. The second prize is always won by an article of artistic or decorative effect. The judges considered this article to be the most artistic one entered in this contest. There are two bulbs in this lamp, one of which may be seen through the window in the upright standard. Wire curled to resemble sea shells is mounted about the base of the lamp. Colored bulbs are employed in this construction making the glow very soft. Note with what extreme care the wire was wound and soldered.

Access to the bulb at the top is obtained by removing the roof of the lighthouse.

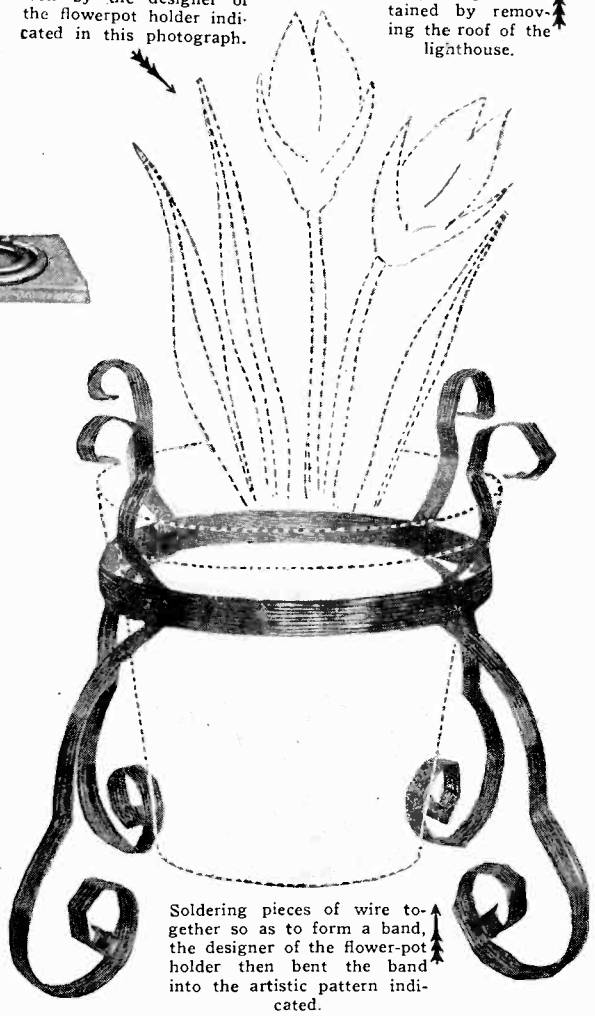


Eighth prize—$5.00. Athmar Maycen of Bronx, N. Y., has designed the airplane landing tower indicated at the right. This tower may be rotated from the base where a wire worm meshes with a wire gear. Note the cannon at the base also made of wire. There is a searchlight at the top of the landing stage and an elevator is provided.

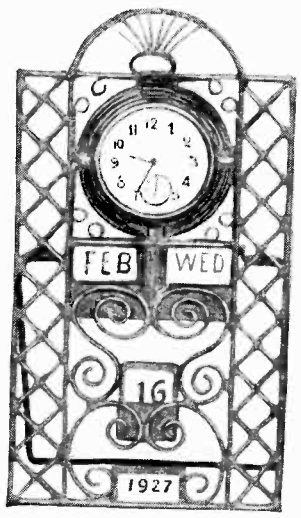


Eleventh prize—$2.00 was won by F. J. Baltaset of Alhambra, Calif., for the juice extractor indicated in the photograph here given. Citrous fruits are pushed over the point and the wire handles are turned.

Seventh prize—$7.50 was won by the designer of the flowerpot holder indicated in this photograph.



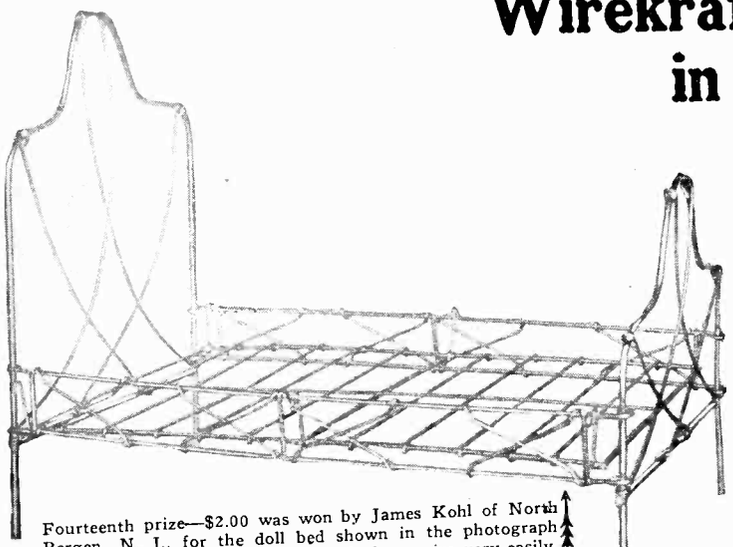
Soldering pieces of wire together so as to form a band, the designer of the flower-pot holder then bent the band into the artistic pattern indicated.



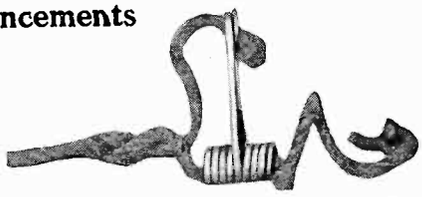
Fifth prize—$15.00 is the award given to E. F. Storz, of Detroit, Mich., for his combination calendar and watch receptacle shown in the photograph above. The watch may be removed from the vest pocket and hooked to the back of the frame. Changeable dates are provided for the calendar.

Wirekraft—$3,000.00 in Awards

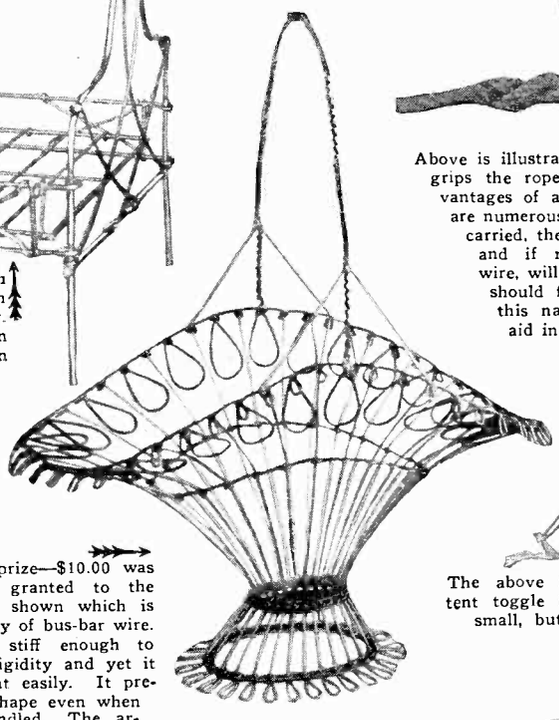
Concluding this Month's Prize Announcements



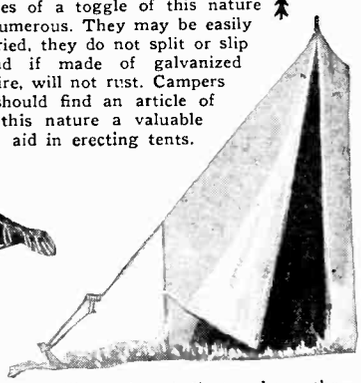
Fourteenth prize—$2.00 was won by James Kohl of North Bergen, N. J., for the doll bed shown in the photograph above. Dolls' furniture can be made from wire very easily. It is serviceable and when bent, or roughly handled, can be again straightened by the aid of a pair of pliers. On removing the springs, the entire bed folds up.



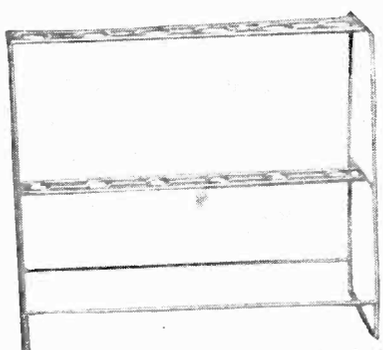
Above is illustrated a tent toggle which grips the rope very firmly. The advantages of a toggle of this nature are numerous. They may be easily carried, they do not split or slip and if made of galvanized wire, will not rust. Campers should find an article of this nature a valuable aid in erecting tents.



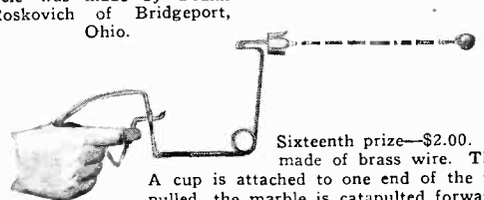
Thirteenth prize—$10.00 was the award granted to the basket here shown which is made entirely of bus-bar wire. Bus-bar is stiff enough to guarantee rigidity and yet it may be bent easily. It preserves its shape even when roughly handled. The article was made by Frank Roskovich of Bridgeport, Ohio.

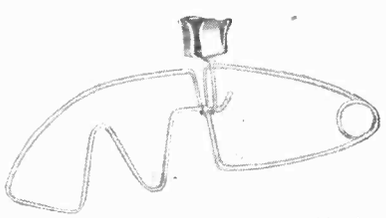


The above illustration indicates how the tent toggle is used. The article is quite small, but yet grips the rope firmly.

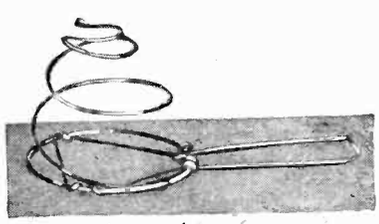


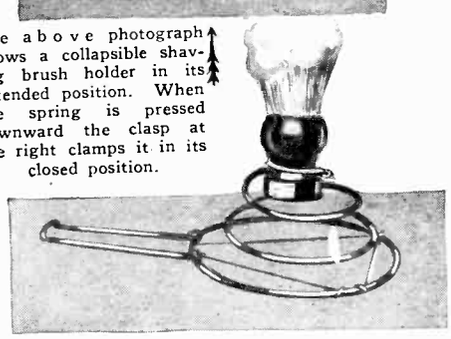
Twelfth prize—$2.00 was won by the designer of the test tube rack here shown. This article was built by A. L. Janora of Nanticoke, Pa. Space for six test tubes is provided in this rack which, being made of copper wire, will not rust under ordinary laboratory conditions. The device is very sturdy.





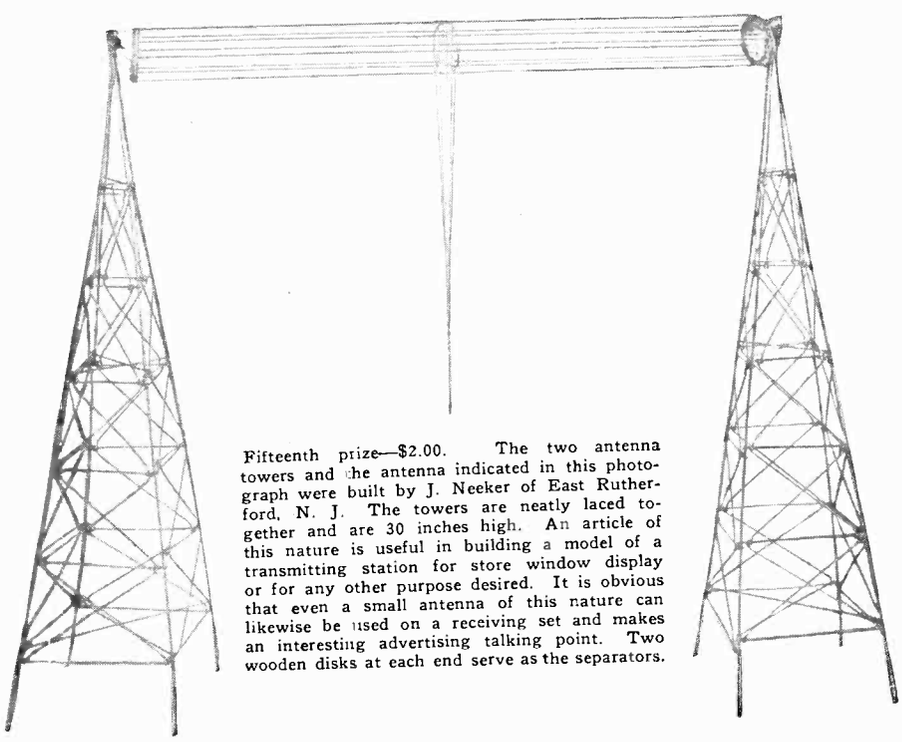
Sixteenth prize—$2.00. The two illustrations above show a marble shooter made of brass wire. This wire is used because of its spring-like nature. A cup is attached to one end of the wire to receive the marble. When the trigger is pulled, the marble is catapulted forward. The article was designed and constructed by R. J. Walker, of San Francisco.





The above photograph shows a collapsible shaving brush holder in its extended position. When the spring is pressed downward the clasp at the right clamps it in its closed position.

Ninth prize—$3.50. A. Baessler, of Manila, P. I., designed the collapsible shaving brush holder indicated in the photograph above. The shaving brush is clamped in a jaw-like arrangement at the top of the brush holder. When the user is through with the article, he collapses the shaving brush holder. The clamp shown at the left is then sprung down over the rim. The entire article is very compact and ideal for the traveling man and if desired, may be hung up and used in this position.

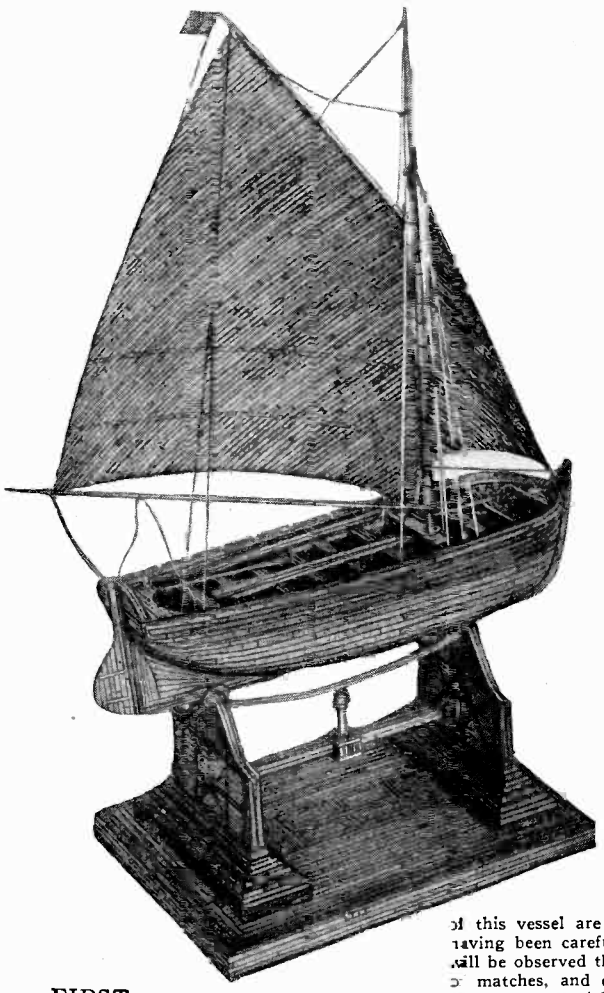


Fifteenth prize—$2.00. The two antenna towers and the antenna indicated in this photograph were built by J. Neeker of East Rutherford, N. J. The towers are neatly laced together and are 30 inches high. An article of this nature is useful in building a model of a transmitting station for store window display or for any other purpose desired. It is obvious that even a small antenna of this nature can likewise be used on a receiving set and makes an interesting advertising talking point. Two wooden disks at each end serve as the separators.

(For Wirekraft Rules See Page 82)

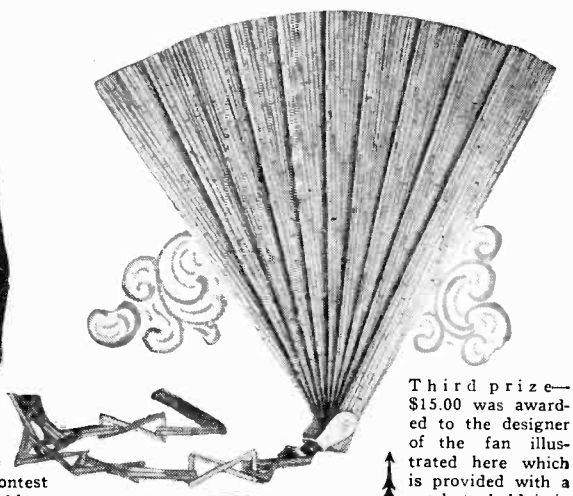
MATCHCRAFT

$100.00 Awarded Monthly



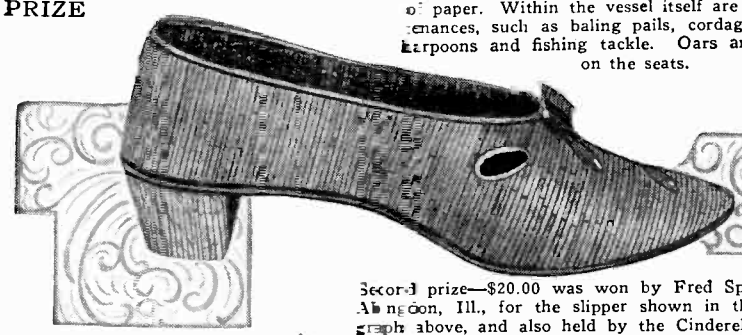
FIRST PRIZE

First Prize — $50.00 was awarded in this month's contest to Raphael Gueril of Brooklyn, N. Y., for the boat equipped with a sail indicated in the photo at the left. The model is being held by Miss Lee Felsher.

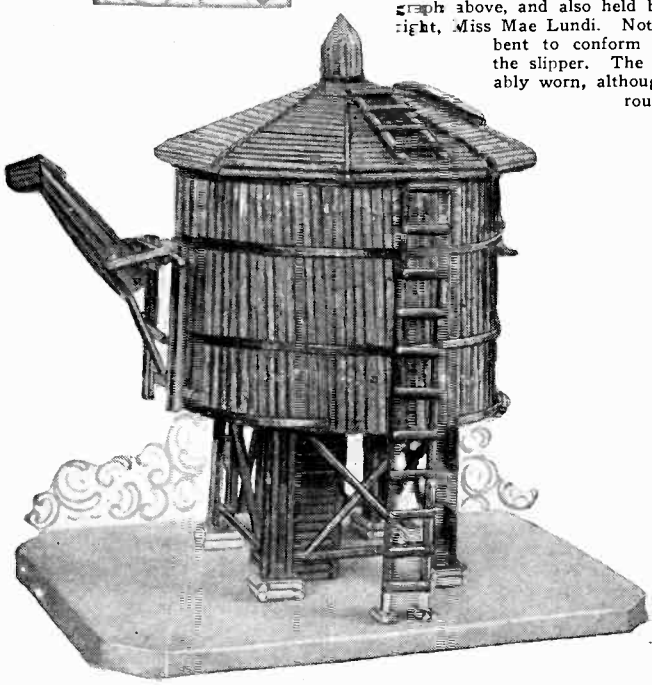


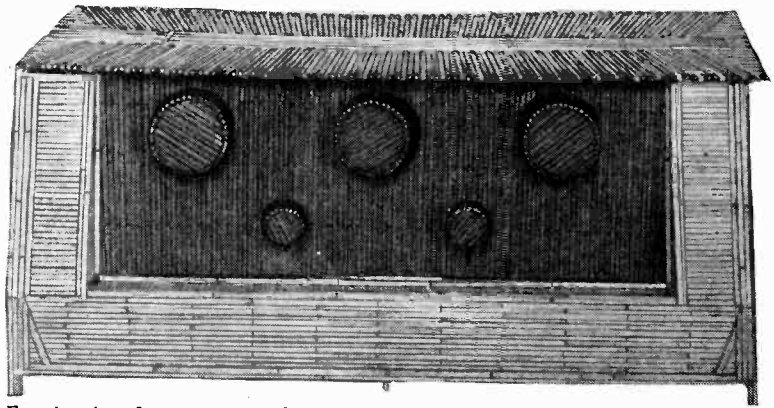
Third prize—$15.00 was awarded to the designer of the fan illustrated here which is provided with a catch to hold it in a closed position, and also has a match chain. Its designer did not send his name.

Here we see the very interesting example of matchcraft. The sails of this vessel are less than one-sixteenth inch thick, having been carefully sandpapered on both sides. As will be observed the sails themselves are made entirely of matches, and even the flag at the tip is made of the same material but is of the thickness of a sheet of paper. Within the vessel itself are various appurtenances, such as baling pails, cordage, boat hooks, harpoons and fishing tackle. Oars and paddles lay on the seats.



Second prize—$20.00 was won by Fred Spinden, of Abingdon, Ill., for the slipper shown in the photograph above, and also held by the Cinderella at the right, Miss Mae Lundi. Notice how the matches are bent to conform with the dimensions of the slipper. The article may be comfortably worn, although it will not stand any rough usage.





Fourth prize—$10.00 was awarded to the designer of the radio set illustrated in the photograph above. This unique set was made by Harold Burrill of Brooklyn, N. Y. Observe the five matchcraft controls. This set is twelve inches long and five inches high, the panel being recessed. The heads of the matches were left in place on the cover, so as to produce a beadlike effect on the edge. It is advisable that all matchcrafters soak the heads of the matches from the sticks to prevent possible fire hazards. "At the water tower" may be an appropriate title for the name of the article illustrated at the left, for which Mr. Lyndon Lee Donahey, of Pittsburgh, Pa., received the fifth prize of $5.00.

Rules for the Matchcraft Contest appear in this issue on page 94

The Biography of a Star

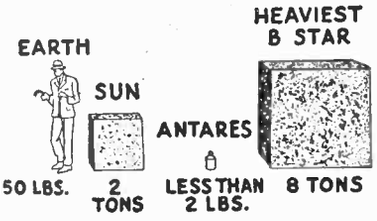
By W. J. LUYTEN,
OF THE HARVARD COLLEGE OBSERVATORY

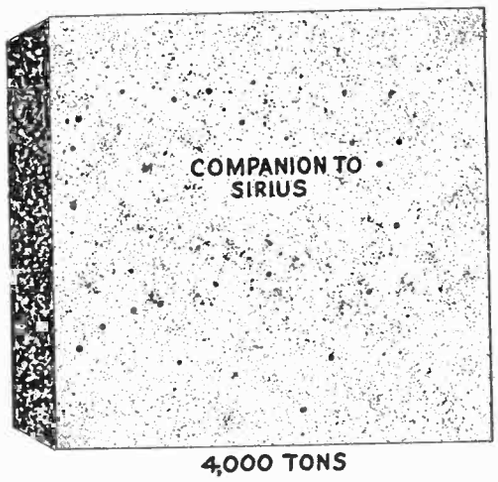
HOW is a star born? How long does it live? How and why do they die? These and other questions have troubled astronomers ever since they began considering the stars as individual citizens of the Cosmos rather than as mere idle points of light. And now the spectroscope has told us that there are different kinds of stars, large red stars, of great brilliance, and small red stars of but feeble radiance, white stars, 100 times more luminous than the sun, and even some blue stars several thousand times brighter than the sun. Now that the interferometer and the radiometer have furnished us with more clues about the sizes and the total energy output of the stars it is high time that we give ourselves account of what we really know about evolution in the universe.

The first facts came from abroad, from Sir Norman Lockyer in England, and especially from Hertzsprung in Denmark. As early as 1906 Hertzsprung pointed out that whereas the white stars and blue stars are not very different in brightness among themselves, the yellow and red stars show tremendous contrasts. The bright red stars Betelgeuse in Orion and Antares in the Scorpion are hundreds and probably thousands of times brighter than the sun; a faint star, No. 61 in the constellation the Swan, and numerous other stars all over the sky, too faint to be seen with the naked eye, are all red but much fainter than the sun. Accordingly Hertzsprung termed the former stars "Giants" and the latter "Dwarfs." That this meant not only that they were more luminous but also much larger in size he proved, by calculating, in 1906, the actual size of Arcturus, a bright yellow star (which calculation was verified by observation in 1921). Soon after this, in 1911, Hertzsprung again came with new evidence, he had observed the colors of stars in the Hyades, that V-shaped group of stars in the constellation the Bull, and found that the majority of the stars followed the rule that they became less brilliant as they deepened their color from white through yellow to red, but that there were a few stars that did not conform to this rule: these were again the yellow giants, of the same class as Arcturus. He even suggested that the stars might be arranged in two "color-lines," one color line where all the "Giants' belonged, because for these the brilliance seemed to be independent of the color; and one line which takes in all the dwarfs, and which connects decreasing luminosity with increasing color, and therefore with decreasing temperature, since, as we all know, a red hot piece of iron is cooler than a white hot one. Then, in 1913 came Russell with a theory trying to explain this behavior of the stars. According to his theory a star begins its life as a huge red star, of the type of Betelgeuse, it then contracts, and heats up doing so, runs through the stages of a yellow giant, and a white giant, until it reaches the apex of its career in the disguise of a blue giant. From then on, although the star continues to decrease in size, it can no longer maintain its terrific heat and begins to cool off; it goes through the stages of being a yellow dwarf, similar to the sun, then becomes a small, faint red dwarf, and expires. The red dwarf stage is the last chapter in its history, after that the dead body may still exist, its coffin may still be traveling through the universe, it has ceased to be a star.

Unfortunately this theory has been proved not to hold water, especially so since Eddington's researches have shown that it is the mass of a star which principally determines its future career. Eddington attacked the problem in quite another way, and showed that a star is not just a mass of glowing gas held together by the force of gravitation, but on the contrary, there is another force which keeps pulling it apart, viz., the pressure of light. This force which is quite small and insignificant for stars of the size of the sun, reaches great strength for stars much heavier than the sun, until, in stars five hundred times heavier than the sun, it becomes preponderant and breaks up the star. No gravitational pull is then able to hold the star together: it blows up simply because it is heavy. This sounds like a paradox: for very heavy stars, stars which have great weight, the force of gravitation which produces all "weight," becomes so small compared with the pressure of light that the star collapses. Yet it is quite true, and supported by the facts: we know of not one star more than one hundred times as heavy as the sun. It seems as if here we have found one of the ten commandments for the behavior of the stars: *Thou shalt not be heavy.*

A man weighing 150 pounds on earth, would collapse on the sun, borne down by his increased weight of two tons; on the surface of Antares he would register no more than one or two pounds; on the heaviest, most weighty B-type star he would weigh eight tons. But on the little companion to Sirius, that densest of all stars, his weight would be 4,000 tons, equal to that of a block of iron 26 feet long, 26 feet wide, 26 feet high.





Since Hertzsprung's first survey of the field, one more class of star has been added to his collection of giants and dwarfs viz., the white dwarfs, stars similar to the famous companion of Sirius. These are very small stars, not much larger than the earth, at very high temperatures and exceedingly heavy, or, as we say, of very great density. The companion to Sirius, e.g., weighs over a ton per cubic inch on the average! At present we know four of these stars, and although their existence has been proved beyond doubt by observations, and the possibility for existence demonstrated theoretically by Eddington, we don't yet know *why* they should exist. Another problem about them is how many of them are there? We know only four, to be sure, but it is quite possible, and indeed probable that if we went fishing for them in space as a whole, they would be more numerous than any other class of stars, and the only reason we do not find more of them is that they are so faint that they very easily escape detection.

Still we do not know how a star is born, we have never witnessed it and we are not likely to. True enough, we have from time to time seen the outburst of a new star, a temporary addition to our sky. But here it is only a catastrophe that transforms an ordinary star into a "supergiant," thou-

(*Continued on page* 79)

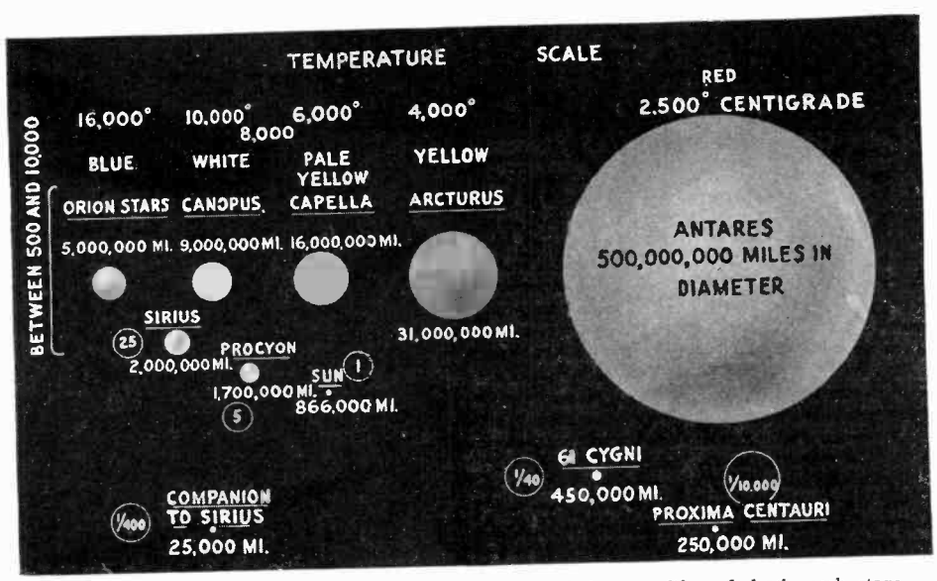
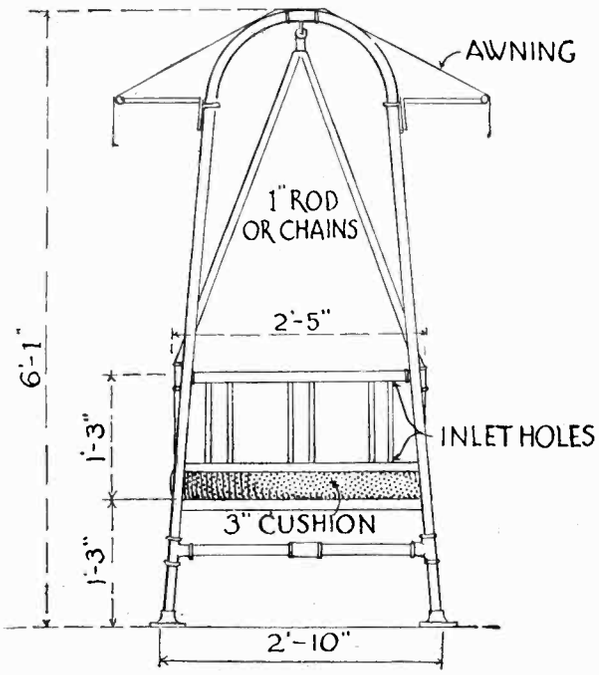
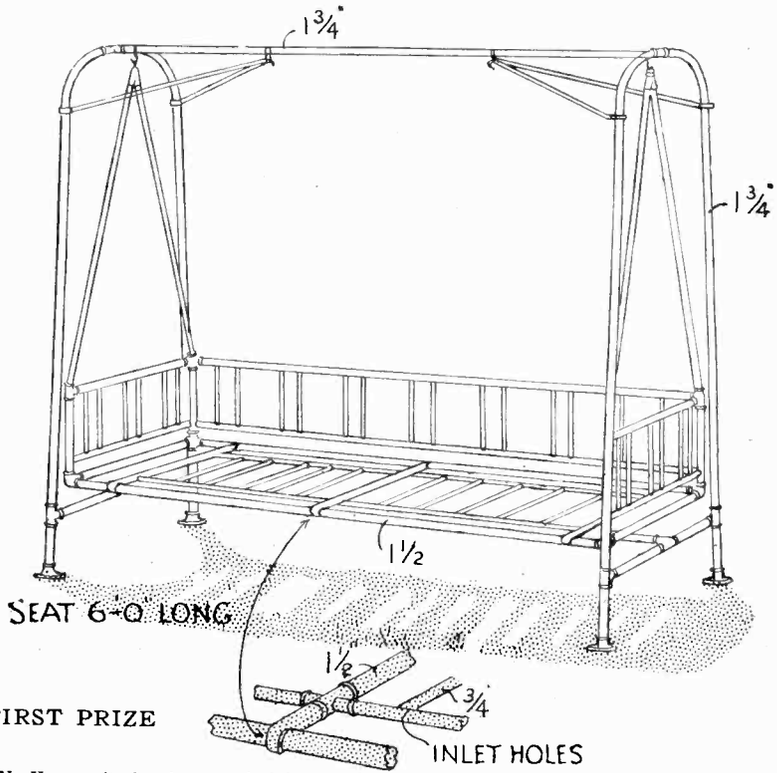


Diagram showing the various stages a star passes through between life and death, each stage being indicated by a typical, well-known star. For each stage are given: The diameter in miles; the temperature and therefore the color; the total output of light, taking that of the sun as a unit. (These are the numbers in circles as (25) for Sirius.)

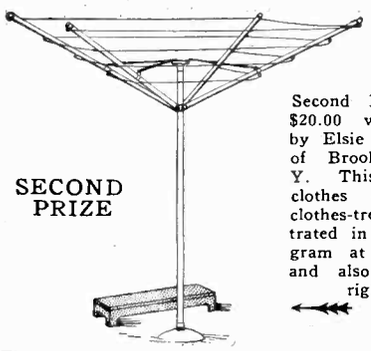
Awards in $100.00





FIRST PRIZE

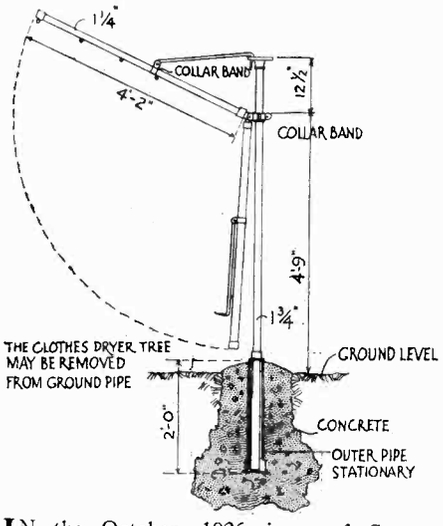
First Prize—$25.00 was won by Ferdinand L. Holly of Brooklyn, N. Y., for the porch swing illustrated in the diagram above. This is made almost entirely from pipe fittings and if the pipes are enameled in some of the pastel shades so popular today it makes a very serviceable swing. This swing could be used in the garden by providing it with an awning as shown. The horizontal pipes of the swing seat are drilled so as to permit the short vertical bars to be inserted in the holes. A leather cushion should preferably be employed for outdoor use, although some of the fabric coverings may be found even more durable and more artistic because they can be obtained in a variety of colors. Fabric coverings are also less expensive.



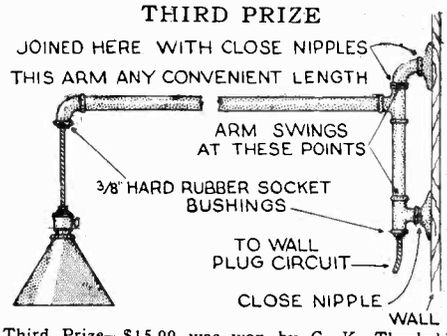
SECOND PRIZE

Second Prize—$20.00 was won by Elsie J. Holly of Brooklyn, N. Y. This is the clothes drier or clothes-tree illustrated in the diagram at the left and also at the right.

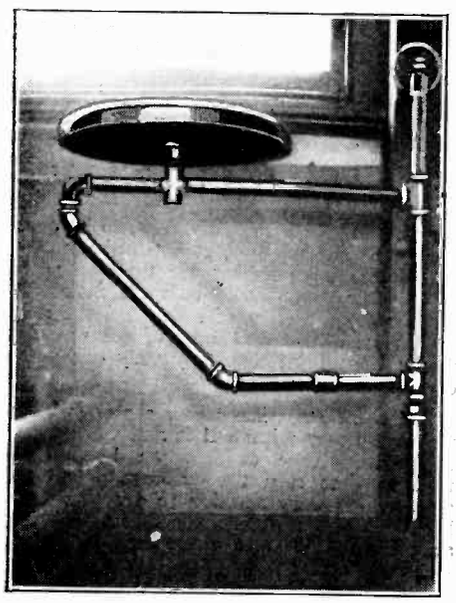
The clothes-tree illustrated at the right and above may be removed from the ground pipe when desired, thus preserving the appearance of the lawn. Be sure to plug the open end of the ground pipe.



THIRD PRIZE



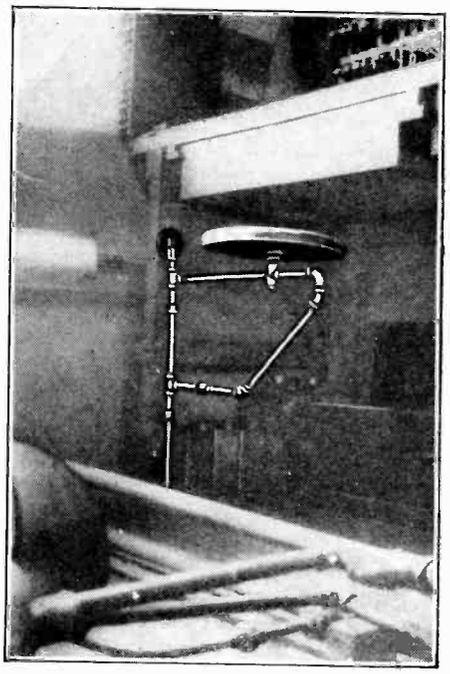
Third Prize—$15.00 was won by C. K. Theobald of McAllen, Texas, for the adjustable swinging bracket shown here.



FOURTH PRIZE

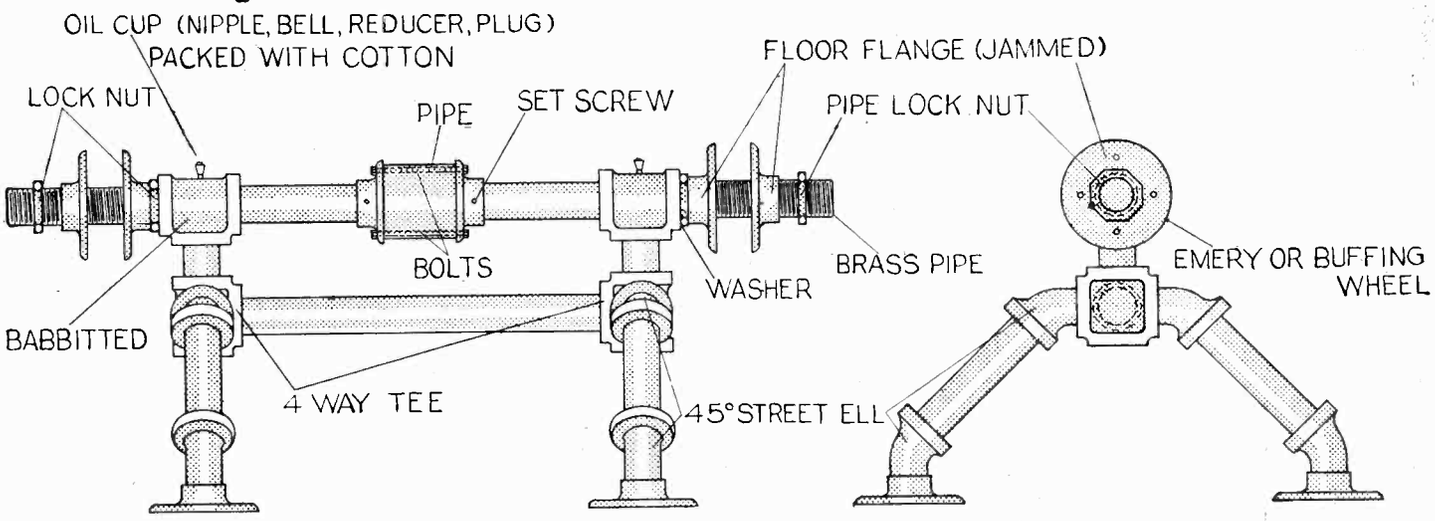
IN the October, 1926, issue of SCIENCE AND INVENTION Magazine an announcement of a Pipe Contest was made. Ten prizes were to be awarded for articles that could be made of iron or other pipe. A number of suggestions were given in the original article and on this and the accompanying page we find the prize-winning ideas. The first prize is a porch swing, the constructional details of which are given at the top of this page. A very clever clothes drier, which is collapsible and which may be removed from its concrete foundation, won the second prize. This is indicated in the diagram immediately above. Full constructional details may also be found. The third prize was awarded for an adjustable swinging bracket, which if made of brass or nickel-plated pipe will be quite artistic.

Fourth Prize—$10.00 was awarded to George A. Hogan of Augusta, Me., for the swinging stool adapted to fit under the kitchen sink and illustrated in the photographs at the left and right.



FOURTH PRIZE

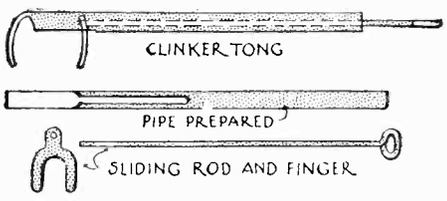
Prize Pipe Contest



FRAME CONSTRUCTED OF IRON AND FITTINGS

GRINDER AND BUFFER

Fifth Prize—$5.00 was awarded to Harrison L. Ketchan of Oakland, Calif., for a buffing and grinding head indicated in the diagram above. The bearings in this grinding head are babbitted so as to give a true surface. The pipes employed in the construction are screwed together tightly so as to guarantee rigidity. No dimensions are given because the article may be made for different sources of power and for many purposes.

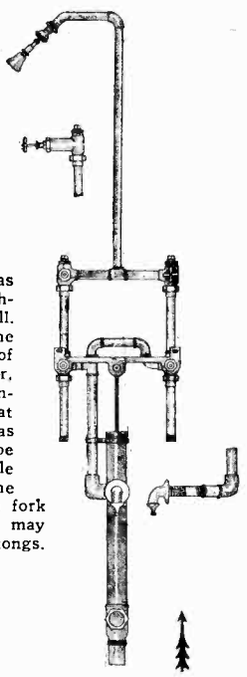


The fourth prize was awarded to the designer of a swinging stool, which may be fitted under the kitchen sink or may be attached to the leg of a sturdy table. This stool if enameled with white enamel and if the pipes comprising its standard are similarly treated, is very valuable to the busy housewife. The fifth prize was awarded for a buffing and grinding head and the sixth for clinker tongs which can be quickly constructed and which will benefit the homeowner.

