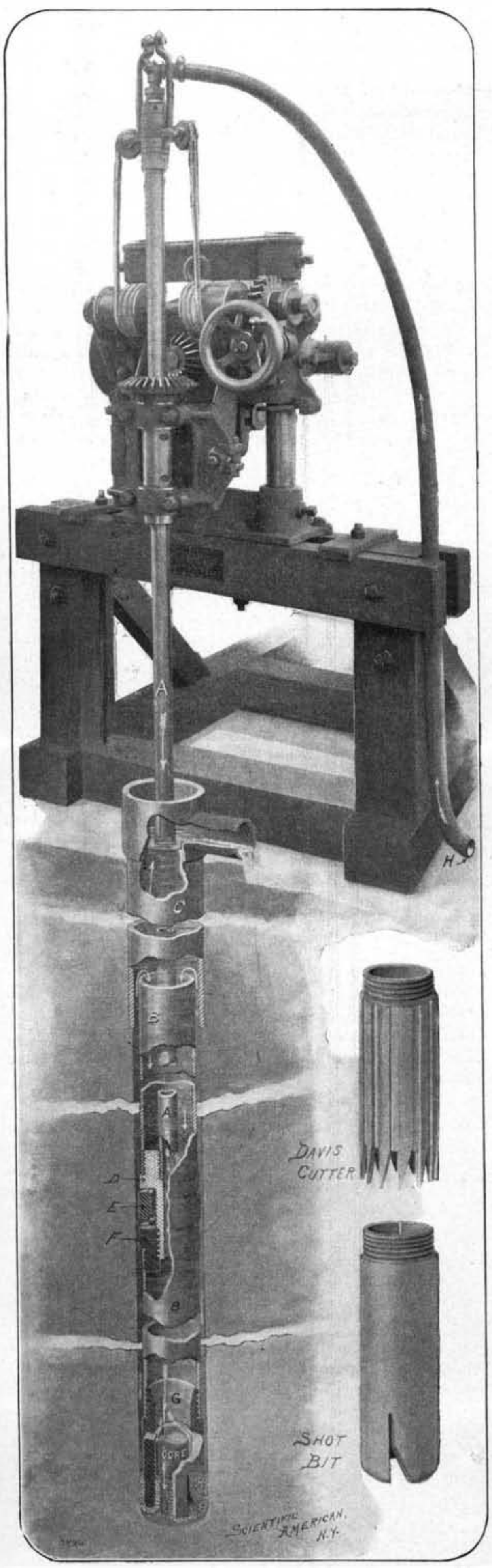
CORE DRILLING WITHOUT DIAMONDS.

Forty years ago, when Leschot invented the diamond core drill, black diamonds were valued at $3 a karat; now they are rated at $50. This advance is attributable, not to a diminution in the supply of the diamonds, but rather to the ever-increasing demand for them. Core drilling is indispensable in a great variety of engineering and mining enterprises, affording, as it does, a means for drilling out a sample core or column of rock, which enables one to tell at a glance the exact nature of the substrata. Heretofore core drilling could be done only with diamond bits. Now, thanks to the efforts of an Australian inventor, we are provided with two very efficient yet inexpensive substitutes for this



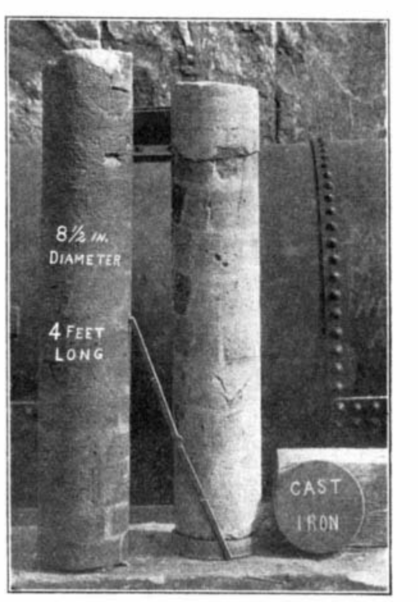
CORE DRILLING WITH STEEL SHOT INSTEAD OF DIAMONDS.

