AN AEROPLANE FACTORY.

BY JACQUES BOYER.

The construction of aeroplanes is the latest new industry to be started in France; and the exploits of Santos Dumont, Bleriot, Farman, Delagrange, and the Wright brothers, by focusing public attention upon aviation, have aided in its development. As a result, there are to-day several factories especially fitted up for this purpose near Paris. The most important of these, that of Voisin brothers at Billancourt, has a capacity of four machines a month.

In the principal room of this original factory are found scattered about the various parts of aeroplanes in course of construction. In one corner is to be seen the body framework or skeleton of a future aerial vehicle, some 36 feet in length by about 2½ feet in width, while a little farther on are placed the cells, or enormous wings, having a spread of some 32 feet, and intended to be mounted on monoplane, double- or triple-surface machines.

The tools used in the aeroplane factory are of the simplest sort. They consist of mallets, saws, chisels, and such other tools as are used by carpenters. The wood used in making the body framework is generally oak, while the uprights that connect the main planes are of the same material or of poplar. The main longitudinal pieces are cut from very dry wood. They are about 32 feet long, and are selected so that the grain runs from one end to the other, in order to give a maximum resistance for a given section. They are planed down and grooved in certain places, and then fitted together by means of uprights that are mounted in aluminium sockets attached to them. The framework thus formed is suitably braced by means of steel piano wire, drawn taut and fastened to eyelets in the aluminium sockets. In the aeroplanes of the Farman type constructed by Voisin, the finished body framework has a total length of 9½ meters (31.16 feet), weighs 55 kilogrammes (121¼ pounds), and is so rigid that it will support a weight of over 1,000 pounds at its front end.

The body framework tapers at the front and terminates in a steel and aluminium plate, in the center of which is fastened the bearing for the propeller shaft. The motor is mounted on a metal frame, and the seat of the aviator consists of a board with a back attached.

The cells or wings, which are attached to each side of the body framework, consist, in the case of a double or a triple-surface machine, of two or three superposed surfaces, connected together by poplar uprights mounted in the aluminium sockets, and braced by steel wires in order to make them sufficiently rigid. These surfaces are made up of a frame consisting of two strips of wood (one in front and one at the back) connected by curved ribs of poplar, and covered with rubber-impregnated cloth, which is nailed to the strips

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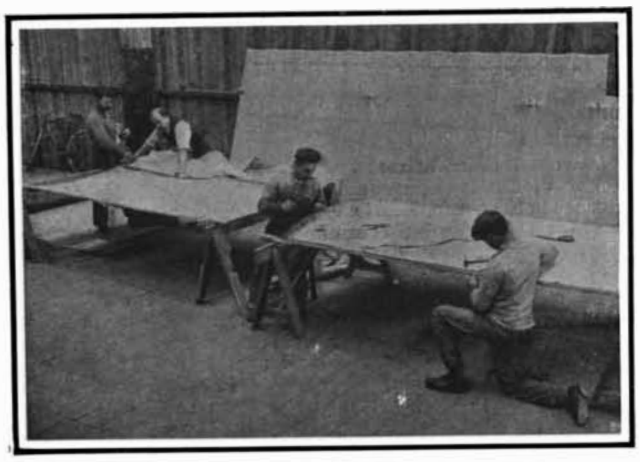
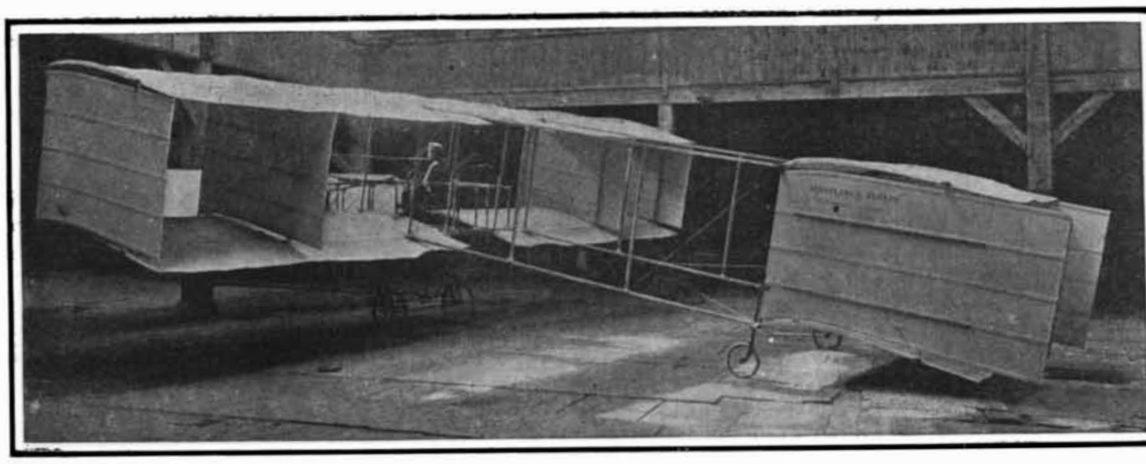