Further awards will be found on page 68.

CLINKER TONG

Sixth Prize — $5.00 was won by Ernest E. Worthington of Rockford, Ill. In these clinker tongs the designer has used a pipe of about 1 inch in diameter, and has cut the end as indicated in the diagram at the left. The pipe was then slotted. Another pipe was provided with a handle and was pushed into the prepared pipe. To this a fork is affixed. Hot clinkers may be grasped with these tongs.

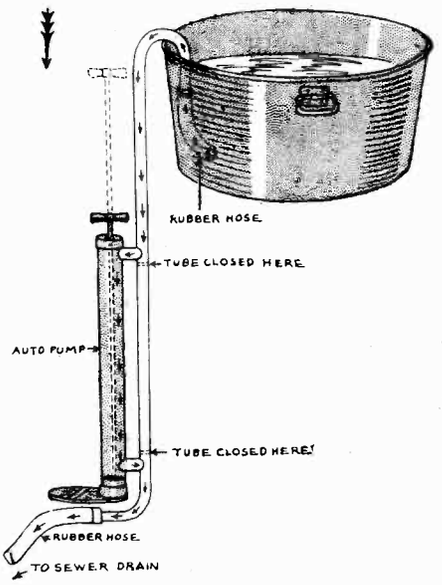


SHOWER BATH

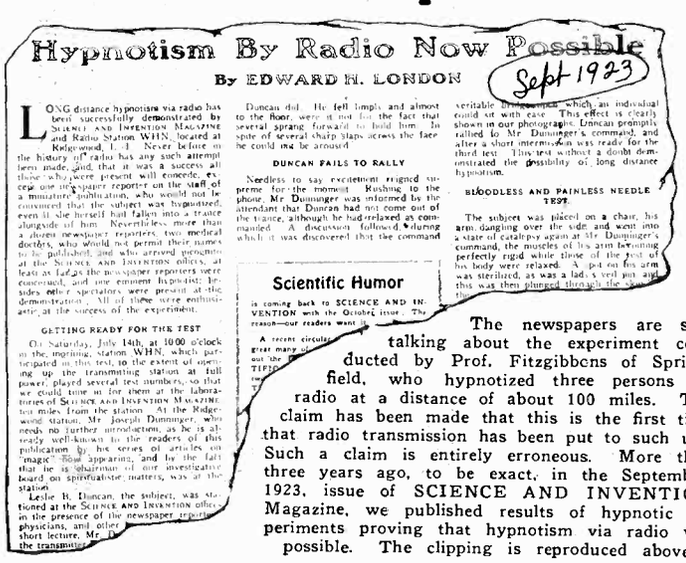
Seventh Prize—$5.00. Fred Spindon of Abingdon, Ill., designed the shower bath illustrated in the diagram above. This is made entirely of pipe fittings.

SIPHON PUMP

Eighth Prize—$5.00 was awarded to Wilson G. Walters, Rep. No. 6385, located at Rochester, N. Y. This is a siphon pump. When the handle of the pump is pushed down, the partial vacuum produced starts the siphon, which continues to flow.



Another Scoop Scored



Hypnotism By Radio Now Possible

By EDWARD H. LONDON

Sept 1923

LONG distance hypnotism via radio has been successfully demonstrated by SCIENCE AND INVENTION MAGAZINE and Radio Station WHN, located at Ridgewood, L. I. Never before in the history of radio has any such attempt been made, and that it was a success all those who were present will concede, except one newspaper reporter on the staff of a minature publication, who would not be convinced that the subject was hypnotized, even if she herself had fallen into a trance alongside of him. Nevertheless more than a dozen newspaper reporters, two medical doctors, who would not permit their names to be published, and who arrived promptly at the SCIENCE AND INVENTION offices, at least as far as the newspaper reporters were concerned, and one eminent hypnotist, besides other spectators, were present at the demonstration. All of these were enthusiastic at the success of the experiment.

GETTING READY FOR THE TEST

On Saturday, July 14th, at 10:00 o'clock in the morning, station WHN, which participated in this test, to the extent of opening up the transmitting station at full power, played several test numbers, so that we could tune in for them at the laboratories of SCIENCE AND INVENTION MAGAZINE, ten miles from the station. At the Ridgewood station, Mr. Joseph Dunninger, who needs no further introduction, as he is already well-known to the readers of this publication by his series of articles on "magic" now appearing, and by the fact that he is chairman of our investigative board on spiritualistic matters, was at the station.

Leslie B. Duncan, the subject, was stationed at the SCIENCE AND INVENTION office, in the presence of the newspaper reporters, physicians, and other [illegible] short lecture, Mr. [illegible] the transmitting

Duncan did. He fell limply and almost to the floor, were it not for the fact that several sprang forward to hold him. In spite of several sharp slaps across the face he could not be aroused.

DUNCAN FAILS TO RALLY

Needless to say excitement reigned supreme for the moment. Rushing to the phone, Mr. Dunninger was informed by the attendant that Duncan had not come out of the trance, although he had relaxed as commanded. A discussion followed, during which it was discovered that the command

Scientific Humor

is coming back to SCIENCE AND INVENTION with the October issue. The reason—our readers want it.

A recent circular [illegible] great many [illegible] out the [illegible] TIFIC [illegible]

veritable [illegible] which an individual could sit with ease. This effect is clearly shown in our photograph. Duncan promptly rallied to Mr. Dunninger's command, and after a short intermission was ready for the third test. This test without a doubt demonstrated the possibility of long distance hypnotism.

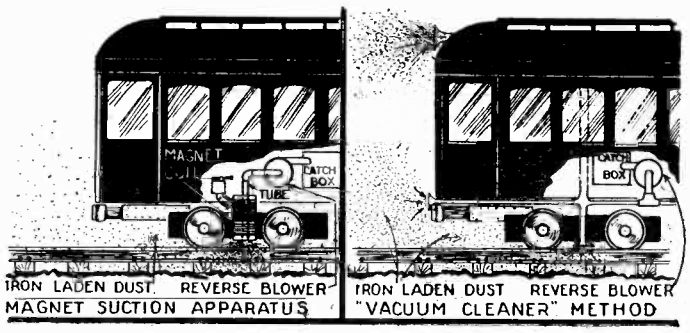
BLOODLESS AND PAINLESS NEEDLE TEST.

The subject was placed on a chair, his arm dangling over the side, and went into a state of catalepsy again at Mr. Dunninger's command, the muscles of his arm becoming perfectly rigid while those of the rest of his body were relaxed. A spot on his arm was sterilized, as was a lady's veil pin and this was then plunged through the skin

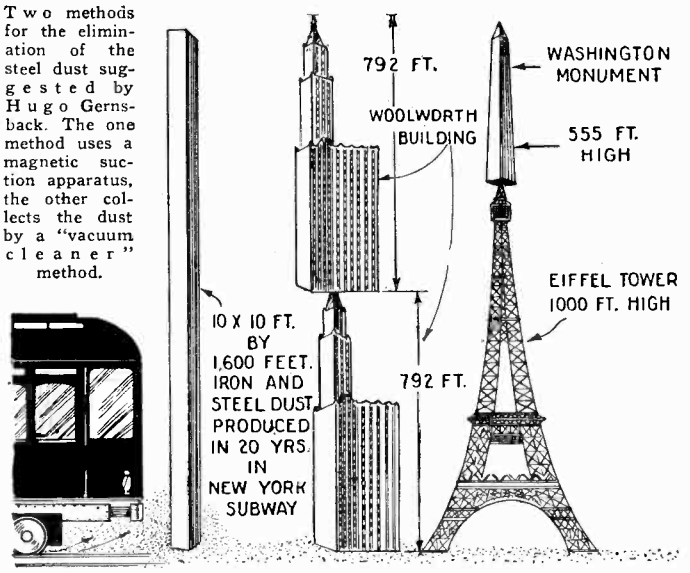
The newspapers are still talking about the experiment conducted by Prof. Fitzgibbons of Springfield, who hypnotized three persons by radio at a distance of about 100 miles. The claim has been made that this is the first time that radio transmission has been put to such use. Such a claim is entirely erroneous. More than three years ago, to be exact, in the September, 1923, issue of SCIENCE AND INVENTION Magazine, we published results of hypnotic experiments proving that hypnotism via radio was possible. The clipping is reproduced above.

Two of the three recent subjects hypnotized and being gently pricked with needles.

Steel Subway Dust

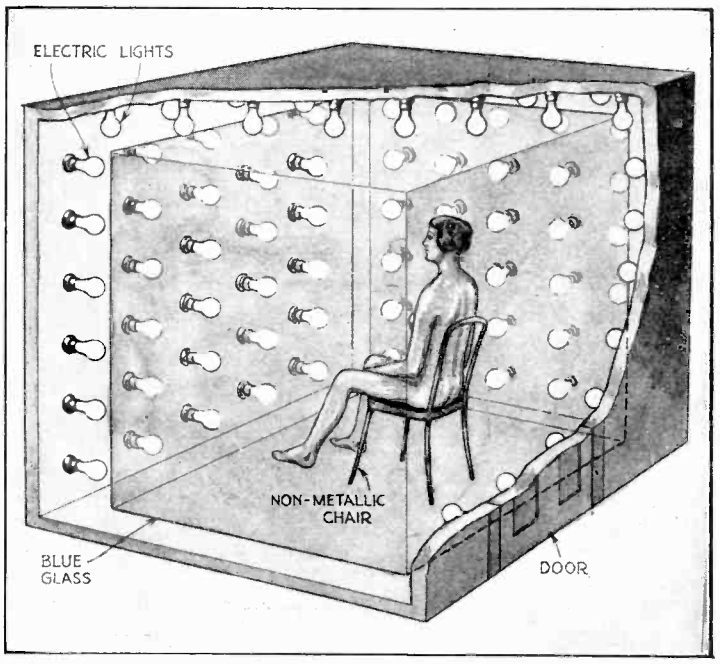


Two methods for the elimination of the steel dust suggested by Hugo Gernsback. The one method uses a magnetic suction apparatus, the other collects the dust by a "vacuum cleaner" method.



The steel dust produced in the New York Subway over a period of twenty years is enormous.. A survey conducted in 1905-1907 by Dr. George A. Soper showed, after a microscopic and chemical examination, that the subway dust is composed of 61.3% iron. It was estimated that one ton of brake shoes were ground up in every mile of subway every month.

New Sunshower Bath



Dr. Charles B. Paterno recently brought the sunshower bath to this country from Italy. The bath room is fitted with batteries of electric light bulbs made of blue glass or a blue glass shield is placed immediately in front of the lamps. It is claimed that "grouches" and "bald heads" are cured by this mode of "bathing."

The Astrology Humbug

By JOSEPH H. KRAUS

Further Letters From Our Readers and Our Answers

OUR VIEW CORRECT?

Editor, SCIENCE AND INVENTION:

Having noticed the articles on Astrology in the past two or three issues of SCIENCE AND INVENTION, I feel inclined to express my views on the matter as you appear to solicit such opinions from readers.

I fully agree with your arguments on the subject and it is absolutely incomprehensible to me that any human being of intelligence should consider the absurd claims of astrologers as deserving of serious thought. My attention was first attracted to the subject when some time ago I noticed in the street small pamphlets on which were printed in large letters, "Were you born in July," "Were you born in August," and so on through the twelve months of the year and for the modest sum of a quarter you learn your future, what to guard against through life, etc., via the stars. From this it most certainly appears that there are just twelve kinds of people inhabiting this sphere, one for each month. Of course, many of your readers will say that this sort of thing is "low-class" astrology, but for all that it is of about the same degree of accuracy. It seems to me that about five minutes of careful thought should be enough to banish any doubt in a person's mind about astrology. Once in a while an astrologer will make a good guess if he be a good student of human nature. Then does his victim firmly and with unshakable faith proclaim the power of the stars to his friends. Truly, Caesar was right; men believe what they like to believe.

I would suggest that the editors, if they have not already done so, read the chapter on astrology in the book "Foibles and Fallacies of Science, An Account of Celebrated Scientific Vagaries," by Daniel W. Hering, Ph.D., Professor of Physics of the Graduate School in New York University This chapter closes with the following statement: "Astrology proceeds upon one of the most complete and highly refined systems ever devised, and that is sufficient to make it fascinating without any necessity for correctness in its principles." In this book we also find the following: "From 1915 to 1920 the English astrological almanacs, Zadkiel's and Raphael's, were rich in data connected with the war. Each year they published predictions for the next one and called attention to many of the preceding year that had been fulfilled. The predictions cited in Zadkiel's for 1917 are in vague terms, but the fulfillment is shown in specific, precise instances of victory or misfortune for the central powers. Raphael took a longer chance and predicted the death of the Kaiser in 1917, and in 1918 he makes a rather limping excuse on the failure of the arch-enemy to comply with the prediction.

"It was a favorite practice of astrologers to call themselves Philomaths, and the more pronounced their charlatanry, the more they resorted to fictitious titles to bolster up their pretentions." And again: "A recent American treatise on Astrology contains the horoscopes of numerous prominent persons of today, but their interpretations are guarded in expression. As an example, in the horoscope of Albert, King of Belgians: "Uranus in the second house in opposition to Venus in the ninth house shows the *loss of fortune through idealism, although the exaltation of Venus in the mid-heaven would presage the victory of those same ideas.*" Has that not been found literally correct? In the first issue of Poor Richard's Almanac is a prediction of similar tenor in the weather forecast for January 7 and 8: "Snow *if not too warm* about this time." Very illuminating indeed. The treatise mentioned above is "Stars of Destiny," by Katherine Taylor Craig, New York, 1916.

Professor Hering continues: "As related to astronomy, astrology is neither parent, child, sister, nor handmaid; rather it is like a cuckoo in a sparrow's nest. Wallenstein, the Field Marshal of the Imperial armies in the Thirty Years' War, relied much upon his astrologer whom he kept always at hand. Evidently, however, he failed to warn the general of his assassination which occurred at Eger in 1634."

Thomas Watson says of the French King Charles the Wise (1364 to 1380), "For all his wisdom, Charles was a firm believer in astrology, and a state astrologer was one of the honored and salaried officials of his administration. It was this man's sworn duty to tell the King what was going to happen, in order that if he desired the King *might take steps to prevent it from happening.* (Story of France, Vol. 1, p. 221). If he foretold disaster and it came, fate was inexorable; if it did not, it was averted by the measures which his royal master put into effect by reason of the timely warning, and the seer and his wonderful science were alike vindicated. In the middle ages an astrologer was a royal

(*Continued on page* 82)

$6,000.00
For Proofs of Astrology

SCIENCE AND INVENTION Magazine holds that there is nothing scientific in Astrology, that Astrology is not a science and that statements made by astrologers unless very general cannot be entertained seriously.

Accordingly, this publication has decided to award an Astrology Prize of $6,000 for the following:

$5,000 will be paid to the astrologer or forecaster who will foretell three major events of such a nature that he will have no control over the outcome of the same. He must describe in advance each event in detail, giving the location and result or the casualties if the event is an accident.

$1,000 will be paid to the astrologer or forecaster who will produce three accurate, detailed and perfect horoscopes, free of contradictions on the lives of three people whose initials will be given him when he requests the same and the birth dates and place of birth will also be supplied by this office.

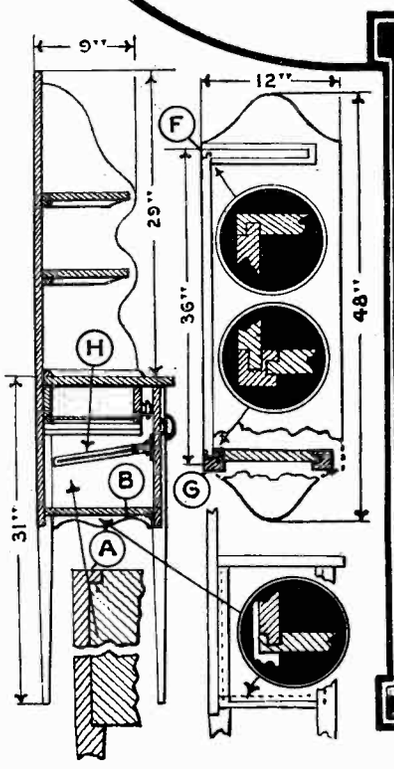
This contest closes October 1st, 1927, and all entries must reach us by that time. In event of a tie, prizes of an identical nature will be given those so tying.

Address all entries to Editor, Astrology, care of SCIENCE AND INVENTION Magazine, 230 Fifth Avenue, New York, N. Y.

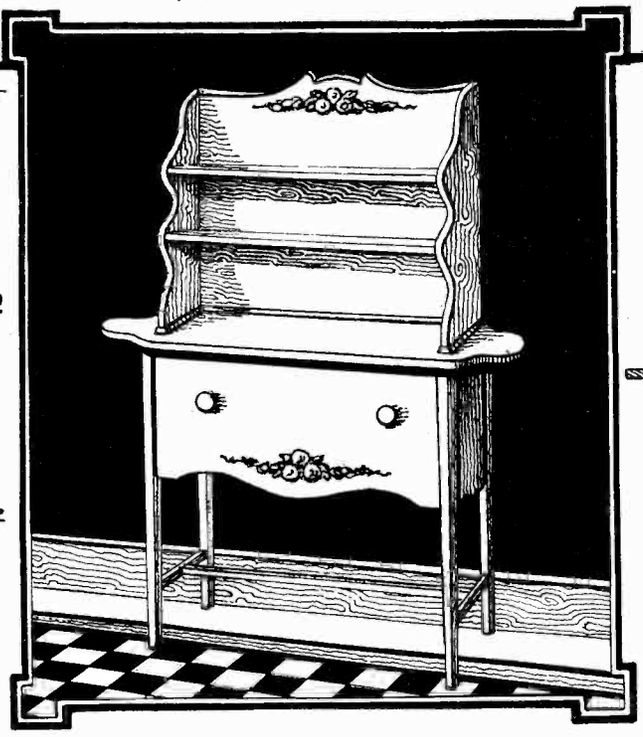
Home Mechanics

HOW TO MAKE A WELSH CABINET

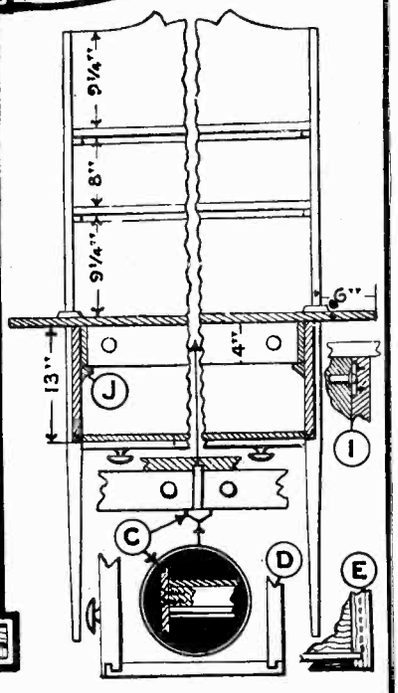
By W. M. BUTTERFIELD



The side view of the cabinet showing the details of the shelves and angles.



The popular Welsh cabinet may be constructed at a small cost and the finished product is useful as well as ornamental.



The front view of the cabinet showing the constructional details of the drawers.

THE Welsh cabinet has become almost as popular as the Welsh rarebit, and has quite as much to do in a way with the gastronomic desires of its owner, for the historic dish of melted cheese and toast, in satisfying the hunger of a merry, round-faced Welshman was served on pewter plates, with mugs for his ale, that were undoubtedly displayed, when not in use, upon the exact counterpart of this modern day favorite; furthermore, it is likely that the originals were painted and decorated in about the same way. No breakfast room set is considered complete without the Welsh cabinet today, and like its predecessor it holds the necessary equipment for serving one of our special meals. It is a quaint, interesting piece of furniture, serving modern requirements admirably. It is not a difficult piece to make and those having a breakfast-nook should try to find a place for it. We have home-mechanicised one of these styles and given its details and picture on this page. The lumber and other materials required are as follows:

43 inches of ½" plyboard 34" wide for back of cabinet.
130 inches of ¾" lumber 9" wide for shelves and case.
65 inches of ¾" lumber 12" wide for sides and bottom of cabinet.
36 inches of ¾" lumber 14" wide for lid of cabinet.
50 inches of ¾" lumber 12" wide for top of cabinet.
64 inches of ½" lumber 4" wide for sides and backs of drawers.
36 inches of ¾" lumber 4" wide for fronts of drawers.
36 inches of ¼" plywood 9" wide for bottoms of drawers.
124 inches of 1½" square lumber for legs.
252 inches of ¾" strips 1" wide for moulding, leg braces, etc.
2 brass knobs 1½" round for lid.
4 brass knobs 1" round for drawers.
2 brass hinges 2" long for lid.
2 brass button catches ⅜" round for lid.
2 floral transfers 12" × 4" for lid and shelf case.

Probably the first thing to do after obtaining the lumber and materials is to cut and shape the four legs. These are 1½ inches square and 30¼ inches long. Each is tapered 14 inches from the top to ¾ inch square at the bottom. The back legs are grooved both for the back and the end pieces forming the sides of the lower part of the cabinet. The grooves for the end pieces do not extend to the top of the legs, as with the grooves for the back, but have 1 inch of wood above the grooves, as shown at Fig. A. This wood at the top of the grooves gives strength to the legs and sides. The grooves are ½ inch wide and ⅝ inch deep for the end pieces and ¼ inch wide and ½ inch deep for the back. The front legs are grooved for the end pieces only, with the grooves the same size and depth (½" × ¾") as the back legs. Mortises are cut in each leg for the braces placed 6 inches from the bottom. These mortises are ⅜ inch wide, ⅞ inch long and ⅝ inch deep. It will be advisable to have the legs grooved and mortised at the lumber yard mill where the work can be done by machinery.

The next thing is to make the end pieces; they are 8½ inches wide between tenons or 10 inches wide including tenons and 12¾ inches long including a tongue (½ inch long and ⅜ inch wide) at the bottom. The bottom tenon engages in a groove in the piece forming the bottom of the cabinet as shown. The tenons can be rabbeted down pretty close to size with a rabbet plane, then trimmed to size with a sharp chisel.

We will now make the bottom; it is 34½ inches long and 10 inches wide. Grooves are cut ¼ inch from each end and then are ⅜ inch wide and ½ inch deep and fit the end pieces as already described. Jogs are cut in each corner to fit over the legs, so that the back edge will be ½ inch from the back edges of the two back legs and ½ inch from the back edges of the two front legs.

The bottom braces are now made, using the ¾ inch by 1 inch stock. The end braces are cut slightly diagonal to fit the taper of the legs and are 8⅞ long at the top and 9 inches long at the bottom between tenons or 9⅝ and 9¾ inches long including tenons. The braces are set with the 1-inch side perpendicular. A cross brace is provided also, having mortise and tenon joints. This brace is 33⅞ inches long between tenons or 34⅞ inches long including tenons. The tenons and mortises are ⅜ wide, ⅝ long and ½ inch deep.

The ½-inch plyboard is now used in making the back; it is 33 inches wide between tongues or 34 inches wide including tongues. The tongues are ¼ inch wide and ½ inch long and cut with the rabbet plane as indicated at Fig. F. They fit both in the legs and the sides of the shelf case. The back is 43 inches long. It is shaped at the top in scroll fashion, using a coping saw, following a pencil outline.

It is now well to glue all of the parts thus far made together, being sure that each part fits squarely and tightly in every joint. Bring all joints snugly together and let the glue dry for at least two days.

(Continued on page 78)

MODEL DEPARTMENT

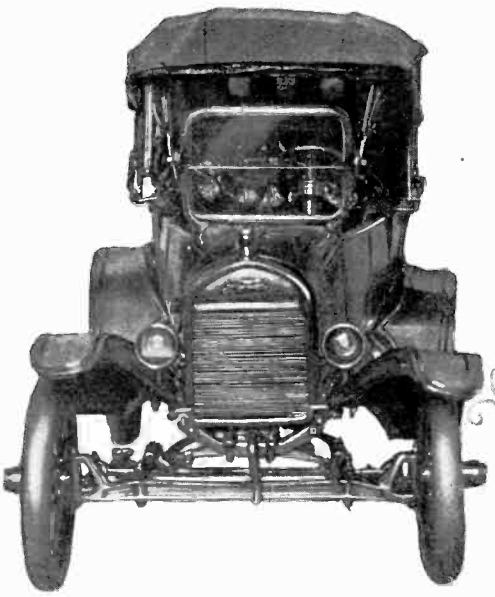
FORD MODEL WINS

Eleventh Science and Invention Trophy

The Monthly Cup For the Best Model Entered During the Month Is Awarded in This Contest to J. A. Teichman of Philadelphia, Pa.

Model Shows Exceptional Workmanship And Accuracy of Detail

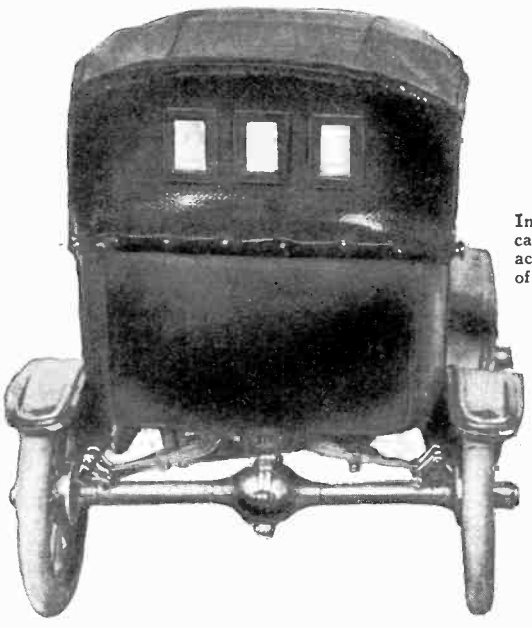
The photograph above shows the model of the Ford standing alongside of the cup which was awarded to it in this month's contest. The model itself is only 8⅞ inches high to the very tip of the one-man top. The cup is 17⅞ inches high. This Ford is made almost entirely of brass, the hubs, spokes, doors and mudguards included. The upholstery and top are fabric, rubber tires are found on the wheels and leather straps anchor the one-man top.



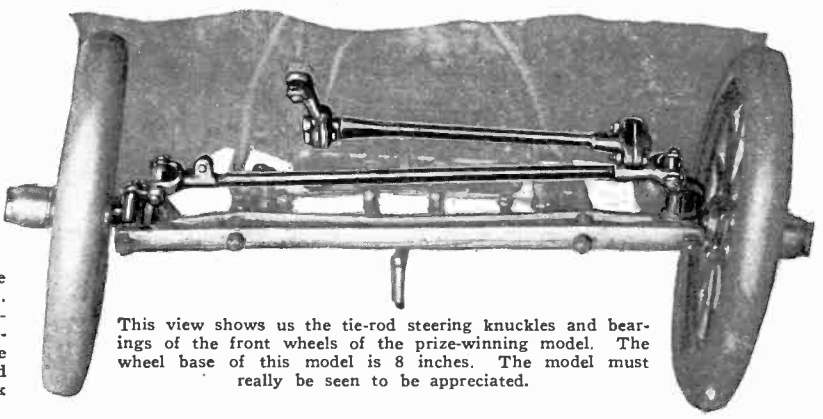
This is a front view of the prize-winning automobile. Note particularly the glass windshield frame and the suspension of the front wheels. The auto may be steered from the driving wheel in exactly the same manner as its counterpart. The radiator cap is removable.

In this view the doors of the Ford touring car are opened. The latches on the doors actually work. The inside of each door is of brass, the latch being completely concealed.

Observe also the diamond shaped embossings on the running board on which the name Ford is also inscribed.



Here is a rear view of the prize-winning model showing the spring suspension of the rear axle and the differential housing. In this model the only thing missing is the engine and transmission. The upholstery is accurately duplicated. The one-man top may be taken down if desired and the lights are operated directly from the front seat. The model is equipped with a steering wheel lock in miniature size and with spark and gas controls.

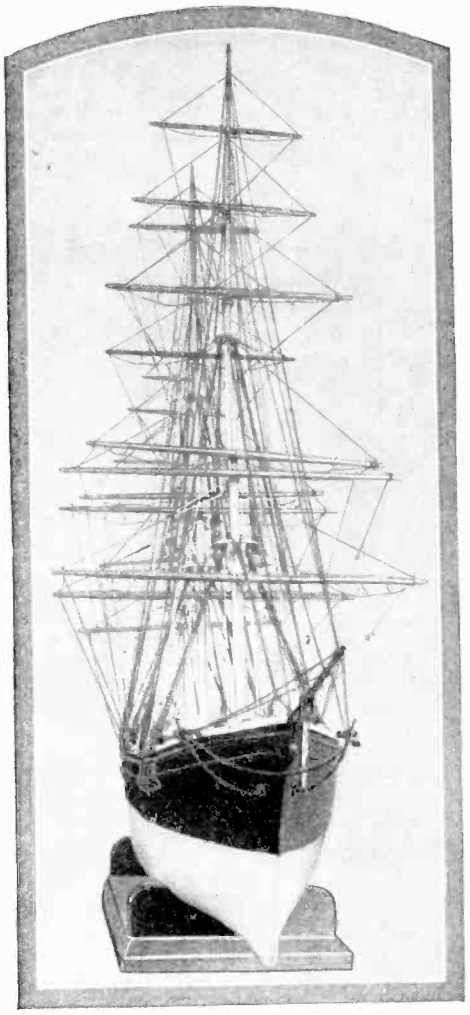


This view shows us the tie-rod steering knuckles and bearings of the front wheels of the prize-winning model. The wheel base of this model is 8 inches. The model must really be seen to be appreciated.

(See page 77 for Rules of Model Department)

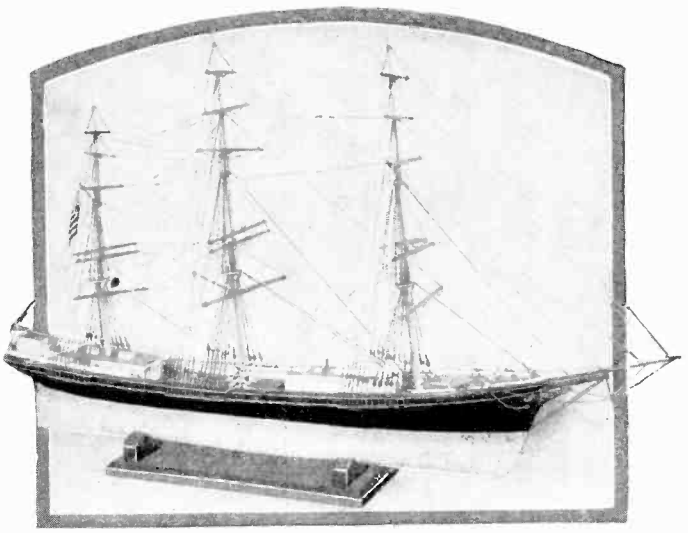
Cup Winner Is Model Builder

George B. Douglas, a Winner of the SCIENCE AND INVENTION Magazine Trophy Cup Shows Another Example of His Handicraft.



A view of the Benjamin F. Packard taken head on. This model is built to a scale of ⅛th inch to the foot. Note hull lines.

It may be remembered that Mr. Douglas won the SCIENCE AND INVENTION trophy cup with his model of the Chinese Junk. This is not the only style of vessel which Mr. Douglas has built. His model ships have been very numerous. On this page are illustrated a series of photographs of the Benjamin F. Packard, a ship upon which Mr. Douglas served as an ordinary seaman, due to his friendship with Captain Allan, at that time in command of the vessel.



Side view of a model ship built by George B. Douglas who has already won a cup in the Model Contest of this magazine.

HERE is a short history of the Benjamin F. Packard. The vessel was built by Goss, Sawyer and Packard at Bath, Maine, in 1883, for Mr. John R. Kelley. She was afterwards owned by Messrs. Author Seawall & Co., and was then sold to the Alaska Packers Association to be used for a time as a store ship and prison ship in Alaska. Here she worked in the salmon trade. At the commencement of the season she was loaded in San Francisco with box boards, sheet tin, etc., and when the season was over, she returned with canned salmon in cases. In 1925 she came to New York by way of the canal. She was then sold and is now serving as the quarters of the Junior Naval Reserve and is docked at the foot of 87th Street, and North River in New York.

The ship is 244.2 feet long, 43.3 feet beam and 26.7 feet deep and is rated at 2,026 tons. She made repeated voyages from New York to San Francisco, England, France, and even to China. This model was built from the plans of the ship which the Captain permitted Mr. Douglas to copy while he served as an ordinary seaman on a trip "Around the Horn." The model was built from these plans and is to a scale of ⅛th inch to a foot. Unfortunately, while the vessel was in the Alaska trade they cut off her skysail masts and yards. When she came to New York, they sent down her top gallant and royal masts with the yards, but there has been much talk of putting these masts and yards up again so that she will appear like her old self. She is about the last of her kind and represents a period when American sailing ships were the finest and fastest the world has ever seen.

An angle view taken from the stern showing this graceful model with all her yards in place, but the sails removed. This is how the vessel would appear when tied to a wharf.

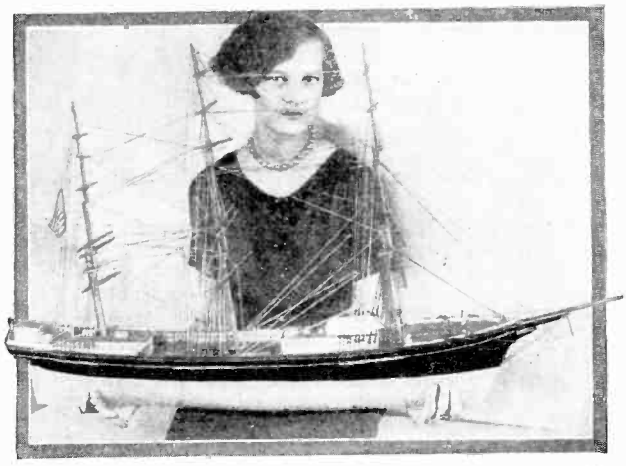
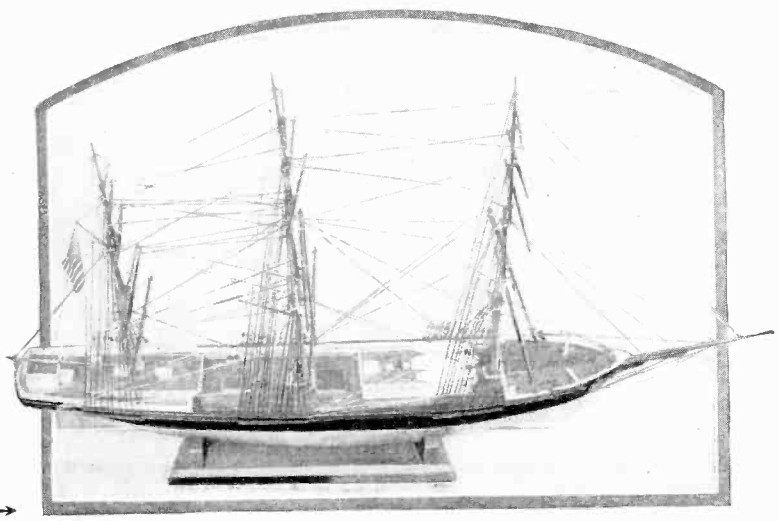


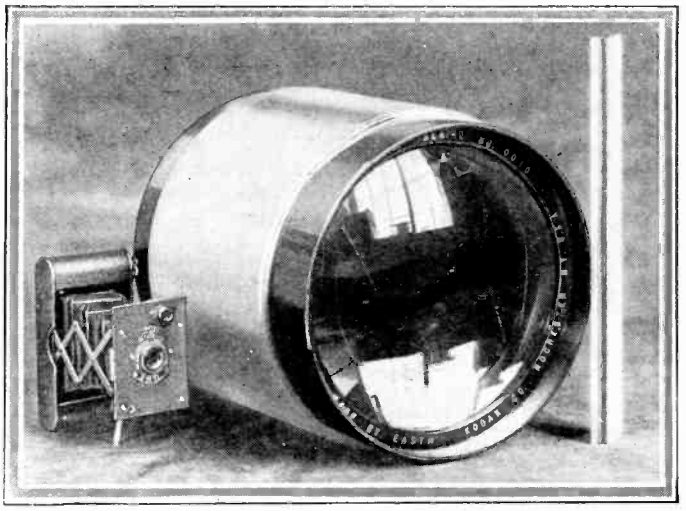
Photo above shows Miss Ruth Olsen holding the model of the Benjamin F. Packard. An idea of the size of the vessel can be obtained from this photo. Right, an airplane view of the deck.

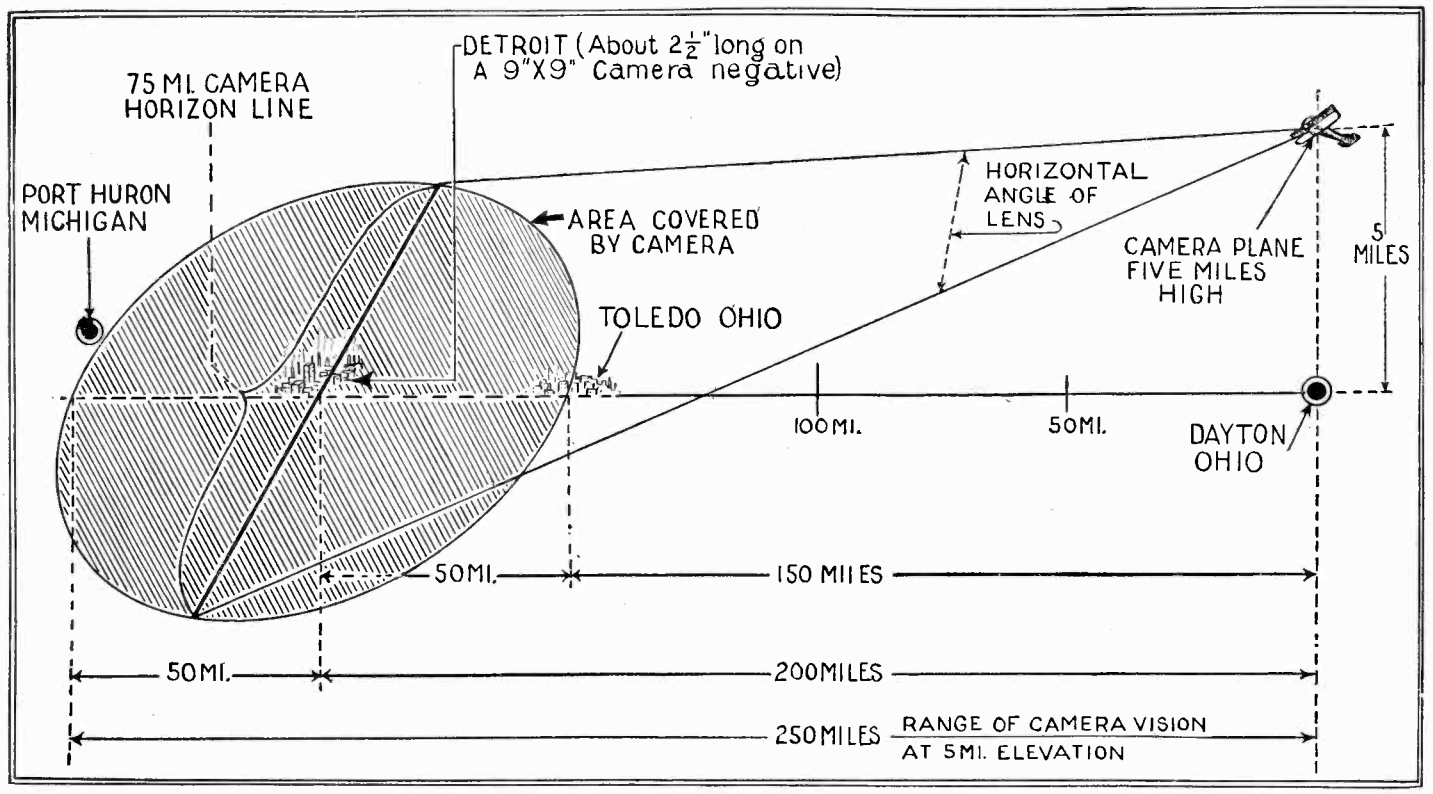


Air Service Uses Immense Sky Camera

The photograph above demonstrates the size of the special airplane camera by comparison with the aviators standing beside it. This camera is designed to be used experimentally in photographing various portions of the terrain in the neighborhood of McCook Field, at Dayton, Ohio. The work is under the direction of Lieutenant G. W. Goddard, who is working in cooperation with the Eastman Kodak Company. The camera is probably the largest which has ever been assembled.

BELOW is the lens used in the new air service camera. This is the largest lens for photographic work ever ground in this country. It weighs forty-five pounds. With its aluminum mounting it is nine inches in diameter and the same in length of mount. The focal length is thirty-six inches and its speed is f. 5. Cemented between the two rear components is a color filter designed to cut out most of the light present in atmospheric haze.





At an elevation of five miles above Dayton, Ohio, the camera was found to have an extreme range of 250 miles. When directed so that Detroit was in the center of the camera field, the limits of the visible portion extended from Toledo, Ohio, nearly to Port Huron, Michigan.