high-priced tool. Mr. Davis' first attempts were directed to the construction of a toothed bit or cutter made of hardened steel. With this he was very successful in soft and moderately hard rock, but for the hardest formations he still had to use a diamond drill. It was not until Mr. Davis had invented the "shot bit" that the diamond drill could be entirely dispensed with. This bit is a soft steel cylinder in connection with which small chilled steel shot are used. The bit grinds the shot into the rock, thus gradually wearing it away, or to be more correct the action of the shot on the rock is one of crushing rather than grinding, and for this reason the smooth bearing surface of the shot bit shows but little wear.

The arrangement of the drill and its accessories is shown in the accompanying engraving. The hollow drill rods *A* are rotated by any available driving means through the medium of the gearing illustrated. The lower drill rod is surrounded by a "calyx" or tube *B*, and the two are joined at their lower ends by a plug *D*. The center portion of the plug serves as a bearing for a protecting ring *E*, and on its lower end a ring *F* is threaded, while to this the core barrel is attached. Either the shot bit or the cutter can be threaded into the lower end of the core barrel. The shot bit, which is shown attached to the core barrel, is provided with a triangular notch in its lower end, one of the walls of the notch being vertical and the other forming an angle of 30 degrees therewith. The steel shot, which are fed through the hollow rods from the top, are carried by a current of water under this notch, and the inclined wall drags them under the edge of the shot bit. The sizes of shot used vary with the nature of the rock to be drilled, some being as large as duck shot and the smallest being very much finer. The working edge of the shot bit is rounded, so that the shot grinds not only directly beneath the drill, but also to a certain extent at the inner and outer sides, thus cutting out proper clearance for the operation of the drill. Water which is pumped into the hollow drill-rods through the pipe *H* passes out under the bit and up the annular space outside the core barrel, carrying with it the sludge or fine particles ground up by the shot. The current of water flows with great strength up as far as the top of the calyx, but here it will be observed that the annular space widens considerably, so that the current is reduced and the sludge it carries drops by gravity into the calyx. The calyx, therefore, provides an additional record of formations penetrated. It is particularly useful when drilling with the cutter bit through matter which is too soft to form a good core.

The cutter bit is clearly illustrated in one of our detail views. It is made of steel, hardened by a special method to give it just the proper temper for the work to be performed. The teeth are very long and sharp and have an alternate inward and outward set, similar to that of saw teeth, so as to cut out the necessary clearance. The cutter does not cut through the rock with a constant feed, but rather with an intermittent motion which is due to the torsional elasticity of the rods; that is, the teeth at the first "bite" on the rock will be checked for an instant until, with the assistance of the energy accumulating in the rods, they break their way through the obstruction and take a fresh bite. The action is, evidently, similar to that of chipping away stone with a mason's chisel.

In order to prevent too great a leakage of water through the loose soil or gravel which usually covers the bedrock, the casing *C* is provided. The weight of the drill rods is ordinarily sufficient to properly feed either the shot bit or the cutter. When additional pressure is necessary, this may be exerted by turning the handwheel shown in our illustration. The handwheel is geared to a pair of winding drums, on which are coiled the ends of a strap passing over pulleys at the top of the drill. When it is desired to remove the core, coarse gravel is poured down the hollow tubes, which wedges in between the core and core barrel so tightly that on lifting out the core barrel the core breaks away and comes up with it. The efficiency of the "shot bit" is indicated by the two cores illustrated herewith. They were drilled out of an old structure at the New York Aqueduct. The shot bit made its way easily through the brick and cement, and was not stopped even by the plates of cast iron which formed part of the structure.



CORES DRILLED THROUGH BRICK AND CAST IRON BY THE STEEL SHOT PROCESS.

AN ELECTRIC HAMMER.

