IMPROVED STEAM ENGINE.

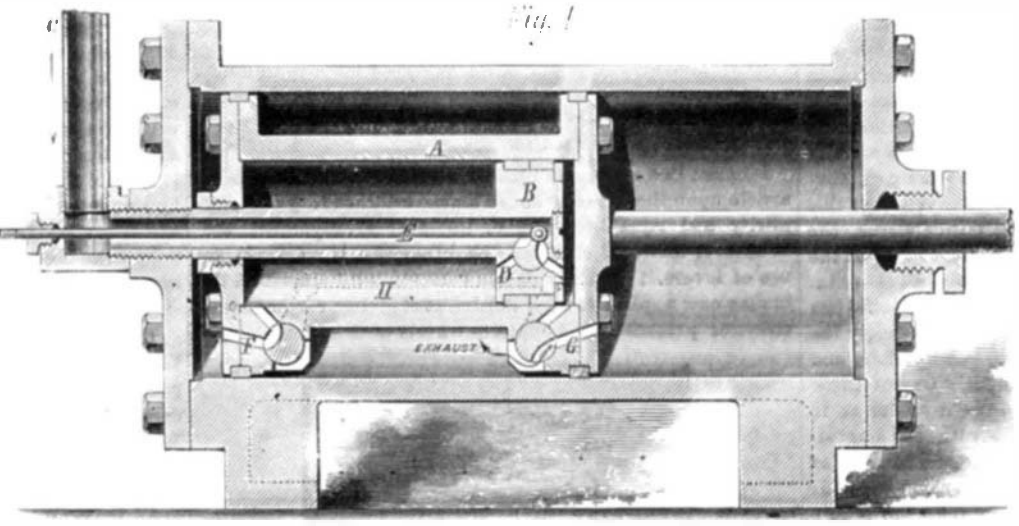
The novel form of steam engine herewith illustrated operates upon the compound principle; but instead of having its high and low pressure cylinders separate, the former is placed within the latter. The smaller cylinder, into which live steam is admitted, constitutes also the piston head, and is moved 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.

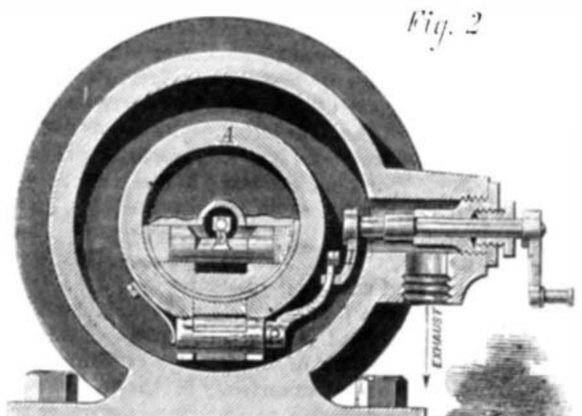
A is the small cylinder which constitutes the piston head of the engine, and which is closed at both ends, and travels in the large cylinder. It connects with the piston rod, passing through the right hand end of the latter, as shown. B is the auxiliary piston, which is perfectly mot'onless, and is secured 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 exhaust ed, 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.

DAVENPORT'S IMPROVED STEAM ENGINE.

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

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.*

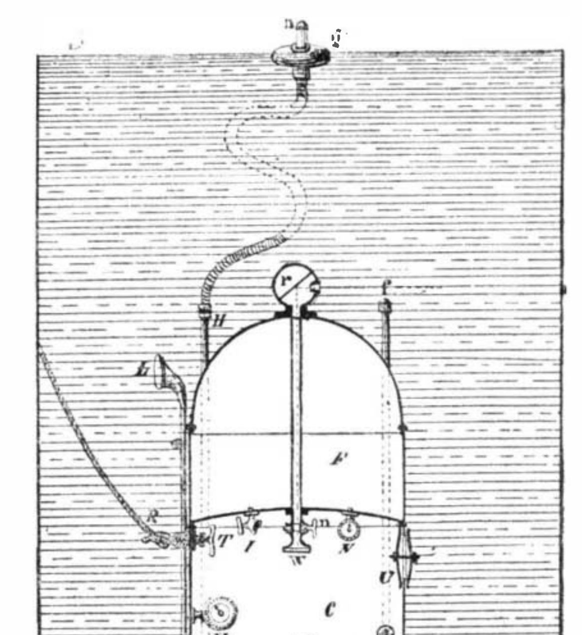
M. Neyreneuf has ascertained by experiments that negative electricity attracts flame, which positive electricity repels.