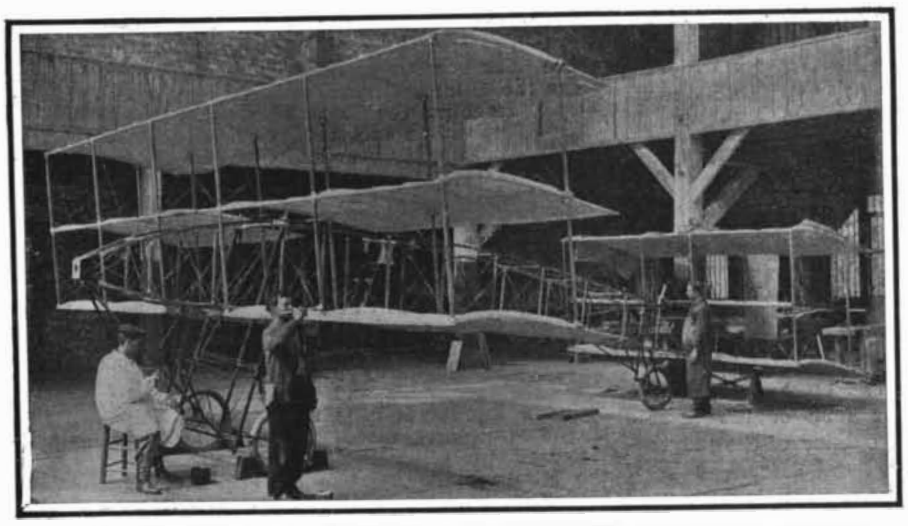
Covering the frame of a plane with cloth.

A waterproof cloth having pockets for the ribs is used to form the planes.



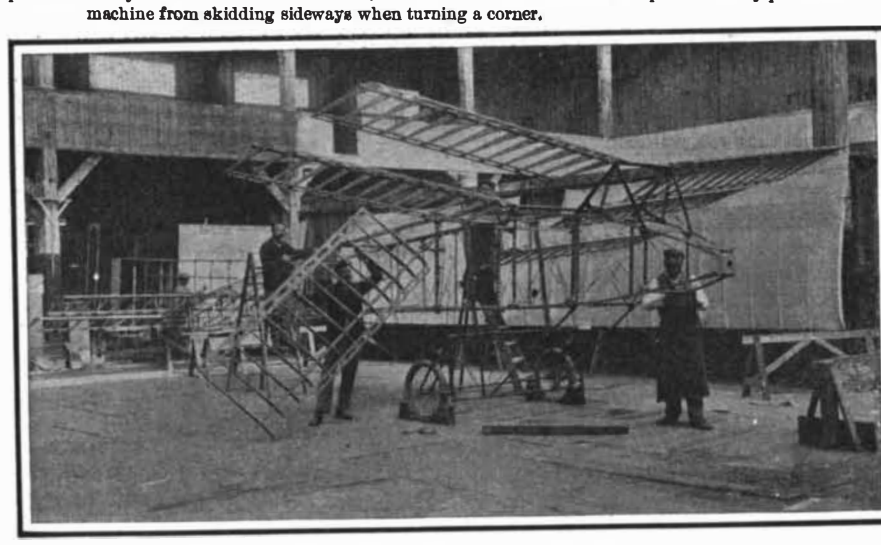
Farman's aeroplane, showing some of the recent changes in its construction.

Vertical partitions have been placed half way between the center and ends, and also at the ends of the main planes. They prevent the machine from skidding sideways when turning a corner.



The Goupy three-decker. This machine was tried without encouraging results.