IN developing the camera illustrated in the photographs above, the air service had in mind the experimental work which they have been conducting in making aerial surveys. The camera proper was designed by the engineering division of the U. S. Army Air Service at McCook Field, Dayton. The film used is of special manufacture, sensitive only on the infra-red end of the spectrum, thus being able to record objects through the blue haze. The first experiment considered is to go up over Dayton and photograph Detroit. At an altitude of five miles, the curvature of the earth allows visibility for about 250 miles. Detroit is 195 miles away from Dayton. The angle of the lens at working altitudes covers a field of view 75 miles across. The negative is about 9 by 9 inches square, so that the city of Detroit will cover about three inches square on the film. The camera is mounted in the rear cock-pit of Lieutenant Goddard's plane, with the front of the lens protruding through the fuselage. The rest of the camera will be covered with an asbestos bag, inside of which electrical resistance wires will be strung and a by-pass from the engine exhaust will be connected. The elaborate heating devices are made necessary by the extremely low temperatures which are encountered at high altitudes. One of the most important deductions to be gained from the flight will be the measurement of the contraction of the metallic parts of the camera at low temperatures. At thirty thousand feet the plane will be out of sight and hearing of the ground, and the distant parts of the area photographed by the camera at this height will be about 144 miles away from the plane. It is possible that the plane will be able to break the world's altitude record, due to improvements since Lieut. John A. Macready flew to a height of 38,000 feet.

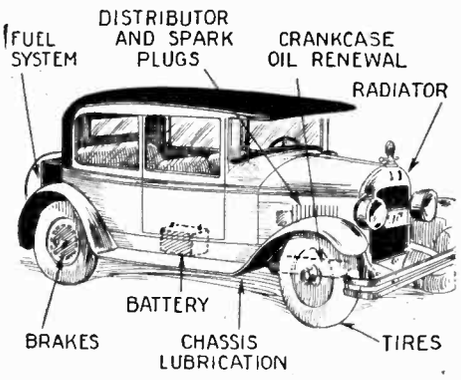
MOTOR HINTS

Conducted by GEORGE A. LUERS

DO YOU KNOW—there is a vent in the side of the carburetor and if clogged it will give more trouble than clogging of the vent in the gasoline tank cap?

GETTING THE CAR READY FOR A TRIP OVER DECORATION DAY

PUTTING THE CAR IN SHAPE FOR EARLY SPRING TRIP



BEFORE UNDERTAKING EXTENDED TRIP, THESE POINTS REQUIRE SERVICING.

Showing some of the many necessary things which have to be overhauled in order to put the car in shape.

The car has probably encountered some rough going, during the thaw and wet, muddy days of spring. The driver is possibly contemplating a trip over Decoration Day, one of the first long runs, and the problem of putting the car in shape for an uninterrupted drive is uppermost in mind.

In general there are several important items which should be attended to, without mention of inspection for loose bolts, lost nuts and missing cotter pins.

These items are arranged in systematic order for convenience in checking them off.

(A) Drain the crankcase and renew the engine oil.

(B) Go over the tires for weak spots, removing the old tires and putting the best tires on the wheels. An old tire has no use on a trip, save it for use near home.

(C) Lubricate all parts of chassis, including the universals and transmission.

(D) Clean and adjust the contact points in the distributor and in the spark plugs.

(E) The brakes are possibly loose and, if not worn, adjust them to hold firmly.

(F) Drain sediment from carburetor, vacuum tank and gasoline tank.

(G) Battery terminals should be removed and cleaned. Battery should be tested and replenished with distilled water as required. Note battery condition so as to avoid overcharging on run.

(H) Inspect radiator hose and flush out the radiator.

RECOVERING THE ROOF OF A CLOSED CAR

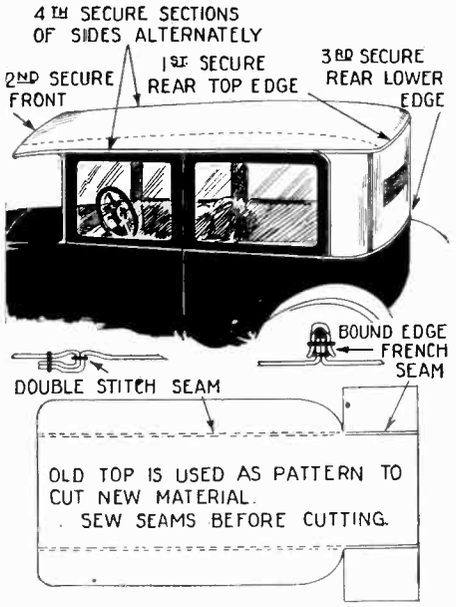
One reader has asked recently, "What can be done with a top, which has been torn by driving under the low hanging branches of a tree?" A top so mutilated or a top which has cracked through age and which is whipped open by the wind as fast as one section is repaired, can only be restored through an entire recovering.

Recovering the roof of the closed car is quite a simple job. The material required will be about two and a half yards for a coupé or three and a half yards for a sedan of small size. Suitable Spanish or Morocco grain rubber drill is obtainable at one dollar a yard or fifty cents more for better grades.

The procedure is to remove the back molding, rear top molding and the drip molding from around the sides. All old tacks should be pried out and the top cover lifted off in one piece. The usual rubber drill is in fifty inch widths and the top requires seams when in this width. Cut the material, using the old top as a pattern and sew seams of the flat type in the roof section. The rear section at the quarters allows for use of the bound edge, French seam which is now so popular. The details of this seam are shown in the drawing. Use heavy linen thread and double stitch the seams.

Put on the top cover, making it secure at the rear top edge first. Pull forward and secure with galvanized tacks only, at the front edge.

PROCEDURE IN ATTACHING NEW TOP COVER



How to attach a new cover to the car. The old top is used as a pattern to cut the new material.

Draw down the rear edge, leaving no slack in the cover. Now work the sides down, alternately, that is, one foot, right side and one foot on the left. Replace the molding and drip and the job is complete.

ENGINE KNOCKS AND THE VARIOUS CAUSES

With the proper kind of a knock in the engine of an automobile, the owner can dispense with the horn entirely. Simply slip the clutch and step on the accelerator, traffic will clear immediately.

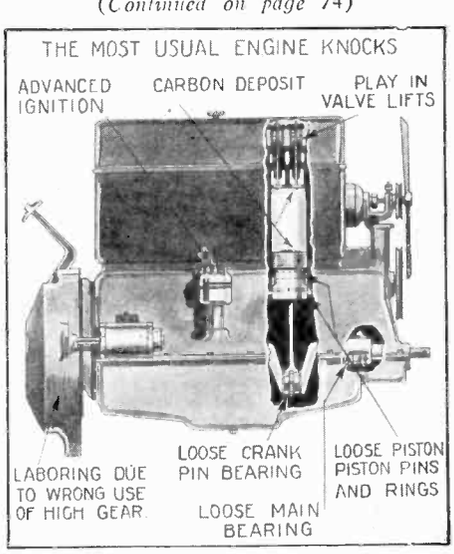
There are other knocks which are not so pronounced, nevertheless these eventually lead to trouble, while if an adjustment is made they are cured at the start. In the appended table, the usual knocks are tabulated and are identified by the accompanying description.

This table should serve a useful purpose in aiding the motorist to determine upon and remove the cause of the trouble.

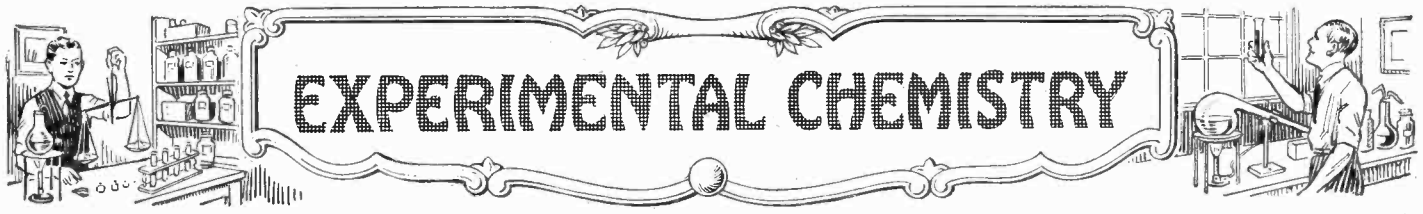
ENGINE KNOCKS

Cause	Evidence and Repair
Carbon Deposit—	Rattle and pounding will occur when the power is applied suddenly as when climbing a grade, not noticeable at high speed on level. Use carbon remover, burn out or scrape out.
Ignition Too Far Advanced—	Evidenced by sharp pinking or rattle, but is continuously regular. Disappears immediately the spark is retarded.
Loose Main Bearings—	The heavy crankshaft hits with a muffled but solid sound, as though the engine were struck with a padded sledge. Caps of the main bearings must be scraped to fit or rebabbited.
Loose Crank Pin Bearings—	Rattle and pound on level, up or down grade, increases as engine is raced. If babbit is burned out connecting rod must be replaced.
Loose Piston Pins—	A sharp, light rattle most evident under closed throttle, but increasing if the spark plug is shorted out. Locate the pin and renew.
Loose Pistons and Rings—	Loose pistons and rings are most evident when starting cold motor. Has metallic sound as of muffled bell. Grows less as motor warms. Replace with fitted piston and new rings.
Play at the Valve Lifts—	Valve lifts give a light tapping sound, not pronounced, but most noticeable when engine is idling. Correct by adjusting at the ends of valve stems or replace push rods if worn.
Overload Laboring —	When under very heavy load, as in hill climbing at slow speed and open throttle, the pounding of engine will be felt. There is no metallic sound, only a pounding that is felt through the controls. Shift to a lower gear immediately and the sound will disappear.

(*Continued on page* 74)



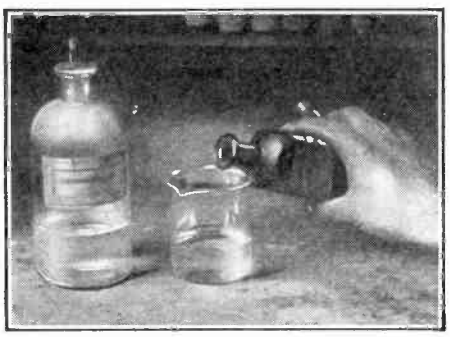
The seats of trouble of most of the engine knocks.



Using Aldehydes in Experiments

By DR. E. BADE

FORMALDEHYDE is, of course, the simplest aldehyde, and it is best known in the solution of "formalin." If equal quantities of this formaldehyde solution are mixed with concentrated ammonia and the mixture is evaporated on the water bath,

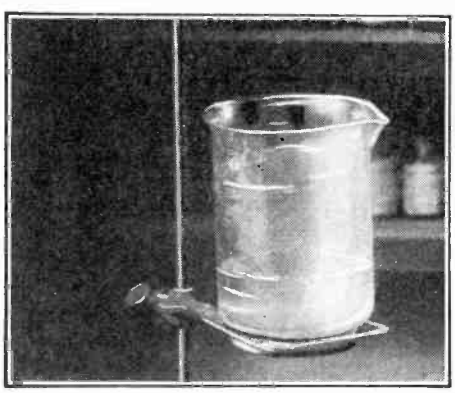


Equal quantities of formaldehyde and ammonia are mixed together. Subsequently the solution is to be evaporated by gentle heat to give urotropine a well-known drug.

colorless crystals, not of aldehyde ammonia as is the case with acetaldehyde, but hexamethalene tetramine are formed. This is a compound used medicinally under the name of aminoform or urotropine and is used as a solvent for uric acid.

When a solution of formaldehyde, either alone or with a trace of a little concentrated sulphuric acid, is evaporated to dryness under reduced pressure, that is, in vacuo, a white, crystalline powder is left behind. This is paraformaldehyde, is very light and is soluble in water. This compound has the same percentage composition as formaldehyde but its molecular weight is a multiple of it, an example of polymerisation. A solution of paraformaldehyde behaves exactly like a solution of formaldehyde.

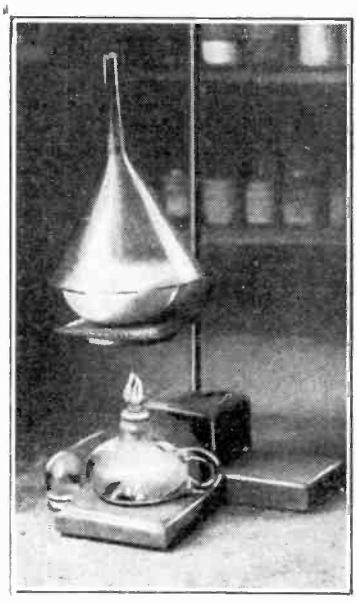
Acetaldehyde has many more peculiar reactions which it readily undergoes. In itself it is a colorless, pungent liquid. When



The evaporation alluded to in the preceding caption is best conducted on a water bath, but it can be done with a beaker on an iron plate, a rather heavy iron plate being used to equalize the heat and prevent sudden variations.

a drop of concentrated sulphuric acid is added to acetaldehyde at ordinary temperatures, an almost explosive reaction takes place, the compound formed being a polymerisation product, a tri-molecular polymer, paraldehyde being formed. The reaction is so vigorous, that the liquid becomes hot and boils up. Paraldehyde is a colorless liquid which boils at 124° C. (225° F.). On distillation with dilute sulphuric acid it reverts to acetaldehyde.

Keeping the acetaldeyde at a low temperature by means of a freezing mixture of salt and ice and adding a small quantity of dilute sulphuric acid, a different tri-molecular compound is obtained which is known as metaldehyde. It is a crystalline body insoluble in water and subliming at 112° C (233.6° F.) when rapidly heated. It can be most readily sublimed in light, feathery



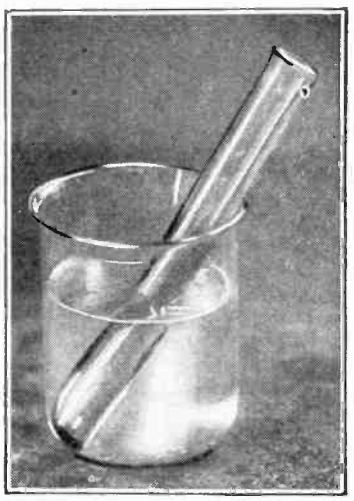
Subliming metaldehyde. Beautiful feathery crystals are obtained which form upon the sides of the glass funnel.

crystals, by heating in an evaporating dish over which a funnel has been placed. The crystals then sublime into the funnel and they can easily be scraped out of it.

Under different conditions the not any too stable acetaldehyde may be made to polymerize to a compound known as aldol. But this aldol, since it can be changed back to

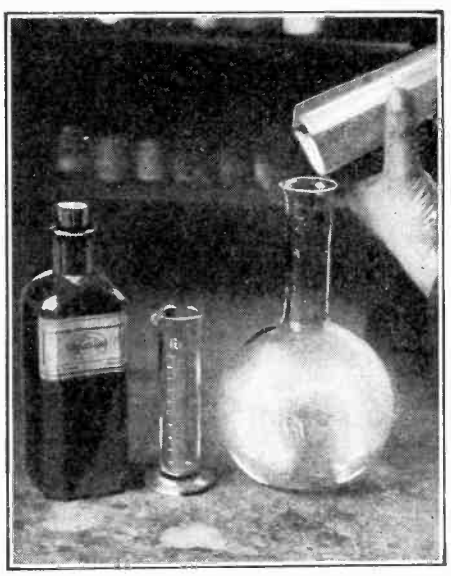
Aldehyde precipitates metallic silver. Above a silver nitrate solution is treated with ammonia until a clear solution is obtained.

the original aldehyde has been classed into the category of reactions which are known as condensation products. The aldol is produced by adding a small quantity of a



The test tube containing the ammoniacal silver solution has a drop or two of aldehyde added and is placed in hot water as shown above. A beautiful mirror of silver will be deposited on the glass.

concentrated solution of potassium carbonate to a well cooled solution of acetaldehyde and permitting the mixture to stand for a few days. Then a syrupy liquid, the aldol, is formed. This is a true aldehyde having twice the number of carbon atoms that are



The smell of burning fat sometimes observable in kitchens is due to a substance called acrolein. This can be produced by treatment of glycerine with potassium bisulphite with subsequent distillation. A large flask must be used as it froths a great deal.

present in acetaldehyde and this aldol can be still further treated, for it still retains an aldehydic group. This condensation is usually brought about by the action of dilute sodium carbonate solution, whereby water is eliminated from the aldol forming an un-

saturated aldehyde namely crotonaldehyde.

In connection with these condensations, many aldehydes, when heated with caustics, polymerize forming resinous substances. This is easily shown by heating a little acetaldhyde to which a few drops of concentrated sodium hydroxide have been added. A yellow coloration takes place and, at the same time, a resinous mass separates.

The aldehydes are also capable of reacting with the alcohols forming acetals with the elimination of water. The presence of a small quantity of acid helps the reaction although it is more or less reversible. Acetal is a pleasant smelling liquid which boils at 105° C. (221° F.) is slightly soluble in water, easily soluble in alcohol and ether.

The simplest unsaturated aldehyde is acrolein and, although it can be obtained by the oxidation of allyl alcohol, it is much easier to prepare with the aid of glycerin. Acrolein is produced quite frequently about the home, especially in the kitchen when fats are heated for acrolein is the vapor given off when fat is over heated. Almost every one has smelled the very pungent, tear-producing odor of this aldehyde.

In a liter flask about 200 cc of glycerin are placed and 10 grams of crystallized potassium bisulphite are added. The mixture is heated and the colorless distillate which boils at 52° C (125.6° F.) is collected with the aid of a long condenser having its receiver in ice water. The large flask is necessary for the mixture froths quite violently when heated. To purify the distillate, it is carefully redistilled and dried over calcium chloride.

One of the tests used in detecting aldehydes is the silver mirror test. To half a test tube full of silver nitrate solution add ammonia, drop by drop, until the precipitate of silver oxide which is first formed, is just redissolved. Then add a few drops of acetaldehyde, shake vigorously for a few seconds, and place the test tube in hot water. In a few minutes a mirror will be found in the test tube. If the test tube is not perfectly clean a black precipitate of silver will be obtained. For some of the other aldehydes it is necessary to add a drop of dilute sodium hydroxide in order to reduce the silver salt to a metallic state. Do not let it stand too long as explosions occur.

The Chemical Joker

By RAYMOND B. WAILES

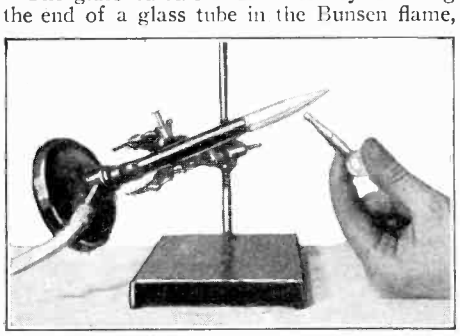
GIVE a friend a pasteboard carton containing a white powder and ask him to shake it up and tell what is the color of the powder which is in the box. He will say "White." Open the box. The powder is *yellow*.

A mixture of finely powdered potassium iodide and lead nitrate which have been ground up separately are placed in a box and form a white powder. On agitation, lead iodide is produced which turns the mixture yellow.

The box contains a mixture of finely powdered potassium iodide and powdered lead nitrate, both of which have not been agitated together, nor ground in the mortar together. The powders are white, but upon shaking them, a chemical reaction occurs which produces lead iodide, which is yellow, consequently after shaking the white powder in the box it will be yellow.

Anarchist or stink bombs are known to everyone. The real article can be made by sealing up a solution of ammonium sulphide in little glass bulbs.

The glass bulbs can be blown by inserting the end of a glass tube in the Bunsen flame,



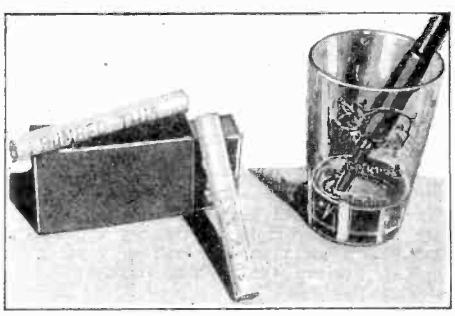
Little bombs of thin glass are made. By sealing ammonium sulphide or carbon disulphide in the little glass receptacles made in the Bunsen burner flame, a miniature riot bomb is produced.

rotating it until the end closes and then keeping it in the flame, constantly turning until the end thickens; a bulb is then formed by quickly but not forcefully blowing into the opened end. Draw out the stem so that the end contains a hole which will admit the graphite point of a lead pencil. Cool, fill, using a pipette if necessary, with a solution of ammonium sulphide, leaving an air bubble at the tip, and then seal in the Bunsen flame as shown. Do not fill too full. The ammonium sulphide solution can be made by bubbling hydrogen sulphide gas through household ammonia or ammonium hydroxide for about fifteen minutes. You can make hydrogen sulphide gas by allowing an acid such as sulphuric acid to act upon ferrous sulphide.

The ends of matches are dipped in sodium silicate solution and dried with disastrous results, as regards their future service.

A good trick to be played upon smokers is to dip the heads of safety matches in water glass solution and allow them to dry, which will take about half a day. When the matches are struck upon the side of the box a sputtering will be produced, accompanied by a crackling spitting noise, with the formation of a big white cloud on the end of the match, but "nary a sign" of a flame.

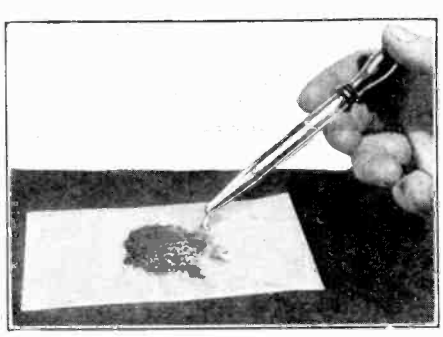
Another cigarette trick is performed by writing a funny saying on some cigarettes in dilute sulphuric acid, using a gold pen point. When dry, the writing is invisible,



Another joke on a smoker; using a gold pen letters are written with dilute sulphuric acid on cigarettes, which are invisible until the heat of the burning end reaches them, then they come out almost black.

but when the cigarette is smoked, the letters come out one by one, and allow the saying to be read, a letter at a time.

Mix equal parts of ammonium chloride (sal ammoniac) and ammonium nitrate. Spread zinc dust upon a little heap of the mixture and add several drops of water. There will be a hissing noise accompanied with bubbles and the zinc dust will catch fire, burning with a bluish white light. You can use this mixture in many ways which the fun-loving joker will surely discover.



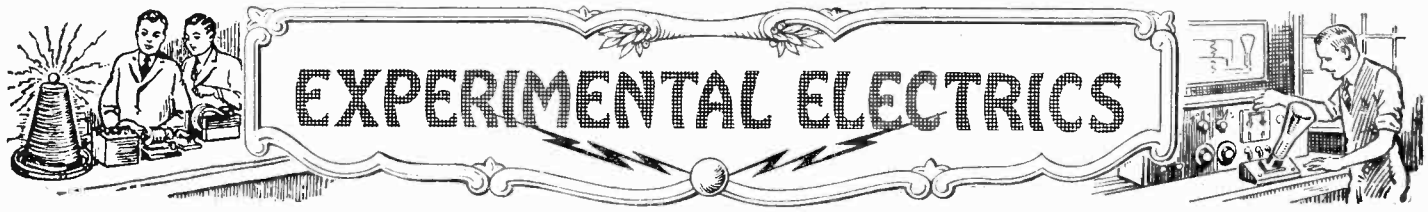
A mixture of zinc dust with ammonium nitrate and ammonium chloride, both the latter very finely powdered is ignited by dropping a few drops of water from a pipette or fountain-pen filler upon the heaped-up mixture.

Engraving on Glass

Mix one part of powdered fluor-spar (fluoride of calcium) with two parts of sulphuric acid, in a lead saucer and apply a gentle heat, when the acid, for engraving, will be disengaged in the form of vapour. Prepare a piece of glass by coating it with a thin covering of wax, and with a sharp pointed instrument draw a design. Now place the glass over the fumes of the acid for half an hour or so, and then heat the glass so as to soften the coating, and wipe it off, the design will then appear "bitten in" as the term is, that is, the acid will have dissolved the glass wherever it was not protected by the wax, and will exhibit the design indelibly fixed on the glass.

This acid requires the greatest care in handling for it is extremely corrosive, producing very troublesome ulcers if it comes in contact with the skin; even the fumes will produce smarting to the skin if long exposed to them.

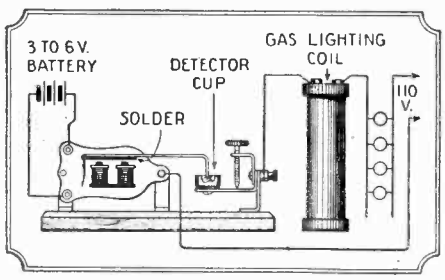
The lead saucer can be beaten up out of a bit of sheet lead.



Simple Experiments with Ultra Violet Rays

By RAYMOND B. WAILES

THERE is something about experimenting with ultra violet rays which fascinates one far more than other branches of science. Perhaps it is the invisibility of the rays which captivates the experimenter or the weird effects which they produce. In either case the phenomena are not difficult to reproduce by the experimenter, even when the simplest apparatus is employed.

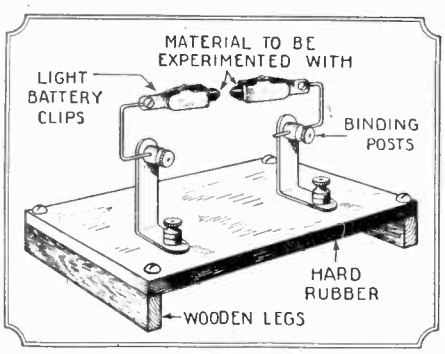


The production of ultra-violet rays by opening and closing rapidly a mercury cup contact. This gives enough mercury vapor to produce the invisible rays.

The most prolific source of ultra violet rays is had by the discharge of electricity through mercury vapor contained in a transparent quartz tube. It would be beyond the scope of the experimenter to construct an evacuated tube of this type so some other source is necessary for simple experimenting.

One source of ultra violet rays is the carbon arc—the ordinary arc lamp for instance. This arc gives off visible light as well as ultra violet light. This visible light can be seen but the ultra violet light cannot. So, in experimenting, some tell-tale substances have to be used to show that ultra violet rays are present and performing their strange antics.

You can make a carbon arc light by placing two carbons in series with a resistance of twenty ohms which is capable of being able to withstand red heats. An electric iron is admirable. Many arrangements can be made for moving the carbons together

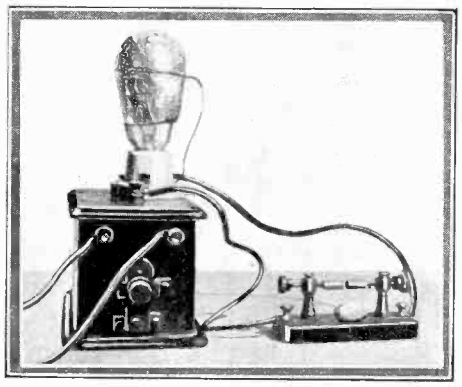


A convenient apparatus for experimenting with different arc terminals to see what amount of ultra-violet light is given by them.

and then separating them. If you will heat the carbons and then immerse them in a solution of ferric (iron) chloride or uranium acetate or nitrate, you will find that they will give off rich quantities of ultra violet light when dried and used in an arc lamp.

Another fair method of generating the rays is by the use of a mercury spark. The generator consists of an iron wire vibrated by an electric buzzer, which dips into a pool of mercury, and, when withdrawn, causes an arc. The iron wire is affixed to the arm of an ordinary buzzer which is mounted upon its side on a base as shown. The buzzer is connected with a switch and several cells of battery. The mercury cup should be adjustable for height and is connected in series with the iron wire affixed to the buzzing arm or clapper, the grounded frame of the buzzer, and a gas lighting coil and lamps in parallel, and the 110-volt lighting system. The coil can be omitted. The buzzer interrupts the 110-volt circuit and causes a succession of arcs to form in the cup. Substances held in proximity to the cup will receive the ultra violet rays from it and be acted upon by them. If this scheme is employed, it is advisable to disconnect the radio set if the radio storage battery is used for the buzzer drive. This will prevent the 110 volts from ruining the tubes.

A discharge of electricity across metals usually results in the production of ultra



Ultra-violet light produced by a spark discharge acts upon various substances placed directly below the spark. The above is a photograph of the actual apparatus.

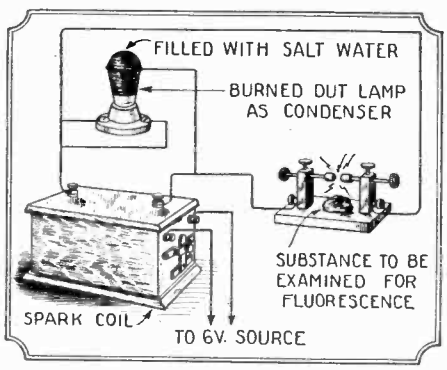
violet rays, together with visible or light rays. The discharge of a spark coil across points of iron, cadmium, etc., will produce the rays.

In order to experiment with these substances as a source a spark gap consisting of two metal spring clamps are excellent. The different materials, such as metals, minerals, etc., can be clipped into the jaws of the clamps and the spark passed between them. The spring clamps can be mounted on a hard rubber base as shown in one illustration.

The ordinary stationary spark gap such as used in the spark days of radio also makes a good generator of the rays when connected in the usual manner with a spark coil. A glass plate condenser shunted across the secondary will produce a richer spark.

A burned out electric lamp bulb filled with salt water makes a good condenser for high potential work. It should be screwed into the socket as usual and the two-socket terminals connected together. A sheet of tin or lead foil wired on the outside of the bulb makes one conductor. The salt water inside acts as the other plate or conductor. The glass acts as the usual dielectric. Connections are shown in the figure and photograph.

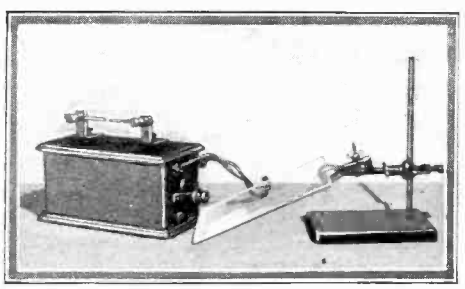
Specimens, described later, are placed directly beneath the spark gap in experimenting. They will glow or fluoresce if ultra



A diagram of the apparatus whose photograph is reproduced in the preceding picture. Note the burned-out lamp filled with salt water and coated with tinfoil which is used as a condenser.

violet light is in the rays given off. Of course the visible light from the gap will somewhat mask the fluorescence, but by holding a strip of glass between the spark and the substance, the ultra violet rays will be absorbed and the substance will not be of as bright a color as without the glass. This is a good test for ultra violet rays.

The spark at the vibrator of the spark coil is also rich in ultra violet rays. If some one specimen affected by ultra violet rays is placed beneath the vibrator and the light from the contact points are allowed to fall upon it, the substance will exhibit its peculiar properties. A sheet of glass held between the spark and the substance will cause a diminution of the fluorescence or glow of the substance, showing that ultra



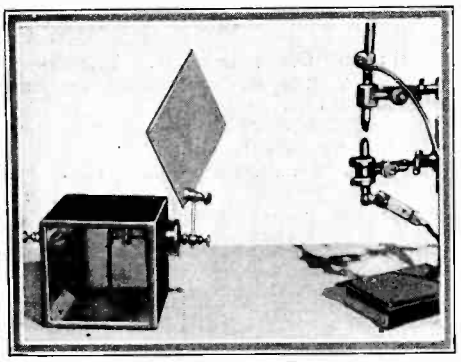
A glass plate is found to pass some ultra-violet rays, but the amount is greatly diminished even by a thin pane.

violet rays are really present in the light but that they are cut off by glass.

An electroscope, such as one described by the writer in the August, 1916, issue of this journal, can also be used to demonstrate that an arc light gives off ultra violet rays. If the electroscope is fitted with a polished sheet of zinc and is charged negatively, and

the light from a carbon arc lamp be allowed to fall upon the sheet, the leaves will rapidly collapse showing that the charge has been dissipated. This is because the ultra violet rays from the arc ionize or make the air in the vicinity of the arc conductive of electricity and the charge held on the leaf of the electroscope leaks off. The leaves will not collapse or lose their charge when they have been charged positively.

Some of the ultra violet rays will pass through glass. If a dispersing prism or an equilateral prism is placed near the arc when it is in operation, a spectrum can be formed and allowed to fall upon a sheet of cardboard. A glass "crystal" or prism from an old parlor chandelier can be used. The white light will be split up into its component colors with violet and blue light at one end of the spectrum. Now right next to the violet color there will be the cardboard, unilluminated by light of any color. But nevertheless there are certain rays—the ultra violet rays—being thrown right where you do not see anything next to the blue end of the spectrum. If you will take a quinine capsule and dissolve it in a bit of water to which a drop of some acid such as that from the storage battery has been added, and hold the quinine solution contained in a bottle next to the blue end of the spectrum it will glow with a beautiful blue fluorescence, due to the ultra violet rays.

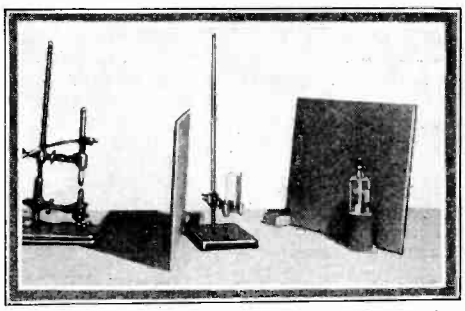


An arc lamp which produces ultra-violet rays and an electroscope are used in experiments with invisible light. The electroscope detects these rays. Enough of them will even pass through a glass plate to discharge the electroscope.

Here is an eye better than ours. Look as sharp as you may you cannot see a bit of illumination, color or light on the cardboard next to the blue. When the quinine solution is placed there it immediately glows, informing us that all light is not visible and that there is light—black light which we cannot see.

It is best to allow the light from the carbon ultra violet end of the arc to pass through a slit cut into a sheet of cardboard with a razor blade, and this slit of light then allowed to fall upon the sixty-degree prism. A block of wood with a slot cut into one side will serve as a support for a sheet of cardboard, the cardboard being thrust into the slot. In place of using quinine solution, other fluorescent bodies can be used.

For experimenting with substances, the following should be procured: scheelite, willemite, which are minerals, and phosphorescent zinc sulphide, unmixed with radium compounds. Chemically pure sublimed anthracene fluoresces when held in the vibrator spark as do the other substances mentioned. You can make a good blue fluorescing specimen of calcium tungstate by strongly heating the precipitate obtained from mixing calcium chloride and sodium tungstate solutions.



Refracting ultra-violet rays with a simple prism, one taken from an old parlor chandelier can be used and a bottle of quinine solution will glow under the influence of the ray and indicate its presence.

A 110-Volt Switchboard

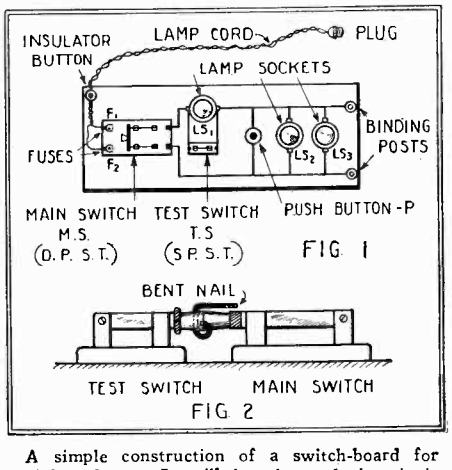
By W. BRUCE ROSS

THE occasion frequently arises when it becomes desirable to use 110 volts from the lighting circuit in experimental work. This is particularly true at the present time when a great many people are trying out new A- and B-eliminator circuits. Usually a makeshift arrangement is contrived utilizing a screw plug and some cord with bared ends. But bared ends with 110 volts behind them are unpleasant things to have lying around the house.

The switchboard described below is a very inexpensive adjunct to the home laboratory, yet it will be found exceedingly useful to anyone who does even a moderate amount of experimenting requiring power from the lighting circuit. Besides fulfilling its purpose as a controller of the power supplied, it also possesses the feature of providing a simple test, which will determine whether all connections in the experimental circuit are safe—that is, whether or not there is a short circuit, which would make it unsafe to draw current directly from the mains.

The diagram (Fig. 1) shows the whole layout and is self-explanatory as far as a general idea of construction goes. While the dimensions will naturally vary according to what the individual experimenter has on hand, it may be well to mention that a good size is 18½" x 5½" x ¾", which includes ample space for all apparatus. The cord, C, is made about ten feet long, giving considerable freedom of movement. One may thus bring the board close to the work in progress, allowing easy accessibility to the main switch and the test switch, and providing a socket for a lamp bulb close by the work, which is frequently of great importance in places only moderately lighted. For use with an electric soldering iron, this feature is often extremely convenient.

The short circuit test apparatus, comprising that marked LS, TS, and P in the diagram, is simplicity itself. When working with the switchboard, connections are made to a binding post, or through a plug in LS_2 or LS_3. Fuses of the proper value (determined by the nature of the work, but always of less carrying capacity than those in the house circuit) are inserted at F_1 and F_2, and the main switch is left open, of course, until all is ready. Insert a bulb in the socket, LS_1, and make sure that TS is open before closing MS. Should there be a short somewhere, the test lamp will burn brightly, but no harm will be done, since it is in series with the apparatus. If it burns quite dimly (how dimly will depend upon its watt-rating and the resistance of the lead) it shows that there is some resistance in series with it and that, so far as blowing fuses is concerned, there need be no fear of applying power directly. This is done by closing TS, thus shorting LS_1. If, during the experiment, a short circuit should occur, the fuses at F_1 and F_2 will go before the house fuses, and may be replaced immediately without interrupting the house supply at all. A fairly low resistance load makes it difficult at times to tell, without some standard of comparison, whether or not the test lamp is burning dimly enough to close TS with safety to the fuse system. In cases of this sort, the push button, P, is pressed, causing an artificial short and permitting the test lamp to burn at normal brilliancy. The greater the difference caused by pressing the button, the safer it is to close TS, which, of course, must always be open before the artificial short is created.



A simple construction of a switch-board for high voltage. It will be observed that it is supplied with fuses to protect it and anything being experimented with from burning out.

Another use may sometimes be found for the series lamp in LS_1, namely, for stand-by work with one of the cheaper electric soldering irons now on the market. These irons must be watched rather carefully, because the thermal regulator is not always effective, and if they are left too long in circuit they may overheat and burn out the element. The screw plug of the iron is inserted in LS_2 or LS_3, and a lamp of fairly high wattage is screwed into LS_1. For rapid heating and during actual soldering, TS is left closed, but when an interval of waiting is due, TS is opened. This introduces the resistance of the series test lamp into the circuit which, if the lamp is properly chosen, will allow enough current to flow to keep the iron fairly warm, and at the same time not enough will pass to run the danger of overheating it.

The short circuit test feature may be made automatic if it is desired, but an unfused main switch will be necessary. The main switch and the test switch are placed end to end as shown in Fig. 2 and through a hole drilled in the handle of TS a piece of heavy wire or nail is bent as shown. The lower end is brought around as indicated to keep the arm from swinging from side to side. With this arrangement, whenever the main switch is opened, the test switch is opened also, and should the latter happen to be pushed to, it must first be raised before the main switch can be closed, thus affording protection to the circuit and fuses.

Simple as the description indicates the construction of this switchboard to be, it must be very well carried out, there must be no chance whatever of a bad connection for such would be liable to cause a disastrous arc and it will be remembered that an arc always threatens rapidly decreasing resistance besides being in itself an element of danger, as it may bring about a conflagration. Otherwise, the construction is very simple.

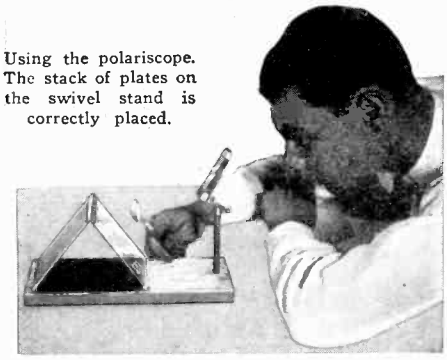
THE CONSTRUCTOR

How to Make a Polariscope

By RAYMOND B. WAILES

HAVE you ever seen some branches or stems of certain flowers which have hairs growing all over them? A ray of light is somewhat like such a hairy stem. We know that light travels in straight lines; that it will not turn around a corner of its own accord. Now imagine the path of travel or course taken by a ray of light as being the same as a straight hairy stem of a plant. But light, like everything else is never still. It vibrates. It vibrates in all the directions which the hairs on the hairy straight stem of the plant takes, that is, at right angles to the ray or stem itself.

Using the polariscope. The stack of plates on the swivel stand is correctly placed.



Now if light strikes a sheet of glass such as a window, or mirror, some of the vibrations or hairs of the stem will be absorbed by the glass, and in the light which is reflected off the glass, there will be light which still travels in a straight line but its vibrations will be in one plane only.

The drawing shows a hairy stem as representing a ray of light and the vibrations going up and then down in the direction of the hairs. Now when the ray strikes the sheet of glass as shown, it is reflected somewhat and some of the light comes off as polarized light. It can be seen that this polarized light still has some of the vibrations left as the hairy straight stem still has some hairs left upon it and these vibrations, or hairs, take a position parallel to the plane of the glass but still at right angles to the path of the ray or direction of the stem. You cannot tell that any change has taken place in the light by simply looking at the reflection with the eye, but with the aid of the polariscope described here, you can readily perceive the effects which this kind of light—polarized light—causes.

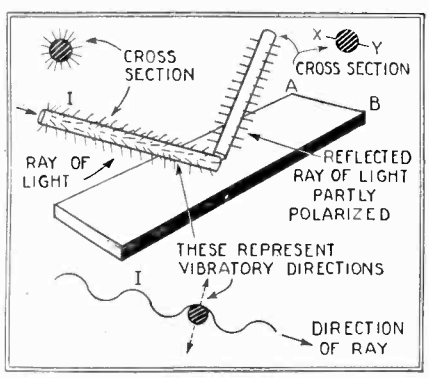
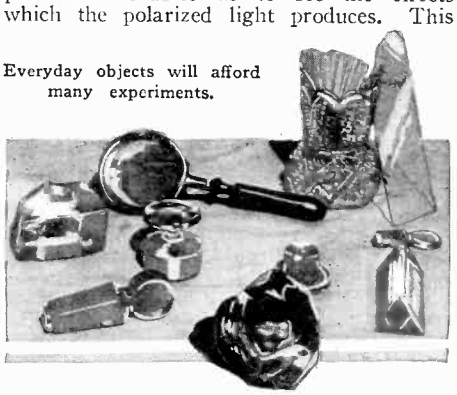


Illustration of the principle of the simple reflecting polariscope with which excellent work can be done.