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 254 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 some extraordinary circumstance the ship should break the line and lose sight of the bell, or if the vessel itself should sink, the operator would first, by unscrewing a nut within, cast his bell loose from the life line, and would then ascend. As soon as he reached the surface, he would be enabled to view his surroundings by means of a camera obscura at *r*; and by revolving the same by its tube, W, he could sweep the entire horizon. Lastly, having determined his course, he could proceed in the proper direction by means of his screw and rudder.

Correspondence.

Notes from Washington, D. C.

To the Editor of the Scientific American:

Congress has adjourned without enriching the lobby so much as usual. In fact it is generally conceded that our Solons have left Washington with cleaner consciences, in this respect, than any of their recent predecessors, and that there never were fewer jobs put through by any Congress for many years past. The patent lobby fared especially badly, not a single extension case, so far as I can learn, having passed, notwithstanding all their efforts. Whether this is owing to a slight spasm of returning public virtue, the approaching elections, the efforts of the press, or fear of the Grangers, is more than I can tell; but probably all these influences had their effects, and so the work of the lobbyists went for naught, although they mustered pretty strongly the last days of the session, trying, both by persuasions and threats, to forward their respective schemes. One of these—a second George Francis Train—even went so far as to threaten the Senators and Representatives with the opposition of the Internationals, of which he represented himself as a high officer, if they did not pass the extension case for which he was working, and that he would take the stump against the members of the committees on patents, if his efforts failed. Of course the Senators were immensely frightened at this fearful threat, but somehow they yet live, and have gone home without helping the client of Train *secundus*.

The bill to reorganize the Patent Office also failed, and a bill, introduced a few days since by Mr. Conger, amending Sections 23, 25, 33, 53, and 64 of the Act of 1870, as a substitute for the first bill, likewise failed to pass. The only act completed, so far as I can find, relating to the Patent Office, is one introduced by Mr. Wadleigh, which allows the usual sentence indicating that a work is copyrighted to be substituted by the words "Copyrighted, 18—, by A. B.," fixes the fees for recording or furnishing a copy of an assignment of a copyright at one dollar, and enacts that labels shall not be copyrighted, but registered at the Patent Office, for which a fee of six dollars is to be charged. This act takes effect August 1, 1874. The object of the change in the first section is to allow the use of the short sentence on small works of art, photographs, etc., that would be defaced by the use of the long rigmarole now employed.

Many curious schemes have been brought before Congress, some of which never got any further than the committee rooms, among which may be classed the application of some would be philosopher for an appropriation to test his method of artificially producing rain; and another case where an inventor wanted a law enacted that every election district in the United States should have his patent ballot box, to receive the votes for President, Vice President, and members of Congress, at a cost of fifteen dollars for each box. The committee to whom this case was referred contented themselves with recommending its adoption to the different State authorities, and so nipped this pretty little scheme in the bud. I endeavored to find out this patent, but could find none under the name of reputed inventor; but judging from the description I received, it must have been similar to one patented in 1858, and used in your city some years ago, as it was said to be composed of iron and glass. OCCASIONAL.

Levees on the Mississippi.

To the Editor of the Scientific American:

Please tell your readers who reside on the banks of the the lower Mississippi that the proper way for them to build levees is to build them on an average a mile back from the banks of the river on each side. They will thereby show a little respect for the river, and give it an opportunity to discharge the waters of the vast valley which it drains; and will secure the remainder of their country from periodical overflow.

This line, a mile back from the river, should not follow the meanderings of the stream, but should average a mile on each side. In places where there are high banks on one side, as at Vicksburgh, the river should be permitted to overflow the low ground on the opposite side for two miles; and if, for any other reason, as at New Orleans, it would be impracticable to permit the river to overflow on both sides, a similar space on the opposite side should be left for the river to spread itself a little whenever it might have business of importance to transact.

Sioux Rapids, Iowa. W. T. CROZIER.

White Ants.

To the Editor of the Scientific American:

The white ants of the torrid zone are somewhat smaller than the large black ants, which are sometimes troublesome here and are rather voracious, eating their way through a wooden box to obtain sugar, of which they are very fond, and of which they will consume a large quantity.