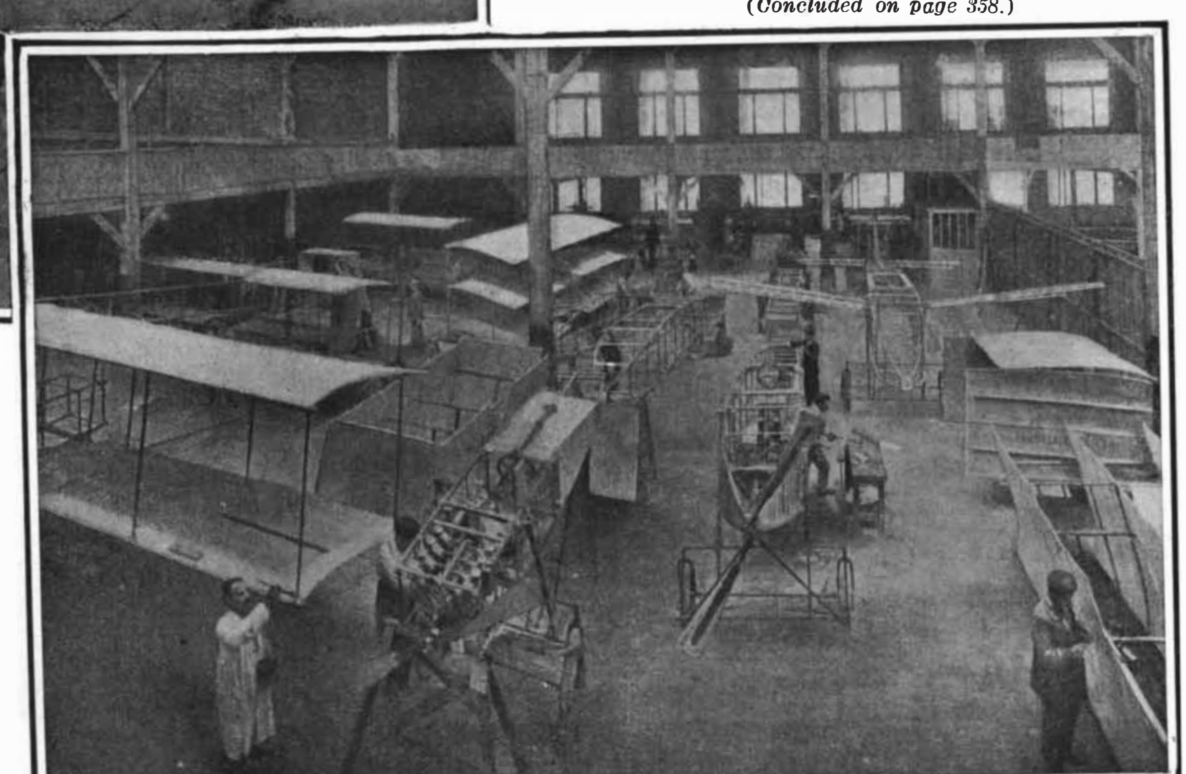
The use of three superposed surfaces makes it possible to reduce the spread of the planes considerably.



Assembling the "Flying Fish," Farman's untried following-plane machine.

This arrangement of following planes also makes possible the reduction of the wing spread.

Side members of the main body frame of an aeroplane.



Interior of the Voisin factory, showing finished aeroplanes and others in course of construction.

THE CONSTRUCTION OF AEROPLANES.

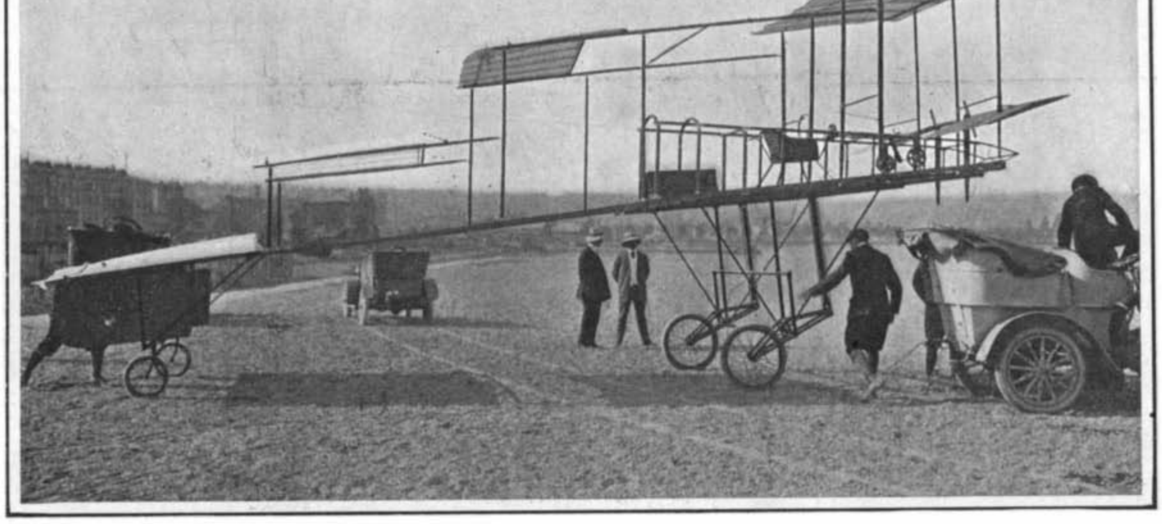
of the bow also. **Among the new features is a telegraph line connecting the two cars.**