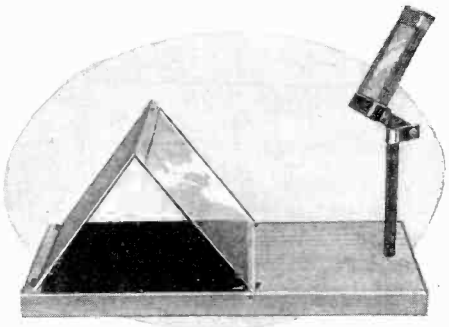
Our instrument, known as a simple polariscope, consists of a wooden base with a tent of sheet glass mounted upon it near one end. The outside glass is frosted or plain glass with a sheet of wax paper on it. Inside of this glass tent there is another sheet of glass varnished black which lies flat on the board. Instead of varnishing a sheet of glass you can use an old glass photograph negative, placing it in the tent uncoated side up. The tent can be made from photo plates with the emulsion removed by immersing in ammonia water, and scraping with a razor blade. This part of the instrument is the part which polarizes the light. The other half of the instrument is that part which enables us to see the effects which the polarized light produces. This part is the analyzer. It consists of seven or eight sheets of thin glass fastened together in a pack. What could be simpler? You can fasten the strips together with book binding cloth or even wire, and also make a little support for the package of plates with wire, or as the writer did, with a dowel stick for a pillar and a swivel joint with brass strip bent to shape. Eight clean microscope slides, about three inches long and three-quarters of an inch wide, were used. Mount the pack of plates in the position shown in the photographs.

Everyday objects will afford many experiments.

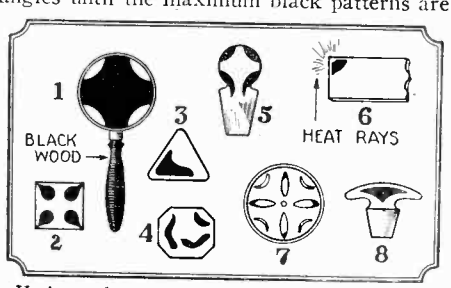


To use the polariscope, place it upon a table and allow light from an electric light to fall upon the end ground glass of the glass tent at right angles to it. Place the light about five feet away. The ground glass or wax paper will diffuse the light, which will then pass through to the black glass, become polarized by reflection and then pass through the clear glass side of the glass tent. Now hold a glass object, such as a glass stopper from a Cologne bottle, a vinegar cruet, etc., between the bundle of glass plates and the clear glass side of the tent so that the polarized light coming up at an angle from the black glass passes through it. Now look through the glass plates or analyzer and you will have a good chance of seeing some weird black spots or figures in the glass. Adjust the plates so that they are on an angle with the eye and the eye seems to be looking almost along the length of the plates but still through the faces. This is important, and not at all difficult to do. All that is needed is to get one glimpse of the peculiar and many times beautiful black figure-patterns in some glass object and you will have found how to set the analyzer, or pack of glass plates. But if you do not see the patterns keep setting the analyzer at different angles until the maximum black patterns are seen. It is useless to try to see anything without the use of this analyzer.

A mica sheet viewed through the polariscope gives wonderful colors.



The finished polariscope. The "Tent" is made of glass sheets, one being frosted. The stack of glass strips on the little swivel stand is the analyzer.

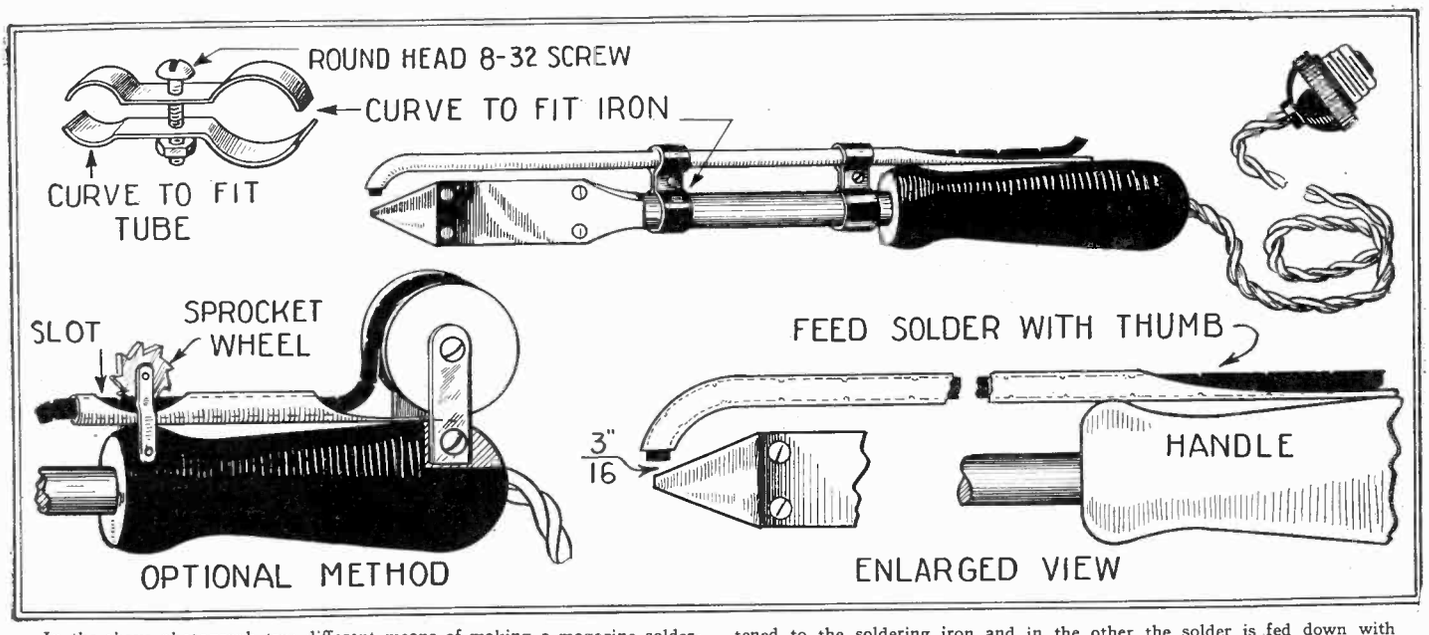


Various glass objects seen by polarized light show the most curious figures, sometimes quite symmetrical ones.

When glass objects such as bottle stoppers, ink wells, glass door knobs, cheap magnifying lenses, prisms, crystals of chandeliers and fancy lamp shades, tooth pick holders, glass mustard spoons, vinegar cruets, etc., are made, they are moulded while semi-plastic and are then cooled slowly. If this cooling process is not done properly, the glass is subjected to internal strains or bursting forces and is liable to burst apart, as perhaps some of your door knobs have done—literally exploded. The polarized light which you have made by reflection from the glass tent shows up these strains.

(Continued on page 82)

A Magazine Soldering Iron



In the above photograph two different means of making a magazine soldering iron is shown. In one of them a spool of resin-core solder is fastened to the soldering iron and in the other the solder is fed down with the thumb and when the end is reached, another piece is added.

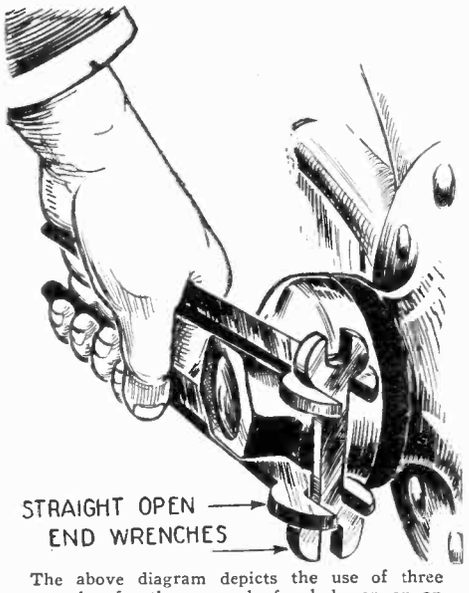
A MAGAZINE soldering iron is a very handy tool to have at home, particularly if the iron is electrical. Of course, this type of a magazine iron will not work if the iron is to be gas heated unless the user will take care to see to it that the solder is removed each time that the iron is placed into the flame. This procedure would result in the heating of the brass tube and make the magazine feature impractical, unless some means for cooling the tube were employed.

But for the electric soldering irons, a magazine addition has no superior. In the illustration at the top of this page two methods for constructing a magazine soldering iron are depicted. In either of these cases the principle is the same, namely that solder is fed through a tube in such a way that it reaches the tip of the iron and so that the quantity may be regulated. A brass tube is cut and fitted to the iron as shown. Resin-core solder is preferable.

(*Continued on page* 68)

Hints for the Mechanic

AN EMERGENCY WRENCH



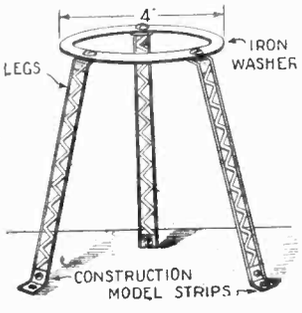
The above diagram depicts the use of three wrenches for the removal of a hub cap on an automobile.

When the hub-cap wrench is not available or has been lost and one of the hub caps must be removed, three ordinary straight wrenches can be pressed into service with excellent results. They are arranged around the hub cap as shown in the accompanying illustration. The hub cap can be easily removed by pressing the wrenches tightly together and turning them in the proper direction. It is obvious that the wrenches should be of the proper size to facilitate removal and to allow for sufficient leverage, making it easier to turn the cap.—*A. P. Peck.*

A New Department!

BEGINNING with this number we are starting a new department — "Hints For the Mechanic," in which we intend to publish wrinkles useful to mechanics in general. You can help us with this department by writing a brief description of your favorite shop wrinkle and sending this to the editor of this department, together with a pencil or pen and ink sketch of the wrinkle. The ideas published herewith will give you some idea of what we want. Our draughtsman will make the necessary mechanical drawings, so you need not send us finished drawings. Beginning with the next issue we will pay $10.00 each month for the best Wrinkle or Hint sent in; others published will be paid for at space rates. Address all letters to Editor, Hints For the Mechanic Dept., in care of this magazine.

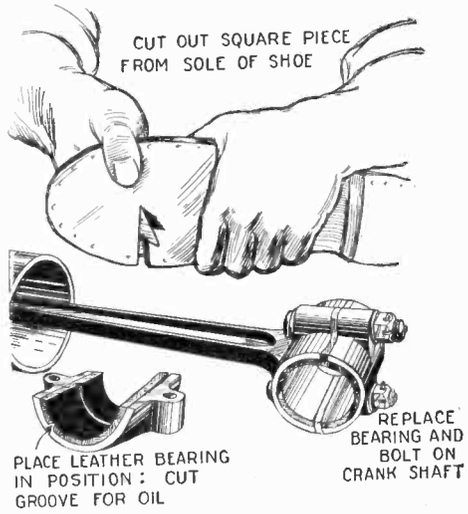
RING STAND



The strips used in model construction sets can be employed in the building of a ring stand if they are bent as shown and then attached to an iron washer. Glue and babbit pots may be heated after being placed on the stand.

Frank R. Moore.

BEARING REPAIR



A burnt-out bearing can be repaired with a piece of leather cut from the sole of a shoe as indicated in the diagram above.

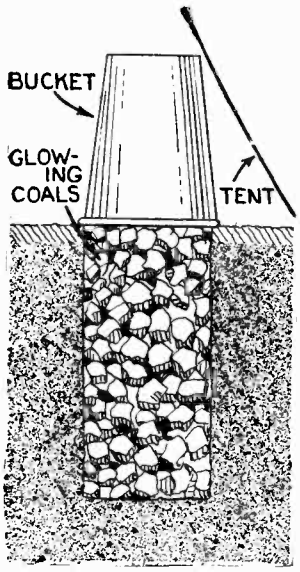
In the January issue of this publication a method for making temporary repairs for burnt-out connecting rod bearings was illustrated. In this a few pieces of tin and a pair of snips were employed. In the method here shown a piece of leather cut to exactly fit the surface of the bearing cap is used for the same purpose.

Rub a little lubricating oil on the leather. Tighten the connecting rod bolts and try to turn the motor over by hand. It should be a little stiff, yet loose enough to turn over. If too thick, trim and replace.—*C. M. Faber, Rep. No.* 28,168.

(*Continued on page* 85)

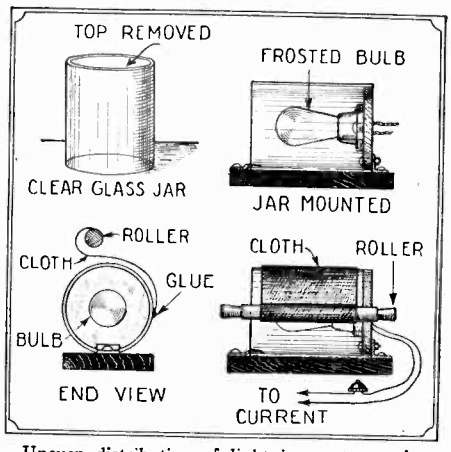
HOW TO MAKE IT

TENT STOVE



It is difficult to heat a tent without running a considerable risk from fire. A perfectly safe heater may be devised in the following manner: Get a bucket and place this in an inverted position on the ground where the stove is desired. Mark the outline of the pail with a stick, then take out the soil in this circle, to a depth of 2 feet. Fill the hole with glowing embers from the camp fire and cover the opening with the bucket and pack soil closely around the edge to keep in all fumes.—S. Leonard Bastin.

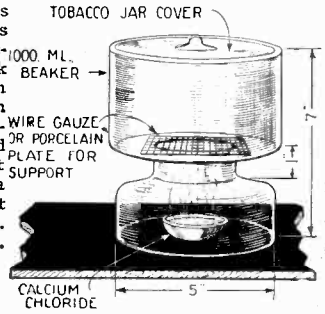
PRINTING FRAME



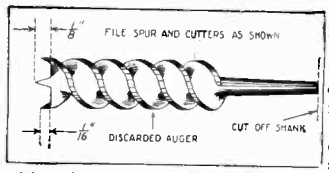
Uneven distribution of light in amateur printing frames results in unevenly toned pictures. The printing frame shown above produces perfect pictures and may be operated very speedily. The light is contained in a clear glass jar. A cloth attached to the jar and provided with a roller holds both the negative and the paper in place. By rolling the cloth, perfect alignment is possible.—H. H. Fisel, Rep. No. 2483.

DESSICATOR

A pyrex glass beaker such as used for electrolyte work can be drawn down to form the construction indicated in the hot flame of a gas-blast burner.—F. R. Moore. Rep. No. 1993.



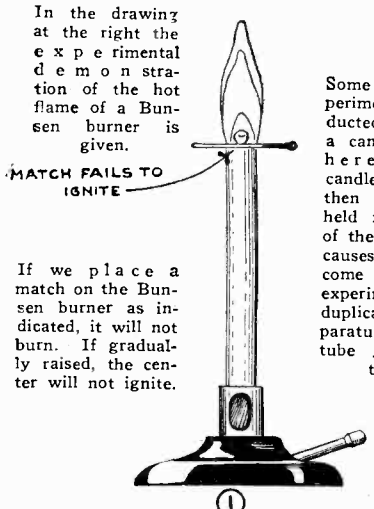
STAR DRILL



A substitute for a star drill can be made from a discarded auger filed as indicated in this diagram. By striking the bit with a hammer it will turn as it cuts into a brick wall and clear itself.—W. T. Markowski.

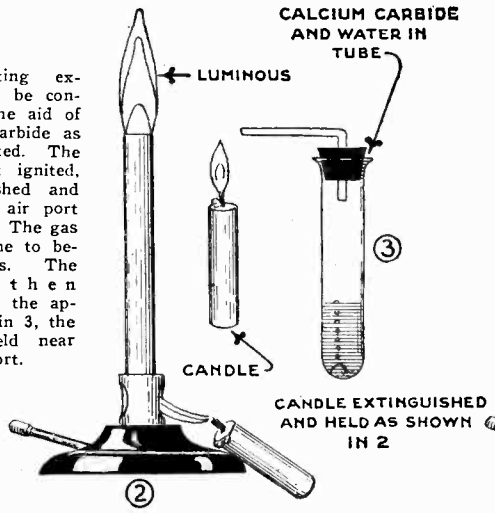
Experiments with Bunsen Burners

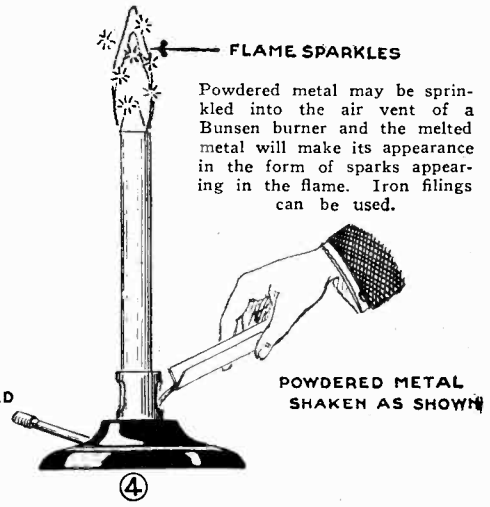
In the drawing at the right the experimental demonstration of the hot flame of a Bunsen burner is given.



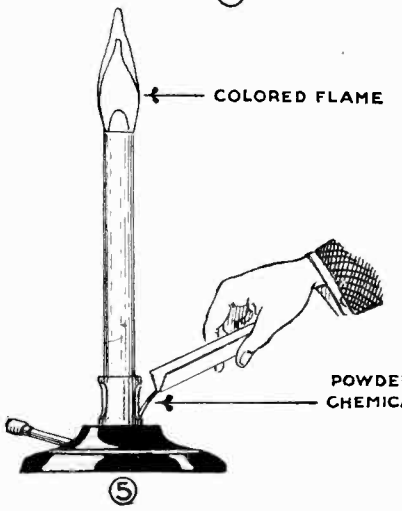
If we place a match on the Bunsen burner as indicated, it will not burn. If gradually raised, the center will not ignite.

Some interesting experiments may be conducted with the aid of a candle or carbide as here illustrated. The candle is first ignited, then extinguished and held near the air port of the burner. The gas causes the flame to become luminous. The experiment is then duplicated with the apparatus shown in 3, the tube being held near the air port.

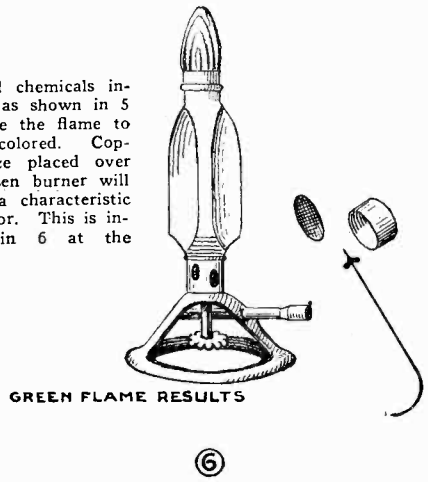


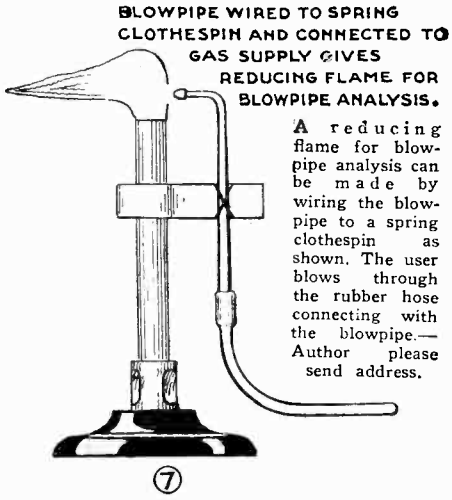


Powdered metal may be sprinkled into the air vent of a Bunsen burner and the melted metal will make its appearance in the form of sparks appearing in the flame. Iron filings can be used.



Powdered chemicals introduced as shown in 5 will cause the flame to become colored. Copper gauze placed over the Bunsen burner will produce a characteristic green color. This is indicated in 6 at the right.



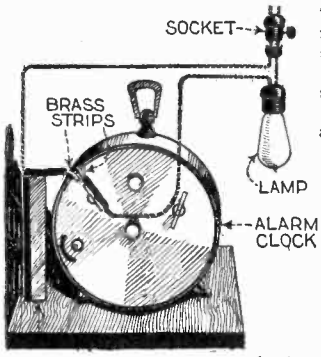


A reducing flame for blowpipe analysis can be made by wiring the blowpipe to a spring clothespin as shown. The user blows through the rubber hose connecting with the blowpipe.—Author please send address.

WRINKLES
RECIPES & FORMULAS

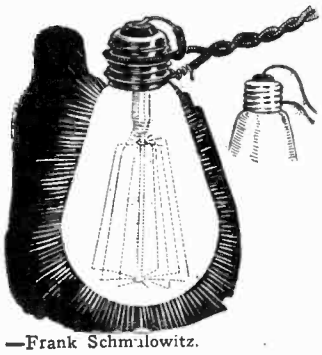
Edited by S. Gernsback

AUTOMATIC LIGHT SWITCH



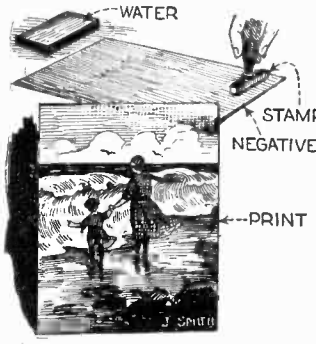
This handy arrangement will shut off the light at any desired time. The alarm clock acts on a switch to automatically open it at a given time. The key is turned once to the left so that the brass strips are in contact with each other when the switch is set.—Frank Schmulowitz.

TEMPORARY SOCKET



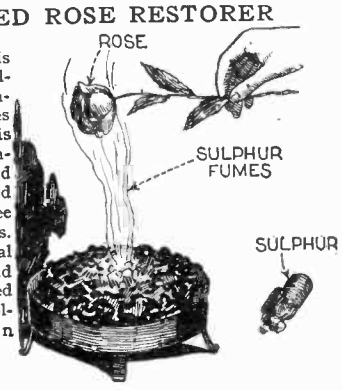
When there is no socket handy the device shown here may be used. In the case of necessity a light may be had in a few minutes. Care should be taken so that the two bare wires do not touch each other. The diagram explains all the details.—Frank Schmulowitz.

STAMPING PRINTS



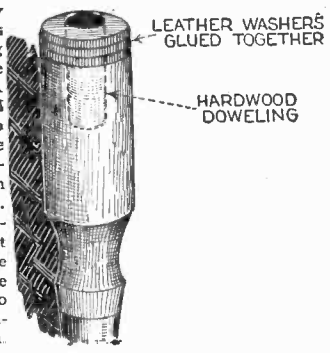
A simple method for stamping the name of the photographer on the prints. The stamp is moistened with water and pressed upon the print before developing. The water holds back developing at that place and the letters show up in white.—Richard Bannerot.

FADED ROSE RESTORER



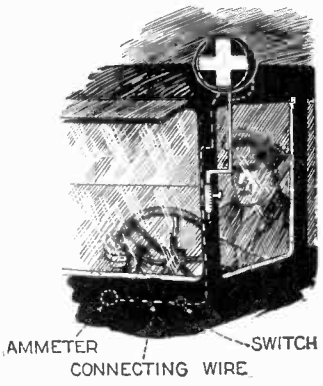
A faded rose is held over sulphur fumes until it becomes white. It is then dipped into water and put in a closed box for three or four hours. Upon removal it will be found it has regained its natural color.—Vernon Miller.

PREVENTING SPLITTING OF HANDLES



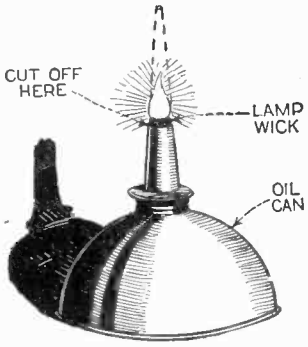
A simple way to keep handles from splitting is shown in the diagram. A piece of dowel is glued into the end of the handle projecting half an inch or more. Leather washers cut to fit around the doweling are glued into place.—Anthony Messina.

DISTINGUISHING LIGHT



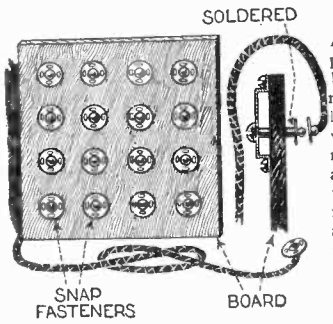
Ambulances, hearses and similar vehicles may be easily distinguished at night. A special spot light supported at proper height over the top of the car may be readily seen after dark.—Frederick E. Dunn.

ALCOHOL LAMP



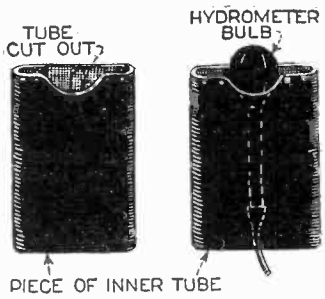
An easily made alcohol lamp may be readily constructed by cutting off the top of an oil can and inserting a lamp wick in it.—Jacob Samachson.

SMALL TELEPHONE EXCHANGE



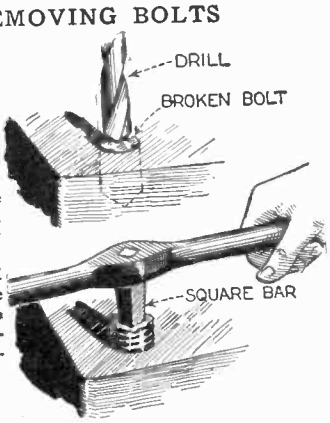
A simple telephone switchboard having many uses may be constructed very easily. A machine screw and a snap fastener are used for the jacks and plugs.—Conrad De Koster Bliss.

HYDROMETER RACK



A rack to hold hydrometers may be made from a short piece of inner tubing nailed above the testing bench.—John H. Wack.

REMOVING BOLTS

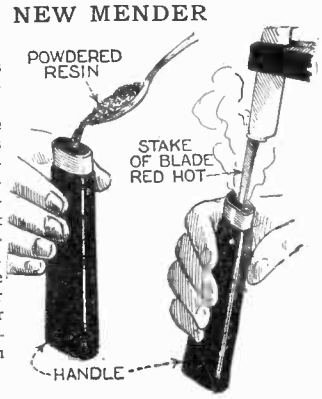


A hole is drilled in the center of the bolt and a square bar is inserted. In this way the bolt may be easily removed without injury to the threads. Or a left hand tap may be screwed into the hole.—George Samaras.

NOVEL SWING

An easily made swing may utilize two discarded auto casings. The casings are suspended by strong ropes about three feet apart. A smooth board is then laid between them for the seat of the swing.—Glen F. Stillwell.

A NEW MENDER



The hollow in the handle is filled with powdered resin and the iron stake of the blade is heated to redness and pressed into the handle until it takes its original position. This may be used for either ivory, bone or wooden handles.—Joseph Wallace, Jr.

Readers Forum

SCIENCE AND INVENTION desires to hear from its readers. It solicits comments of general scientific interest, and will appreciate opinions on science subjects. The arguments pro and con will be aired on this page. This magazine also relishes criticisms, and will present them in both palatable and unpalatable forms. So if you have anything to say, this is the place to say it. Please limit your letters to 500 words and address your letters to Editor.—The Readers Forum, c/o Science and Invention Magazine, 230 Fifth Avenue, New York City.

CHEMICAL BRUSH

Editor, SCIENCE AND INVENTION:

Here is an idea that might interest your readers. Over several millions of acres of land in the western states there is a brush, called Chemical Brush, growing. It covers land which was once valuable grazing land. The larger limbs and roots of this brush wood make excellent stove wood, but it does not pay to grub and cut it for the market to clear the land. The wood burns like wood soaked in oil. If some one could find the chemical properties of this brush and be able to get the products on the market at a profit, such a person could make a great fortune for himself and also help thousand and thousands of land owners. A great portion of the people owning this brush-covered land are very poor, many of them poor homesteaders.

Tanning fluid, quinine, and many other things might be extracted, if only a person knew how to go about it. Also there is another idea. If some one could invent a machine that would pull out his brush, run the limbs through trimming them of all branches too small to cut for stove wood, and then cut it into stove wood lengths right in the open, a sort of a thresher. It would prove of great value to the inventor. The only way now of getting this brush off the land with any return toward the expense is to grub it by hand, a slow, tedious, back-aching job, then cut up the trimmed limbs into stove wood with a circular saw. A very good worker can get out two tiers in four days and get it delivered for the sum of $10.

This brush grows in the semi-arid climates, and the land, after the brush is off, is mostly good for grazing, but it is not valuable enough to clear by hand, as the returns are so slow.

If a machine were to be had at a reasonable cost, there would be an enormous demand for them, as people would buy them to clear their land, whether there was a market for stove wood in their vicinity or not, as they could use the wood to burn in their own stoves, farm some of the better parts of their land, and graze the balance. In semi-arid countries a person needs a great deal of land for both grazing and farming, as the returns per acre are not so great as in climates with more rainfall; but for all that, great fortunes are made in semi-arid climate countries.

If any of your readers would be interested to experiment with the Chemical Brush, I will be pleased to send them any amount of Brush they desire, free of cost, and only request that they pay postage or transportation charges. I shall be pleased at any time to give any information that I can to any one about this Chemical Brush. I have some 800 acres of it.

JENNIE TONGE,
Soledad, Calif.

(Here is a chance for the amateur chemist to experiment and discover a way to make use of this brush for something else besides fire wood. We should be glad to forward Miss Tonge's complete address to any one who cares to have it.—EDITOR.)

DISLIKES "INTO THE FOURTH DIMENSION"

Editor, SCIENCE AND INVENTION:

SCIENCE AND INVENTION has always been the leading informer of the scientific layman and amateur scientist, and just credit is therefore due. But there is a certain feature which is, in the writer's opinion, not up to the high standard that should be maintained by "S. & I." That feature is scientific fiction.

There is no reasonable objection to scientific stories when they are of a nature to inspire scientific thought or clear up any scientific facts. But much of the fiction in "S. & I." falls far short of this worthy purpose. In fact, any person with only a mild interest in science would, upon reading the fifth and sixth installments of "Into the Fourth Dimension," say: "Well, if that's science, it's too much for me."

Of course he will see the fantastic illustrations and then be led into the story itself; that is, if no one discovers him "in the act." In that case, he would feel as if caught reading "Mother Goose."

Certainly he can derive no scientific information or logic therefrom, unless we class "sex appeal" as a worthy scientific subject.

Too much can not be said in favor of the efforts of "S. & I." in exposing spiritualism in its true light. These cruel harpies who subsist upon the sorrow and fear in the minds of their superstitious victims should have their talons clipped for all time.

Astrology is nearly as bad, and certainly just as illogical and unscientific as spiritualism. The only fact the astrologer is sure of is that "there is one born every minute."

Do not, by any event, consider dropping the experimental departments. They are of great value to the newer experimenters.

Text and illustrations are now being combined in good proportion, in the writer's opinion.

All in all, SCIENCE AND INVENTION is a remarkable publication, and were it not for the lurid twaddle printed under the name of science, I would have no brick to hurl. Scientific fiction can be made both interesting and instructive—why not have it so?

ARTHUR L. SAUVOY,
Fox, Mich.

(Now we shall undoubtedly hear from those of our readers who enjoy "Into the Fourth Dimension." Perhaps their idea of science differs from that of Mr. Sauvoy, or perhaps that type of a scientific fiction story appeals to some and not to others. The author's reputation as a writer of scientific fiction is well known to the readers of this publication. We believe that the present story is the deepest and most involved, which he has ever written.—EDITOR.)

PAGE MR. TIMONY

Editor, SCIENCE AND INVENTION:

On page 959, February issue, Clarence A. Timony, Brooklyn, N. Y., states that Hiram E. Butler wrote the greatest and most well-known book on Astrology to this day.

This book is called Solar Biology and in an advertisement of it we find this: "Solar Biology (Butler's book) has nothing whatever to do with astrology. It takes no account of the stars or constellations, neither does it concern itself with the jargon (used by astrologers) of aspects, houses and so on."

Advertised by Dr. J. A. MacDonald of Binghampton who wrote a book purporting to deal with Astrology.

I write this to introduce, if possible, a little accuracy into this valuable attempt to de-bunk Astrology.

The Bible says astrologers failed years ago. Daniel, chapter 2.

EZRA R. AVERILL,
Editor, Kingdom of Heaven Advocate, Grand Rapids, Mich.

(Perhaps Mr. Timothy will now have a few words to say about Mr. Butler's book on Astrology. We shall be glad to hear from him.—EDITOR.)

LIKES THE OLD MAGAZINE BETTER

Editor, SCIENCE AND INVENTION:

I have been reading your publications for over 12 years, and right here I must say that your present paper cannot compare with the old Electrical Experimenter. At present your "S. & I." makes an excellent pictorial representation of the latest in science. After reading the February issue I thought that the title should be changed to "Pictorial Science" or "Scientific Pictorial," also "Science in Artgravure." These suggestions are gratuitous. At least you could occasionally run articles with some intrinsic value, not ridiculous as your "Into the 4th Dimension." There may be, and doubtless are, people who find enjoyment in such preposterous literature, but they are the ones who while away precious hours reading such light stuff as your present "S. & I."

I do, however, approve your successful attempts to discredit Astrology, and find enjoyment reading Dunninger's exposures of spiritual monstrosities. Your recent remark "How-to-Make-It is not, by actual vote, extensive enough for our readers" is ambiguous. Young readers and handicraft workers answered in greater ratio than the really scientifically inclined.

Gernsback is a gifted editorialist and, it is to be lamented (on my part) that he should be connected with such a sheet. Eventually your staff will consist of photographers and caricaturists, and then you can run your journal as a supplement to the Hearst papers or some magazine with a real scientific value. However, you must please the majority,—cynics to the contrary notwithstanding.

Inadvertently a roughly penciled manuscript was mailed to your office, entitled "Perpetual Motion" about six to eight weeks ago. The manuscript was intended to be a reference, whilst I was addressing a group of young fellows on the fallacious reasoning and mechanical ignorance behind all attempts to construct such a contrivance. As the paper had no editorial or market value you may destroy, publish, or preserve same as you see fit. Doubtless you have done either the first or the last.

GEORGE ARTHUR WHITTAKER,
New Bedford, Mass.

(While there are a few readers of SCIENCE AND INVENTION *Magazine who prefer the old Electrical Experimenter, we have found that by actual count there are ten times as many readers who like* SCIENCE AND INVENTION *Magazine better. The experimental electrical departments have not been dropped from the present style of magazine, and approximately 50 per cent of this magazine is now text and the rest is pictures. There is an old Chinese proverb that says a picture is worth 10,000 words. Many of us can learn things more quickly from a picture than by reading masses of verbiage. Occasinally explanations are necessary, but we have practically no requests for further explanations of any of the articles featured in* SCIENCE AND INVENTION *Magazine. It therefore follows that our readers understand the material.*—EDITOR.)

SCIENCE CLUB

Editor, SCIENCE AND INVENTION:

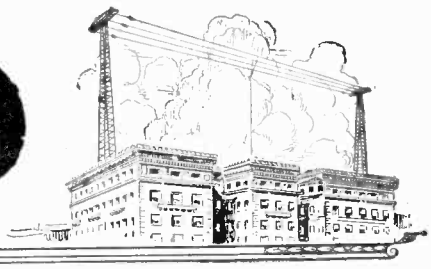
In looking over your Readers' Forum I often notice letters from young men who want you to form a club made up of young men between the ages of 16 or 17 and 23 or 24, who are interested in science. You state that you are unable to do this because of the time it would take. As you may see by my letterhead, I am president of the Gold Star Science Club, which has members all over the United States. If you could give this letter space in your Readers' Forum where it would attract the attention of the Amateur Scientists they could write to me and in that way we could form the club. The purpose of the club will be to promote interest in science among the young men of today.

Sincerely yours,

JAMES W. ROGERS.

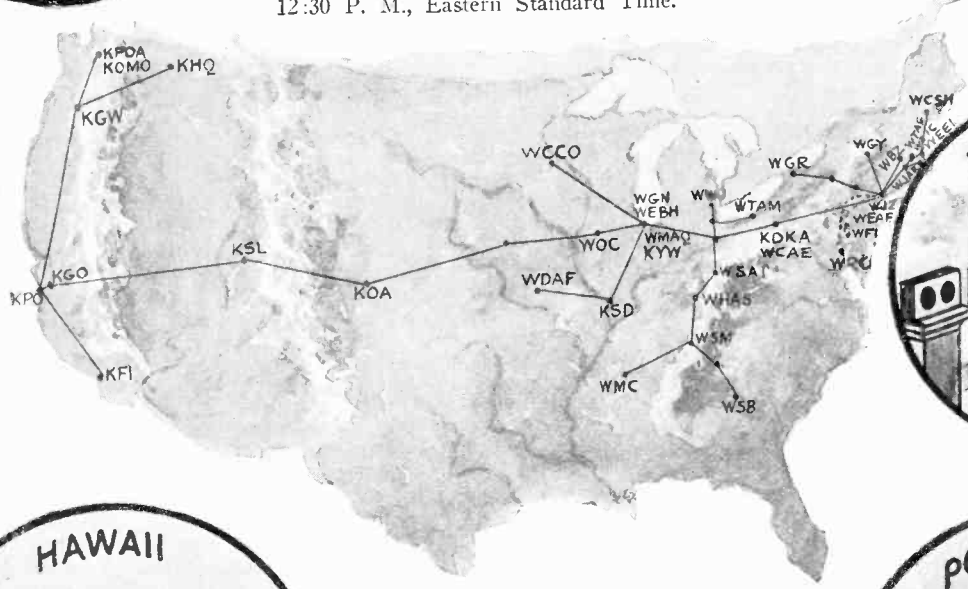
(A very good suggestion. Mr. Rogers' address will be sent on request.—EDITOR.)

RADIO



The President Speaks to America

ON February 22nd, an army of radio and telephone experts combined their efforts to enable chain broadcasting to make a new record. On that date the National Broadcasting Company linked together 38 stations extending from the Atlantic to the Pacific, for the simultaneous transmission of an address by President Coolidge at Washington, D. C., involving the use of special circuits covering 10,000 miles, and making necessary the services of 400 telephone and radio technicians. For the first time, the 7 stations of the National Broadcasting Company's new Pacific Coast network were linked with the East, forming a huge nation-wide chain bounded by Portland, Me.; Atlanta, Ga.; Los Angeles, Cal., and Seattle, Wash. The distribution of the 38 stations was such that practically every radio listener in the United States was able to hear the President's words. The first simultaneous transmission by the 38 stations began at 12:30 P. M., Eastern Standard Time.



IT is impossible to estimate the size of the audience which heard the speeches, but a glance at the map will reveal that the stations in the chain were concentrated in the areas of densest population throughout the country. Outside of these areas, it is common for radio listeners to obtain good reception from stations up to 500 miles distant, which should insure that every receiver which was tuned to the nearest station in the special chain was able to reproduce the broadcast. The ceremonies were undoubtedly heard throughout the world due to the location of short wave transmitters at WGY, Schenectady; KDKA, Pittsburgh, and KFKX, Hastings, Neb. Hooking up the special circuits, testing them and making sure that they were kept free from noise and in constant connection with each other occupied the attention of the army of telephone and radio engineers.

THE microphone installed in the House of Representatives at Washington was connected by special circuits with the Bell System Long Distance Headquarters Building, at 24 Walker Street, New York City, and from this point other special circuits carried the ceremonies to the other 38 stations. The ordinary long distance circuit may carry at the same time four or five telephone messages, besides numerous telegraph messages. However, a special circuit between broadcasting stations can carry only the broadcast, and must be equipped with special repeaters or vacuum tube amplifiers.

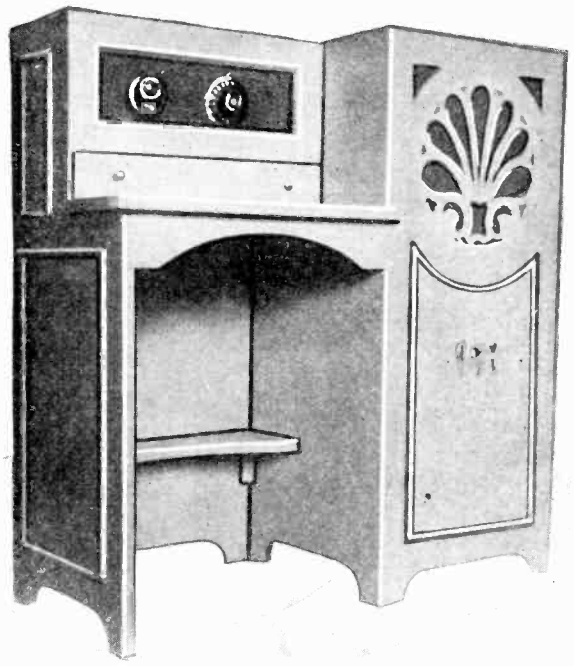
The detailed routing of the ceremonies from 24 Walker Street to the other stations in the chain started with 6 special circuits, which left New York in different directions. New England stations were supplied through two circuits. The third main circuit from New York supplied WGY in Schenectady, and the fourth fed WGR at Buffalo, passing through Scranton, Pa., and Elmira, N. Y.

Still another circuit paralleled the incoming line from Washington, passing through Philadelphia. The sixth circuit from New York traveled West to Brushton, Pa., where a tap emanated to KDKA and WCAE in Pittsburgh, and passed on to Beaver Dam, Ohio. Various connecting circuits linked up with these 6 special circuits, which came from New York, and thereby supplied the rest of the stations in the nation-wide broadcasting chain. All stations in the chain were kept in constant communication with each other by telegraph.