A form of electric hammer is now widely used, a description of which may be of interest to some of our readers. It will be seen from our illustration (Fig. 1) that the hammer is driven by a flexible shaft

Fig. 1.—THE HAMMER IN USE.

which transmits the requisite power from a small portable electric motor placed in any convenient position. The wires which are shown running from the motor to the handle of the instrument are connected to a push button in the handle, by means of which the motor can be switched in and out of the circuit at will. This arrangement and the whole mechanism of the hammer are shown in detail in our second figure. In the handle, *d'*, is placed a push button, *E*, which carries at its lower extremity a cut-out, *e'*, and just above it a contact piece, this latter forming a shoulder which rests against a flange in the tube inclosing the push button. Pressing against this flange from above is a spring, by which the push button is normally pro-

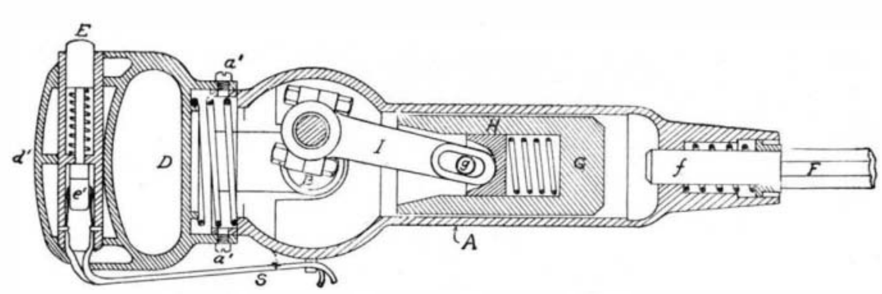


Fig. 2.—LONGITUDINAL SECTION THROUGH HAMMER.

jected out of the casing. Two springs form the terminals of the wires, *s*, and are in contact with the cut-out, *e'*, so that the motor circuit is open, and no power flows to the hammer. On pressing down the button, *E*, the contact piece above *e'* touches each of the terminals of *s*, and the hammer is set in motion. For convenience the wires *s* are best taken through the lug, *s*, where they pass close by the flexible shaft to the motor. The working parts of the hammer itself are disposed as follows: The flexible shaft is continuous with the shaft, *B*, the crank of which works within the expanded portion of the casing and bears the connecting rod, *I*. This connecting rod is coupled to the crank in such way as to be readily removable,

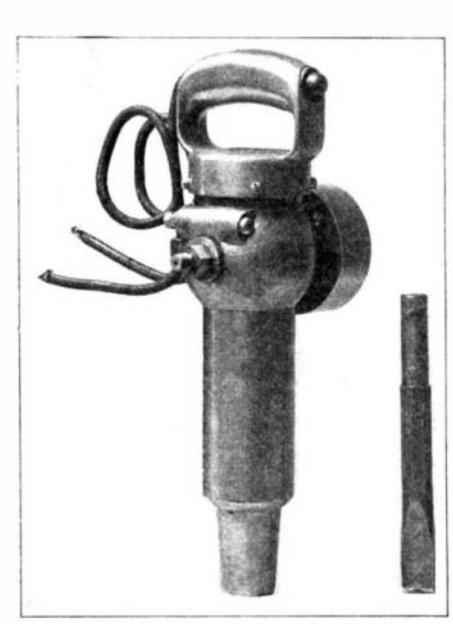


Fig. 3.—THE HAMMER AND ITS TOOL.

the casing consisting of two parts joined together and fastened by the set-screws, *a' a'*. These set-screws fit into slots in the outer flange of the casing, and a spring, while keeping the two portions of the casing in position, takes up much of the vibration of the tool when working, thus protecting the hand from jolts.

At its farther end the connecting rod *I* has a longitudinal slot through which passes the pin, *g*, attached to the plunger, *H*. This latter works in a cavity of the hammer, *G*. The plunger is shaped to fit the end of the rod, as shown, so that at each revolution of the crank, a blow is transmitted from the rod *I* to the hammer *G* through the plunger *H* and the spring in the cavity of the hammer. This latter is therefore a floating hammer, not being rigidly connected to the power shaft and its blow depending entirely upon its momentum.

