IMPROVED STEAM ENGINE.

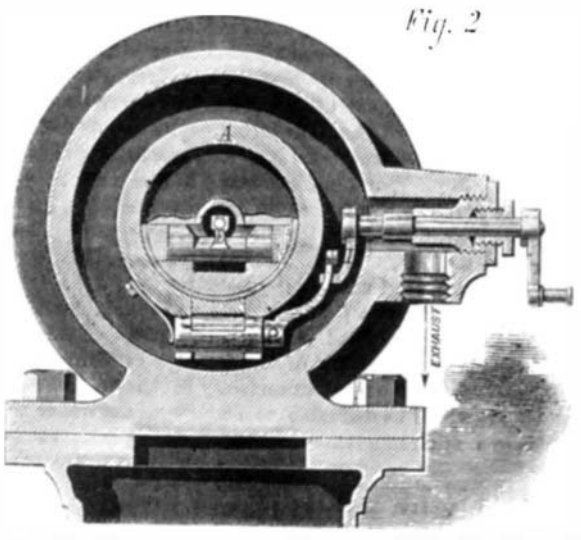
The novel form of steam engine herewith illustrated operates upon the compound principle; but instead of having its high and low pressure cylinders separate, the former is placed within the latter. The smaller cylinder, into which live steam is admitted, constitutes also the piston head, and is moved both by the entering steam reacting against an auxiliary stationary piston placed within, and also by the expansive force of the steam which is used in the previous stroke, which is allowed to pass into the outer and larger cylinder. This will be rendered clear by the following detailed description of the engravings.

A is the small cylinder which constitutes the piston head of the engine, and which is closed at both ends, and travels in the large cylinder. It connects with the piston rod, passing through the right hand end of the latter, as shown. B is the auxiliary piston, which is perfectly motionless, and is secured to a hollow rod which is fastened, as shown, in the cylinder head, and connects with the pipe, C, through which the steam enters, as indicated by the arrow.

The head of the auxiliary piston is hollow; and leading out at each end of it are ports, D, which are provided with a rocker valve, to which is attached the operating rod, E, extending out through and beyond the piston rod. At each end of the bore of the cylinder, A, and underneath, are passages, F and G, leading to rotary valves, from which pass other conduits through the next adjacent end plate and opening into the main cylinder. Each of the rotary valves is so constructed that, when either is in the position shown on the left, it will open communication between the port, F, and the adjacent passage, the two forming a bent or V shaped conduit. When resolved in another position, the valve will, as represented on the right, close the port, G, and establish communication, by means of the other passage, through from the main cylinder to the annular space around the head, A, and between the flanges of the latter.

The two valves just described have bent arms, H, extending from them, as shown in dotted lines, Fig. 1, and in the transverse section, Fig. 2. These arms are connected by a rod jointed to both. Another arm, I, Fig. 2, is attached to the inner end of a shaft, which shaft is arranged within the exhaust passage leading out of the main cylinder. The object of this shaft and bent arm mechanism is to trip each of the valves connected with the arms, H, at the proper time, which it is caused to do by suitable apparatus operated by the engine in connection with the exterior crank. Similarly the rod, E, moving the rocker valve on the auxiliary piston, is also properly actuated to travel back and forth as is necessary.

The operation of the machine may now be readily followed. Steam being admitted into the small cylinder or piston head, A, the latter will be drawn in one direction lengthwise the large cylinder. On the head arriving at the end of such movement, the valves are tripped so as to open communication between the space that receives the live steam and that part of