A few of the recent flights of the remodeled airship are enumerated below. The first was made on October 23, when the airship flew over Lake Constance and the city of the same name about four hours. On the next day a flight of two hours was made, and on Sunday, the 25th of October, another two-hour flight much more remarkable than the one of the previous day was carried out. According to experts, the remodeled vessel operates even better than the "Zeppelin IV." On the 26th of October a three-hour flight was made, but one of the motors did not operate satisfactorily. The following day, Count Zeppelin took Prince Henry of Prussia with him for an extended flight, which lasted six hours. A trip was made to the Falls of the Rhine, and the airship developed a speed of 50 kilometers (31 miles) an hour. Several days after, on November 7, Crown Prince Frederick William accompanied the Count, and made a trip to Donaueschingen, Baden, where the Emperor arrived by rail shortly after the arrival of the airship. The Emperor conversed with his son through a megaphone, and afterward the Crown Prince returned in the airship to Friedrichshafen. Emperor William himself expected to make a trip in the airship on the 10th instant, but instead he watched it from the lake, and at the termination of the flight he conferred upon Count Zeppelin the order of the Black Eagle, in recognition of his achievement. At the present time there has been raised by popular subscription in Germany, for the construction of Zeppelin dirigibles, $1,378,334. This gives a good idea of the decided success Count Zeppelin has finally met with among his countrymen.

The other dirigible which we illustrate is the "Clement-Bayard" of M. Clement, the well-known automobile manufacturer of Paris. This airship has been constructed for the personal use of M. Clement. It is 56 meters long (183.6 feet) by 10.58 meters (34.7 feet) in diameter, and it has a capacity of 3,500 cubic meters (123,602 cubic feet). The body framework is 28½ meters (93½ feet) long, made of steel tubing. A triple-surface horizontal rudder is placed at the forward end of the body framework, and a 5-meter (16½-foot) propeller is at the extreme front end. The 120-horse-power Bayard-Clement motor is mounted on springs, and drives the propeller 380 R. P. M. by reduction gearing. Every conceivable kind of indicating apparatus has been fitted. For example, there is a tachometer which gives the number of revolutions of the motor at every instant. For the convenience of the passengers a closed cabin of sheet aluminium has been provided. A specially noticeable feature of this dirigible is the peculiar tail, which consists of four club-shaped gasbags placed beside the reduced rear end of the main envelope. This form of tail has been found to work quite satisfactorily, and to give the balloon a considerable degree of stability. M. Clement expects to use this airship in making excursions to his country place.

Two of the photographs reproduced herewith show Farman's remodeled aeroplane and the latest Bleriot monoplane in full flight. The Farman machine has been changed by the placing of vertical partitions at the ends of the main planes and by the moving of the partitions that were formerly on each side of the center part to points about half way between the center and the ends of the main planes. M. Farman has also fitted horizontal auxiliary planes or shutters to the rear edges of both the upper and lower planes. The angle of these shutters can be varied to tilt up the machine when turning a corner. After making the sensational cross-country flight mentioned elsewhere, Farman, on October 31, won the "Prix de la Hauteur" of the Aero Club of France by flying over a line of captive balloons placed at a height of 82 feet.

The Bleriot monoplane has not been changed very much of late. The movable wing tips are still used on the ends of the plane, and there is but a single horizontal rudder below the rear end of the body framework. A small additional plane is fitted above the body framework toward the rear. These rudders and movable wing tips apparently work very well, since M. Bleriot was able, on October 22, to drive his machine against a strong wind of between 25 and 30 miles an hour. The speed of the machine itself is about 37 miles an hour.



Side view of Witzig-Lioré-Dutilleul aeroplane, showing step-like arrangement of the following planes.

SOME NEW AND IMPROVED FOREIGN AEROPLANES AND AIRSHIPS.

The other aeroplane we illustrate is a new type, in which the surfaces are arranged in a series of steps. This aeroplane is known as the Witzig-Dutilleul. It has a total surface of 50½ square feet, and is to have a 50-horse-power Antoinette motor. No experiments of any account have as yet been made with it.

AN AEROPLANE FACTORY.

(*Concluded from page 356.*)

and to the curved ribs that pass through pockets in it, and thus hold it in the proper curve which it is desired that the surface shall have. The horizontal and vertical rudders are fitted in front of and behind these planes, the former being mounted at the forward end of the body framework, and the latter in the box tail at the rear. The main frame is supported upon a chassis of steel tubing by means of two long coiled springs that absorb the shock when the aeroplane alights upon its pneumatic-tired wheels. The two front wheels are pivoted so that they can assume any direction and act as casters when the machine alights.

