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T. SHAW.

APPARATUS FOR AUTOMATICALLY TESTING MINE GASES.

No. 359,102. Patented Mar. 8, 1887.

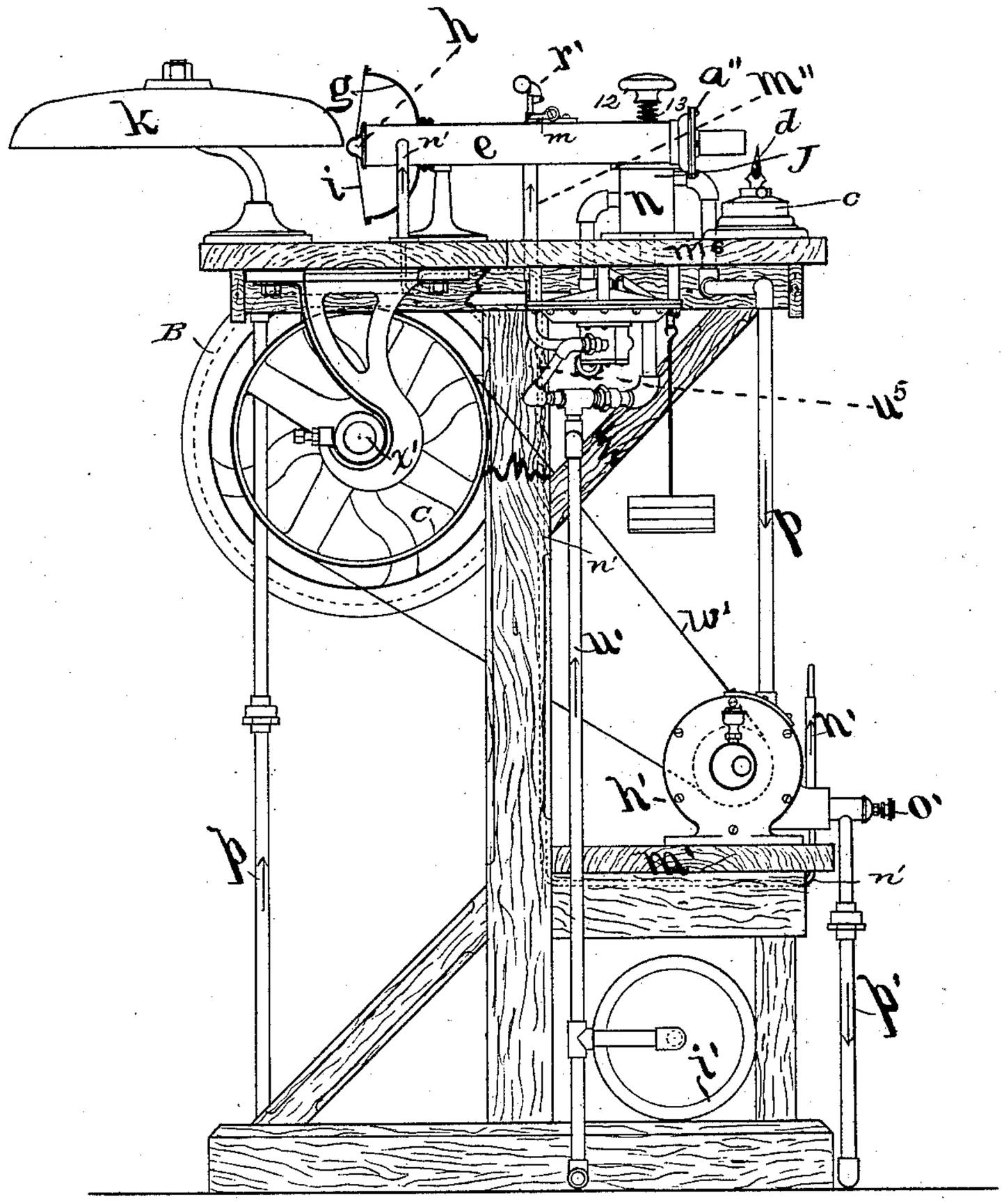
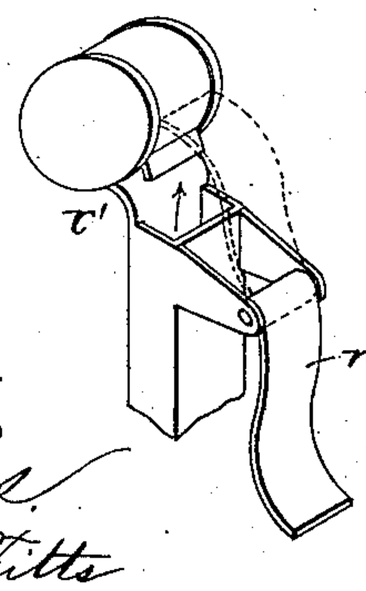


Fig. 1.