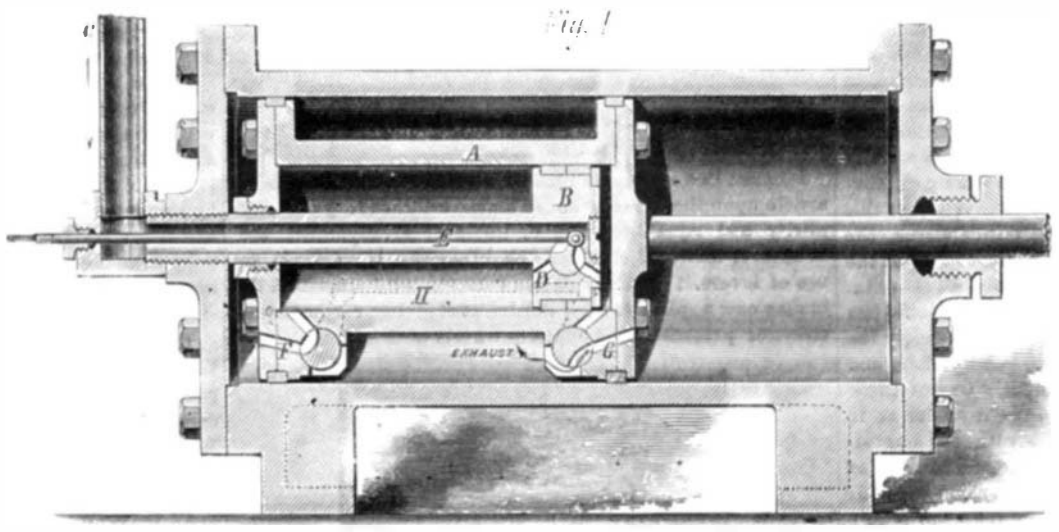
the main cylinder next adjacent to the end of the same toward which the piston head has advanced. It will be observed that in Fig. 1 the head has just finished its stroke to the left, so that, as above stated, the valve connecting with the port, F, has opened a way through the latter and into the large cylinder. At the same time the rocker valve in the auxiliary piston is tripped so as to cut off admission of steam to the space into which the steam first entered, and to allow the steam to operate from the reverse side of the piston. This is clearly shown in the engraving. The head will now travel to the right, impelled not only by the action of the second quantity of steam but by the pressure of the first amount expansively in its rear.

The first quantity of steam, on escaping from the head into the main cylinder, will expand in both while the former is in motion, and, by pressing against the outer surface of one end of said head, will there exert a greater amount of force than it will on the stationary piston, B. Hence it is the excess of pressure which operates to drive the head.

The space in front of the latter, it may be supposed, contains steam used expansively in a previous stroke. This must be withdrawn from the front of the head and exhausted, an operation accomplished by the valve, in the passage, G, becoming placed as shown in Fig. 1, thereby establishing connection with the right hand or forward portion of the cylinder and the annular space around the head, which, as represented in Fig. 2, connects directly with the exhaust port.

Among the other advantages claimed by the inventor, for this machine, over the ordinary compound engine, is a smaller loss by radiation. The heat radiating from the steam entering the hollow piston rod aids in keeping the outer cylinder warm, while, by jacketing the latter, there would be comparatively little waste of steam due to condensation. The short passages and easy connection to the crank obviate the use of double crank and connecting rods, saving not only the wear and tear necessary to overcome back pressure in the smaller cylinder, but also the extra expense of construction. The invention can be applied to any ordinary engine by removing the cylinder and substituting the one described.

Patented January 1, 1867. Further particulars may be obtained from the inventor, Mr. S. F. Davenport, Hallowell, Me.



DAVENPORT'S IMPROVED STEAM ENGINE.

THE GRAVITATION COMPASS.

A new mariner's compass, remarkably devoid of complication in its various parts, has recently been invented by the Earl of Caithness, F.R.S., of London, and patented in the United States. The ordinary compass is mounted upon gimbals, that is to say, upon two axes at right angles to each other, for the purpose of allowing the compass box the power of swinging freely in all directions, the necessary result being that the bottom of the compass box is kept, by the force of gravitation, parallel, to a great extent, to the plane of the horizon, while its mountings move in various directions, as influenced by the motion of the ship.

The essential feature of the Caithness compass is that, instead of its being mounted upon gimbals, it is mounted upon the top of a pendulum, which swings in a ball and socket joint. The gimbals of the ordinary compass are intended to give the compass box the power of moving in a true circle; but they do not absolutely give that power, and never can, since there are two points in the performance of the circle, in which there is a slight catch, which tends to make the box oscillate, first to the right and then to the left, or *vice versâ*, as the case may be.

The new Caithness compass consists of a ball close underneath the compass box, working in a socket fixed at the top of a conical support. The pendulum is about two feet in length, and is attached to the small ball, which has thus the power of giving a perfect rotation. It works in a perfect circle, and it does not matter how much the ship rolls. The Earl of Caithness calls it the gravitation compass, because the pendulum always points to the center of the earth. He says that it will bear very great rolling and pitching of the vessel—in fact a roll of more than thirty degrees.