By this construction the shaft is relieved of all jar due to the hammer striking the end of the tool, and thus the even running of the shaft without undue racking is insured.

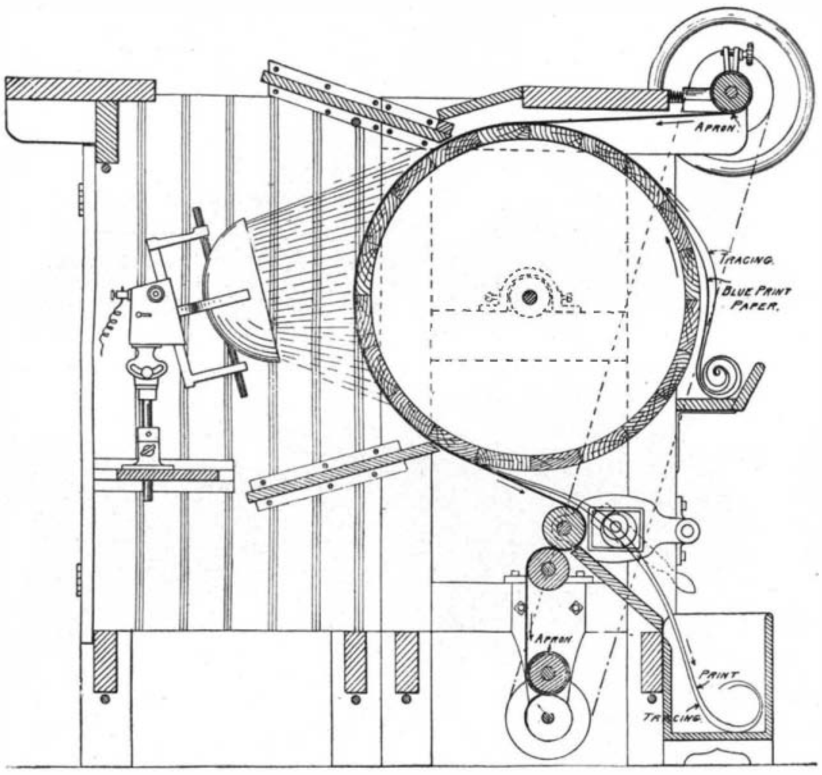
It is evident that the instrument can be worked from any other power source instead of an electric motor. But the latter is found by far the most convenient. The hammer can be used in places which would be inaccessible to instruments of the pneumatic kind.

The shaft is driven at high speed, and the motion is kept uniform by means of a flywheel situated within the flat cylindrical portion of the casing shown at the rear of the instrument in Fig. 3, which also shows the tool. This latter, *f*, *F* in the diagram, has a cylindrical portion, *f*, fitting into the anterior end of the instrument, and a thicker portion, *F*, of polygonal cross-section, preventing the tool from entering beyond the shoulder formed by this polygonal portion, except in so far as the collar against which that shoulder presses is forced inward against the spring behind it by the hand holding the instrument. By this arrangement the workman is enabled to regulate the blows of his instrument.

ELECTRIC BLUE-PRINT MAKING.

BY GEORGE J. JONES.