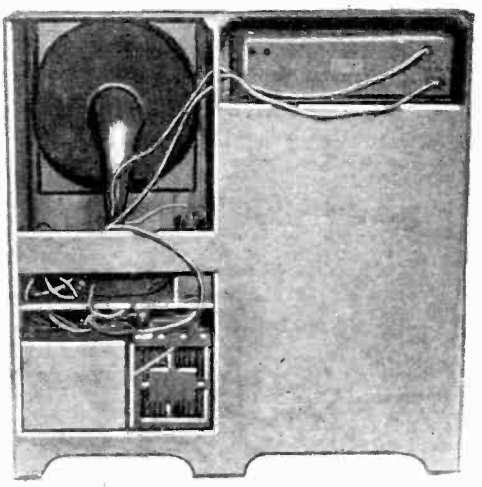
Building a Radio Console

By H. L. WEATHERBY

Director of Manual Arts, City Schools, Montgomery, Ala.



The neat appearing radio console completed and with the set installed. The novel disposition of the set and loud speaker should be observed.



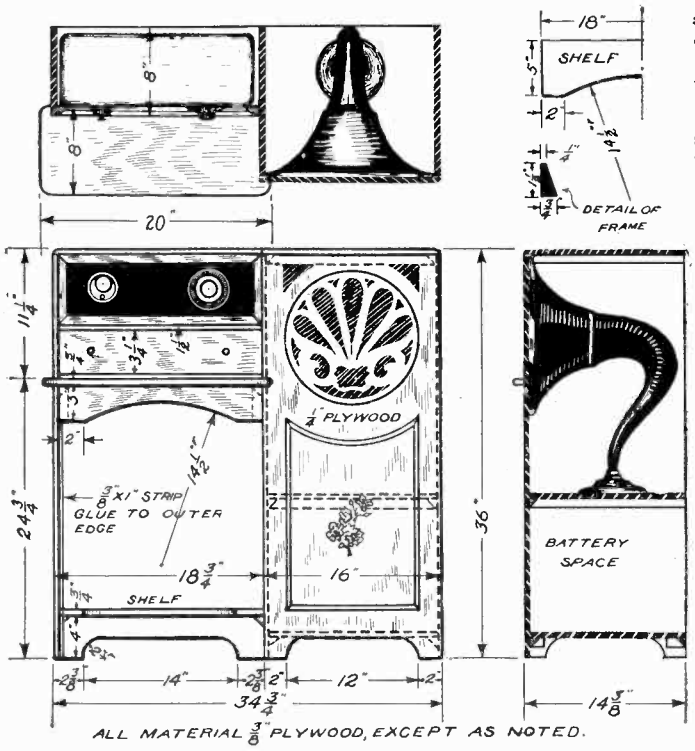
The rear view of the console, showing the placement of the parts. The set itself is housed in the upper right-hand corner of the cabinet. The loud speaker and batteries are placed on the left-hand side.

A HOME built radio cabinet that will be a credit to any radio set is illustrated herewith. The dimensions as given will accommodate the new single-dial control Atwater Kent receiving set and the Atwater Kent loud speaker of either size. However, by a few changes in dimensions, the console cabinet may be altered to fit practically any type of home built radio, any style of speaker and almost any of the factory built sets, not already installed in cabinets. The space beneath the loud speaker provides for all batteries and the charger, while the small drawer under the set will furnish ample space for logging charts, instruction book, small parts, tools, etc.

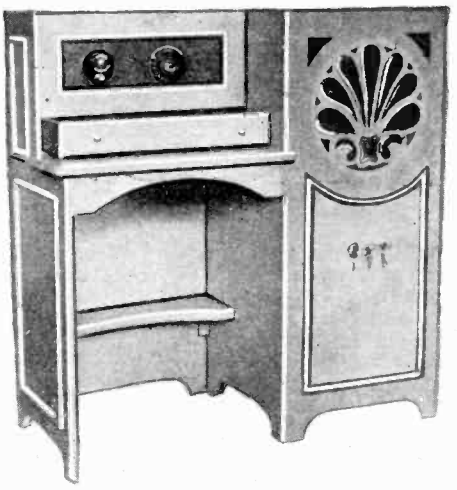
The cabinet as illustrated is finished in two tones of blue-gray lacquer, a lighter shade being used on the panels, on the drawer front and around the grille. The finished cabinet adds a touch of color that contributes greatly to the appearance of the room in which it is used. Other suggestions for finishing are lacquered Chinese red on jade green with appropriate Chinese or Japanese art decorations, which are very easily applied to the painted surface. The cabinet, if made of suitable wood and carefully sanded, may of course be finished in mahogany or walnut and varnished, or several coats of a good quality varnish stain, which provides stain and varnish with one operation, may be used with professional results. Now for the construction Purchase material sufficient to cut the desired number of pieces as indicated in the material list, noting that most of the job is done with plywood which provides strength with lightness.

The first step is to design the grille for the front. The best method for securing a uniform pattern is to draw one-half of the pattern on a piece of white paper using a soft pencil. Now to get the opposite half, completing the pattern, fold the paper along the center line, with the drawing on the inside, and with the thumb nail or any other smooth, hard surface rub over the lines, thereby giving an impression to the other half of the paper. Transfer this to the piece of ¼" plywood, which has previously been squared to dimensions for the front. The next thing to do is to saw around the design using a coping saw with a deep frame, or a jig or scroll saw if such is available. Small holes must be bored on the inside of each section to be sawed out, for the insertion of the saw blade. This operation will prove to be the most arduous task connected with the construction of the cabinet. Care must be taken to saw the curves smoothly and in finishing with file and sandpaper.

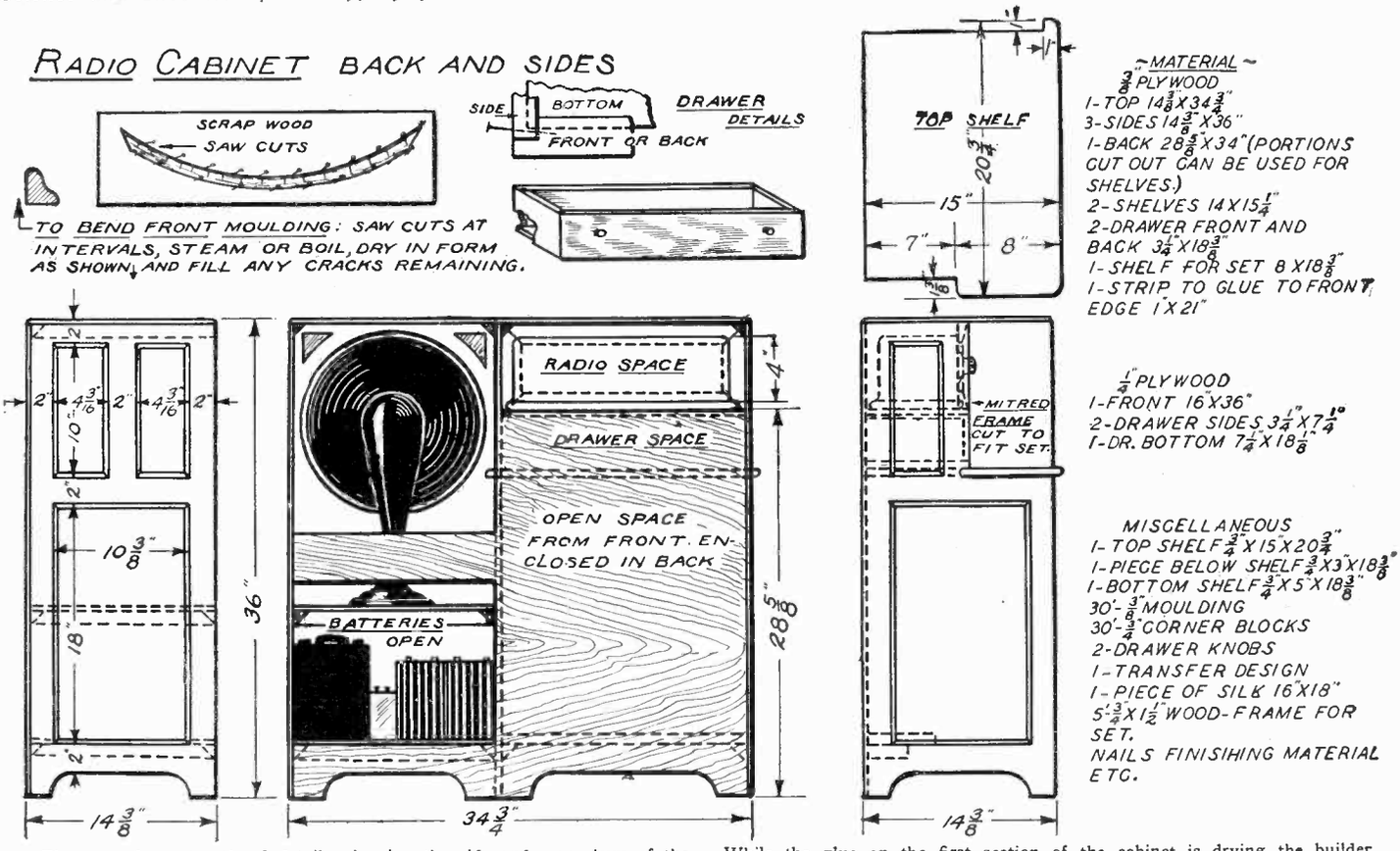
After smoothing the cuts that form the grille, square to size the two sides of the loud speaker portion of the cabinet, and the shelves that support the batteries and speaker. Assemble these pieces with the front, nailing the corners, and reinforcing all inside corners with blocks as indicated in the drawings. Do not fasten the loud speaker shelf in place, since it should be removable to give easy access to the batteries. These blocks may be made from any ¾" square scrap pieces or ¾" quarter round moulding. They should not be nailed or clamped into place but should be rubbed into position, using a good grade of hot cabinet glue. Too much importance cannot be laid to this feature of the work since the strength of the cabinet depends almost solely on these reinforcing blocks. Allow twenty-four hours for the glue to set before doing further work on this section.



The front and side views of the console, showing the constructional details. Plans for the loud-speaker compartment, battery space, shelf and the radio set compartment are given. The set compartment, of course, should be made to coincide with the size of the set used.



Another view of the finished radio console. The cabinet as illustrated was finished in two tones of blue-gray lacquer. The finished cabinet adds a touch of color that contributes greatly to the appearance of the room in which it is placed. The cabinet, if made of suitable wood, may, of course, be finished in mahogany or walnut. Chinese red or jade green with appropriate Chinese or Japanese art designs, which are very easily applied to the painted surface, make a novel finish. It is suggested that the console be finished in a tone which harmonizes or is in accord with the room.



The general constructional details, showing the side and rear views of the console. Note that most of the work is done with plywood, which provides strength with lightness. Although the sizes herewith given were made to accommodate an Atwater Kent receiving set and loud speaker, there is no reason why they have to be strictly adhered to.

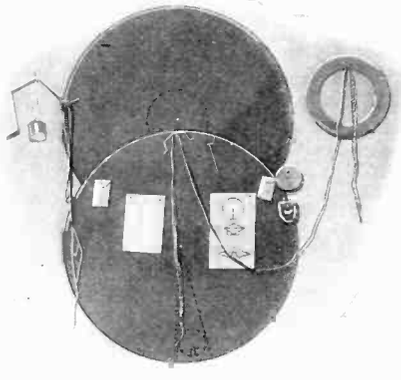
While the glue on the first section of the cabinet is drying the builder does not have to stop his work on the console. He may continue by making the opposite end and the intervening shelves. It is important that a good grade of glue be used and that all pieces are nailed or clamped into place while the glue is setting.

Now shape to size the opposite end, the intervening shelves, the piece that fits under the top shelf and the top of the cabinet. Nail these into position linking up the two parts of the case. Glue corner blocks in all unexposed corners.

Construct the mitred frame for the front of the radio receiver, fitted of course to the particular type receiver to be used, the one illustrated being for the Atwater Kent set. Nail and glue the mitred corners and fasten the frame into place in the cabinet. Fasten cleats in position and place bottom board on which set rests. Next build and fit the drawer, grooving and rabbeting the sides with a grooving plane if a machine saw is not available. Now fit the back, keeping in mind that the battery space and loud-speaker space should be left open and the shelf holding the loud speaker should be easily raised to give ready access to the battery compartment. However, a strip should run all the way across the back to provide strength.

Double Cone Knock-Down Loud Speaker

The front view of the assembled loud speaker, which presents a neat and attractive appearance.



The parts for the knock-down cone speaker showing the parchment disks, tape, unit and accessories.

THE loud speaker illustrated on this page shows a new knock down loud speaker. The small cost, the relative ease of assembly and the results obtained should appeal to many radio fans. The simplicity of construction makes it possible for one to assemble this speaker in a short time. The unit is of rugged construction and is of the adjustable type. A strip of tape holds the edge of the parchment cones together and permits them to move freely in any direction. The unit itself is held in position by means of the wooden ring which may be seen in the photograph at the right. A

(*Continued on page 75*)

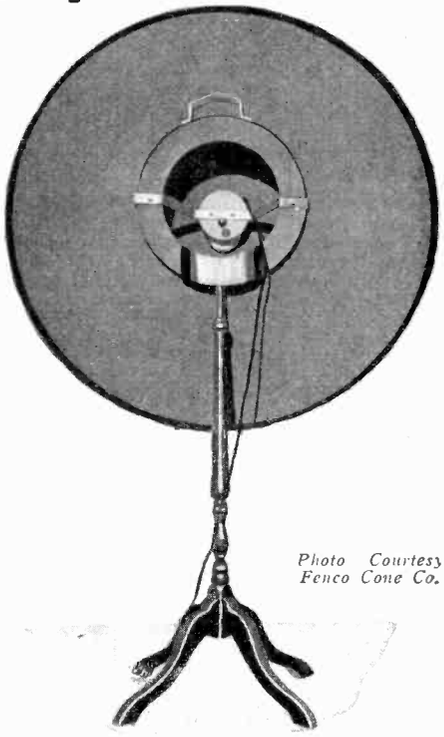


Photo Courtesy Fenco Cone Co.

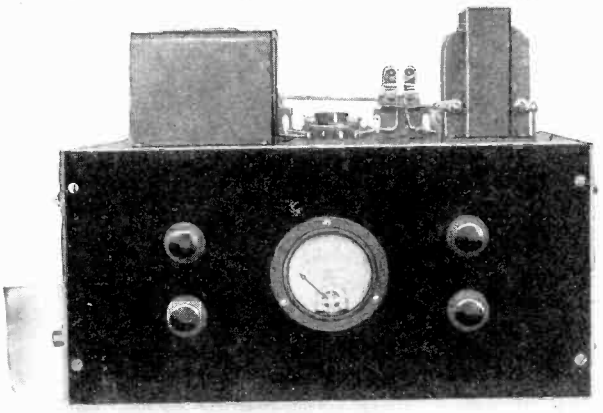
A rear view of the completed loud speaker showing the arrangement of the unit. The handle and stand make it adaptable for convenient home use.

Dressing Up Experimental Work

All Audio Amplifiers Are Essentially the Same: Why Build a New One Every Time You Try a New Circuit?

By A. P. PECK

EVERY real radio experimenter likes to try out new circuits as they appear in the various current periodicals, and in doing so he is often faced with the necessity of pulling apart a previously constructed set so as to obtain sufficient apparatus for trying out the new circuit. This is all very well and good up to a certain point. The writer has gone through all this sort of thing, and has constructed and taken apart many different types of receiving sets. In doing this the thought often occurred that it seemed to be rather a waste of time to dismantle a complete audio frequency amplifier every time that a new set was built, but as everyone required a somewhat different layout, this was a necessity. In an endeavor to get away from this troublesome feature of experimenting and at the same time "dress up" the result, and graduate from the haywire and breadboard affair of yesterday, the system was evolved which is described and illustrated in the various photographs and diagram re-produced here.



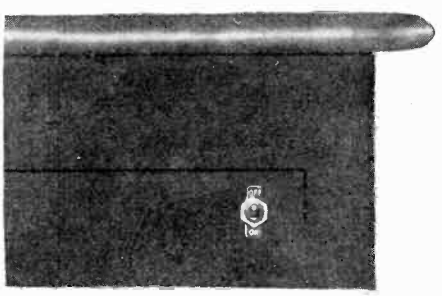
A front view of the eliminator-amplifier shows it to be a very neat assembly of apparatus, the greater part of which is protected from dust by the cabinet into which it is built.

The start toward the dressing up, was the purchase of a radio console table such as are available in any size and style in all of the larger radio stores. The particular console that the writer selected had a so-called battery compartment under the table top which measured approximately 24 inches long by 12½ inches deep by 14 inches high. This, it was reasoned, would allow ample room for the placement of storage battery, a "B" battery eliminator, and a power amplifier.

The next step was the design and construction of the above mentioned eliminator and amplifier, which it was decided, could best be incorporated in a single unit. After much designing and re-designing the form illustrated was decided upon as being the most compact and at the same time, easily workable unit. By a process of elimination and cutting down of unnecessary leads and binding posts, it was found possible to use only four leads from this unit to the receiver proper. These together with the two leads for the antenna and ground, constitute the only six wires which will have to be led up through the top of the table to the receiver.

A word about this receiver will not be amiss here. It can be of any desired type incorporating radio frequency amplification and a detector either of the regenerative or straight type. Thus, it will be found possible to quickly assemble and test any type of receiver which may be found described in any publication. You need only build the *radio frequency and detector unit* and place it on the top of the table, hook the six leads to it, and you are ready to test it. You will know that at all times you have a nearly perfect amplifier, capable of delivering ample volume, and a "B" eliminator and "A" supply which will furnish ample current, not only for the power amplifier, but also for any receiver which you may be testing out on the table top. In this way you can build yourself one completely finished receiver, house it in a nice cabinet and keep it on the table top at all times for all-around reception. The test table, since it is now dressed up, can be kept in the living room or other location available to the entire family, and can be used in the same way as any regular receiving set. Then, when a new circuit comes out, you can retire to your work shop and construct all of it but the audio amplifier. After this work is done, it is only a matter of seconds to remove the standard receiver from its table, hook in the newly completed one, and try it out. By following this procedure you will encroach upon the use of the standard receiving set for a minimum period of time, and will also be saving yourself many hours of constructional work.

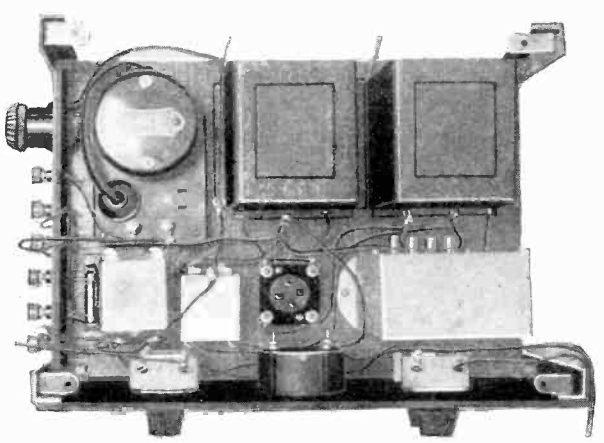
The eliminator that it was decided to use in connection with this glorified experimental lay out, was one employing a Raytheon (or other equivalent tube) full-wave rectifier tube and a standard filter circuit. The transformer for supplying the rectifier tube supplies in the neighborhood of 300 volts on either side of the center tap. This high voltage transformer used with a type BH tube was selected so as to be sure that at all times, plenty of power would be on tap for the operation of all the vacuum tubes in the receiver, the two standard and the one power tube in the amplifier, and for supplying a proper "C" bias to the three tubes last mentioned. Of course, any standard eliminator could be used here, but it would have to be changed somewhat in order to provide connection for the "C" biasing resistances.



This apparatus is as near to a self-starting mechanism as you can possibly imagine. All that is required to start it going is to throw the small toggle switch inserted into one corner of the cabinet. This switch operates the battery relay, controlling the line voltage and the filaments of the tube.

Reference to the circuit diagram will show that there are five available resistances for controlling the out-put of the eliminator. These are indicated by R7, R8, R9, R10 and R11. The values of these are as follows: R7 is a variable resistance (10,000 to 100,000 ohms). It controls the voltage supply to the RF tube. R8 is a variable resistance with a value of from 25,000 to 250,000 ohms. It controls the plate potential delivered to the detector. R9 is a fixed resistance unit of 10,000 ohms resistance. R10 is the "C" biasing resistance for the first two audio frequency tubes, and is valued from 100 to 1,000 ohms. R11 is connected in the circuit for the purpose of biasing the grid of the UX 171 power amplifier, and its value is from 1,000 to 10,000 ohms.

In regard to the rest of the apparatus used in the eliminator proper, T1 is the high-voltage transformer which is also equipped with a 5.5 volt secondary for heating the filament of the UX 171. C4 and C5 are the usual .1-mf. buffer condensers. BH is the Raytheon (or other make of equivalent tube) full-wave rectifier tube. C6 and C7 are 4-mf. fixed condensers, while C8 is a 6-mf. These three are incorporated in several condenser blocks now available. CH1 and CH2 are the choke coils of the filter circuit, and in the unit employed, are housed in a single casing. C9, C10 and C11 are 1-mf. fixed condensers.



Looking down from the top of the lower level, the choke coils and transformers of the eliminator are seen. The relay is also shown, with the meter and voltage control resistances.

When designing the combined eliminator and power amplifier, it was decided to make it a "double decker" affair. The lower sub-panel supports the "B" eliminator proper, the various voltage controls and the useful milliammeter, range of 0 to 100, are placed on the front panel, and the power amplifier is mounted on the upper sub-panel. The latter is supported by four brass angle strips 7 inches long. These are equipped with angles so that they may be screwed down to the lower base board and securely bolted to the upper base board, thereby forming a rigid frame. Two of the brass uprights also support the front panel which is of a standard size measuring 7x14 inches. Both

baseboards are of the same size, measuring 10x14 inches and were cut from ½-inch thick stock.

Mounted on the lower base with the eliminator, is the automatic control relay labelled S1. By means of this, the eliminator is disconnected from the 110-volt A.C. circuit when the filament circuit is opened. This latter is accomplished by means of a small push-pull or toggle type switch, mounted on the side of the console cabinet at a place convenient to the operator's hand. Placing the switch here and connecting it in series with one side of the storage battery lead to the post on the power amplifier unit, eliminates the necessity of building a filament switch into any receiver which may be used with this unit. This placement of the switch also simplifies the wiring.

On one of the short ends of the unit and supported by two of the brass uprights is a binding post strip. This was made wider than usual so as to accommodate the small electric light base socket indicated by S in the diagram and shown in the photographs. This little unit is very handy in "B" eliminator construction, as it does away with unsightly wires which would otherwise be connected to the eliminator at all times. With a socket of this type, a twisted pair can be run in through the back of the cabinet and equipped with a plug. Then when occasion arises to remove the eliminator from the cabinet, it is only necessary to pull out the plug and the A.C. circuit will be disconnected. Six binding posts are mounted on the strip, two of them for connection to the speaker, the cord of which is to be run in through the back of the cabmet. The others are for leads which are to connect to the receiver on the table top. Flexible wires are connected to the posts and led up through tiny holes drilled in the table top close to the back. Spade-type lugs soldered to each end of these four wires will facilitate connections.

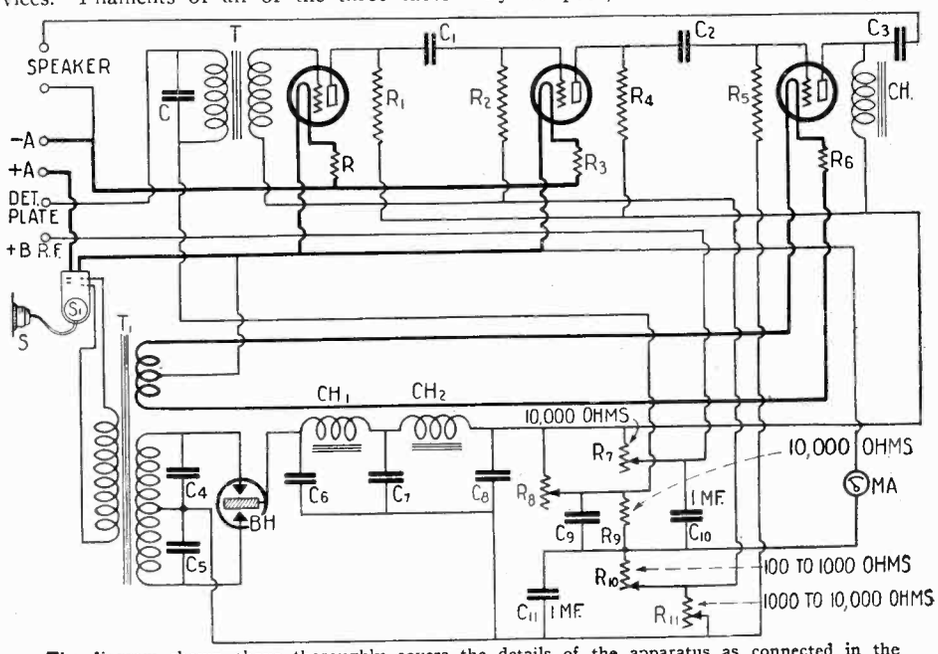
It is advisable to build a combined eliminator and amplifier of this type in sections, and to mount the instruments in place as the wiring proceeds. In this way the entire eliminator is wired first before the upper baseboard is bolted in position, and sufficient length of wire is left at the various necessary points to enable connection to the instruments mounted on the upper level. After all the wiring of the eliminator is completed, the upper base is bolted in position, and the long wires run to the various parts of the amplifier where they are to be connected.

In deciding upon the type of amplifier to be used, the writer picked upon one which much experimental work has shown to be about ideal. A good audio frequency transformer, T, in the diagram, is provided for the input of the detector circuit to the first audio tube. The primary is shunted by a .001 or a .002-mf. fixed condenser, C. The transformer that the writer selected was of a husky well-known make which gives excellent and uniform amplification. The other two stages of amplification are coupled together by means of standard resistance coupling devices. Filaments of all of the three tubes are controlled by means of amperites of the correct size. The first two tubes in the writer's unit are of the UX 201A type while the third is a power tube of the UX 171 type.

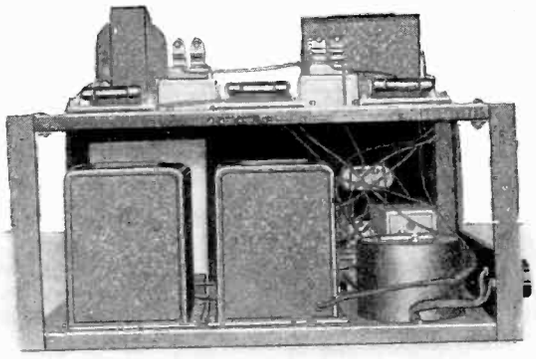
The constants for the resistance-coupled amplifier are as follows: R1 and R4 have a resistance of .1 megohm. R2 is a .5 megohm resistor while R5 has a resistance of .25 megohms. C1 and C2 are to be high-voltage type fixed condensers, each with a capacity of 1-mf.

The use of power amplification and high voltage on the plate of the last tube makes it almost impossible to secure good quality if the speaker is connected directly in the plate circuit, as has heretofore been general practice. It is quite necessary that the D.C. component of the plate circuit current be kept out of the speaker winding as otherwise not only will the quality be poor, but there will be danger of burning out the speaker. Therefore, a tone filter consisting of a choke coil and a high-voltage condenser, indicated by Ch and C3, respectively, in the diagram, must be employed. In the unit illustrated, these two instruments are combined in a single housing. In case an experimenter desires to build his own tone filter, the fixed condenser C3 should have a capacity of in the neighborhood of 2-mf., and must be of a high-voltage test type. This is because it is shunted directly across the entire output of the "B" eliminator. It must therefore be able to stand at least 300 volts in order to insure a fair safety factor. The choke coil may have a value of 30 henries. Some experimenters make use of the secondary of a Ford spark coil in this location, leaving the primary and core in place.

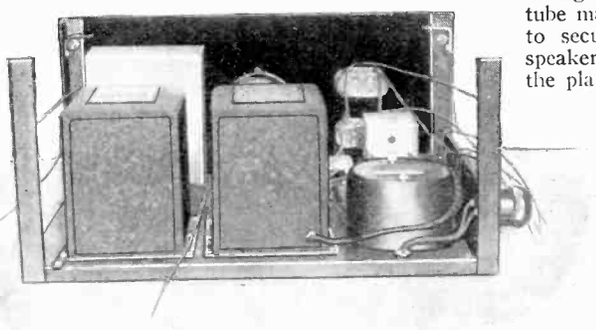
In the writer's opinion the above described eliminator and amplifier makes an ideal instrument for the serious experimenter who does not have a very great amount of time available for constructional work, and who must also conserve in a financial way.



The diagram shown above thoroughly covers the details of the apparatus as connected in the eliminator-amplifier. It will be seen that the circuit is quite standard, but that a few refinements are included to improve the unit's efficiency.



The eliminator is placed on the lower level of the decked mounting, with the amplifier placed immediately above so that short leads may be installed. The whole assembly requires very little space.



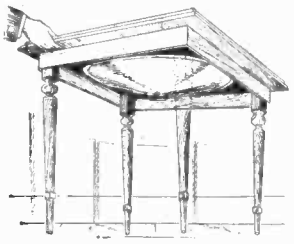
Another view of the eliminator with the amplifier deck removed, showing that the parts of the eliminator are easily accessible, even when the upper shelf is in place.

THE TOOLS REQUIRED

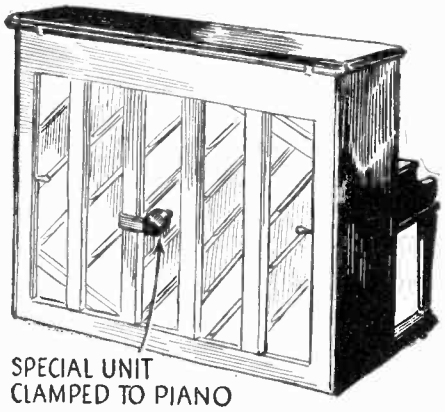
Pliers, several kinds.
Screw drivers, several sizes.
Hammer, hacksaw and blades.
Hand drill.
Twist drills, several sizes.
Scriber.
Center-punch.
Soldering iron, electric or other type.
Wire solder, self-fluxing or plain solder and non-corrosive flux.
Rule, steel or wood.
Center finder for dials.
One 3- or 4-cornered reamer and handle for expanding panel holes for shafts, jacks, etc.
Small tool and awl handle very useful.
Volt and ammeters for testing set, batteries, etc.
One countersink.

(*Names of manufacturers of parts supplied on request.*)

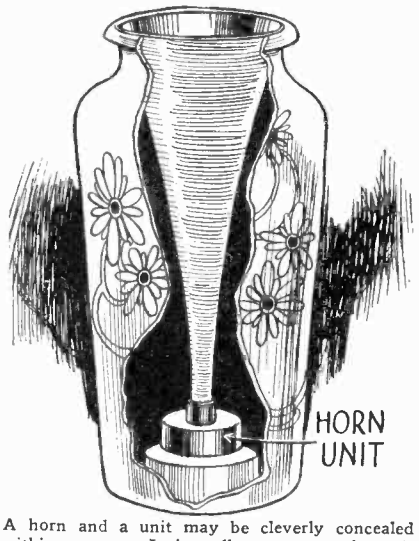
Artistic Loud Speakers and How to Make Them



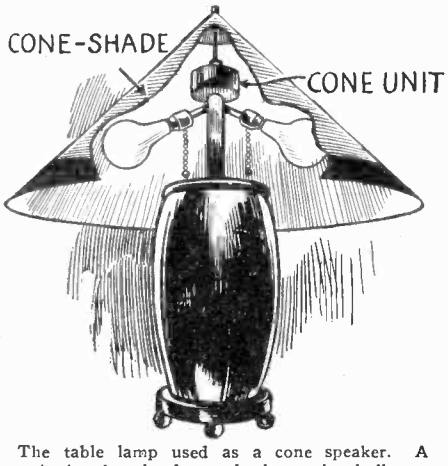
One of the most convenient methods for concealing the cone speaker is to place it beneath the top of a small table. In this manner the speaker may be readily moved from place to place. The table itself may support the radio set or some object of decoration, thus serving a dual purpose in the household.



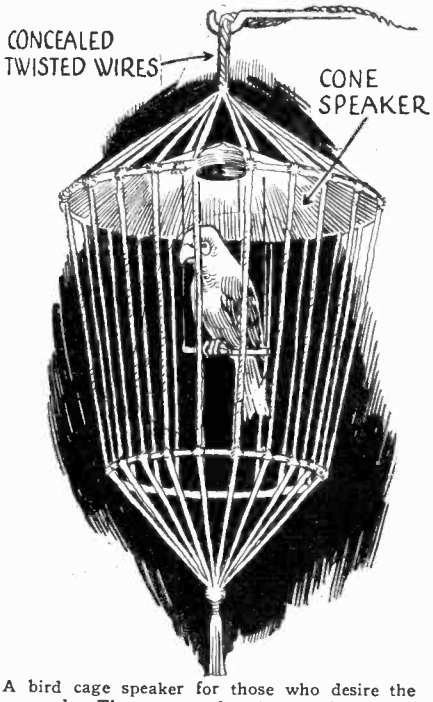
A clever arrangement doing away with a cone entirely. The unit is attached directly to the piano sounding board, giving faithful reproduction, especially on the bass notes.



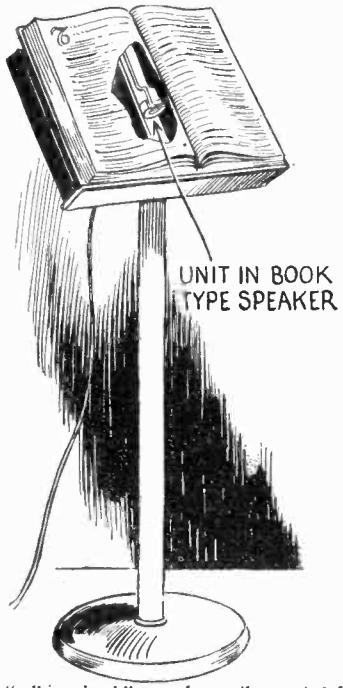
A horn and a unit may be cleverly concealed within a vase. It is well to support the unit upon a piece of sponge rubber.



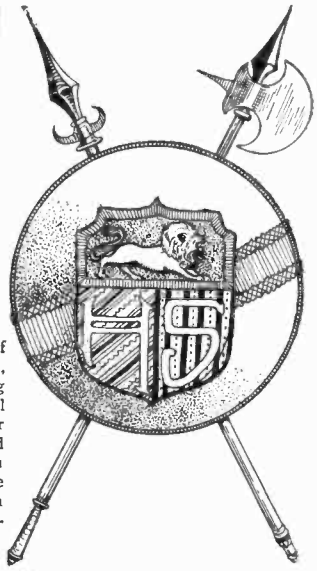
The table lamp used as a cone speaker. A unit is cleverly fastened above the bulbs so that it can make contact with the shade, which is used as the cone.



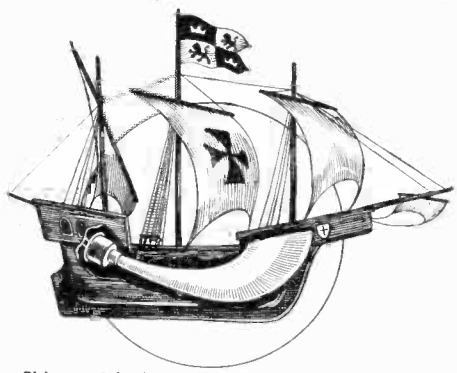
A bird cage speaker for those who desire the unusual. The cone and unit are situated in the upper part of the cage. Plush or chenille cord holds the cone in place. The two leads to the set are twisted together and concealed by winding the ends of the cord about them. A wooden bird placed inside of the mock cage further adds to the realistic effect of the speaker.



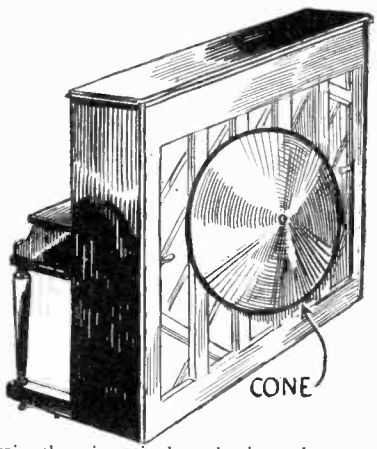
The "talking book" may be easily carried from place to place and also provides a unique mounting for the loud speaker. This particular type can be used to advantage in schools, churches, and similar institutes. The unit is placed inside the book itself. The leaves of the book are made from parchment or vellum paper and are connected to the unit in the middle of the book. The leads from the speaker may be led directly from the back of the book or may be concealed.



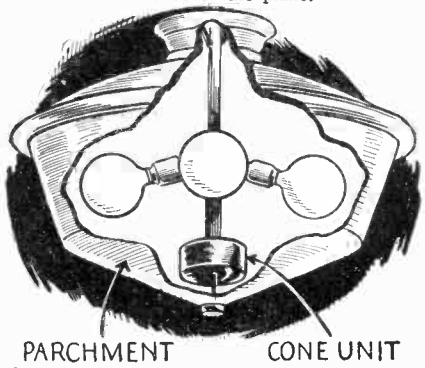
A new type of wall speaker, the talking shield. One will have to go far in order to find a speaker which can compare with this one in artistic and decorative effect.



Ship models have become a popular form of decoration within the past year or two. Those who are fortunate enough to possess one of these models may use it to advantage as a mode for concealing a small horn loud speaker.



Again the piano is brought into play as an accessory to the radio set. In this case the unit is not clamped directly to the piano, but is attached to the cone, which in turn is fastened to the piano.



A loud speaking ceiling-light is an effort to get away from the commonplace. The globe itself is made of parchment. The unit is concealed within the globe. The two leads may be brought out through the top.

RADIO ORACLE

In this department we publish questions and answers which we feel are of interest to the novice and amateur. Letters addressed to this department cannot be answered free. A charge of 50c. is made for all questions where a personal answer is desired.

AMATEUR LICENSES

(537) James F. Marcy, Milwaukee, Wis., asks:

Q. 1. Will you please publish the requirements which must be met to obtain an amateur transmitting license?

A. 1. We quote from the Radio Communication Laws of the United States bulletin, furnished to us by the Department of Commerce:

"Amateurs before applying for licenses should read and understand the essential parts of the International Radio Telegraphic Convention in force and sections 3, 4, 5 and 7 of the Act of August 13, 1912. The Department recognizes that radio communication offers a wholesome form of instructive recreation for amateurs. At the same time its use for this purpose must observe strictly the rights of others to the uninterrupted use of apparatus for important public and commercial purposes. The Department will not knowingly issue a license to an amateur who does not recognize and will not obey this principle. . . .

"Amateur First Grade.—The applicant must have a sufficient knowledge of the adjustment and operation of the apparatus which he wishes to operate and of the regulations of the International Convention and Acts of Congress insofar as they relate to interference with other radio communication and embody certain duties on all grades of operators. The applicant must be able to transmit and receive in Continental Morse at a speed to enable him to recognize distress calls or the official 'keep-out signals.' A speed of at least ten words per minute (five letters to the word) must be attained.

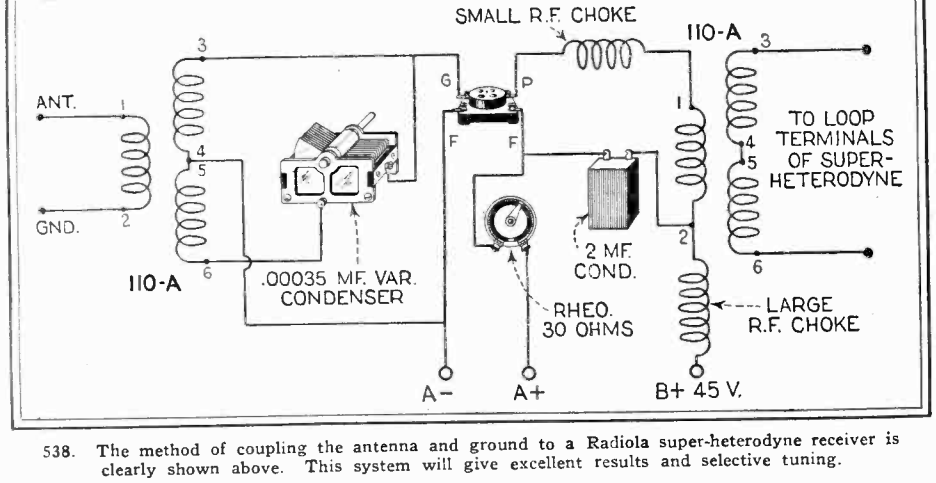
"Amateur Second Grade.—The requirements for the second grade will be the same as for the first grade. The second grade license will be issued only where an applicant cannot be personally examined or until he can be examined. An examining officer or radio inspector is authorized at his discretion to waive an actual examination of an applicant for an amateur license, if the amateur for adequate reasons cannot present himself for examination, but in writing can satisfy the examining officer or radio inspector that he is qualified to hold a license and that he will conform to his obligations."

ANTENNA "SUPER" OPERATION

(538) J. C. Stevens, Elgin, Illinois, writes:

Q. 1. I wish to use an antenna in connection with my Radiola Super, which is of a model about 2½ years old. Have tried several antenna connections, but they are not selective. How may this be done?

A. 1. While you could build an antenna tuner with antenna circuit separate from the secondary, and tuned by means of a variable condenser and loading coil, a stage of tuned R.F. amplification would be a better means of providing selectivity, added sensitivity, and freedom from radiation of energy into the antenna, to the great joy of your neighbors. In figure is shown a suggested circuit for an antenna tuner, R.F. amplifier, and coupling transformer, requiring only one control and no critical adjustments. The output transformer, which in this case is a Silver Marshall Type 110-A, is designed so that the secondary is tuned with a .00035 mfd. variable condenser, to cover the broadcast band. As the condenser shunted across the loop in your set is about .0008 mfd., it would probably tune the 110-A coil through a range of from 250 to 800 meters and you would be unable to tune in the lower wavelength stations. Hence only one whole section of the stator winding should be used, with 6 additional turns from the other stator winding, the remaining turns being removed. It is best to unsolder the wire leading to terminal 3 of the transformer, and remove turns from the coil until only 6 are left, soldering the end of the 6 turn coil to terminal 3. Connect the terminals 3 and 6 of the coil to the binding posts in the set which are marked for "external loop" connection, and the loop condenser will thus be shunted across the coil. The filament and plate voltages for the R.F. tube may be obtained from the same set of A and B batteries supplying the main set.