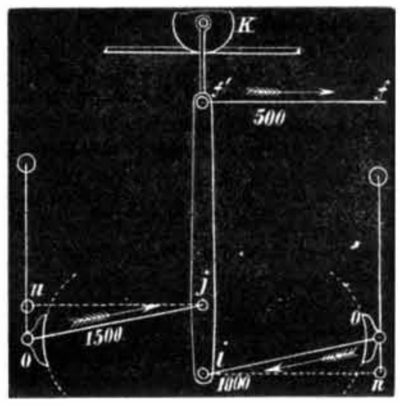
But the white ants of the torrid zone throw the black ones entirely in the shade as regards voracity. Pernambuco (South America) is on about the 8th southern parallel; and the inhabitants build houses and make furniture of the native wood, which is hard and heavy, and proof against these ants. In one instance, a family moved from the South to Pernambuco, taking their household goods with them. Among the rest was a mahogany bureau with white wood inside work, as usual. This bureau, containing linen and cotton goods, was placed in a room but little used, and was not visited for some days. The lady of the house unlocked an upper drawer, and to her astonishment the front piece, of mahogany, fell to the floor, and on looking in she discovered that the inside work was nearly all eaten out, and her goods were in one common mass, resting on the floor, in a mixed condition but otherwise uninjured. The depredators had departed, but were soon discovered cutting out the interior of another piece of furniture. They proved to be the white ants of the torrid zone. TRUMAN HOTCHKISS.

Stratford, Conn.

The Westinghouse Brake.

To the Editor of the Scientific American:

I notice in a recent number of *Engineering* an illustrated article upon the Westinghouse brake, commending the simplicity and equable action of its lever arrangement, etc. Whatever merit, of simplicity or otherwise, there is in its use of levers, it certainly has (in common with almost all the brakes now applied to cars) the defect of giving very unequal stress or pressure upon opposite wheels of the truck.



Let *k f j i* represent the lever that operates the brake blocks, *o*. I use the delineation and letters employed in the article referred to. The lever is held up by a pulley at *k*, which travels back and forth on a rod, as shown. Power is applied to the lever at the point, *f'*, through the medium of the rod, *f' f*, in the direction indicated by the arrow, one pair of the brake blocks being operated by the rod connected to the lever, at *j*, and the other pair by the rod connected at *i*, the pull being in the direction indicated by the arrows, and the leverage three to one, that is to say, the distance from *i* to *j* is one fourth of the distance from *i* to *k*. Hence a pull of 500 lbs., applied to the rod, *f' f*, will cause a pull of 1,500 lbs. upon *j*, and a pull of only 1,000 lbs. on the rod *i*.

This unequal stress upon the brake blocks may not be a very serious matter, but it is a universal characteristic of the lever arrangement now applied to car brakes. The fault might be easily mended by connecting the rod, *j*, to the suspending bar of the brake blocks a little above the usual point, and the rod, *i*, a little below the usual point, as at *n*.

Worcester, Mass. F. G. WOODWARD.

ASTRONOMICAL NOTES.

OBSERVATORY OF VASSAR COLLEGE.

For the computations of the following notes (which are approximate only) and for most of the observations, I am indebted to students. M.M.

Positions of Planets for July, 1874.

Mercury.

At this time, June 20th, Mercury can be beautifully seen after sunset, below Venus, and a little further north.

On the 27th of June, Mercury will be at its greatest elongation, east of the sun. July 1, Mercury sets at 9 P. M. July 31, Mercury sets at 6h. 25m. P. M.

Venus.

Venus, which has been so beautiful all through the month of June, increases in apparent diameter, but sets a little earlier in July.

July 1, Venus rises at 7h. 11m. A. M., and sets at 9h. 33m. P. M. On the 31st, Venus rises at 8h. 17m. A.M., and sets at 9h. 00m. P. M.

Mars.

Mars is very unfavorably situated. It rises early in the morning, and sets at 7h. 42m. P. M., or nearly with the sun, on July 1. On July 31, Mars rises at 4h. 14m. A. M., and sets before 7 in the evening.

Jupiter.

Jupiter's diameter is becoming perceptibly less, and it sets before midnight. It comes to the meridian, the position best adapted to good observation, in the afternoon, so that we have only a few hours of darkness in which to watch its changes.

July 1, Jupiter rises at 10h. 51m. A. M., and sets at 11h. 15m. P. M. On the 31st, Jupiter rises at 9h. 15m. A. M. and sets at 9h. 26m. P. M.

Saturn.

The month of July is the best of the year for observations on Saturn; and although Saturn is very low in altitude, it will be an interesting object.