In the construction of monoplanes the ribs of the wings are mounted upon steel tubes or I-beams of aluminium that are suitably secured to the body framework. The cloth is provided with eyelets and is laced in place.

One of our photographs shows a workman mounting the six planes of Farman's "Flying Fish" aeroplane upon the body framework. The planes can be set at varying angles, and the proper angle for them will be determined by experiment. The factory has a laboratory, in which experiments are made to determine the best form of aeroplane, the curves of the surfaces, and the resistance of the planes and of the framework. In constructing an aeroplane, use is made as much as possible of the different light metals and their alloys. Ordinary steel tubing is used for the planes, while for the propeller shafts and the blades nickel steel, offering the greatest resistance for the least weight, is employed. All pieces working under compression are made of aluminium, in order to diminish the weight. The propellers, in particular, are very carefully constructed. The hub is made of cast steel, and to it are clamped the steel arms, which are forgings of very high resistance. To these arms are secured aluminium blades. When one notes that this mass of 2.3 meters (7½ feet) diameter revolves at from 1,000 to 1,400 revolutions a minute, one can see that it must be exceptionally strong. At 1,335 revolutions per minute the end of one of the blades travels through space at the rate of 525 feet a second (350 miles an hour) and the blade itself is constantly under a centrifugal force of nearly 9,000 pounds, tending to project it outward.

The motor is one of the most important parts of the aeroplane. Heretofore Voisin brothers have used only the Antoinette motors of the 8-cylinder V type; but lately they have adopted the "Vivinus," or the motor of the Belgian Société Metallurgique. This latter motor, which is the one used on the Goupy, Florio, Moore-Brabazon, Farman ("Flying Fish" for two passengers), and De Caters aeroplanes, is a 50-horse-power, lightweight, automobile motor weighing about 300 pounds. Whatever motor is adopted, the installation of it requires only a few days. In fact, a complete aeroplane can be constructed in about a week's time. The cost of one of these machines in France is $4,000, half of which is represented by the motor. Very probably, however, the cost will be reduced as the machines come into more general use, for in reality, the materials used and the work necessitated in their construction are less than in the case of an automobile.

The Arc of Peru.

The committee of the French Academy of Sciences having scientific control of the French geodetic operations on the equator has reported the completion of the remeasurement of the historic arc of Peru.

This arc was measured by the French (1736-1743) and used in connection with a similar arc in the Arctic regions, also measured by the French, to decide a question in regard to the form of the earth which had arisen as the result of Cassini's surveys in France.

In 1889, the question of remeasuring this arc was brought before the International Geodetic Association by the delegate of the United States, Prof. George Davidson, who suggested that France should have the prior right to execute the work.

Circumstances prevented any active work until 1898, when the association voted in favor of the proposition to remeasure the arc, and the French delegates undertook to have the work done.

Officers of the Geographic Service of the French army left Paris for Ecuador in May, 1899, and the work was continued until completed.

The arc extends from Tulcan, Ecuador, Lat. +0 deg. 48 min. 25.6 sec., to Payta, Peru, Lat. —5 deg. 05 min. 08.6 sec. and the work accomplished in the remeasurement may be summarized as follows, viz.: Seventy-four geodetic stations. Three base lines measured.

Eight differences of longitude determined between stations at Tulcan, Piular, Quito, Latacunga, Riobamba, Cuenca, Machala, and Payta. The first five of these stations are distributed along the northern section of the arc, the sixth at the middle of the southern section, the seventh on the coast at the same latitude as the sixth, and the last at the end of the southern section, on the coast. The comparison of the differences of longitude, geodetic and astronomic, between the stations at Machala and Payta and the station at Cuenca will throw light on the form of the geoid, as the first two stations are on the coast and the third is in the inter-andine region.

Six azimuths were determined, namely, at Tulcan, Piular, Quito, Riobamba, Cuenca, and Payta.

Sixty-four determinations of latitude were made.

The forty-eight magnetic stations were distributed all along the arc.

Of the six pendulum stations, one is at Machala, on the coast, at the point where observations for longitude were made; one at the foot of the western Cordillera, near Chimborazo; one, at an elevation of 4,150 meters in the western Cordillera; two, in the inter-andine region at Riobamba and Quito; and one at an altitude of 1,800 meters in the plain of the Amazon on the eastern slope of the eastern Cordillera.

Of the two lines of levels of precision, one runs from the Riobamba base line to Guayaquil and to the tide gage at Salinas on the Pacific coast and the other from the southern base line to the tide gage at Payta, the two lines covering a distance of 410 kilometers.