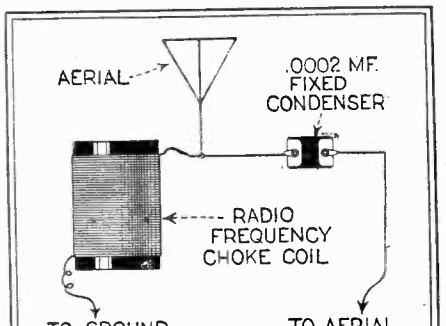
538. The method of coupling the antenna and ground to a Radiola super-heterodyne receiver is clearly shown above. This system will give excellent results and selective tuning.

REDUCING MACHINE INTERFERENCE

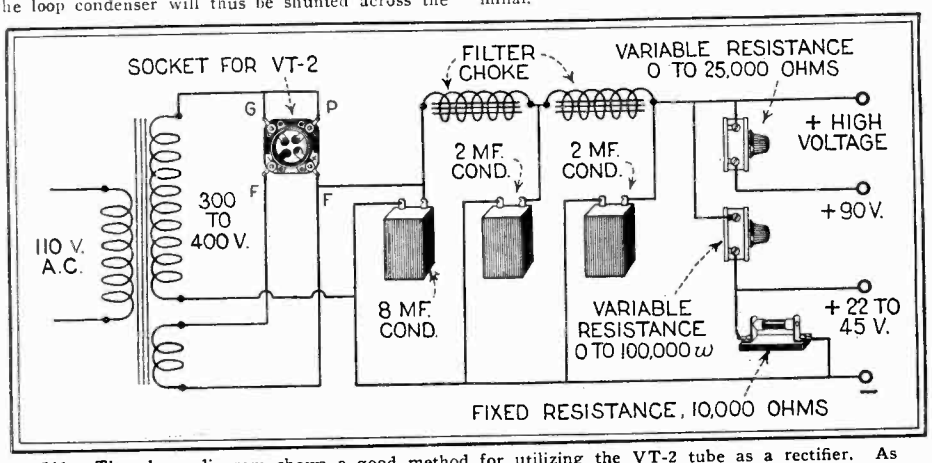
(539) J. G. Bendigo, Salem, Mass., writes:

Q. 1. I have an electrical lighting plant in my neighborhood. Is there anything I can do to reduce interference from this source?

A. 1. See the circuit printed in these columns. This shows the circuit of an interference eliminator. The apparatus required will be one coil consisting of 100 turns of No. 26 DCC wire wound on a three-inch cardboard former. This is the radio frequency choke. Next one fixed condenser of about 0.0002-mfd. capacity is required, but the exact capacity must be found by experiment. The choke and condenser are joined together as shown. The other terminal of the condenser is connected to the aerial terminal of the set. The aerial must be connected to the junction of the choke and condenser. The remaining end of the choke is connected to the ground terminal of the set, and the ground wire should be left connected to the terminal.



Interference Eliminator Hook-up



541. The above diagram shows a good method for utilizing the VT-2 tube as a rectifier. As the tube is capable of operating at a plate voltage of 400 volts, it will deliver sufficient voltage when used as a rectifier.

VT-2 AS A RECTIFIER

(540) Harvey Seton, Sacramento, California, writes:

Q. 1. I have several VT-2 Western Electric tubes which I believe could be used in a "B" eliminator. Can you suggest an appropriate circuit in which one of these tubes could be used to supply plate voltage for a six-tube set?

A. 1. A good circuit for the VT-2 tube is shown in Fig. 1. As the tube is capable of operating at a plate voltage of 350 to 450 volts, you can supply sufficient voltage, using it as a rectifier, to operate a type 310 power tube, as well as a number of tubes of lower voltage requirements. One of the power transformers designed for use with either the CX-316-B rectifier tubes, or the heavy duty Raytheon rectifier can be used, provided that the transformer has a filament winding of at least 6 volts. If no filament winding is furnished with the transformer, a small bell-ringing transformer having a 6-volt secondary can be used, with the primary connected in parallel with the plate transformer primary. The filter circuit is the same as for any of the "B" eliminator circuits now in use, and the voltage reducing resistances are connected in the customary manner, as is shown in the diagram. The grid and plate of the tube are connected together, at the socket terminals.

OPERATING A SUPER-HET

(541) Arthur Manson, Kalamazoo, Mich., writes:

Q. 1. I would like your advice as to the best method of operation for my eight-tube super-heterodyne.

A. 1. A superheterodyne is a very flexible type of receiving set and one which if properly operated will afford great satisfaction. It requires a certain technique of operation which is peculiar to itself alone, but it is not at all difficult to master the principles and to put them into effect. There are usually three active controls on the superheterodyne: The antenna or loop condenser, the oscillator condenser, and the potentiometer. The best method to proceed for tuning-in local stations is to adjust the potentiometer to a point considerably below the oscillation point and to run over the wavelength range with both condensers until foreign signals are picked up, when the process may be concluded by tuning the condensers more carefully to the point of maximum audibility. This process will hold for local reception under ordinary conditions, and if the tubes are kept from oscillating, there will be no interference with the reception of neighboring listeners. When the set is adjusted in this fashion, carrier waves will not be heard, hence there will be no squeals floating around uninvited. For "DX" work, it is quite necessary to bring the set to the point of maximum sensitivity, which is attained when the tubes are adjusted to a point just below oscillation. The best way to tune in a "DX" station is to advance the potentiometer until the carrier-wave whistle may be heard on rotating the oscillator and loop dials. While the potentiometer is still adjusted so as to cause the tubes to oscillate, the set may be sharply tuned to a point between the two peaks of the carrier-wave whistle, and then the potentiometer should be retarded to stop the oscillation. The next step is to retune the set by means of verniers or other fine adjustments, to bring the signal in as loud as possible, with the potentiometer retarded to eliminate distortion.

Scientific Humor

ONLY THE FIRE

"Say the jokes in that last issue were terrible."

"I don't know. I threw a lot of rejected ones in the stove and the fire just roared." —*Elsie Koester.*

DEFINITION OF A SPEEDER

FIRST: "His ears remind me of a pair of front fenders."

SECOND: "They are big, aren't they?"

FIRST: "And they are on opposite sides of a vacuum tank."—*Horace Potter.*

"DUMBNESS" WOULD BE MORE DESCRIPTIVE

PROF.: "What is density?"

STUDENT: "Er—it's something like thickness?"

PROF.: "Yes, when applied to students.—*George Licsak, Jr.*

A GREAT SUCCESS

FIRST RADIO FAN: "What are you doing?"

SECOND RADIO FAN: "Sending a post card to the weather man to tell him that the static is coming in fine."—*Paul S. Powers.*

EVERY LITTLE DROP HELPS

BILL: "My new airplane reminds me of coffee."

JACK: "How is that?"

BILL: "It's good to the last drop."—*A. Hirschfeld.*

WILLIE HIDE THE ERASERS

MARION: "You are a very artistic dancer."

MABEL: "Yes, I got that way by chewing art gum." — *Leslie Carpenter.*

SOLID?

PROFESSOR (attempting to be witty in geometry class): "And can any of you gentlemen tell me where has my polygon?"

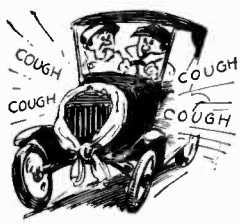
BRIGHT STUDENT (also "attempting"): "Up a geome-tree, sir."—*Chas. C. Zimmerman, Reporter No.* 21608.

THE REASON

Wild flowers get that way from trying to learn their botanical names.—*Chas. C. Zimmerman, Reporter No.* 21608.

First Prize $3.00

PROBABLY CAUGHT COLD



HENRY: "Your engine is coughing badly again."

FORD: "Shouldn't wonder. I had its muffler off last night. — *John W. Somrock.*

IS IT SO?

TEACHER: "What is a conductor of electricity?"

LITTLE TOM: "A conductor of electricity is the man who changes the trolley pole when it finishes its run and starts back over it."—*Leroy Vincint.*

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. We cannot return unaccepted jokes. Please do not enclose return postage.

All jokes published 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.

SOUNDS PASTY

JACK: "My wife gave me a two-tube set for my birthday."

TED: "Regenerative?"

JACK: "Naw! shaving and tooth!" — *John W. Somrock.*

CHEMICAL ANALYSIS OF GREEN

A green little chemist
One fine summer's day,
Mixed some green little chemicals
In a green little way.
The green little chemicals
Gave off green smoke
And the green little chemist
Began to choke.
The green little grasses
Now tenderly wave,
O'er the green little chemist's
Green little grave.

—*Burris Cunningham.*

SHORT RATIONS

MARY: "Are you coming in swimming?"

ANN: "I can't. A mole ate my bathing suit."

MARY: "The little rascal must be on a diet."

THE ANSWER IS DESIRED

POLICEMAN (to old Prof. seeing smash-up): "You say you saw the accident? What was the number of the car that killed him?"

PROFESSOR: "I'm afraid I've forgotten it. I remember that if it were multiplied by itself, the cube root of the product would be equal to the sum of the digits reversed."—*Jess Ellis.*

RADIOTICALLY SPEAKING

ALGEBRA PROFESSOR: "John what is a—plus a,+?"

JOHNNY: "Ah—, short circuits."—*Frederick Thomas.*

BETWEEN SHEETS

1ST BOZO: "What is the scientific name for snoring?"

2ND BOZO: "Sheet Music."—*J. Hillman Supper.*

A LINE THAT MOVES!

"Customers push my goods for me," said the manufacturer.

"What line are you in anyhow?" asked the hardware jobber.

"Baby carriages," was the reply.—*Mabel Skinner.*

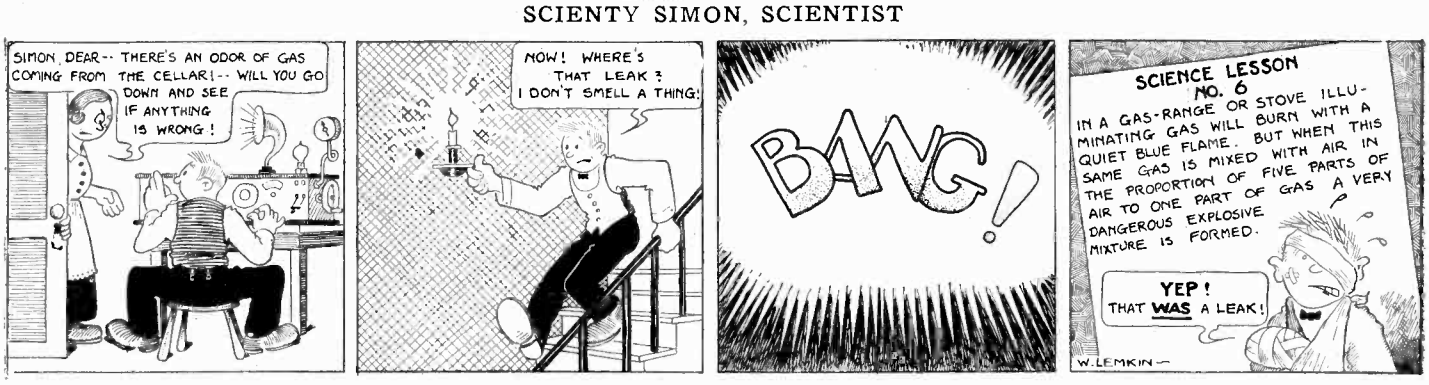
JUST THE THING

"What is this?"

"Sympathetic Ink."

"I think I'll take some. I have a friend who is ill and I must write a letter of condolence."—*Mr. Gerald Biennemard.*

SCIENTY SIMON, SCIENTIST

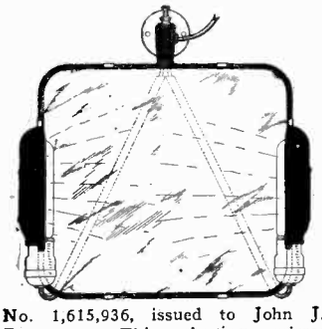


LATEST PATENTS

SHAMPOO BANDEAU

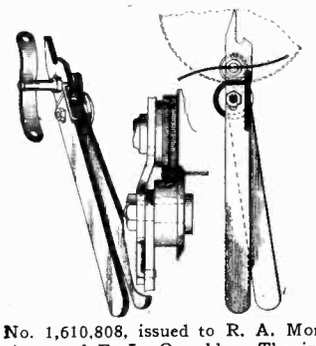
No. 1,612,602, issued to Ellen Hartman Bowman. This invention is a novel bandeau equipped with an elastic chin strap to be used while shampooing the hair. The device precludes the descent of water into the face, eyes or ears of the wearer, and will also protect the back and shoulders. It carries all of the water from the head to a conveniently placed receptacle.

SHAVING MIRROR



No. 1,615,936, issued to John J. Donovan. This shaving mirror comprises a mirrorglass, a metal backing, reflectors secured to opposite sides of the mirror and a lamp mounted in each reflector. The wires from the switch to the lamps are housed and protected against displacement and the switch is conveniently arranged for operation.

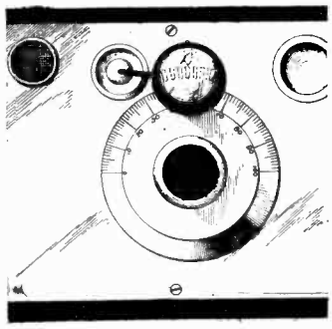
CAN OPENER



No. 1,610,808, issued to R. A. Morrison and F. L. Oswald. The improved can opener shown above comprises a pair of levers which are arranged to form a handle. On the end of this handle a guide roller and a disk cutter are mounted.

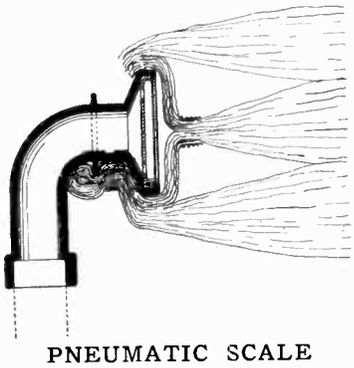
READING GLASS

No. 1,610,252, issued to Ralph C. Browne. This magnifying lens is particularly adapted to assist in reading dials, indexes, or scales such as those used on radio sets and similar apparatus. The device comprises a lens held in a frame and secured at one end by a stand, the end of which is embedded in a rubber suction cup.



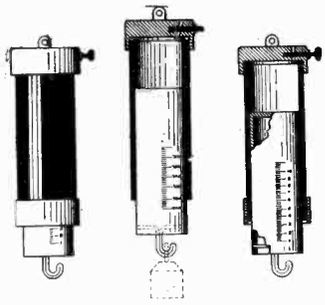
FOUNTAIN MOP

No. 1,613,790, issued to H. L. Engendahl and Edna W. MacLean. This invention consists of a nozzle device having an apertured ventage plate. The mop material strands are secured midway of their lengths to the nozzle body in back of a metal flange.

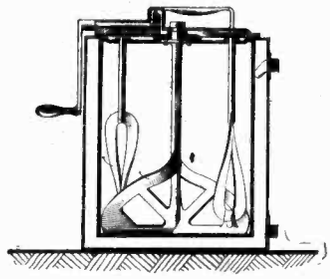


PNEUMATIC SCALE

No. 1,162,743, issued to Sverre Quisling. This particular type of scale combines a cylinder having a closure cap secured to the upper end and a piston disposed in this cylinder to form a variable fluid-tight chamber. A graduated scale is provided on the outer periphery of the lower end of the cylinder.

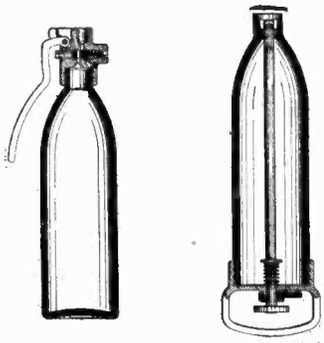


MIXING APPARATUS



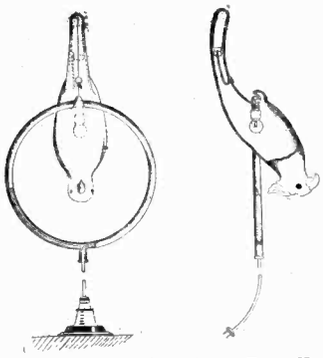
No. 1,612,281, issued to Joseph F. Goetz. The rotary agitator shown above includes blades of double or reverse curvature, which are rotated simultaneously. The center blade is of latticed construction and tapers upward, conforming to the bottom and lower portion of the vessel. The auxiliary agitators or beaters travel in a circular path, in unison with the rotation of the primary agitator.

DANDELION KILLER



No. 1,611,681, issued to Max Schilling, of New York, N. Y. A hand gardening implement consisting of a flask to hold a poisonous agent on the forward end of which is a lever to be pressed down in order to administer the poison. The cylinder is pressed directly on the plants and a small localized charge of poisonous liquid is administered.

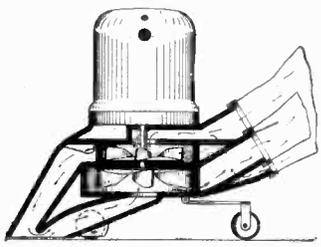
LIGHTING APPARATUS



No. 1,616,579, issued to Roy Kadowaki. This lamp consists of a hollow celluloid body having a slit at one end for engaging the socket support.

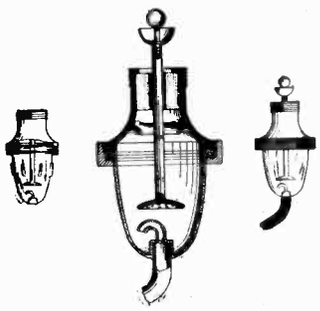
SUCTION CLEANER

No. 1,611,786, issued to Adam A. Serva, Canton, Ohio. Below is a view of the new cleaner which includes a head with an elongated mouth and contact lips. Air is discharged into the mouth through a slot for sweeping. These slots are placed on opposite sides of the lips. Air is drawn from the head through the other slot for suction cleaning. Two dust bags are connected to the inlet.



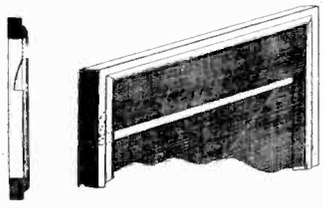
STORAGE BATTERY INDICATOR

No. 1,611,677, issued to Mr. Richard Raines, New York, N. Y. This indicator for storage battery cells, includes a hollow shell open at the bottom and adapted to be secured within the filler opening of the cell. A float level indicator is located within the shell and projects within the cell, a buoyant member at the end of this, and floats upon the electrolyte, thereby raising or lowering the indicator.



FLY SCREEN

No. 1,611,250, issued to Squire James Smith. The fly screen shown below is constructed of a frame divided in a line with the bottom of the triangular recesses which are formed on each side of the frame. The upper portion is separated horizontally from the lower portion and secured to the inclined side of the recesses.



NOTICE TO READERS. The above illustrated and described devices have recently been issued patent protection but are not as yet to our knowledge available on the market. We regret to advise that it is impossible to supply the names and addresses of inventors of the above devices to any of our readers. The only records available, and they are at the Patent Office at Washington, D. C., give only the addresses of the inventors at the time of application for a patent. Many months have elapsed since that time, and those records are necessarily inaccurate. Therefore, kindly do not request such information as it is practically impossible to obtain up-to-date addresses. —EDITOR.

THE ORACLE

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

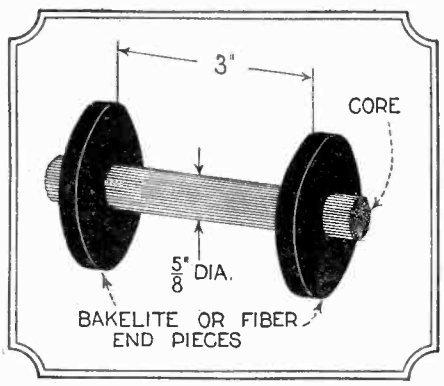
1. Only three questions can be submitted to be answered.
2. Only one side of sheet to be written on; matter must be typewritten or else written in ink; no penciled matter considered.
3. Sketches, diagrams, etc., must be on separate sheets. Questions addressed to this department cannot be answered by mail free of charge.
4. If a quick answer is desired by mail, a nominal charge of 50 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.

MAGNET DESIGN

(2165) Mr. A. D. Albert, Glendale, L. I., writes:

Q. 1. I am working on a device which requires the use of an electro-magnet, to be connected to the 110-volt A.C. or D.C. line, and want to get the maximum lifting power for that size coil. Please illustrate the size and shape of core suitable for work of this type, with an indication of the number of turns of wire necessary.

A. 1. You will find illustrated on this page a cross-sectional view of a magnet form which may fulfill your requirements. We would advise you to use No. 22 D.C.C. wire on your particular magnet, winding it evenly in layers, and continuing the winding until the form is full. This magnet if to be used with a D.C. supply should be connected to the circuit through a proper protective resistance, such as a lamp bank of suitable value.



Design of magnet coil as specified in text above.

CHEMICAL GARDEN

(2166) Miller Baum, Danville, Ill., writes:

Q. 1. Can you furnish me with the directions for making a "chemical garden" in a globe?

A. 1. Put a layer of sand in the bottom of a fish globe or small aquarium. The sand must be fine, clean, white sand from the beach if possible. Next place a few pieces of copper sulphate, aluminum sulphate, and iron sulphate on the sand. Cover this with a solution of waterglass, made up of 1 part sodium silicate and 3 parts of water. Let this stand for about a week, then carefully replace the waterglass solution with pure distilled water.

Q. 2. What materials are required to make luminous paint?

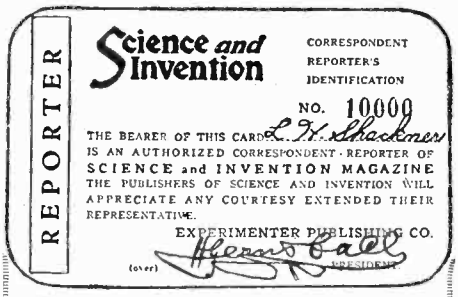
A. 2. Luminous paint may be made from the following chemicals: 100 parts strontium carbonate, 100 parts roll, sulphur, ½ part potassium chloride, ½ part sodium choloride, ½ part manganese chloride. This mixture should be heated three-quarters of an hour to a temperature of about 2,400 degrees Fahrenheit. After being permitted to cool, the paint is ready for use.

GAS EXPANSION AT GIVEN TEMPERATURES

(2167) Mr. J. M. Skeen, Mojave, Calif., inquires:

Q. 1. What is the rate of expansion of gases with a change in temperature, the pressure remaining the same?

A. 1. All gases have the one characteristic in common that they expand and contract at precisely the same rate with the same change in temperature or pressure. Physicists and chemists have determined this to be a fact, and they have found an ultimate point of reduction in volume, a temperature at which the molecular vibration of any gas would absolutely cease. This point has never been reached in practice, of course, but research engineers have come so close to it that it is accepted as an absolute certainty that if it were possible to obtain a temperature of minus 273 degrees Centigrade, no thermal vibration would exist. The theory also works the other way around. Taking a gas at normal conditions, when you specify a temperature of zero Centigrade, the volume of this gas will decrease 1/273 with each drop of 1 degree in temperature. Given a volume of gas of 273 cubic centimeters at zero Centigrade at 180 degrees below zero Centigrade, this same gas will occupy a space of 93 cubic centimeters. All computations involving the expansion and contraction of gases are worked on a temperature scale which takes minus 273 degrees Centigrade as its zero. This temperature is called the "Absolute Zero," hence the scale is termed the Absolute Scale. Any temperature in the Centigrade scale may be converted to an Absolute temperature by adding 273 degrees to the Centigrade value.



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Address Field Editor, SCIENCE AND INVENTION.

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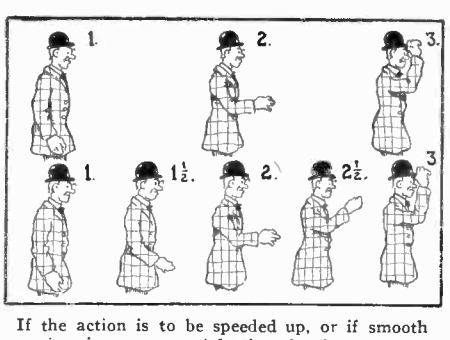
ANIMATED MOVIES

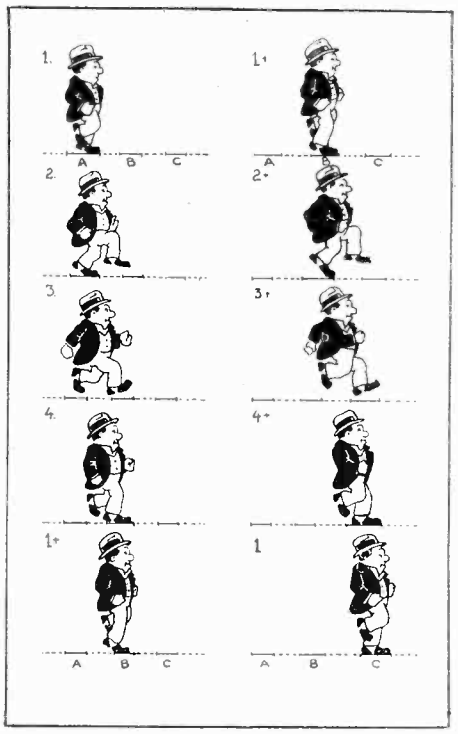
(2168) Mr. Raymond Smith, Brooklyn, N. Y., inquires:

Q. 1. Once, while attending a theatrical performance, I was much amused by the very interesting antics of the characters in an animated motion-picture cartoon. Since that time I have had occasion to wonder how these drawings were caused to assume lifelike positions, and how they were endowed with the faculty of motion, common to animal and human life. Can you tell me something about how this is done?

A. 1. You will find on this page a group of drawings illustrating the process through which a cartoon character is required to pass before the projected action will appear normal. All the various types of motion are reproduced by this same method, and where the action is recurrent, the same series of drawings may be used over and over again. If each drawing were made and used but once, for every second that the film is projected on the screen sixteen drawings would have to be made by the artist to produce a flickerless movie. A number of interesting books are obtainable on this subject, which you will no doubt be able to find in your public library and many articles have appeared in past issues of this publication.



If the action is to be speeded up, or if smooth motion is not essential, the sketches may be made as in the upper line. Compared with the lower group, showing the more elaborate interpretations of the same action, it will be seen that alternate sketches are omitted.



As a sample of how the cartoon animator works, we have included the above illustration. This series shows the successive drawings necessary to reproduce with resonable accuracy the motion of a man running at a trot.

PREHISTORIC TOWERS

(2169) Mr. James Ferguson, Edinborough, Scotland, writes:

Q. 1. I have read of mysterious ruins, possibly the remnants of an ancient civilization, which have been brought to light in various portions of Europe and the British Isles. These ruins take the shape of towers, called by the natives "Nuraghes" or "Nurhags." Can you give me any information as to the possible origin of these remains?

A. 1. According to the new International Encyclopedia, "Nurhag" is the name given to ancient towers, in the shape of truncated cones, 3,000 of which, in greater or less state of preservation, are scattered about the island of Sardinia. They are built of granite, limestone, basalt, porphyry, sandstone, and schist. Some of the stones in the lower courses are of great size; they have been roughly hewn, and were laid up without cement. The entrances are small and low, and the interiors are divided into two or three stories each with dome-shaped ceilings. The upper chambers are reached by means of spiral staircases, and are lighted through loopholes. There is supposed to have been a terrace on the summit. They are to be compared with the talyots of Majorca and Minorca, the burgs or duns in the north of Scotland and in the Shetland Islands, and with the round towers of Ireland, in structure and possible function. Skeletons and deposits made with the dead have been found in them, but of their original builders and purpose nothing is known.

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Patent Advice

Edited By
Joseph H. Kraus

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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.

NOTE:—Before mailing your letter to this department, see to it that your name and address are upon the letter and envelope as well. Many letters are returned to us because either the name of the inquirer or his address is incorrectly given.

MARKETING AN INVENTION

(1015) Polly Pettit, New York City, asks us whether manufacturers or wholesalers offer the best markets for an invention.

A. 1. We would suggest that in marketing an invention you try to get in touch with those manufacturers who make devices similar to the ones in which you are interested. In other words, if you have a household object, you should get in touch with a manufacturer making such material; if your device is of stamped metal, communicate with metal stamping concerns that place materials of such nature on the market. There is a possibility also of selling the idea to wholesalers who deal in such objects and then permitting them to manufacture the devices, but we doubt if there are many wholesalers who would be interested in carrying out such a proposition. Your best procedure is with the manufacturers to whom you can sell your patent either outright or on the preferred royalty basis.

PERFORATED ENVELOPE

(1016) J. Prihoda, New York City, submits a sketch for a perforated envelope, easy to open. He asks our advice.

A. 1. Your suggestion for an envelope perforated along the edge is not new and we doubt very much if you can secure a patent on the same, inasmuch as it has already been covered. You will find that this system is not in general use in this country, although many of the communications coming from France are contained in envelopes which may be easily opened and which are constructed as you have illustrated. Some of these envelopes contain the writing on the inside and the envelope forms the writing paper of the letter.

PATENT PENDING

(1017) James Manson, Bronx, N. Y., asks us whether he can stamp an article pat. pending. Also wants information concerning priority claims.

A. 1. You cannot mark your article "Patent Pending" unless you have applied for a patent and the action is actually pending. You can undoubtedly stamp it as "Patent Applied For," although in this respect your statement would be a falsehood unless you did apply for a patent on the device, even though you had no intention of ever seeing the action go through.

The only protection which you would get by having your invention recorded on paper and signed before a notary would be that of priority, which will establish your claim in any court in the country, should it become necessary to resort to court litigation to prove that you are the originator of the idea.

SELLING UNPATENTED INVENTION

(1018) Conwell McClelland, Madisonville, Ky., wants to know how to dispose of a railroad journal box cooling device without getting a patent on same.

A. 1. We would suggest that you record your idea and then take it to the engineers of any of the larger railroads. Generally, you will find that they will listen to your suggestion and give you reasons why the device cannot be made to operate properly or what should be done to the same in order to improve it.

We believe that this system would be superior to applying for a patent on the method for cooling hot boxes, because if the device is not practical the railroad company will not be interested, and you will save the finances necessary to patent the idea.

LIFE BUOY AND ADVERTISING SYSTEM

(1019) J. Abad, New York City, has submitted a sketch for a life buoy and an advertising system for disc auto wheels. He asks our opinion of both.

A. 1. In this letter we will comment upon both of the devices that you have described in your two last letters to us.

Taking first the life buoy, we would advise as follows: Even though the device has been thoroughly tested by the various authorities that you mention, still we believe that you will find very great difficulty in commercializing it to any extent whatsoever. There have been many similar designs made for life buoys and in fact, several of them have been patented. The main objection to all of them is the high initial cost and the cost of upkeep. You will find few if any steamship companies that would be willing to equip their vessels with life-saving devices of this nature for just these reasons. Although your life-saving device is very cleverly designed and will undoubtedly operate in the manner that you describe, still we do not believe that it would be at all worth while for you to attempt to further develop this device. If, however, your patent has been allowed, it would do no harm to address some of the larger steamship manufacturing companies in an attempt to dispose of the system. If this is done, we believe that it would be better for you to make an outright sale rather than to attempt to work on a royalty basis.

In regard to your advertising device for automobiles, we would advise that this system is very old indeed. There are several very similar devices patented, but none of them has ever come into very wide use. This is because of the disfiguring effect to any automobile and because the disks may become battered and stained, rendering them unsatisfactory and illegible. Considering prior claims, we would not advise you to proceed further with this device in any way whatsoever.

AUTO MOTOR BRAKE

(1020) H. J. Wagner, Pittsburgh, Penna., submits an auto brake consisting of a valve placed in the exhaust and intake to cause the auto to slow down because of compression and back pressure.

A. 1. We believe that the addition of a valve such as you mention in your letter of recent date would have a very detrimental effect upon the existing valves of an internal combustion engine. The only type of compression brake that would be of any particular value would be a valve placed in the exhaust and this would cause the exhaust gases to "back up" into the cylinders and badly burn and pit the valves and valve stems. Such an effect would of course be very detrimental and not at all desirable. There have been systems similar to yours proposed in the past and they have been tried out with the results noted above. In view of these facts, we would not advise you to proceed further with attempting to patent this system.

Into the Fourth Dimension

By RAY CUMMINGS

(Continued from page 27)

Brutar! His few picked men down there in New York working death and destruction! I had forgotten them completely. Thone issued other orders. "If thoughts of distress come from here—let the thoughts out. They may reach Brutar—bring him back to help his battle here. Let out their thoughts—that way." He gestured toward New York. "And if we drive Brutar and his men up here, let them in."

Other orders. A hundred or two of our fighters withdrew from the line. One here and there, ceasing to fight, coming toward Thone, forming behind us. A picked force with which we were to descend into New York.

And soon, leaving the scene here, we sped under the grey shadows of Westchester, southward toward the city. And in time, came upon it. New York! Splendid giant. Like some great helpless lion standing harried. Cuffed, wounded, stricken. Unable to fight back. Amazed, bewildered, yet undaunted, ready to fight.

But helpless.

But at last we made him understand. An ingenious fellow! He took a shadowy paper and pencil from his pocket and wrote what he thought we intended to convey to him; and we read it and nodded and smiled—grimly, for this was grim business indeed—grim, horrible!

CHAPTER XIX
THE STRICKEN CITY

THE little glowing bricks had been spread in scores of places. The acres of tumbled masonry which once reared aloft in proud splendor—the Woolworth Building—lay still smoking. Other buildings were down. Lower Manhattan—its pile of monuments to the engineering skill of man—was interspersed with areas of ruin. A smoke pall hung over everything. Through it as we arrived, I saw another giant building come down. . .

A warship lay in the upper harbor. Small boats were clustered around it. Over its decks and within its structure, men were frantically rushing. It stood there, a shadow on the shadowy water, the embodiment of impregnable power; the small anxious boats around it like milling pygmies trying futilely to help its distress.

Then men began pouring from it. The little boats took them and made off. Alone it lay there. Motionless. Then there came a surge of its giant bulk upward—a torrent waterspout as of a great mine exploding beside it. Bow down, it began to sink.

The Statue of Liberty fell. Head down, with torch plunging like a falling symbol. . .

The great Fort Wadsworth guarding the Narrows, as though an earthquake had torn it apart, rose and shook itself and fell into a shapeless mass. A small police boat was scurrying by in a panic. The tumbling white waves engulfed it. . .

The Brooklyn Bridge lay broken and fallen. Its dangling cables hung like rent cobwebs ripped apart by a giant, ruthless hand. . . Figures of men were clinging to parts of it. . .

Death, destruction everywhere. But there were soldiers grimly standing in Battery Park. Machine guns idly standing. Another warship, unattacked, belching belligerent smoke, moving majestically around the Battery from one river to another.

A harried lion. Undaunted. But helpless to fight.

CHAPTER XX
THE DESTRUCTION OF THE GHOSTS

BENEATH the shadows of the lower Hudson we came upon Brutar and his clustered cohorts. The devastation was slackening; the bricks had done their work. Brutar was doubtless thinking of

rejoining his people up there under the little Westchester town. He saw our shapes, and started north. We followed. Urging upon him, but not attacking.

Thone began, "Once we get them all together up there—all of them together——" But he did not finish.

Our lines let them through. It was a crescent battle line now, open to the south. But when Brutar swept in we closed it as before.

The scene here had changed somewhat since we left it. The lurid red of the opposing thought-streams still held balanced between the lines of the fighters. But in one place it was indented now far into Brutar's territory—a red gash like a wound gaping amid his huddled throng. And I noticed, too, that the dim purple haze hung now like an aura close above the heads of our enemies.

I asked Thone about it. He said, "Those who are not fighters in there are beginning to feel our thoughts. Perhaps even they begin to suspect what awaits them. Soon the fighters also will know."

He spoke quietly, but on a note of calm certainty that in the end we would triumph. From that same height we watched the scene. Almost immovable, struggling ghosts —grey translucent shapes to my vision as now I regarded them. Yet—I wondered—were not those shapes of Brutar's people more solid than our own? A vague shudder mingled with triumph unholy, swept

(*Continued on page* 69)

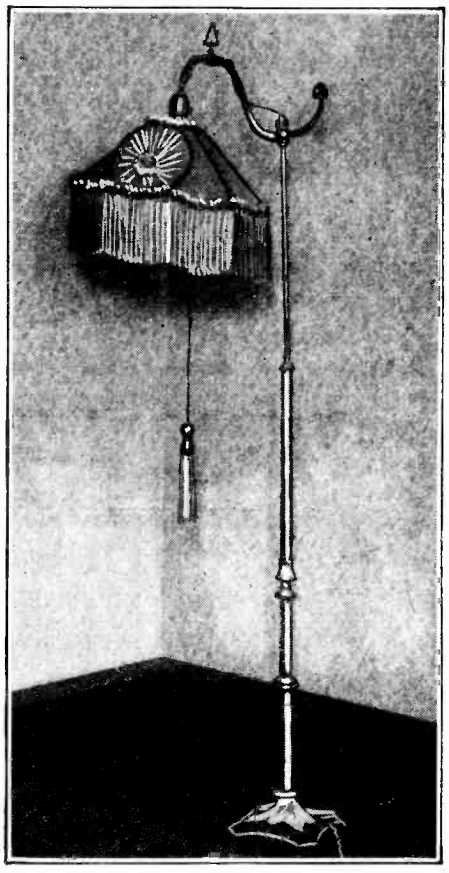
Magazine Soldering Iron

(*Continued from page 49*)

AN optional method for the construction of the magazine soldering iron is indicated in the drawing. In this particular system a spool of resin core solder is directly attached to the iron. Near the front end of the handle of the iron a toothed wheel is placed in such a manner that by placing the thumb on the wheel and turning the wheel toward the user any quantity of solder may be fed to the tip of the iron. This optional method is preferable to the previously described system because the quantity of solder is accurately regulated and the user need not stop to push another piece of solder into the tube provided to receive it.

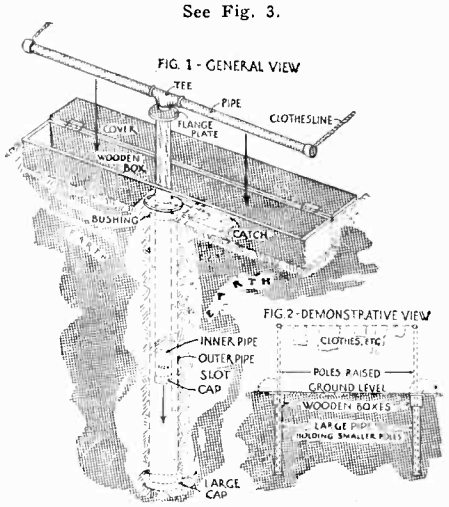
Pipe Contest Awards

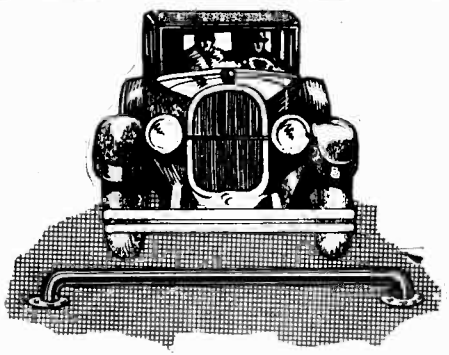
(*Continued from page 37*)



Tenth Prize—$5.00 was awarded to Karl Fichtner of Philadelphia, Pa., for the lamp illustrated in the photograph above. It will be observed that the gas fixtures entered into the construction of this lamp extensively.

First honorable mention is given to Wilson G. Walters of Rochester, N. Y., for a disappearing clothes line pole. This consists of an iron pipe which slides down into another pipe as indicated in Fig. 1 below. A wooden box covers the entire contraption when not in use. It is buried beneath the surface of the lawn. See Fig. 3.





Ninth Prize—$5.00 was won by Emerson Gaze, Rep. No. 12.414 of Venice, Calif., who suggested the garage bumper here indicated. The driver can enter the garage and run his car close to the wall without fear of damaging the mudguards.

$5,000 for Perpetual Motion

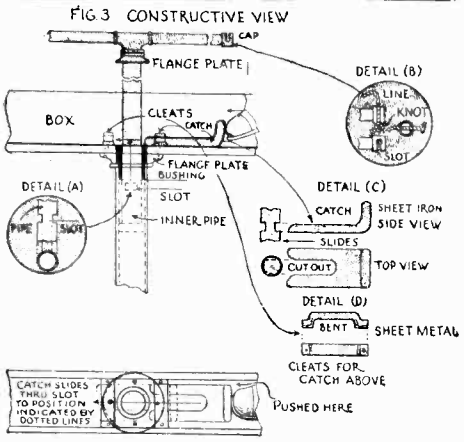
When SCIENCE AND INVENTION Magazine was still in its infancy, the editors denied the possibility of constructing a perpetual motion machine using those forces of nature as we now know them.

Since that time the editors have received thousands of different designs for perpetual motion devices, and have received hundreds of circular letters soliciting finances for the building of perpetual motion machines.

The editors know that if they receive these letters, there are thousands of others in this country who get similar letters and who fall for the claims made in the numerous prospectuses giving the earning capacities of the various machines.

Most of the shares of stock for these perpetual motion machines are being sold at a rate of $1.00 per share, although some inventors are trying to sell shares of stock at $100.00 per share.

Therefore the editors of this publication say, "Just come in and show us—merely SHOW us—a working model of a perpetual motion machine and we will give you $5,000.00. But the machine must not be made to operate by tides, winds, water-power, natural evaporation or humidity. It must be perpetual motion."