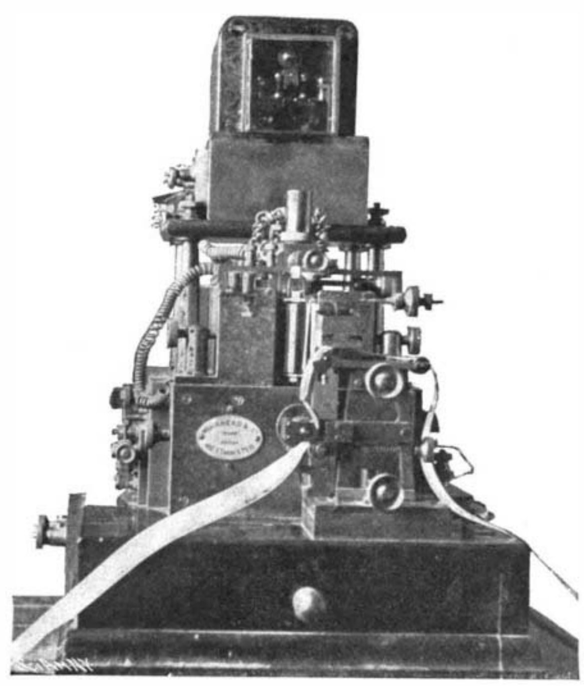
The marvelous development of the blue-print has been responsible in no small measure for the rapid manner in which great engineering and mechanical tasks are now performed in the workshops of this country. Our facility to successfully carry out stupendous engineering undertakings has within a few years carried our industrial fame to the four corners; and that the tremendous feats which have been done with such marvelous rapidity by our engineers and our industrial establishments have been made possible by the humble blue-print, is conceded by those who know.



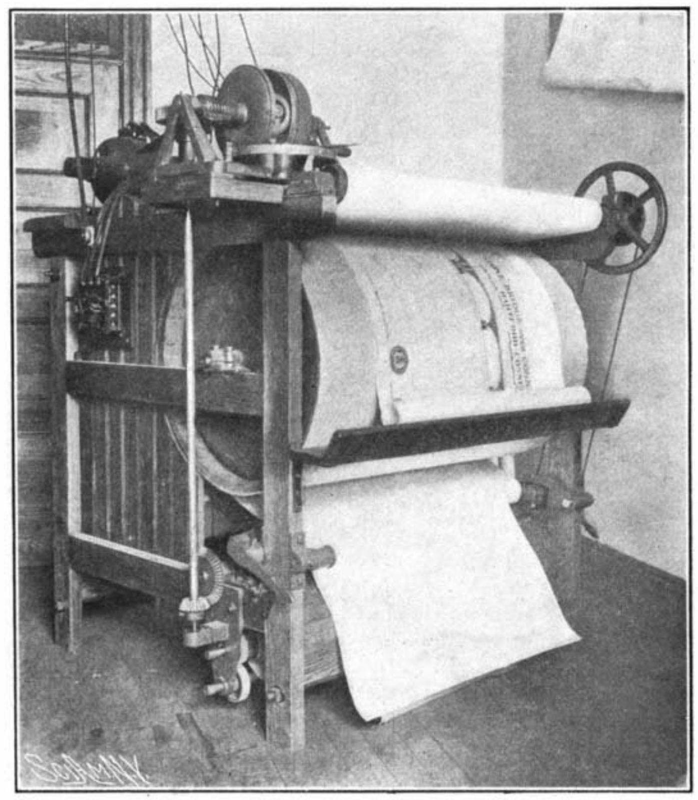
CROSS-SECTION OF BLUE-PRINTING MACHINE.

It has been only a few years since the virtues of the blue-printing process were first recognized, and since that time there has been an almost complete revolution in workshop and building methods, and the manufacture of these blue-prints has developed into a vast industry. So formidable has the business grown, that it has been found necessary to find a substitute for the sun for the purposes of printing, not only for the reason that the sun is more or less an uncertain commodity, but because he can not be induced to work overtime, no matter how serious the emergency.

Naturally the electric light has been resorted to, and while it is somewhat slower than the sun, prints can be turned out night and day. These machines are of recent invention, and it is by their use that certain large photographic plants are enabled to hang up signs reading something like this: "Blue-prints made on short notice. Night or day. Rain or shine."



The Siphon Recorder.