The preliminary computations are far enough advanced to assure the value of the observations. The closure of the triangles and the agreement of the computed and the measured lengths of the base lines compare well with the results obtained in the revision of the meridian of France.

The publication of the results of the work will be regarded as an important event by geodesists throughout the world.—Abstract from Science.

A new and peculiar use for electricity has been found. The city of Zittau possesses extensive and beautiful forests, in which such depredations have been made by the larvæ of the "nun" moth that it has been found necessary to cut down all the trees over large tracts. Last summer the electric light was enlisted in the warfare against the insects. On the roof of the city electrical station were mounted an exhaust blower and two powerful searchlights, the beams of which were directed to the forest five miles away. The hoped-for result followed. The moths flew by the thousand toward the searchlights but, before they could reach these, they came within the field of action of the blower and were carried away to destruction. In one night 66 pounds of moths were destroyed in this way, in addition to the great numbers of moths which found death in the electric arcs of the street lamps, from which the globes had been purposely removed.

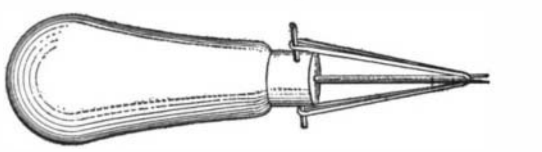
The Editor of Handy Man's Workshop will be glad to receive any hints for this department and pay for them if available.

Christmas Hints for the Handy Man will be published in next week's issue.

HANDY METHOD OF REPAIRING A PUNCTURED TIRE.

BY GEORGE F. LINKE.

The accompanying sketch shows a handy device for mending punctures in bicycle tires. It consists of a common darning needle of a large size and with a



A TOOL FOR REPAIRING PUNCTURES.

large eye, with its point inserted into a wooden handle. There are two pins also in the handle, projecting from opposite sides, and the top of the needle is cut off, leaving the end of the eye open.

To mend a puncture, stretch elastic rubber bands over the pins and through the slot in the end of the needle as tightly as possible until judgment shows that there is enough rubber to fill the puncture. Then insert needle and rubber through puncture in tire, throw the rubber off the pins and withdraw the needle. The rubber being tightly stretched will contract when released, filling the puncture and leaving a small lump inside and outside of tire. This will wear off outside in a very short time. It is advisable to ream the hole smooth before applying the rubber. This can be done by heating the needle with a match and then searing the edges of the hole.

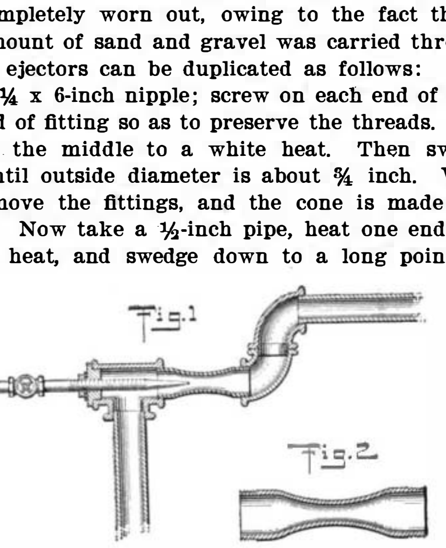
EJECTOR MADE OUT OF PIPE FITTINGS.

BY B. A. JOHNS.

A simple ejector may be made out of ordinary pipe fittings, which will compare very favorably with some of the ejectors on the market. It may be used in draining a flooded cellar, in which case it may be attached to the ordinary water faucet for motive agent. It can also be used for emptying cisterns or in excavations for new work where water is struck. (Of course, in this case, steam will be used as motive agent.)

Some time ago I was engaged in building a reservoir, and at a depth of 15 feet a spring of water was struck. Having no means at hand to get the water out of the excavation, I decided to make an ejector out of some old pipe fittings I had in the tool chest. I succeeded in making four that kept the water level down while the work was being done. One of these ejectors worked night and day for nearly three weeks until completely worn out, owing to the fact that a great amount of sand and gravel was carried through.

These ejectors can be duplicated as follows: First take a 1¼ x 6-inch nipple; screw on each end of same any kind of fitting so as to preserve the threads. Heat same in the middle to a white heat. Then swedge down until outside diameter is about ¾ inch. When cold remove the fittings, and the cone is made (see Fig. 2). Now take a ½-inch pipe, heat one end to a welding heat, and swedge down to a long point. A



THIS EJECTOR CAN BE USED FOR DRAINING FLOODED CELLARS.