Into the Fourth Dimension

(*Continued from page 67*)

over me. Was it fancy, or was there indeed a change?

I could see Brutar, or at least a shape I assumed to be his, raised upon a height in the center of his forces; his arms waving; his soundless voice doubtless exhorting his fighters to greater effort. The fog of purple haze swirled about him, tinting, but not obscuring, for it seemed utterly transparent. Was it my fancy that Brutar's shape was of changing aspect?

And then I was aware of an uneasiness growing in the mob huddled there in the midst of the fighting. A stirring. A ripple of movement. Spreading like the ripples of a pebble thrown into a pond; spreading until abruptly the mob was surging, struggling to break the bonds of its own protecting ring of fighters.

The fighters felt the press of the throng behind them. Their efforts wavered. With diverted minds their thought-stream weakened. At once the red tumult moved in upon them.

But Thone called his orders and a score of shapes relayed them throughout our cir-

Articles In May "Radio News"

Below 50 Meters with Reinartz, By G. C. B. Rowe

The Phono-Radio Combination Set, By Fred A. Jewell

The Improved Browning-Drake Receiver, By Arthur H. Lynch

Advancement in R.F. Stabilizing Systems, By M. L. Muhleman

"What's Wrong with the Cover Picture?" $300 Prize Contest

How to Build a Three-Foot Cone Loud Speaker, By W. T. Mithoff

cular investing ring. I could not understand it. We were not to press our advantage. Our fighters lessened visibly the strength of their attack. And our antagonists in a moment recovered.

Thone said quietly, "No, Rob—if we were to force in there now and overwhelm them, there would be many minds unhinged, but not driven irrevocably away. They might return. It is my aim to destroy them completely—mind and body—annihilation!"

Savage purpose, savagely expressed! But he added, "It is best—and I think, more merciful."

There came presently a sudden change to this silent battle. For the purely mental, abruptly was substituted a semblance of physical struggle. The two mingled. In the Ego-world it would not have been possible; but here in the Borderland, these bodies of half-material substance abruptly found themselves capable of it. From physical immobility there sprang movement. A panic at first; but Brutar quelled it, organized it into a concerted rush. His mob, his fighters, began pressing forward in a single direction. The Borderland slope lay well beneath the ground level of the village overhead; but off to the left there seemed an area in the outskirts of the town where the slope and the ground of Earth reached

a common level. And Brutar's people were pressing that way.

They surged forward; were forced back—surging and rebounding as one would press against a yielding but entangling net. Our lines, and theirs, and the red tumult of conflict surged with them; bending, but the whole scene holding its contour. And I saw that very slowly, with each forward sweep and rebound they were gaining in their direction.

I heard Thone beside me addressing Will. "They will never make it. They will be too late." He seemed to realize something.

As though, there in the bowels of the earth a pent-up volcano had suddenly broken forth, the abandoned village heaved into the air; rose, shattered apart, and fell in a tumbled waste. An earthquake, a very cataclysm of Nature outraged. . . .

"Those people up there in the town, Will—they must escape! Abandon the town! All of them escape—now before it's too late!"

Will said, "If we could only communicate with them. Do you suppose we could?" And Bee eagerly put in, "Let's try. Let Rob and me try. We will go up there to the level."

They explained it all to me then. Horrible, sinister, shuddering outcome! Grewsome! Of course, the Earth-people in the town must escape. . .

Bee and I together took ourselves up the Borderland slope to the outskirts of the village where the slope was level with the ground. We were now half a mile beyond this spectral town which was thronged with ghostly vehicles and ghostly people staring in wonderment down at the battle scene.

We came to the common level, stood upon a spectral road with a few wraiths of houses lining it. There seemed no people here—they were all crowding the town to gaze at the struggling ghosts directly beneath them there.

"No one is around here, Bee." But no sooner had I said it than we saw, standing by a fence nearby, a ghost warily regarding us. A man in uniform, a State trooper I thought. He appeared, standing there alone, to have no desire to approach us. But I waved. And Bee waved. We carefully advanced upon him—carefully, for fear of startling him into flight. Gesturing, smiling with every effort to appear friendly. He understood us at last; came to the middle of the road, and there we joined him.

Fantastic meeting! Ghosts, all of us, standing there in a group, gesturing. I put out my hand as a friend, and his came to meet it. Touched it? Had a billion million miles of Space and Eons of Time been between us we could hardly have been further apart!

But at last we made him understand. An ingenious fellow! He took a shadowy paper and pencil from his pocket and wrote what he thought we intended to convey to him; and we read it and nodded and smiled—grimly, for this was grim business indeed—grim, horrible!

When at last he knew, astonishment, terror was upon him. And he was off down the road at a run, waving his arms, shouting no doubt, screaming to everyone his terrible warning. . .

We rejoined Thone upon the height overlooking the struggle. He murmured, "I see you were successful. And just in time—this is almost over now."

The battle lines still held. But what a change was come to our enemies! There was no mistaking it now—their bodies were materializing. The purple haze carrying the malignant influence of our fighters, was forcing their bodies into the Earth-state! . . .

The town above us, warned by our messenger, was emptying. Vehicles—shadowy moving shapes of cars and wagons—were scurrying out of it over all the roads. The houses were empty; the roads all thronged with fugitives on foot. Empty-handed; and families trudging with what little worldly goods they could carry in their arms. Wagons and cars piled high with household furnishings hastily rescued. The lines of pedestrians urged, lashed to greater haste by frightened officials. An exodus from death into safety. . .

The end came suddenly, unexpectedly swiftly. Thousands of ghostly bodies, there beneath the ground of the village abruptly leaping over the last gap into material being. *In the ground*—the earth, the rock—the very atoms of these foreign bodies intermingled, blended to their essence with the atoms of the rock and soil. And suddenly leaping into solidity. . .

The scene everywhere seemed to shudder. Its grey details slurred into a blur, a formless chaos of power unleashed. A soundless rumble; a sweep of tumbling movement. Upward, with a burst; an infinity of newly created entities demanding space. Space! Demanding it; heaving upward over the path of least resistance to find it. . .

As though, there in the bowels of the earth a pent-up volcano had suddenly broken forth, the abandoned village heaved into the air; rose, shattered apart, and fell in a tumbled waste. An earthquake, a very cataclysm of nature outraged. . .

A shattered, tumbled mass of wreckage where a moment before there had been a village. . . Fire leaping to the last destruction. . . Smoke rolling up in great spiraling clouds. . .

And visible, down beneath the ruin, a ring of victorious shimmering ghosts, standing awed and alone in the empty darkness. . .

CHAPTER XXI

EACH TO HIS OWN ALLOTTED PORTION

WE stood in the Borderland with Thone and Ahla.

"You will not return to our Ego-world?" said Thone. It was a statement in tone, rather than a question. "You are right, friends. Each to his own, as the Creator intended. Your world, better for you—but ours, best of them all, for us."

Ahla was standing close by Will. So near was she to our Earth-state, here in the Borderland, that I knew she had felt for Will those stirrings we call love. And now she was fighting them.

He toucher her. "Could you not find it best to come with my sister and me, Ahla?"

But she shook her head. "No. Father speaks truth. One should hold in contentment his allotted portion." But I think it tore at her with a new, very human temptation. "Good-bye," she said resolutely.

It wrenched at us all. Friendship, even over so brief an interval, cannot be lightly broken. We told ourselves we would not break it. Some day, some time, we would again come together.

"Good-bye." Soundlessly it echoed within us. Will, Bee and I stood silent as we watched them trudge away into the shadows and the darkness.

Each to his own allotted portion.

Thone had assured us that our natural tendency of body would be to resume an Earth-existence from this adjacent Borderland. And Will had formerly returned and found it easier than staying. We located, after roaming a time, that corner of Will's own garden where the ground level of Earth coincided with the Borderland slope. . .

Blessed solidity! Again—at last—we were solid, human—wraiths no longer. Will had gone on into the house; Bee and I lingered in the garden. Blessed sounds and sights and odors. We could hear the murmur of insect life; hear the night breeze stirring the leaves, feel it fanning our hot cheeks. The roses and honeysuckle were heavily, thrillingly odorous. The moon bathed us with its pale silver fire.

I took Bee in my arms. She came, willingly, eagerly, trembling with this new-found world of love. And returned my kisses, and clung to me.

"Each to his own, Bee darling. How good this world of ours seems! I never appreciated it before. Did you?"

"No! No, never!"

But I appreciated it now. And I thought of the discontent to which we mortals often fall. The graceless discontent with our allotted portion. And thought of the old poetic lines, and murmured them to Bee:

"Though patriots flatter, still shall wisdom find
An equal portion dealt to all mankind."

A graceless discontent. And I murmured the reproachful ending lines:

"The naked negro, panting at the line
Boasts of his golden sands and palmy wine;
Basks in the glare or stems the tepid wave
And thanks his Gods for all the good they gave."

Each to his own allotted portion.

THE END.

Watch For New Scientific Fiction Feature Next Month!

Testing Dam to Bursting Point

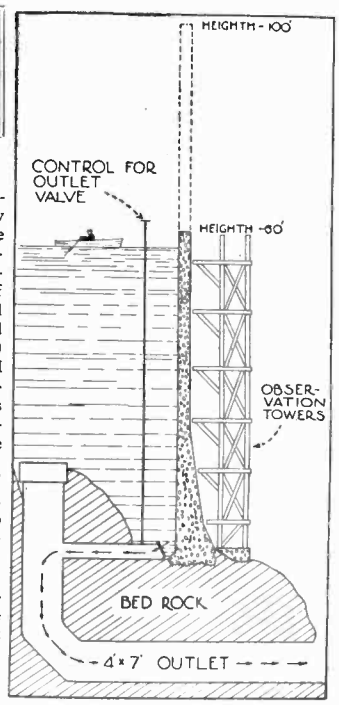
By SAM BROWN

(*Continued from page* 10)

The leakage under a 50-foot head was about six gallons per minute. Of this it seems fair to estimate that ninety-five per cent came through fissures in the rock entirely away from the dam. Under a head of sixty feet the leakage was considerably larger, but the percentage which came through under this level was even less.

The dam will be tested with water under control from the California Edison No. 3 tunnel for a period of two or three months. Following the test period, an additional forty feet will be constructed, bringing the wall up to 100 feet.

It is expected that at this 100-foot level the narrow column of concrete will take the inevitable smash and that wall, towers, instruments, a $150,000 scientific plaything, will be swept away to a total loss. But the project will not have been in vain. Carefully tabulated records compiled from tests taken on the dam should make for substantial economies in future dam construction, while increasing the safety of the dams and the lives and property of the people dependent upon them.



A cross-sectional view through the test dam showing the present height of 60 feet, and the proposed height of 100 feet, as well as the observation towers and the control for the outlet valve. By the aid of the valve it is possible to regulate the height of the water and in this way determine the leakage at great and small pressures.

Our Spiritualistic Investigations

By DUNNINGER

(*Continued from page* 25)

The windows were heavily hung with deep brown velour curtains. A portière was drawn across the door as we entered, so as to prevent any light from entering through the cracks of the moulding. Some twenty or more people were seated about the room, in the form of a circle, save for three seats, which were vacant, a reservation for which had probably been made by one of my associates. After we had taken our seats on the three chairs, an elderly gentleman, who was, to all appearances, an attendant upon the medium, carefully walked about the room, and extinguished the flames in the lamps, which had previously illuminated the place. One of the foremost features of this room was that the floor was covered with carpet, so heavily packed beneath, that footsteps could not be heard. Anyone walking about the room, could do so noiselessly. The medium was seated in the center of the circle, in a comfortable arm-chair. I had looked about as I entered, for the usual cabinet, from which I presumed the ghosts were to pour forth. Much to my surprise, however, no such cabinet was to be found.

The room was now pitch dark.

In the customary way, a number of hymns were sung, and then all was still. Suddenly, in the distance, came an uncanny voice. It was the voice of a baby. "Mother dear . . . I am here . . . can you see me?" . . . came the words from the apparently unknown sphere. "My child" . . . cried a lady's voice, in the darkness. "My darling baby boy, how are you?" "I am with you always, Mother, and though I long for you often, I know that I will some day see you, in this beautiful spirit world." More conversation between mother and child . . . then all was still. Suddenly from another corner of the room, came another ghostly voice. This time, an elderly gentleman spoke. "Martha, my darling wife . . . do you see me? . . . I am so glad you are here."

More conversation proceeded. Ghostly words, apparently from the mouths of different subjects, were distinctly heard. Suddenly, from out the darkness, came a ghostly vision. Two or three heads were seen. Nearer and nearer came these faces, and floated through space about the room, in uncanny fashion. "I see you, Walter" . . . came a shriek from one of the spectators. "Do you know me, daughter, dear?" . . . came another. And so the ghostly business proceeded. The heads would become visible and invisible . . . now they were here . . . and then they were there. Finally, they vanished altogether.

There wasn't anything in the room that seemed suspicious. The furniture was ordinary, and a quick glance was sufficient to show that there were no panels in the wall, nor were there any trap doors in evidence. How was it brought about? Was this lady supernatural? Were these apparent visions of faces truly genuine? Where did the voices come from? . . . All of these things were simple to answer. Checking up the medium's history, a day or so previous, I found that she had, some twelve years back, been married to a circus ventriloquist. This gentleman was one of the supposed believers, and mingled with the rest of the guests. He not only produced the voices, but the spirits as well. These heads were painted upon the back of his vest, and in the dark, it was only necessary for him to remove his coat, and walk about the room. Although his footsteps could not be heard upon the heavy carpet, I made sure of my analysis, by placing my ear to the floor. The pitch black room made this possible. I heard footsteps clearly. As he walked about, these spirit faces could be seen by some, but were invisible to others. They apparently vanished and reappeared, as his body assumed various positions. Upon replacing his coat, and resuming his chair, all evidence of the ghostly visions disappeared.

Madam Beiderman posed as a widow. Several houses of more fashionable type, located in the more populated residential district, belonged to her. There, in all probability, she and her husband shared the harvest. It was disappointing to my newspaper friends to be enlightened, as to the *modus operandi*, which this ghost woman employed. They were quite silent after my explanation had been rendered, which was convincing, and assured me that my theory had been accepted.

Shoes and Old Clothes Are Explosives!

By F. W. HORTON

(*Continued from page 8*)

is a large factor in the results. For example, tests show that with only 33 per cent oxygen in the liquid no explosion occurs, while with 98 per cent oxygen the explosion produced an enlargment in a Trauzl lead block 20 per cent greater than an equal weight of 60 per cent "straight" nitroglycerine dynamite.

With economical production of liquid oxygen, Mr. George S. Rice, of the U. S. Bureau of Mines estimates that the cost of one pound of liquid oxygen explosive is 14c as compared with 16c for one pound of dynamite; further, that one pound of dynamite will break down 4.5 tons of coal as compared with 6.8 tons of coal by one pound of liquid oxygen explosive. In other words the cost of dynamite per ton of coal is 3.5c and the cost of liquid oxygen explosive 2.1c or more than one-third cheaper. This estimated saving is confirmed by long experience with liquid oxygen in many German coal mines where its use has reduced explosive costs from one-third to one-half.

The chief advantages of liquid oxygen explosives besides their lower cost per unit of material blasted are as follows:

There is no danger in storage or transportation to the point of use as neither the liquid oxygen nor the cartridges are explosive before they are combined.

There is no danger of misfires, for by waiting 30 minutes after lighting the fuse the oxygen will have evaporated and the charge will be no longer explosive.

For this reason there is no danger from unexploded sticks in cleaning up the working face or in loading the ore or coal out of the mine or in handling it after it comes to the surface.

There are no dangers such as are attendant in thawing out frozen dynamite cartridges.

There is no danger of explosions in storage from lightning or from fire.

The disadvantages of liquid oxygen explosives are: they must be used quickly and at a definite interval after charging. This limits the number of shots fired in a round to 3 or 4 and makes the firing of group shots difficult.

A plant for the manufacture of liquid oxygen must be situated nearby in order to insure a supply and it must be kept running regularly in order to make its product at a low cost. In other words liquid oxygen explosives are not suitable for intermittent work.

In spite of these disadvantages, liquid oxygen explosives have great merit and are being used to a large extent in coal and other mines and quarries in Germany, France, and elsewhere.

The principal cost of the explosive is the cost of the liquid oxygen which at present is made in Europe at about 25c per gallon. A decided reduction in cost is hoped for through promised improvement in the liquifying apparatus. Moreover, there has been a steady increase in the cost of standard explosives so the difference in cost in favor of liquid oxygen explosives may soon be so notable as to overcome the opposition of those who have used other explosives all their lives.

Did You See "Hints for the Mechanic"?—a new monthly department.

MOTOR HINTS

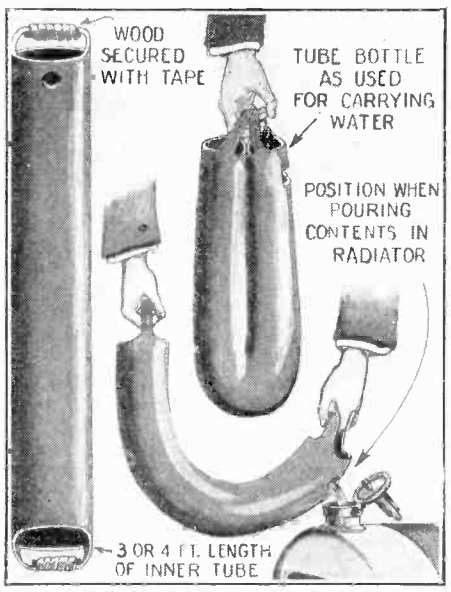
Conducted by GEORGE A. LUERS

(*Continued from page 43*)

INNER TUBE WATER BOTTLE

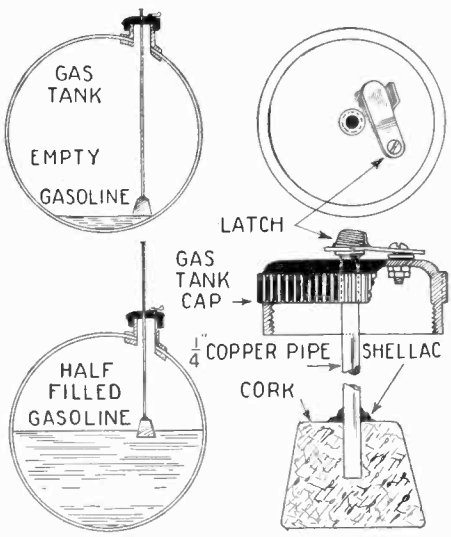
In the sketch is shown, a simple, unbreakable and satisfactory carrier for water, consisting of a three or four foot length of inner tube arranged for carrying and pouring.

The ends of the tube are cut and jointed over pieces of wood with tire tape to form handles. A pouring hole about one inch in diameter is cut in the tube just below one of the handles.



An ingenious method for utilizing the old inner tubes, is outlined above.

GASOLINE GAGE

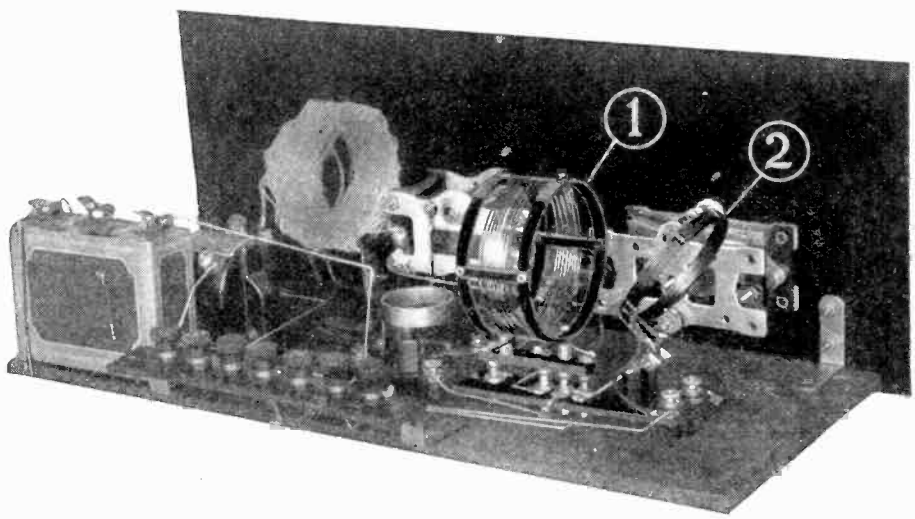


The diagrams above show the workings of this novel gasoline gage.

This type of gage may be made quite readily by utilizing the gasoline cap tank. The gage itself is composed of a length of copper tubing and a large cork. When the base of the cork rests on the bottom of the tank the tube should just reach the filler tank cap. Two holes are drilled in the cap and the rod calibrated. The diagram makes the idea clear.—*A. P. Peck.*

Interchangeable All Wave Kit

THE short-wave, interchangeable coil system is intended primarily for amateur and experimental use, but is suitable also for the reception of broadcast programs on the short wavelengths. Long wavelengths may be received by using a different set of coils. The system consists, briefly, of three interchangeable coils, each unit comprising a grid and plate inductance. A suitable base is provided, on which an adjustable primary coil is mounted. The coupling of this coil may be set for the best results with any antenna. We prefer the "fixed tickler," capacity controlled circuit.



The set shown in the above photograph was constructed with the interchangeable short wave kit. The coils will be seen mounted at the right-hand side of the set. By using different coils a range of 15 to 550 meters may be obtained. The coils are of rugged construction and are firmly held in place by means of a special plug-in mounting. When tuning it will be found that the feed-back need not be touched over any of the amateur bands, making the set really single control.—Photo courtesy Aero Products, Inc.

Double Cone Knock-Down Loud Speaker

(*Continued from page* 55)

small handle is affixed to the wooden ring so that the speaker may be carried from place to place with ease. The manufacturer furnishes an attractive wooden stand with the speaker. The neat appearance and faithful reproduction of the cone more than repay one for the time spent in the construction.

How a Famous Phonograph Was Invented

By W. H. JENKINS

(*Continued from page* 12)

Production of machines and records was begun with the same enthusiasm that had been poured into the invention itself. In addition to the improved record, Mr. Johnson had invented a spring motor which ran absolutely evenly, and could be manufactured at a reasonable price, so that the new company was starting out with superior products which enabled it to meet any competition that developed.

Over in England, Francis Barraud, an artist, had one of the earliest talking machines. Another of his treasured possessions was a little black and white fox terrier named Nipper. As Nipper sat before the horn of the instrument, exhibiting interest and bewilderment in every line of his tense body and pricked-up ears, the artist had an inspiration. Setting up a fresh canvas, he began to paint. When he had finished an exact replica of the scene before him he appended a title which was as happy an inspiration as the picture itself—"His Master's Voice." It was the same picture that today appears on products of this well-known talking machine company and that has become one of the best known trade symbols in the world.

With a machine which gave a creditable reproduction of music and the human voice, and a trademark which not only identified its instruments and records, but actually told a convincing story as well, the new company and its tireless founder began enthusiastically the task of supplying music to the world. A dealer here and there, at first, took on the new machine and as the number grew, production began to mount up and up. In the devotion to his blossoming ideal the founder lost sight of the inevitable flood of money that was to pour in to the company. To some of his old comrades at the bench, who had stood with him through the lean and heart-breaking days, the founder handed out substantial allotments of stock, which were later to represent millions of dollars.

Hand in hand with the building of a dealer organization went that other essential of sales—advertising. In fact, the company and its advertising can be said to have started and grown together. It is true that the original advertising appropriation would hardly be a decent postage item in their present-day advertising program. A total of $1,500 was all that could be squeezed out for that first educational effort. But it was a start toward one of the greatest continuous advertising campaigns the world has ever seen—a campaign in which, in the last twenty-five years has been invested considerably more than $40,000,000.

A good machine, a good record, an organized business and national distribution were not the only stepping stones to Mr. Johnson's success. The moment he could

(*Continued on page* 77)

Mechanical Devices Animals Use

By DR. ERNEST BADE

(*Continued from page* 18)

The bones of some birds like the crane, which often stand on one foot, have a locking device on the knee whereby the bones of the foot are made to act like one continuous column, permitting the creature to stand motionless for hours without fatigue. Locking devices are also found on the dorsal fins of certain fish. Here the mechanism spreads the spine-like fins and holds them in position, even after death. This is a sort of a protective device whereby larger fish are prevented from eating the smaller. As a usual thing these dorsal fins are only actuated by muscles and when the fish dies, the fins relax.

Then, too, there are various types of valves or flaps which permit the flow of liquids, primarily that of blood, in one direction only. Under normal flow the valve is open and pressed against the walls of the conducting vessel. When the flow attempts to reverse itself the flaps of the valve close and stop the flow until the correct direction begins again. The highest type of valves are found in the formation of the heart of the higher animals.

The pump itself is used, as an additional means of locomotion, by the larva of the darning needle. This creature lives in ponds and small bodies of water and when suddenly disturbed it ejects water at the same time that it rushes away with the aid of its legs. This stream of water has considerable force and drives the little animal rapidly through the water. How efficient such a means of travel really is, may be seen from the fact that only recently a ferry has been completed in England which uses the recoil of pumped water as motive power. For this means of transportation the claim is made that it can maneuver much more quickly than a propeller-driven craft.

The Canal-Geometers of Mars

By DONALD P. BEARD

(*Continued from page* 22)

The canals composing this star-figure, shown in Fig. 3 are named Phison, Euphrates, Typhonius, Orontes, Hiddekel and Protonilus. The reason why it was not discovered previous to 1922 was that the late Dr. Percival Lowell had drawn the canals upon a Mercator projection which he himself confessed "is an invention of the Devil", in which on our world-map Greenland becomes spread out bigger than Mexico. This system of projecting the canals had masked their assembly into a star-shape.

At the 1924 approach, however, it stood out boldly and startlingly upon a drawing by Trumpler of Lick observatory, in what Prof. Pickering described as "the most conspicuous possible position upon the planet."

Migration of the southern border of Elysium some 118 miles northward was noted by Prof. Pickering in 1922, while at the same time its northern border moved 76 miles to the southward. "After the (Martian) summer solstice these motions were reversed, Southern Elysium moving 18 miles southerly, while Northern Elysium moved northerly 86 miles in the same time." A migrating lake on Mars was also described by Pickering in the twin lakes or Ismenius to the right of the great Syrtis Major region in Fig. 3. "It moved 133 miles southerly, carrying with it the two conspicuous canals Protonilus and Deuteronilus—shown in Fig. 3."

It is in only one transitory position such as occurred at the 1924 opposition, that the "Star of Elysium" appears symmetrical as, (and this is the amazing point in the whole matter) *it really is not symmetrical at all as laid out upon the surface of the planet itself!* This implies a complicated calculation in the laying out of such a figure upon the surface of a sphere, correlating it exactly with empirical visual angles seen from the earth *beyond the capacity of any save master geometers to accomplish!*

In symbols familiar to reasoning minds throughout the Cosmos that other life dimly visioned on Mars may today be beating vainly against the heavy door of our lethargic consciousness, while we refuse to hearken until it has succumbed to the cold and thirst of its perishing world. When it has lapsed forever beyond recall we may feel, too late, the poignant sense of an intellectual loss.

Radio Wrinkles Wanted!

The Radio Editor, Mr. Paul E. Welker, wants to hear from you, if you have a good idea or wrinkle. Make a pencil or pen and ink sketch of the contrivance, write 50 words or so of description, and mail to the Radio Editor, c/o this magazine.

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How Famous Phonograph was Invented

(*Continued from page* 75)

divert a portion of his energies from the perfection of the machine and the launching of the new company, he began work on a phase of the industry that gave it incalculable prestige and added greatly to its financial success. Nothing short of the exclusive right to record the voices and music of the world's greatest artists of concert and opera would satisfy him.

The difficulties in the way of this ambition were considerable, but they were brushed aside with the same sureness and determination that had eliminated mechanical and organization problems. The coveted artists were the idols of the public. They knew how their voices or instrumental renditions sounded amid the favorable settings of the theater or the concert hall. But in sounds that came back from the record of that day there were lacking the accustomed volume, some of the musical detail, and the charm of the artist's personality.

But Mr. Johnson's company held up the picture of a world-wide audience, instead of a few thousand people in a darkened auditorium. There was the vision of singing to lonely pioneers, travelers in the far places, music lovers huddled around the fire in snow-bound farmhouses, music lovers in the countless homes of the great cities. And there was that still greater lure, the assurance that the actual music of the artist would be preserved for all time.

These arguments finally prevailed. They fell in line, these immortals of music; one or two, timidly, at first, and then a procession that gradually swelled until a contract with the company was as sure a badge of success as any triumphal world tour—and a much surer success from a financial standpoint. Royalties from records made recording artists wealthy beyond their fondest dreams.

(*To be concluded*)

Rules for Model Contest

(*Continued from page* 40)

1. A handsome trophy cup engraved with your name, will be awarded as the prize for the best model submitted during the month. The decision of the judges will be final and will be based upon, A—novelty of construction; B—workmanship; C—operating efficiency of the model as related to the efficiency of the device which the model simulates, and D—the care exercised in design and in submitting to us sketches and other details covering the model.
2. Models of all kinds may be entered. They may be working models or not, according to the subject that is being handled.
3. Models may be made of any available material, preferably something that is cheap and easily obtainable. Models made of matches should not be submitted to this department but should go to our Matchcraft Contest Editor.
4. Models must be submitted in all cases. Good photographs are also highly desirable and where the maker does not desire the model to be taken apart, legible drawings with all dimensions covering parts that are not accessible must be submitted.
5. Models should be securely crated and protected against damage in shipment and sent to us by parcel post, express or freight, prepaid. Models will be returned when requested.
6. Models for entry in any particular contest must reach this office on or before the 25th of the third month preceding date of publication. For instance, models for the July contest must reach us on or before the 25th of April.
7. Address all entries to Editor Model Department, c/o Science and Invention Magazine, 230 Fifth Ave., New York City.

Home Mechanics

(*Continued from page 39*)

We will now make the top for the cabinet; it is 48 inches long, 12 inches wide and shaped with the coping saw, commencing 5½ inches from each end. It is also cut out on the back edge to go round the back of the shelf case and cabinet part. A ½-inch groove is cut from the back in the center to take the drawer division piece shown at Fig. C. The groove is ½ inch deep and 8½ inches long. This top is first glued to the top of the lower frame, formed by the tops of the end pieces, legs and back, and then screwed to the back legs, end pieces and back. The top screws are placed, where the sides of the shelf case will cover them, in countersunk holes. The drawer division-pieces should be glued and screwed in place at the same time (see Fig. C). Each piece is 8½ inches long, 4 inches wide and ½ inch thick. It has a double draw slide screwed to its bottom edge, as shown in the same figure.

The end pieces for the shelf case are 9 inches wide and 28 inches long. Each is grooved to fit over the sides of the back piece as shown at Fig. F. The grooves are ¼ inch wide and ½ inch deep. In shaping the scroll edges tack or clamp the two pieces together and saw at one time. All shelf-cleats, etc., should be bradded and glued before the ends are glued to the back and top. The lower moulding is then put on with brads and glue. The shelves are then fitted, and a screw or two put in through the back with long brads from the two sides to hold the glue while drying. Scroll pieces, shown at Fig. B, can be made and glued to the legs and bottom piece to carry out the scroll effect on the sides if desired.

In making the drawers we use three thicknesses of lumber, ¾ inch, ½ inch and ¼ inch. The thickest forms the fronts, the next the sides and backs and the thin, the bottoms. At Fig. D is shown the easiest good method for joining the pieces, and at Fig. E the best way to put in the bottoms. It will be seen that the back part of the drawers is narrower by ½ inch than the sides or front and that a 2¼-inch groove is cut in the side pieces to slide the bottom into. A small brad or two driven through the bottom into the back piece will hold it in place. Brads cannot be used for joining the drawer, for they will work out and cut the wood along the drawer opening. Besides the center division-slides two other slides are put in as shown at Fig. J. After these are put in the drawers are made to fit the openings, as shown at Figs. J and C.

The lid or drop front for the cabinet should be made like a moulding board with cleats set in with tongue and groove at each end to prevent its warping. It is 14 inches wide, 33 inches long and shaped as shown at the bottom. Brass supports shown at Fig. H are used when the front is open, and hinges secure it to the bottom piece. Two button catches (indicated at Fig. I) hold the front when closed. These catches are placed one on either side of the lid.

A coat of flat paint, sandpapered down when perfectly dry, makes a good surface for enameling, crack filler or putty is used after this first coat of paint, to fill brad holes or gaping joints, after which the first coat of enamel is put on. After two days the second coat is put on and allowed to dry. The transfers are then cemented in place, using transparent varnish for cement. The knobs are put on the drawers and front and the cabinet, if desired, finished still further by lining or striping with variegated shades of color. If striping is done the whole cabinet should have a finishing coat of transparent varnish. Pine or whitewood is the best stock for enameling.

The Biography of a Star

By W. J. LUYTEN

(*Continued from page* 35)

sands of times its original splendor, but only temporarily. Soon the excitement dies away, and the debris are thrown on the scrap heap of the universe.

The birth of an actual star must be very different from this, because a star must be given enough supply of fuel to last it a quadrillion years or so, and no star while still in its infancy will be as wasteful as a new star during its short supremacy of brilliance.

Even though we have to admit that we do not know how a star is born, we do know what it looks like in infancy. Probably all stars, when they are very young, are "red giants," not unlike Betelgeuse and Antares. Antares, in the heart of the Scorpion is so large that it would take a ray of light two hours to run clear around it. If our sun were placed in its center the orbit of the earth would easily fall inside it, even the orbit of Mars would be swallowed up by this giant. Yet, even if we were inside we might not know it, for this star must be thousands of times rarer than our atmosphere, about as rarefied as a good vacuum we can make with a hand pump. A man, who on earth weighs 150 pounds and who would be crushed on the surface of the sun under his own weight of over two tons, could fly on the surface of Antares for he would be burdened with only one pound as the total weight of his body. Measures made by Coblentz with a radiometer indicate that the temperature on the surface of these red giants is less than 3000 degrees centigrade (about 5500 Fahrenheit), a temperature "so low" that atoms are not very excited about it, and even molecules may exist in it. As a result, the spectroscope shows us the presence of Titanium oxide on the surface of this star, and of a lot of iron vapor. Betelgeuse, the well known star in the shoulder of Orion, is very similar to Antares, although not quite so large. It presents another unusual feature, viz., it changes its light and, according to recent measures with the interferometer, its diameter also. During the time covered by the observations Betelgeuse varied its diameter by more than a hundred million miles, but without showing any ill effects of it.

On the Russell theory, a star, after having started in the Antares fashion will climb up to the level of Aldebaran, the bright star in the Bull, then reach Arcturus, at 4000 degrees centigrade, Capella, at 6000 and finally Vega, at 10,000 and Rigel and the other Orion stars at 12,000, all the while getting smaller in size, hotter, but very nearly constant in its output of light. Here, when it has arrived in the blue stage, the star is much smaller, less than ten times larger than the sun, and it has become much denser, about as dense as water on the average. It is now going to settle down, and take things easy. If the trend of stellar evolution really is this way, then the stars begin by reversing their engines and backing uphill so to speak, climbing from a low temperature to a higher one. Once they have reached the top, they change to forward motion, and run downhill first in high gear, but, as they gather more and more speed they have to put the brake on, and finish up running very slowly in low. And all the while the stars are shining they are wasting energy, pouring it out into space by the barrel, so fast that a star such as the sun loses per second 30 million million million million horsepower: 30,000,000,000,000,000,000,000,000 horsepower!

According to the theory of relativity the stars are then losing mass; losing *weight*, because light, energy weighs. The sun, e.g., loses over a million tons of matter every second. At first sight this seems very alarming but careful consideration shows that even so, the sun could go on for more than a million years without shedding much more than the earth weighs.

Nevertheless there is here a difficulty which needs to be explained: geological evidence has shown us that the sun has been of practically constant energy output for at least half a billion years. Therefore the sun cannot have "evolved" much in that time, and the whole process of stellar evolution must take more than a trillion years. And yet, on the calculation we made above, the sun must have lost very nearly its own weight in that time, and must have been a great deal heavier in the remote past. And if it was heavier it must also have been brighter, and sent out more light, an additional argument for the theory that it must have lost a great deal of weight.

Another difficulty which must be explained by a workable theory of evolution is the distribution of the stars over the various classes; why there are so few giant stars, and why especially there are so exceedingly few yellowish white giants, of the type of Capella and Canopus. Is it because the stars run through this stage so quickly, that at any one time there are few stars in this class, or is it perhaps that there is some peculiar difficulty connected with this stage of the development which makes most stars shun it? One argument in favor of this theory is that the famous "Cepheid" variable stars all belong to this group. These stars are pulsating globes of gas contracting and expanding with clock-like precision, and changing the intensity and the color of their light. They are all very massive stars and stars of exceedingly high luminosity.

If the relative numbers of stars in each group are to be explained by the shorter or longer time it takes to pass through the various stages, then there is some explaining to be done about the giants and dwarfs as a whole. If we should take a dragnet, and collect everything that comes in our way in space, we should find that out of every ten thousand stars we catch, at least 9300 are dwarfs, smaller and fainter than the sun. Of those brighter than the sun probably five to six hundred would be classed between Sirius and the sun, and no more than a hundred or so could be called bona-fide giants; and of these the majority would be white. We might find two or three blue giants, perhaps there would be one red giant of the Antares type, and we should consider ourselves very lucky indeed if we had caught any of the Capella type. How many of the kind of the Sirius companion we should find we do not know, perhaps there would be many, perhaps only a few.

For the present it does not matter, we know so little about them and they form such stumbling blocks in most of our theories that we might take the easiest way out and consider them out of season when we catch them, and throw them back into the ocean of space.

Russell has lately advanced a new theory, an extension and modification of his old theory, which does take into account these white dwarfs, and may explain their presence satisfactorily. It has long been accepted that the source of stellar energy may lie in the annihilation of mass, i.e., in the collision inside the star of particles which blow themselves up in the process, disappear completely as matter but manifest themselves as energy, light, and heat. Thus it may well be that the millions of tons of matter the sun is losing every second find their origin in millions

of tons of matter being destroyed in its center, being converted into light, and radiated into space by the sun. If, for example, one pound of hydrogen were transformed into helium inside the sun, about one-tenth of an ounce of matter would disappear, but we should obtain, in turn, enough energy to heat a million tons of water from freezing to boiling. Russell's idea now is, that there are three distinct, and different types of matter which can be turned into energy at different temperatures. The first of these to go is the "giant" material which gives up the struggle at comparatively low temperatures and which therefore accounts for the beginnings of the red giants. Later on, as the temperature rises, and the inside temperature of the star goes up to 30,000,000 degrees centigrade, the trigger is pulled and the second charge is fired. This is the time when the annihilation of mass begins, and the star is now radiating away so much of its energy, that it is losing weight very rapidly. It pays very dearly for its desire to "keep up appearances" as a respectable star, its life blood is ebbing away. Naturally this cannot last forever. By sacrificing its inside the star may be able to maintain its splendor for some trillions of years; ultimately even this store of energy gives out. What happens next all depends on the way in which this Harakiri before was accomplished. If done in a very reckless manner the whole star will die out very quickly, it will cool off at its surface, and disappear as a red dwarf.

If the star has used a little caution, it may be able to prolong its agony and shine a little longer as a white dwarf, it is still hot on its surface and it still has a lot of matter inside it. In fact it is so stuffed with it that it attains the incredible density of fifty thousand times that of water. Whichever way the star decides, at this time the curtain soon descends upon the last act, and the star passes again into oblivion.

What happens to it afterwards we can only guess. Is there such a thing perhaps as a celestial morgue, where dead stars are put in cold storage until such time as there will be enough to start a new diffuse nebula or a star cluster or whatnot? And this brings us back to the beginnings of a star's life, to that time before the stage of the red giant. The red giants cannot spring from nowhere, and yet where do they come from? It is the eternal question of the hen and the egg, which is the same in all cyclical processes. And to us scientists it is the eternal question of the questionmark, at the end of every solved difficulty, the only thing that keeps us going and the only thing that makes science interesting forever.

Can I Study Engineering at Home?

By H. WINFIELD SECOR

(*Continued from page 13*)

teacher in most cases, you will generally find that he has the initiative and perseverance to look into every new problem confronting him until he has mastered it thoroughly. The chief asset of the college trained engineer, so far as the speaker's experience has been, is that usually he is much better trained in mathematics and physics also that he has studied one or two languages.

There is one point where many college students of engineering can brush up on and that is mechanical drawing. The correspondence schools certainly do teach mechanical drawing in fine shape and some of the best draftsmen that the writer has had the pleasure of working with have been correspondence school graduates.

(*Part II will appear soon.*)

The Astrology Humbug

By JOSEPH H. KRAUS

(*Continued from page 38*)

prerequisite, a court astrologer was hardly less necessary than a court jester, even if he were not of as much real use.

I notice in a letter published in SCIENCE AND INVENTION that Mr. Hardie, the author, states: "The Ancient Science of Astrology could not have persisted throughout the ages until today were it not founded on some rock of Universal Truth." In my opinion, Astrology will exist as long as Ignorance itself exists on the earth. The two go hand in hand.

I await with interest any comment your readers may have to make on the above.

JOHN FRANCIS JOSEPH FAY,
Los Angeles, Calif.

(*And so do we.*—EDITOR.)

How to Make a Polariscope

By RAYMOND B. WAILES

(*Continued from page 48*)

Mica and celluloid bent while being examined in the polariscope will show beautiful colors and figures.

You can strain some glass yourself by squeezing it with a pair of pliers until it breaks, and actually see the strain in the glass where the pliers grip it, through the polariscope. Another experiment is to view the corner of a strip of window-glass through the polariscope. It will, no doubt, seem clear and with no figures showing strains. Now hold the corner of the glass in a blue gas flame until it becomes hot and quickly look at the heated spot through the instrument. You will at once see a figure pattern, due to the unequal heating of the glass, causing strains in the glass.

Wood-Working Articles in Every Issue An S. & I. Feature

Wirekraft--$3,000.00 in Prizes

(*Continued from page 33*)

Rules of Wirekraft Contest

THIS is a wirekraft contest. Hence wire is to be used in the construction of all of the models entered in this contest.