In the course of a voyage across the Atlantic, made about the middle of October last, in the Java (Captain Martin), by the Earl of Caithness, he tried experiments with the compass on a large scale, the result being that the maximum vibration of the compass card was about a quarter of a point, while heavy standard compasses on board gave much larger vibrations.—*The Engineer.*

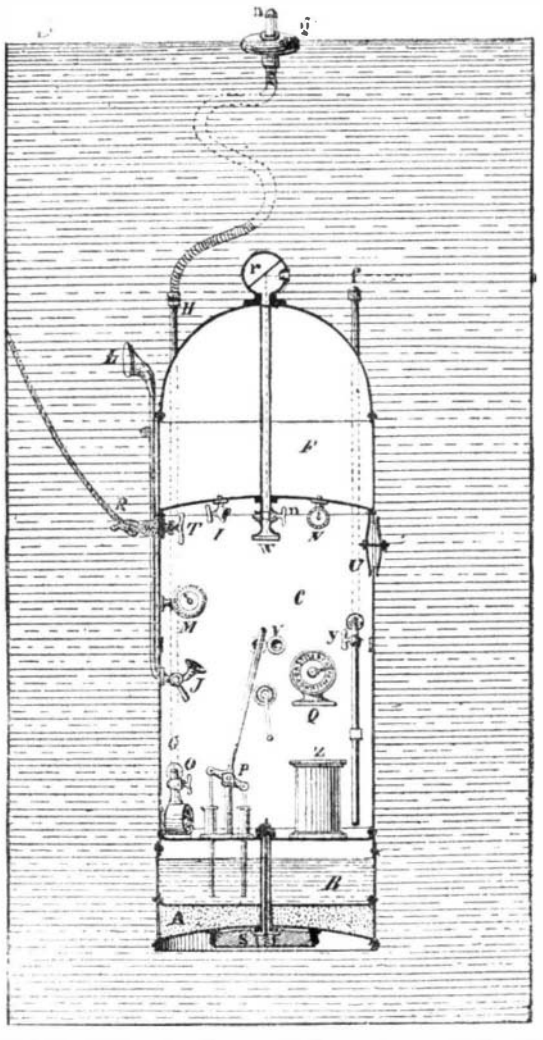
M. Neyreneuf has ascertained by experiments that negative electricity attracts flame, which positive electricity repels.

A NAVIGABLE DIVING BELL.

M. Toselli, an ingenious Italian inventor, has lately devised a novel diving bell, an engraving of which we present herewith, by means of which he can proceed to the bottom and rise at will, and travel around while submerged, or at the surface, with perfect safety. He has already descended several times to the bottom of the Bay of Naples, a depth of 224 feet, and finds the device admirably adapted for submarine exploration, for coral or pearl fishery, or for the clearing of sunken ships.

As shown in the illustration, the apparatus is a kind of turret divided into four compartments. The bottom division, A, contains lead, and serves to hold the bell in vertical position. B can be filled with water by opening a cock communicating from without, or may be rendered entirely empty by aid of the pump. Consequently this chamber serves to augment or diminish the weight of the machine and to determine its up and down travel, serving the same purpose as the natatory vessels in fish. In the large compartment, C, the operator and the observer are stationed; and finally, F is a reservoir, into which air is compressed in a quantity sufficient to last during the time which the bell is to be submerged. I is a cock which admits air from this chamber into the main compartment. G is the pipe for carrying off the foul atmosphere, which communicates with the tube, H, and a float, *g*. The latter has a valve, *h*, to prevent entrance of water. The bell has a rudder and a screw, not shown in the illustration, the screw being worked by a hand crank by one man, and driving the machine at the rate of about 25 feet per minute.

M is the manometer, which indicates exterior pressure, and hence the depth of submersion. N is another manometer, which shows the pressure of condensed air in the chamber, F. R is a life line connecting the bell with the ship. This contains a wire by means of which telegraphic despatches may be sent to the instrument, Q. U is the manhole, allowing access to the interior of the machine and closed with a double door. V are heavy glass deadlights, and Z is a seat.



The ingenuity of the inventor will be made apparent by considering the simple way in which M. Toselli avoids the dangers common to machines of this class. Thus, should the tube, H, which carries off foul air, break or choke, water would be pumped immediately out of B, the bell would ascend, and meanwhile the bad atmosphere would be allowed to escape through the extra pipe, *f*. In case the electric wire in the life line should part, preventing the passage of signals, the machine would again ascend and communicate with the vessel through the speaking trumpet, L J. If the line remained intact, the bell could be instantly hauled to the surface by those on the ship, in case of a breakage of the hydraulic pump, on signal being transmitted. If pump, wire, and life line should all break down at once, then the operator would unscrew a nut and free the lead underneath, when he would immediately ascend to the surface. Finally, if by