3/16 rod may be inserted in the end to give the hole the right dimension, as it may be drilled out afterward. When cold, thread the pipe about 4 inches and screw on a jam nut (see Fig. 3). On the "rim" of a 1¼-inch tee attach the cone above described and then a 1¼-inch elbow into which screw a close nipple. On the other end of the nipple screw another elbow, forming a kind of step or stop. To this elbow may be attached either a hose or a pipe to carry off the water. On the opposite end of the tee attach a reducing bushing, into which insert the nozzle shown in Fig. 3. Care should be taken to get the nozzle in perfect alinement with the cone, and when in proper place, screw up the jam nut with some packing behind it, to make it air tight. In the other opening of the tee attach a pipe or a very heavy hose, preferably "ironclad," as the suction will have a tendency to close it up.

STORAGE BATTERY WITHOUT CHEMICALS.

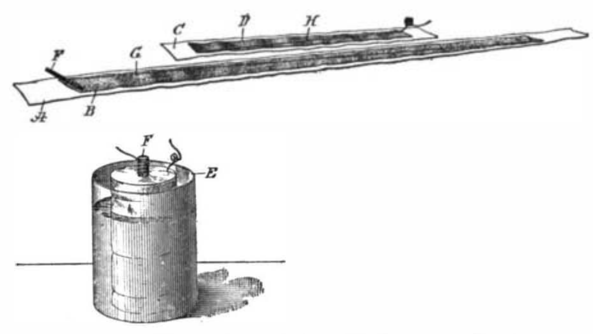
BY WALTON HARRISON.

An experimental storage battery, having qualities of interest, and at least remotely suggestive of commercial possibilities, may be constructed at a cost of a few cents, as follows:

Provide four strips *A*, *B*, *C*, *D*, of thin cloth (calico will answer), the strip *A* being 20 feet long and 4 inches wide, the strip *B* 18 feet long and 3 inches wide, the strip *C* 10 feet long and 4 inches wide, and the one designated as *D* 9 feet long and 3 inches wide. Procure an ordinary battery jar *E* of cylindrical form, a pound of commercial flake graphite, a few gum bands, and two pieces of No. 30 bare copper wire, one (*G*) being 20, and the other (*H*) 10 feet in length. These parts and materials, together with a carbon rod *F* of the kind used for arc lighting, comprise everything needed except water and enterprise.

Spread out the strips *B* and *D*, shower them liberally with water, and dust the graphite upon them. Then stroke them off with the hand. This will remove all excess of graphite, and leave them shining like strips of new tin plate. A single coating of the graphite upon one face of the cloth is sufficient.

Spread out the strip *A*, which remains uncoated, and lay the strip *B* centrally upon it, so as to leave exposed all margins of the strip *A*, its ends extending equally and in opposite directions beyond the ends of the strip *B*. Extend the wire *G* along the strip *B* from one of its corners to the opposite corner, the wire thus being slightly oblique relatively to the strip, and extending a couple of feet beyond one corner. Next place in position the strip *C*, which remains uncoated, centering it lengthwise in relation to the other strips, and bringing its longer edges flush with those of the



STORAGE BATTERY WITHOUT CHEMICALS.

strip *A*. Place the strip *D* on the strip *C*, leaving all margins equally matched. Stretch the wire *H* along the strip *D*, from one corner to the corner opposite, the wire being slightly oblique to the strip, so as to cross the wire *G* and leaving a foot of the wire *H* projecting.

Wind the projecting end (2 feet long) of the wire *G* tightly around the carbon rod *F*, and lay the rod squarely across the adjacent end of the strip *B*, so as to make good contact with the graphite. This will leave a foot of the strip *A* extending from the rod *F*. Bend this extending portion back over the rod so as to cover it, and then, using the rod *F* as a spool, roll it along, pressing it down hard; and thus wind tightly upon it all of the strips and both of the wires, so as to form a hard roll having generally the appearance of a solid white cylinder. Stretch two or three rubber bands around the roll, so as to hold all of its parts rigidly in position. Find the projecting end of the wire *G*, and leave it exposed. Set the roll into the jar, so that the exposed portion of the wire *G* and also a portion of the carbon rod *F* extend upwardly. Now fill the jar with water, preferably submerging the roll to within half an inch of its top.

This completes the battery. In some instances it may be improved by making the strips *A C* of cloth thicker than that above designated.

The battery may be charged from an ordinary dry cell, by connecting the zinc shell of the dry cell with the carbon rod of the storage battery, and the carbon of the dry cell with the protruding wire of the storage battery. After being thus charged for fifteen or twenty minutes, the storage battery may be disconnected, after which it will yield, for a few minutes at least, a current not differing greatly from that with which it was charged, and adequate to operate a telegraphic sounder or an electric bell. If the energy of the battery be conserved by leaving the circuit open, the charge may last for several days. Like other storage batteries, this one, after being partially exhausted, will recuperate to some extent if the circuit be left open, though of course the total energy it gives out can never exceed that with which it is charged.