Fig. 2.



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T. SHAW.

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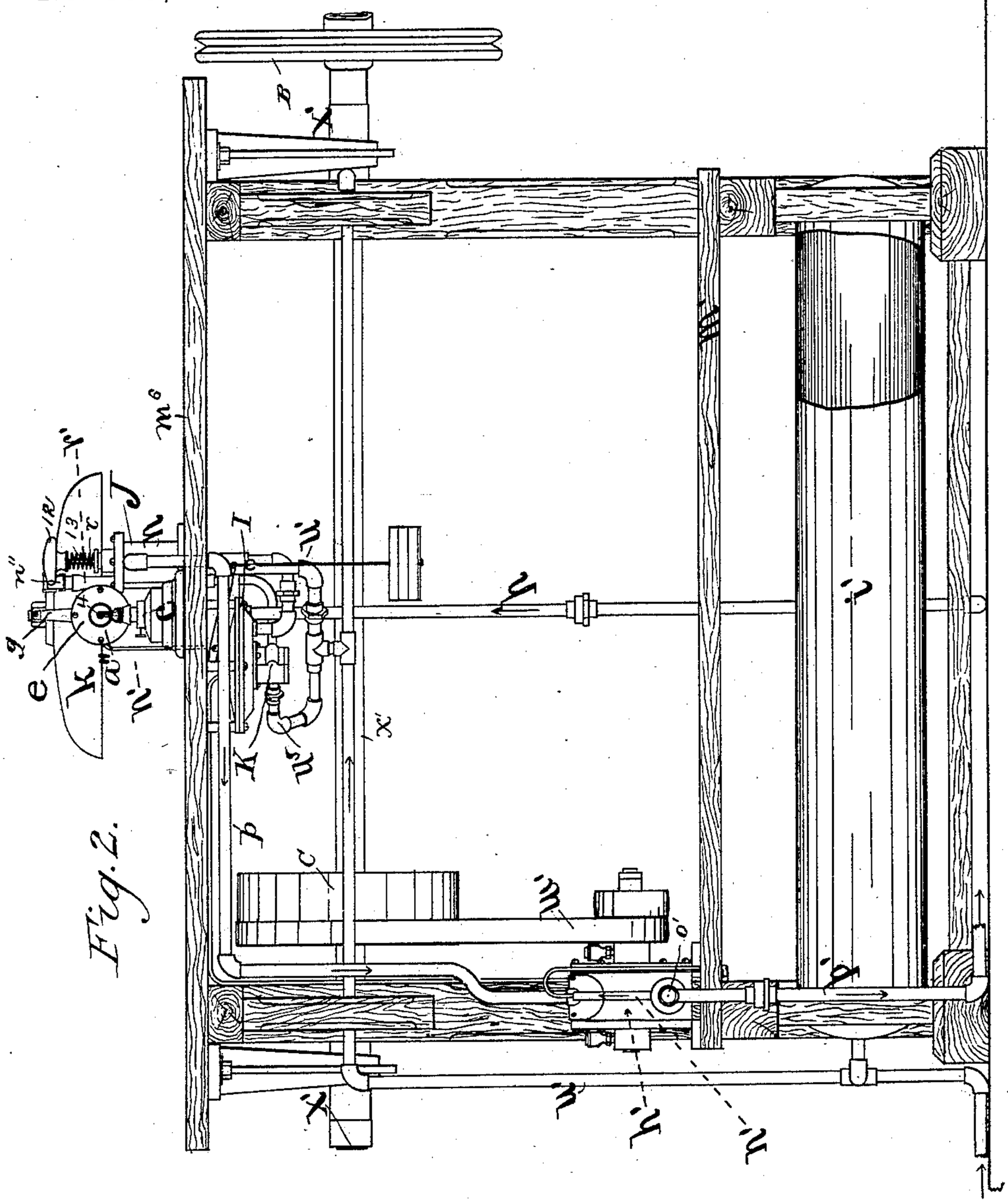

Fig. 2.