The size of the wire to be employed is limited. The heaviest wire must not be larger than No. 8 American or B and S gauge, and the smallest no smaller than No. 30 B and S gauge—or (for foreign countries not having these exact sizes), the nearest available equivalent.

No. 8 B and S gauge is .12849 inches in diameter or 3.264 millimeters. Its nearest equivalent in the Birmingham or Stubs iron wire gauge is No. 18. In the Stubs steel wire gauge it is No. 30; in the British Imperial Standard it is No. 10. The nearest wire to No. 30 B and S gauge which is .01002 inches or .2546 millimeters in diameter is No. 31 in the Birmingham or Stubs iron wire gauge. In the Stubs steel wire gauge it is No. 80; in the British Standard it is No. 33.

The builder may avail himself of the opportunity of using any intermediate sizes of wires between No. 8 and No. 30, B and S gauge.

The wire may be copper, brass, iron, steel, or these materials coppered, tinned, nickel-plated, or galvanized, or the wire may consist of an alloy. Any kind of wire available on the market may be employed.

It is preferable to use non-rusting wires. The publishers will not be responsible for the rusting of any model. To protect wire

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which rusts easily or for color effects, the models may be painted, lacquered, varnished or otherwise covered.

Any additional decorations or accessories may be employed to enhance the effect. (Example: Silk on a lamp shade; glass in decorative fixtures; electric motors for operating mechanisms, etc.)

Only those portions actually constructed of wire will be judged.

(Example: A reed basket is suspended from a wire chain. The basket not being made of wire is NOT considered. On the merits of the chain only will the prize be awarded.)

Wires may be twisted, spliced, soldered, welded or bound together. Wire may be used to bind other wires together. If soldered a non-corrosive soldering flux should be employed.

There is no limit to the size of the models which may be entered nor to the number of entries which any maker may submit during any calendar month.

In every case the model must be forwarded express prepaid to SCIENCE AND INVENTION Magazine. It should be tagged with name and address of the maker, who will prepay charges if model is to be returned.

The first prize will always be awarded to a model possessing the greatest utilitarian merits. This must be an object NOT found on the market today.

The second prize will always be awarded to an object possessing the best decorative artistic or constructive effect. It may be a replica of an existing object or a model of an imaginative object or effect.

The remaining prizes will be judged from either one or the other viewpoints at the discretion of the judges.

All models may remain at the office of this publication until the close of the contest at the discretion of the editors.

This contest started January 1st, 1927, and will terminate January 1st, 1928.

This is a monthly contest lasting for twelve months, each monthly contest closing on the first of the month following dates of issue. Thus the contest for the month of April, 1927, will close May 1st, 1927. Winners for April will be announced in the July Issue.

Address all entries to Editor Wirekraft

SCIENCE & INVENTION MAGAZINE,
230 Fifth Avenue, New York City

$3,000.00 In Prizes Arranged in Monthly Awards

First Prize	$100.00
For Utility Only	
Second Prize	50.00
For Artistic, Decorative or Constructive Effect—may be a replica or model of some imaginative or existing object.	
Third Prize	25.00
Fourth Prize	20.00
Fifth Prize	15.00
Sixth Prize	10.00
Seventh Prize	7.50
Eighth Prize	5.00
Ninth Prize	3.50
10th to 16th Prizes of $2.00 each ...	14.00
Total	$250.00

Tools Required

THE tools required for the construction of Wirekraft articles may be found in the Dec. issue of this publication, a reprint of which will be sent free upon request. The following tools may be used advantageously:

1 pair flat-nosed pliers. 1 pair round-nosed pliers. 1 wire cutter, 1 hacksaw, 1 small vise, 1 soldering iron.

The materials which are necessary are:

Solder, soldering paste or flux, nails, one piece of wood, and most important of all, wire of the sizes specified in the contest rules and regulations.

If the builder decided to weld his wires together, a small welding transformer or a storage battery may be used for this purpose. For the formation of long cylinders, a coil winding machine or a lathe may be advantageously employed. Toy motors for the operation of any devices constructed of wire could of course be procured and added to the model and the addition of miniature sockets and bulbs to illuminate the interior of any buildings constructed of wire might also find a place in some of the constructions.

40,000 Germs in a Kiss

By JOSEPH H. KRAUS

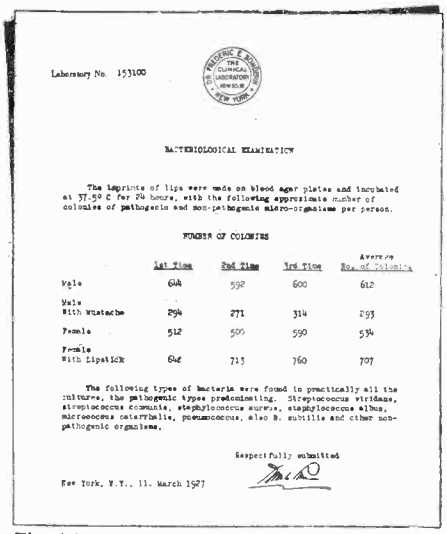
(Continued from page 14)

mitted on lipsticked lips was 707. Inasmuch as the same girls were used in the test, the proof is conclusive that painted lips aid materially in germ transmission.

A number of girls picked at random were asked to impress a kiss on blood agar plates. The plates were incubated and the number of colonies counted and the nature of the germs were then microscopically analyzed. The cultures indicated the presence of many pathogenic types of oganisms. We have the streptococcus viridans, which is found in cases of endocarditis lenta, a malignant endocarditis of a slow course (endocarditis is an inflamation of the membrane lining the cavities of the heart); streptococcus communis; staphylococcus albus; a species from milk and the pus of osteomyelitis which is not generally considered contagious. The staphylococcus aureus which is found in the air, water, soil, etc., and which is the cause of the carbuncle was located on the lips. It is also found in cases of osteomyelitis and sometimes in broncopneumonia. The culture plates also showed the micrococcus catarrhalis which is found in the nose and throat of healthy persons, as well as those suffering from colds and other respiratory affections. It may excite catarrhal inflamation and pneumonia may occur as a secondary invader. Another important organism is the pneumococcus. This organism causes lobar pneumonia.

What then, do the tests show. They indicate clearly that the average healthy person has about 500 germs on his lips which are transmitted during a kiss. It further shows that many of these germs are capable of causing disease, but the reason they do not do so is because the body resistance is sufficient to ward them off. Germs die rapidly when exposed to temperatures lower than that of the body and such temperatures are found on the lips and palms of the hands. Germs also rapidly lose their virulance. It has been claimed that about one in 250,000 people will contract a disease by kissing. The figure must be much less if unpainted lips are kissed. It therefore follows that kissing is reasonably safe and that only those diseases actually due to germ infections could be propagated. In addition to those listed above the important ones are typhoid, measles and diphtheria.

The facts given in this article indicate that kissing, as far as transmission of germs is concerned, is not as dangerous as the first reports would have it. From any other angle we refuse to comment.



Laboratory No. 153100

BACTERIOLOGICAL EXAMINATION

The imprints of lips were made on blood agar plates and incubated at 37.5° C for 24 hours, with the following approximate number of colonies of pathogenic and non-pathogenic micro-organisms per person.

NUMBER OF COLONIES

	1st Time	2nd Time	3rd Time	Average No. of Colonies
Male	648	592	600	612
Male With Mustache	294	271	314	293
Female	512	509	590	534
Female With Lipstick	646	713	760	707

The following types of bacteria were found in practically all the cultures, the pathogenic types predominating. Streptococcus viridans, streptococcus communis, staphylococcus aureus, staphylococcus albus, micrococcus catarrhalis, pneumococcus, also B. subtilis and other non-pathogenic organisms.

Respectfully submitted

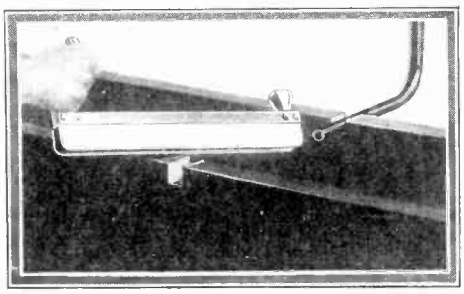
New York, N.Y., 11 March 1927

The laboratory report on which the facts in this article were based.

Hints for the Mechanic

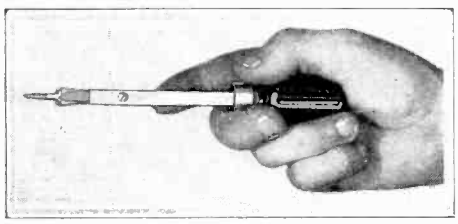
(*Continued from page 49*)

ELECTRICIAN'S SAW



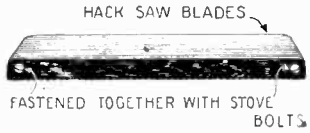
The above photograph shows a double-bladed saw so arranged that it will cut a slot wide enough to permit of the passage of BX or pipe for electricians when wiring a house.

SCREW GRIPPING DRIVER



This photograph shows a screwdriver which will save much time and make it easier to place screws in practically inaccessible places. The screw is gripped by two springs against the blade of the screwdriver.—John B. Roswick.

HACKSAW FILE



To speed up filing, particularly of material which can be coarsely filed, a number of hacksaw blades joined together with stove bolts as indicated are very serviceable.—Thomas F. Johnson.

SANDPAPERING MACHINE

A sanding and polishing machine which makes it easy to sand wood surfaces at a speed ten times faster than hand finishing is illustrated in this photograph above. This consists of a one-half horsepower electric motor running at a speed of 1800 R.P.M. and coupled with the rotating disk by means of a flexible cable.—Photo courtesy Mall Tool Co.

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Bankrupt and Rummage Sales. Make $50.00 daily. We start you, furnishing everything. Distributors, Dept. 171, 609 Division, Chicago.

Make Money Silvering Mirrors, refinishing auto headlights, tableware, metal plating, bed steads, chandeliers. Outfits furnished. International Laboratories, Dept. 69, 309 Fifth Ave., New York.

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$50.00 Weekly easy, applying Gold Initials on Automobiles. No experience needed. $1.45 profit every $1.50 job. Free Samples. "Raleo Monograms", R1043, Washington, Boston, Mass.

Polmet Polishing Cloth cleans all metals like magic! Gets enthusiastic attention. Sells fast at 25c. Sample Free. F. C. Gale Co., 93 Edinboro Sreet, Boston, Mass.

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"Inventors' Guide" free on request; gives valuable information and advice for all who have original ideas or improvements. Frank Ledermann, Registered Attorney and Engineer, 17th Floor, Woolworth Bldg., New York.

"Inventor's Advisor." Patentbook, with 139 mechanical movements, illustrations, sent free. Labiner, Patent Attorney, 3 Park Row, New York.

Patent, Trade-Marks, Copyrights. Reliable services by an experienced practitioner devoting personal attention to each case. Inquiries invited. References furnished. B. P. Fishburne, Patent Lawyer, 525-D McGill Building, Washington, D. C.

Inventors who derive largest profits know and heed certain simple but vital facts before applying for Patents. Our book Patent Sense gives those facts; free. Lacey & Lacey, 644 F St., Washington, D. C. Established 1869.

Carl Miller, Registered Patent Attorney, McGill Building, Washington, D. C.

Patents

Inventions commercialized. Patented or unpatented. Write Adam Fisher Mfg. Co., 205 Enright, St. Louis, Mo.

Two Inventions—Two automatic inventions and a plaster paris process. Beware invenors' rights. William Haines, Habana, Cuba.

Patents Wanted

Mr. Inventor. If you have a patent or invention for sale write Hartley, 38 Court St., Bangor, Me.

Inventions Commercialized. Patented or Unpatented. Write Adam Fisher Mfg. Co., 205 Enright, St. Louis, Mo.

Inventors—If you have an invention of merit for sale, Write Horan, R901, 509, 5th Ave., New York.

Photography

Have you a Camera? Write for free sample of our big magazine, showing how to make better pictures and earn money. American Photography, 118 Camera House, Boston, 17, Mass.

Photoplays Wanted

$1,250—For A Photoplay—$1,250. Written by an unknown writer whose story was sold through our sales department. We copyright, revise, criticize and market photoplays. We are right on the ground in Hollywood in daily touch with the studios. We know the market. Send manuscript today for free criticism and advice. Universal Scenario Co., Room 217, 5507 Santa Monica Blvd., Hollywood, Cal.

Printing Outfits and Supplies

Print your own cards, stationery, circulars, paper, etc. Complete outfits $8.85; Job Presses $11, $29; Rotary $149. Print for others, big profit. All easy, rules sent. Write for catalog presses, type, paper, etc. Kelsey Company, F-6 Meriden, Conn.

100 Each, Letterheads and Envelopes printed, your name and address, $1.00. H. Thompson, 83 Stanley, Houston, Texas.

Big money awaits you Here. 250 signs or pictures an hour without press, type or machinery. Samples and particulars 10c. Straco, 1015½ Mulberry, Springfield, Ohio.

Radio

Boys! Don't overlook this. The "Rasco" Baby Detector. Greatest detector ever brought out with molded base. Fully adjustable. See former advertisements in this publication, or our catalogue. Detector with Galena Crystal complete 50c. the same detector with Radiocite Crystal 75c prepaid. Send for yours today. Radio Specialty Company, 100 Park Place, New York City.

Rubber Stamps

Your name handsomely moulded in fancy letters upon a rubber stamp $1.00 plus 10c for postage. Please print name. R. Skeffington, 18 Bulfinch St., Boston, Mass.

Your Name and Address on rubber stamp 70c. H. Thompson, 83 Stanley, Houston, Texas.

Salesmen Wanted

Millions of business men waiting for Brand New Indispensable $10.00 office utility saving hundreds of dollars annually. One man sold sixteen in three hours. Splendid profits. Write quick for trial offer and exclusive Virgin territory. Lightning Calculator Co., Dept. W, Grand Rapids, Mich.

Salesman: Manufacturer of established line guaranteed tools offer profitable connection to men with mechanical and some sales ability; part time men considered; two average sales daily net $50.00 weekly; advance against commission. Write for free catalogue and money-making plan. J. G. Woods, Inc., Dept. 215, 37 West 20th St., New York, N. Y.

Song Poems

Free "Song Writers Guide." B24-1239 Elm, Green Bay, Wis.

Song Poem Writers—Address Ray Hibbeler, D24, 2104 N. Keystone Ave., Chicago.

Song-poem writers. Address Monarch, 1472 Broadway, Dept. 1535, New York.

Stamps and Coins

Stamps 100 All Different 3 cents. S. I. Quaker Stamp Company, Toledo, O.

Fine Approval Selections at 50% discount. 100 stamps free for 3c postage. Write NOW. Wineholt Stamp Co., Woodbine, 27, Penna.

Typewriters

Typewriters, all standard makes. $10 up. Fully guaranteed. Free trial. Write for complete illustrated lists. Northwestern Exchange, 121 N. Francisco Ave., Chicago.

Wanted

Detectives Earn Big Money. Work home or travel. Experience unnecessary. Write, George Wagner, 2190 Broadway, N. Y.

Cash Paid for used riding boots, (not cowboys). Send description. J. Roy Reasonover, Kemp, Texas.

Radio Constructor Series No. 17

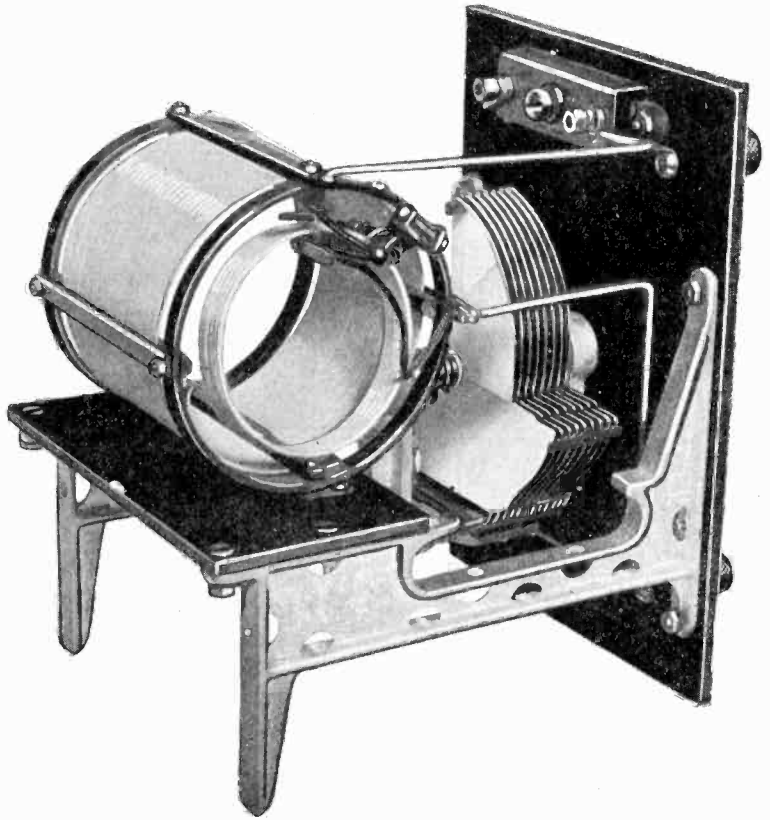
How to Make
A SIMPLE WAVE TRAP & CLARIFIER

It Solves Your Tuning Problem

Every one who owns a radio set has noticed how difficult it is to tune-in the stations desired. This is because there are so many stations now on the air, that the wavelengths have become too crowded for the average radio set to operate satisfactorily.

The only solution to this problem is a Wave Trap. This simple instrument greatly assists in selecting stations on your set. It separates stations that are close together, makes tuning sharper and clearer, and reduces static.

If you want to really enjoy programs and to be able to select them at will, you need a Wave Trap.



A rear view of the WAVE TRAP showing the location of the various parts

Complete Constructional Pattern

Consrad has developed a new series of constructional patterns for radio listeners. The first of these is the Wave Trap shown on the left.

This new pattern contains a gigantic blueprint, size 27¼ inches by 20½ inches, containing simplified Panel layout, Front View, Top View, Side View and Picture Wiring diagram. All measurements are shown actual size. Also a complete Illustrated Pamphlet is enclosed that shows you exactly how to proceed throughout the entire construction; these are enclosed in a heavy folder envelope size 9¼ x 9½ inches.

Note: This wave trap can be installed in a few seconds. It does not have to be put inside your set.

25c AT ALL RADIO DEALERS

If your dealer cannot supply you, write direct to

THE CONSRAD CO., Inc., 230 Fifth Avenue, New York N. Y.

BOOK REVIEW

THE RIVER OF GOLD AND COBWEBS, by Harriette Ensley Hodgson. Soft covers, 5" x 6¾", 200 pages. Published by Harriette Ensley Hodgson, New York City.

This is a sprightly little production giving the author's views about the patent system. The writer does not seem altogether satisfied with the way patents are treated in the courts, and is not altogether pleased apparently with Patent Office methods. It certainly makes very amusing reading.

ELEMENTARY CHEMISTRY, by H. E. Roscoe. Stiff cloth covers, 5" x 7½", 266 pages. Published by Frederick J. Drake & Co., Chicago Ill.

This very clever little book plunges into its subject at once by a ten-page presentation of the atomic theory. The text goes on to such topics as chemical combination, crystallization, and we follow right down the line and find the same system carried to the end, short treatises on different phases of the subject, until we reach the elements. These are treated, singularly enough, yet very practically in alphabetical order. But it does seem curious to find them given in what is really a jumble because the specific letter with which their names begin fix their places in the text.

HEPHAESTUS OR THE SOUL OF THE MACHINE, by E. E. Fournier D'Albe. Stiff cloth covers, 4¼" x 6¼", 76 pages. Published by E. P. Dutton & Co., New York City. Price $1.00.

This is a publication in the To-day and To-morrow Series issued by Dutton and Company of this city. In its seventy-odd pages it gives a picturesque description of the rôle that mechanics play in the world, assigning to them even a physical importance. Included is a treatise on the development of man from primitive races.

HYPATIA OR WOMAN AND KNOWLEDGE, by the Hon. Mrs. Bertrand Russell. Stiff cloth covers,, 4½" x 6½", 80 pages. Published by E. P. Dutton & Co. Price $1.00.

When we consider the vast number of books which are being written, it seems open to question whether it is not enough to have one author in the family, but here we have Mrs. Russell, the wife of Bertrand Russell, supplying this little production to the To-day and To-morrow Series. It claims to present in spirited form the gospel of feminism. While she is what is called an advanced thinker, Mrs. Russell does distinctly recognize the fact that woman's functions are different from those of men. Some modern feminists are inclined to confuse the two sexes.

THE GREAT PACIFIC WAR, by Hector C. Bywater. Stiff cloth covers, 5" x 8", 304 pages. Published by Houghton Mifflin Co., New York City. Price $2.50.

This is a novel whose scene is laid in the future. It is assumed that a great war is carried on upon the Pacific Ocean. The book is intended to picture what a future war on that ocean may be, and what will take place if we are attacked by the Orientals on the great expanse. While distinctly a novel, it is a scientific discussion on naval affairs, and, although a novel, it is deemed of sufficient seriousness to be supplied with two indexes which are certainly a comfort.

MAN AND HIS ANCESTORS IN THE LIGHT OF ORGANIC EVOLUTION, by C. Hill-Tout, F.R.S.C. Stiff cloth covers, 6" x 9", 156 pages. Published by Cowan Brookhouse, Limited, Vancouver, B. C.

In a dedication this work is dedicated to truth, but wherever truth is too much emphasized by modern writers, it is very apt to mean their own views. It is hardly too much to say that before going through a book of this kind, one should get themselves in the proper frame of mind by determining to accept everything the author says as absolutely settled, but some of us believe that there is a good deal yet to be learned, and that some of the old-time scientists evolved theories which are worthy of very respectful consideration.

CIVIC SCIENCE IN HOME AND COMMUNITY, by G. W. Hunter, Ph.D., and Walter G. Whitman, A.M. Stiff cloth covers 5"x7½", profusely illustrated, 51 pages. Published by American Book Co., New York City. Price $1.60.

This book treats of home life, of the works of the body, of proper food, proper sanitation of the house, drug habits and almost every conceivable subject of everyday life. It is profusely illustrated and has the excellent feature which we find in a good many modern books, of giving the bibliography of its subjects at the end of the different chapters. We strongly recommend it to all. An admirable index indicates the care given to the book.

THE LAST LAP, by D. W. Starrett. Stiff cloth covers, 5¼" x 8", 376 pages. Published by Sherman, French & Co., Boston, Mass.

This book is dedicated to Hester A. Dickinson, of whose mentality the author writes as follows: "Whose mind, of all whom he (the author) has taught during a period of five years, was the first to grasp the ultimate of this work as outlined in the preface." We can reasonably understand why only one individual "has grasped the ultimate of this work," because, as a collection of ridiculous, nonsensical and absurd scientific misstatements this book is without a peer. The author attempts to mix religion with psychology, psychology with medicine and medicine with his own personal ideas. For instance, he writes, "The loss of blood during the monthly 'periods' is surely the result of wrong thinking." An expression of this nature might well come from a person having a perverted tendency of mind on this class of subjects, but it surely is not to be expected from the author of this work. The author reasons further that the loss of a single cell should be looked upon with regret. He advises that if we can lose one blood cell, we could lose two or three or four and so on until all is lost. Consequently, the loss of one cell is nothing short of murder. His reasoning with regard to the loss of a single spermatozoa is based on similar lines.

Such are examples of nonsensical statements. Throughout the work his writings show either total ignorance of medicine or attempts at originality which are so far-fetched as to be untenable. The work winds up with ghosts, spirit photographs, spirit messages and objects moving, without contact. SCIENCE AND INVENTION Magazine has $21,000.00 on hand which will be offered to the individual proving the possibility of spiritual contact between this world and the next. Our prize conditions have been published repeatedly and the offer is open to even Mr. Starrett.

HOW TO LIVE A HUNDRED YEARS, by Gay M. Brunson, M.S., M.D., D.D.S. Stiff cloth covers, 5¼" x 7¾", 230 pages. Published by Gay M. Brunson, Joliet, Ill. Price $2.00.

This is a very interesting work containing some good information and also some information which is not quite so good. The author states that fresh meats should be eaten, that cold storage meats contain a greater number of bacteria and frequently formaldehyde and sodium benzoate. The pure food law does not permit the preservation of meats by either formaldehyde or sodium benzoate. The bacteriological counts are inconsequent by reason of the fact that bacteria are killed due to the prolonged and high heat of cooking. The author advises against the use of tobacco for longevity, yet we have seen centenarians and we have read letters from many people close to the hundred mark who attribute their age to the daily use of the pipe or cigar. It is doubtful if tobacco has any effect on the number of years a person will live. Some important data are given and some very well balanced menus appear in this work. On the whole it is worthy of more than passing attention.

THE PROSTATE GLAND, by Chester Tilton Stone, M.D. Stiff cloth covers, 5" x 7", 110 pages. Published by Allen Ross & Co., New York City. Price $1.50.

A small book, very brief but very meaty; it is a heart-to-heart talk from a physician to a patient, medical terms and phraseologies being avoided as much as reasonably possible. In those places where medical terms are necessary, they are thoroughly explained. Beginning with a history of ancient urology, the author rapidly carries us to prostatic conditions, he tells us what they are, what they do; what are their complications and what results may be expected, without in any way attempting to frighten the lay reader. Surely those who read this book are going to place greater confidence in their physicians than they did before. An exposé of modern medical quackery and charlatanry completes the work.

PHOTOGRAPHIC FACTS AND FORMULAS, by E. J. Wall. Stiff cloth covers, 5½" x 8", 386 pages. Published by American Photographic Publishing Co., Boston, Mass. Price $4.00.

This is one of the most thorough works on

(*Continued on page 92*)

photography which has recently appeared from the press. The book is of value to the student as well as to the proficient photographer. Formula upon formula for developing solutions, intensifiers, fixing baths, reducers for film, plate, developing out papers and special papers, toning baths, varnishes, flashlights and color photography details are found in it. There is scarcely a branch of the photographic art omitted from the book and it should surely find its way into the library of anyone interested in making better photographs. It is to be regretted that a chapter on how photographs should be taken is not included although exposure tables are contained amongst the 400 pages.

MAGIC IN THE MAKING, by John Mulholland and Milton M. Smith. Stiff cloth covers, 5" x 7½", 134 pages. Published by Charles Scribner's Sons, New York City. Price $1.50.

This book contains a series of very interesting magical tricks which are quite new and which have not appeared in print heretofore. The magical experiments can easily be duplicated by the layman and the work is illustrated well enough to make this duplication doubly easy. The tricks themselves require very little paraphernalia and the book therefore is to be recommended.

PROHIBITION AT ITS WORST, by Irving Fisher. Stiff cloth covers, 5¼" x 8", 256 pages. Published by The Macmillan Co., New York City. Price $1.75.

Irving Fisher is a Professor of Economics at the Yale University and shows by a remarkable series of tables and figures that prohibition has been an economical good, has increased longevity, has been of social advantage and in general is the boon of the white race. Professor Fisher's figures cannot be questioned and presumably also corresponding figures of prohibition officers remain undisputed. Statements made by both conflict. The Prohibition Chief of New York claims that within the city there are 15,000 speakeasies and Professor Fisher shows that there is less drinking going on than formerly. The metropolitan newspapers indicate that alcoholic deaths are numerous, yet this book indicates that deaths have decreased and that crime is less since the prohibition era than before it. This work is certainly to be most highly recommended. Those individuals taking a prejudiced viewpoint of the advantages or the disadvantages of national prohibition might well look over the figures compiled by Professor Fisher and gain some information about this almost universally disregarded law. Professor Fisher's attention to prohibition is not a recent acquisition. He has studied this subject for more than 25 years. He has disrupted the contention held by the wets and it will certainly be difficult for anyone to dispute his remarkably thorough exploitation of the subject. The figures startled the reviewer who by the way, believes in moderation.

MODERN ALADDINS AND THEIR MAGIC, by Charles E. Rush and Amy Winslow. Stiff cloth covers, 7¾" x 5", 312 pages. Published by Little, Brown & Co., Boston, Mass. Price $1.50.

One of the finest books on the subject of popular science, which has up to the present time been called to our attention, is this one written so that the average child can understand it. Subjects are taken from the school room, the kitchen, the jewelry store, from nature, from factories and in fact, from so many different classifications that it would be impossible to name them all here. True, the work is not an exhaustive treatise on every subject, but one cannot fail to grasp sufficient detailed information about the 75 or more different topics to make him well versed in many of the common facts of the day. For instance, could anyone ordinarily answer the following questions, how are thimbles made, how are scissors made, why do sheep need shepherds, how and from what are combs made, which animals make ink and how do they do it; how is rope made from banana and cactus plants, what is the story of the tin can and what is the ancestry of money? More books of this nature can well be added to the library of modern knowledge. They are certainly to be recommended to anyone, from elementary school pupils to the college professor.

THE LAZY COLON, by Charles M. Campbell and Albert K. Detwiller, M.D. Stiff cloth covers, 5¼" x 7¾", 296 pages. Published by The Educational Press, New York City. Price $2.50.

We cannot recommend this work too highly. It is one of the most complete books catering to no fads whatever and describing in detail the newer methods and the latest advances in the treatment of constipation. The authors first explain in popular non-technical language interspersed with well explained technical phrases what the colon is, what it does and how little digestion there is in the stomach. The advantages of drinking water and the peculiar theories concerning the drinking of water then follow. Then we find a chapter on the causes of intestinal stasis and self-poisoning or auto-intoxication. The values of foods, purgatives, vitamins, and exercises then follow and we also find chapters on effects of tobacco and alcohol on

(*Continued on page 94*)

longevity. Chapters which undoubtedly will interest everyone of us are those on the cause of coated tongues, bad breath or halitosis, the loss of hair and finally the real facts about good complexions. This latter chapter should be of inestimable value to modern youth. We can heartily recommend this work, knowing full well that the lessons contained therein will be of value to anyone who will heed and follow them.

Rules for Matchcraft Contest

(*Continued from page 34*)

$100.00 Monthly Prize "Matchcraft" Contest

DURING the past year SCIENCE AND INVENTION Magazine awarded $5000.00 for articles made entirely of matches. While this $5000.00 contest has officially expired, the publishers have decided that because of the great popularity in Matchcraft constructions, the contest would continue in force on a new prize rate basis until further notice. The list of new prizes will be found in the center box and the same rules for the first contest are to be observed in this contest.

(1) Models submitted must contain at least 90 per cent. safety matches in their construction.

(2) Models made of toothpicks, paper matches, or non-safety matches, are not eligible in this contest.

(3) Models can not be built around boxes or other supporting articles. Walls, roofs, etc., must all be self-supporting and made of matches.

(4) All liquid adhesives, such as glue, shellac, cements, etc., are permissible.

(5) Models may be painted, gilded or silvered.

(6) Models may be of any size.

(7) In order to win a prize, it is necessary that either models be submitted, or, if this is not practical, owing to their size, a 5"x7" photograph of the model may be sent in lieu of the model itself. The best models submitted each month will be awarded the prizes scheduled herewith.

(8) All models submitted to SCIENCE AND INVENTION Magazine will be promptly returned to the builder, who will prepay all charges.

PRIZE AWARDS

First Prize	$50.00
Second Prize	20.00
Third Prize	15.00
Fourth Prize	10.00
Fifth Prize	5.00
Total	$100.00

(9) Where SCIENCE AND INVENTION has any doubts as to the model (where photos only are submitted) complying with all the regulations, the judges may, at their discretion, require that the actual model be sent in for inspection, paying transportation charges both ways.

(10) This is a monthly contest and will continue until further notice. Each monthly contest closes on the first of the month following date of issue. Thus the contest for the month of April will close May 1st and prize-winning announcements will be made in the July, 1927 issue.

(11) Models must be shipped in a strong wooden box, never in a cardboard box, as SCIENCE AND INVENTION can not be held responsible for breakage in transit due to models having been improperly packed.

(12) When models are sent, be sure to affix tag, giving your name and address, to the model itself. In addition, put name and address on outside wrapper of package.

(13) Address all letters, packages, etc., to Editor, "Matchcraft" Contest, care SCIENCE AND INVENTION Magazine, 53 Park Place, New York.

Caution—Soak or cut heads from matches before building your model so that the models may be expressed or mailed. The strike-everywhere square cut Liberty matches can be used if the heads are cut off.

Radio Waves— What Are They?

Waves we cannot feel, see or hear, yet they are everywhere.

Waves in a body of water are clearly visible, but Radio Waves can neither be seen, heard nor felt. Yet these same Radio Waves have length, frequency, velocity, height and form.

Radio Waves travel with a velocity of about 186,000 miles a second. The distance to which a Radio Wave will travel before dying out depends to a certain extent on its frequency.

The sound waves at the broadcast station are impressed upon a Radio Wave and this carried to a receiving set which in turn transforms them back to sound waves.

How this remarkable transposition is made and all about Radio Reception is thoroughly and simply explained in the Consrad Book, No. 11, "HOW RADIO IS RECEIVED."

The book can be bought at your Radio Dealers or you can buy a copy direct, the price is 25c—use the coupon below for ordering.

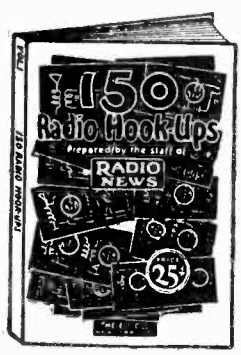
The Fun of Building a Radio Set—and the Thrill of Saving.

A good, carefully built Radio Receiver can equal, even surpass, in some cases, the finest factory made sets.

There is no special difficulty in constructing a good set if one starts with a good circuit and the proper instructions.

To help home set builders in achieving the best results, the Consrad Book No. 2 "HOW TO BUILD PRACTICAL RADIO SETS" is published.

The 64-page book contains many circuits of the most practical and efficient types—complete circuits are shown in all cases. The price of this book is only 25c—you can buy it at most Radio Stores or order direct by the coupon below.



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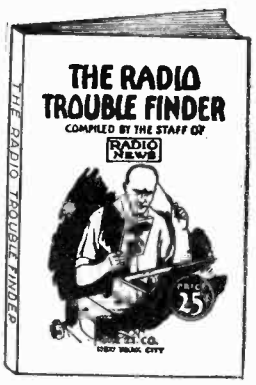

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Simplified chart system locates trouble when your set goes wrong.

Radio Sets can be repaired far more easily than you imagine, if you know where to look for trouble and just how to correct it.

Here's a 64-page book on trouble finding and set repairing—all charted so that you can systematically check all parts of the set.

Size 6 x 9 inches—fully illustrated—"THE RADIO TROUBLE FINDER."

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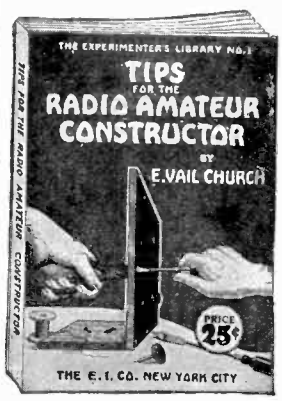

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Book 6—How to Tune Your Radio Set.
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Book 8—One Hundred and Fifty Radio Hook-ups.
Book 9—All About Radio Parts.
Book 10—History and Operation of the Vacuum Tube.
Book 11—The Neutrodyne, All About It.
Book 12—How Radio Is Received.
Book 13—The Radio Trouble Finder.
Book 14—Reflex Radio Receivers.
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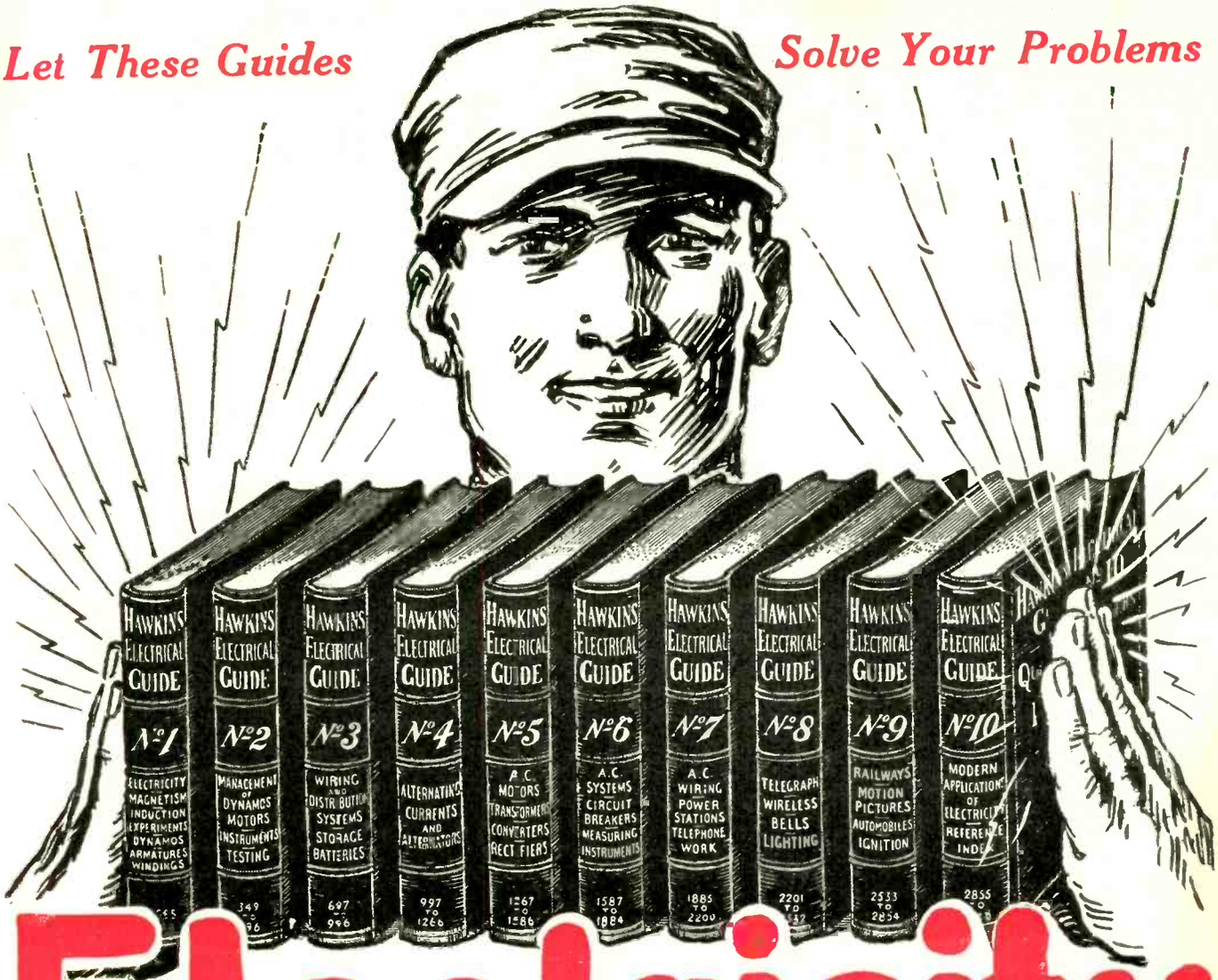

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Please submit me for free examination, HAWKINS ELECTRICAL GUIDE (Price $1 a number). Ship at once prepaid, the 10 numbers. If satisfactory, I agree to send you $1 within seven days and to further mail you $1 each month until paid.

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POSTAL PEN CO., INC.,
Desk 217, 41 Park Row, New York City

You may send me a Postal Reservoir Pen on 5 days' trial. If I am not entirely satisfied with it, I have the privilege of returning it and you are to refund the full purchase price. I am also to receive 5 premium post cards, each worth 50c on the purchase price of a new Postal Pen. I reserve the right to sell these cards at 50c each or dispose of them in any way I wish. I will pay postman $2.50 upon receipt of my pen. Send me the model I have checked. ☐ Men's Size. ☐ Women's Size.

Name .....

Address .....

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

If you live outside the United States send International Money Order with Coupon.

You Can See Right Through it!

And It Holds 3 to 4 Times More Ink Than Others
No Other Like It In The World
Only One Way to Get It

This one exclusive feature puts the POSTAL Pen in a class by itself. Regardless of how fine a fountain pen may be, it is useless when empty. The unbreakable ink reservoir of the Postal Pen is transparent. You can see right through it and always tell when your ink supply is running low.

And in addition . . . another exclusive Postal feature is its tremendous ink capacity. It holds from 3 to 4 times more ink than other self-filling pens, yet is actually no larger. Illustration at left shows actual size. The patented filling device—the simplest and easiest ever invented—eliminates rubber sac in barrel and provides additional ink capacity.

Why the Postal Pen Costs Only $2.50

Judging this remarkable pen by its quality, fine workmanship, smooth writing 14-karat iridium-tipped gold point and its many other features found only in the highest priced pens, you would naturally expect it to cost from $7 to $8.75. And at that price it would be extremely reasonable.

But the Postal sales policy, direct-from-manufacturer-to-user, eliminates all in-between profits and brings the cost of this peer of all pens down to $2.50. In no other way could such a superior pen be sold at such a surprisingly low price.

You Do Not Buy a Postal Pen Until You Have Proved Its Worth

There's only one way you can get a Postal Pen. *You must try it 5 days before you can keep it.* Simply mail the coupon. Your Postal will be sent to you at once. Give it the hardest use you can think of for 5 full days. Then decide for yourself whether you want to keep it. If you do not agree that it is the best pen you ever saw, regardless of price, return it and your money will be promptly refunded. Every Postal Pen owner must be entirely satisfied with his pen. That's why the 100,000 people who are using Postals are now our best "salesmen"!

How You Can Actually Earn a Postal Pen Without Cost

With each Postal Pen you receive, absolutely FREE, 5 Premium Post Cards, each worth 50c on the purchase price of another Postal Pen. You can easily sell these cards at 50c each and earn back the cost of your Postal Pen. You do not have to sell them. Dispose of them any way you wish. Whatever you make on them is yours to keep. Merely an easy way to get, without cost, the most dependable and unusual fountain pen ever made—the one pen so sure to please that its manufacturer is willing to let you try it out before you buy it.

Costs Only $2.50

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RESERVOIR PEN

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