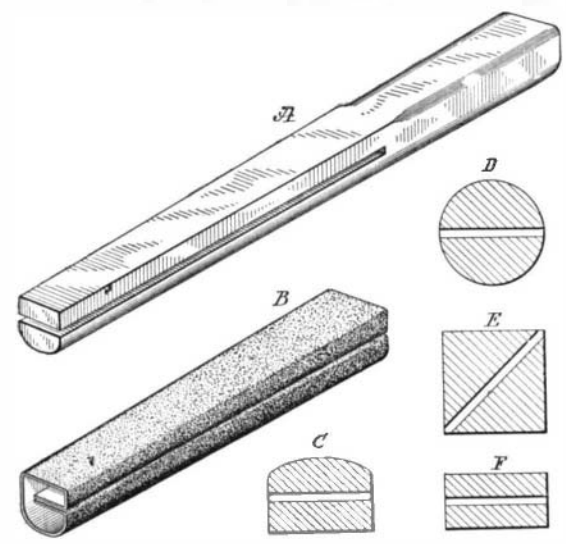
This device is in every sense a true "gas" battery as well as a storage battery. While it is being charged, the current sent through it disintegrates a portion of the water into its two component gases. The hydrogen, being disengaged throughout the entire length and breadth of the graphite coating carried by the strip *B*, is simply absorbed or occluded within the pores of the cloth, and thus effectively held as a free gas in a state of captivity. The oxygen, being in part in its allotropic form of ozone, is similarly collected and held in the strip *C*. The strip *A* holding the hydrogen, being twice as long as the strip *C* holding the oxygen, is adapted to hold twice as much gas, thus compensating for the difference in volume between the hydrogen and oxygen. Both gases, being freshly liberated, are in their nascent state and eager to recombine. After the charging is completed, therefore, and a conducting path is established from one of the coated strips to the other, the gases recombine, forming water, and in so doing they generate an electric current flowing in a direction opposite to that of the current previously used for breaking up the water and forming the gases.

It is a fact not generally known that if a quantity of hydrogen and a quantity of oxygen be subjected as nearly as practicable to the same physical conditions, they will present relatively to each other a difference of potential of about a volt and a half.

CONVENIENT HOLDER FOR SANDPAPER.

BY EDWARD J. TIEDE.

In sandpapering irregular shaped woodwork, the paper is laid over a stick of wood and used practically as a file. For holding the paper I have often used a simple holder for different kinds of work with satisfactory results. The holder consists of a stick, preferably of pine wood, of the required shape and size and tapering slightly toward one end. Into the narrow end saw a slot in the center to about two-thirds its length. Cut off a piece of sandpaper wide enough to go around the stick, allowing a liberal margin to fit into the slot. Fold the paper so it can be slipped



CONVENIENT HOLDER FOR SANDPAPER.

into the slot and around the holder from the end; pull it down until it fits snugly, when it is ready for use. Emery cloth can be used in the same way for polishing parts of machines and the like.

In the drawing the holder is shown at *A*, and the paper folded ready to apply at *B*. The sections *C* to *F* suggest some shapes that may be used.

THE CONSTRUCTION OF A WORKSHOP.

BY I. C. BAYLEY.

The interest taken by the boy in a shop that is his very own, particularly if he is allowed to build it himself, will be very manifest, and the good derived, by keeping him off the street, if nothing else, will well repay the small outlay of the first cost.

Fig. 1 shows the inside view of a workshop good enough for any boy, no matter what his station in life may be. The framework was put up by a first-class mechanic, but the furnishings are all home-made, such as any boy will be able to construct. Such a shop as this is hardly necessary for the average young mechanic, the object of the sketch being more to show how a shop can be fitted up inside. The lathe, and also a jig saw, not shown, will be described, in a later number, as will also the bench, drawing table, and other accessories.

A shop about 9 feet by 12 inside dimensions will be ample enough, and if it is made as an addition to the house, but three extra sides will be necessary, or if built in a corner, as is sometimes convenient, then but two extra sides will be needed.

The ground must be leveled, and prepared for the six piers, which can be of concrete, brickwork, or timber. If of timber, let them be 6 to 9 inches square by 2 feet long, buried in the ground about 18 inches. Holes should be dug of suitable depth and the stumps dropped in, care being taken to get them the proper distance apart, 9 feet by 12, out to out, so that the sides of the building, when erected, will be flush, and not have to be cut around the piers, or offset in an