July 1, Saturn rises at 9h. 29m. P.M., and sets at 7h. 21m. A. M. July 31, Saturn rises at 8h. 25m., P. M., and sets at 5h. 12m. A. M. It is among the small stars of *Capricornus*. Saturn does not attain an altitude of more than 31° during the month.

Uranus.

Uranus rises in the morning and sets early in the evening, and is therefore not well situated for observation.

Neptune.

This planet can be seen only by means of a good telescope. It crosses the meridian in the morning at 7h. 15m. on the 1st, at an altitude of 58°.

The Comet.

Clouds have prevented good observations upon the comet. It is bright enough to be seen very easily with the naked eye, and with an opera glass is a beautiful obj ct. On the 13th of June an observation, made during partially cloudy weather, gave R.A. 7h. 4m. ±, Dec. + 69°. At that time its apparent motion was very slow.

It does not set, and is very readily found. On the 13th it made a nearly equilateral triangle with the pole star and the brighter star of the pointers. The same position would enable one to find it as late as the 18th of June, and probably it has not changed its position very much. To the eye, it is an elongated hazy star. With a glass, the nebulous center and the streaming train are very interesting objects. It passes the meridian at present (June 21) at 1h. 20m. in the morning, below the pole.

Sun Spots.

The record is from May 15 to June 16. Fourteen views have been photographed during this interval. Spots have generally been very small, only two groups appearing which contained good sized spots. In some instances the changes from day to day have been very marked; in others, only such as result from the sun's revolution on its axis. The daily motion of one group is shown for five days, from May 27 to June 1. While the group as a whole remained recognizable, there was a decided change in the arrangement of the constituent spots. Faculæ have been unusually extensive and are beautifully marked in one of our pictures which happened to be very clear. The same picture also shows the mottling of the sun's surface, which is usually shown when both the weather and photography are good. Very bright faculæ accompanied a group which was near the eastern limb on June 15. They were less prominent on the next day as the group was more distant from the limb.

Barometer and Thermometer.

The meteorological journal from May 17 to June 20 gives the highest barometer, June 15, 30·27; the lowest barometer, June 1, 29·58; the highest thermometer, June 9, at 2 P. M., 86°; the lowest thermometer, May 20 and May 22, at 7 A. M., 50·5°.

Amount of Rain.

The rain which fell between the evening of May 17 and the afternoon of May 18 amounted to 0 28 inches.

The rain which fell during May 20 amounted to 0·17 inches.

The rain which fell during May 25 amounted to 0·43 inches.

The rain which fell during the night of May 31 and the morning of June 1 amounted to 0·45 inches.

The rain which fell during the night of June 3 amounted to 0·16 inches.

The rain which fell during the afternoon of June 12 amounted to 0·15 inches.

Spectrum of the Comet.

Father Secchi has observed the spectrum of Coggia's comet, and finds the lines of carbonic oxide and carbonic acid very brilliant. The same astronomer notes a curious phenomenon which recently happened in Jupiter's first satellite. The atmosphere at the time of observation was quite clear, and the disk of the planet, while plainly defined, presented a slightly wavy surface. As the satellite neared the edge of Jupiter, and had advanced so that a distance of about one of its diameters separated it from the same, the observer was surprised to see the disk apparently extend itself toward the satellite, touch it, and then retract. This to and fro motion continued until the satellite was completely obscured by the planet, a period of four or five minutes. Father Secchi suggests that if similar undulations of the solar disk take place at the time of the passage of Venus, there will be strong elements of uncertainty in the observations, and that it would be desirable to employ means which will reduce to a minimum these effects of atmospheric oscillation.

Fatty Matters in Cast Iron.

An experiment made long ago by Proust revealed the fact that fatty matters can be extracted from cast iron when the latter is dissolved in certain acids. M. Cloez has recently separated these materials in a pure state, and their analysis reveals the interesting fact that they consist of carburets of hydrogen of the series $C^{2n} H^{2n}$, and present all the terms thereof at least from C^6H^6 (propylene) to $C^{16}H^{16}$. This is a veritable organic synthesis, realized by the aid of substances purely mineral, and is susceptible consequently of important applications. In the *Science Record* for 1873 will be found an account of the extraction of similar matters from meteoric iron.

THE Sandy Hook boiler experiments, which have been suspended since December last, will be resumed about the beginning of August. The recording instruments used last year were found to vary considerably in the forms made by different makers, and careful tests are now being conducted in order to ensure absolute uniformity and correctness of indications.