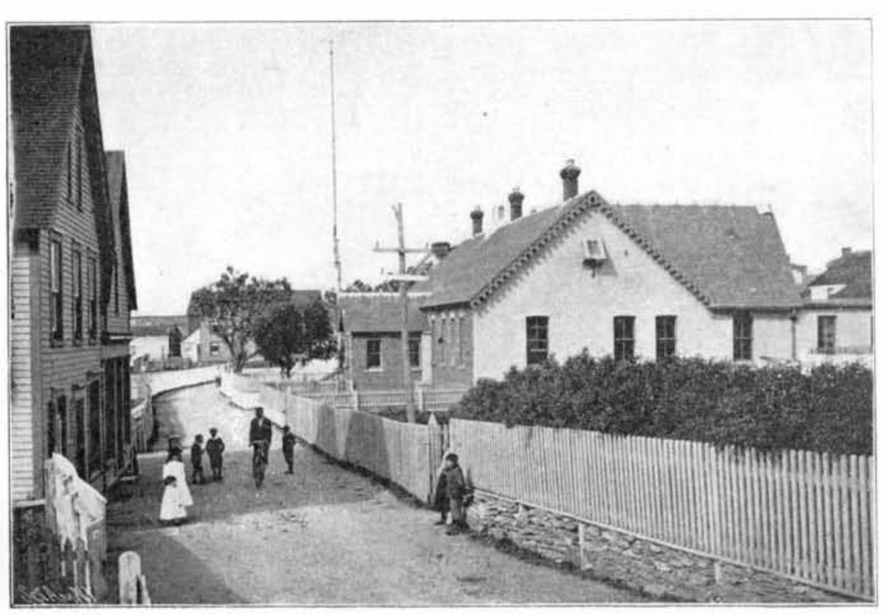
A BLUE-PRINT-MAKING MACHINE.

Probably the most complete of these machines is one which is continuous in its operation, and which is fed by the operator with great lengths of tracings and blue paper in much the same manner as the washerwoman feeds the wet clothes into the wringing machine. This is known as the Federal, and is shown in the accompanying cuts in perspective as well as section, clearly revealing its operation as well as its general appearance. The large wooded drum, around which the tracings and printing paper pass, is moved either by a connection with the shafting or by an electric motor mounted on the apparatus, the speed of the drum being regulated by a device shown on the top of the machine. A traveling apron of transparent material takes the place of the glass in the printing frame of the ordinary type, and as it is under tension at all times, it insures an even and close contact at all points. This apron is wound on a small drum at the top, and after passing along the large drum where the contact and exposure take place, it is wound up on the drum below; after the printing operation has been completed it is rewound by hand back on the upper drum. In the rear of the machine are three arc lamps with reflectors, which concentrate the light on the tracings which, with the exposed prints, drop out into the box in front. The blue paper may be kept in a roll ready for use on the upper front part of the machine, or may be fed in small sheets with the tracings where the work being done is of ordinary size.

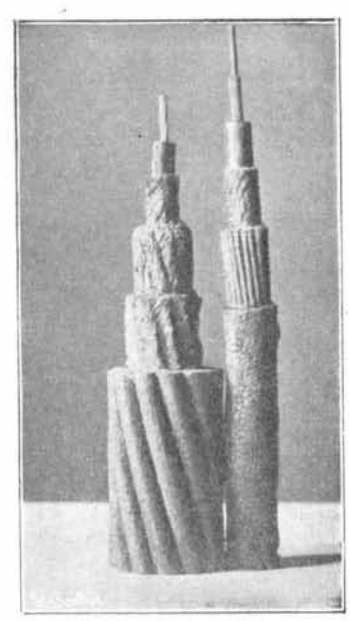
These machines are made in two widths, thirty and forty-two inches, and the apron supplied with them is seventy feet long, and prints of this size can be made as readily as smaller ones where it is desired. The ability to make prints of this size greatly enlarges the sphere of usefulness of the blue-print.

A feature of this machine quite as valuable as its capacity for making large prints is the fact that it can

A Corner of the Battery-Room at Heart's Content.



The Station at Heart's Content.



Sections of the Cable at the Shore End and Deep-Sea Portions.

THE FIRST ATLANTIC CABLE STATION IN AMERICA.—[See next page.]