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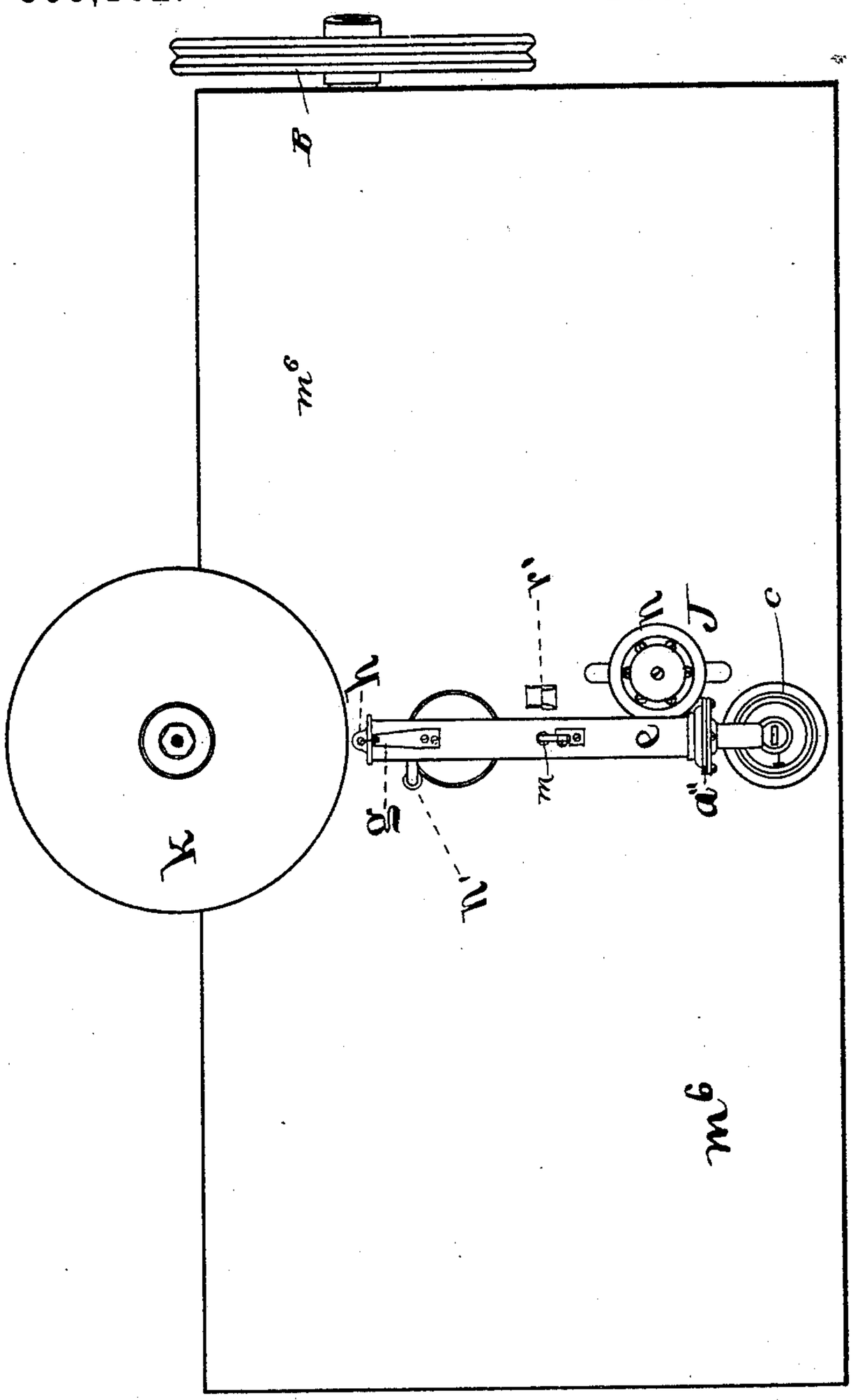

Fig. 3.

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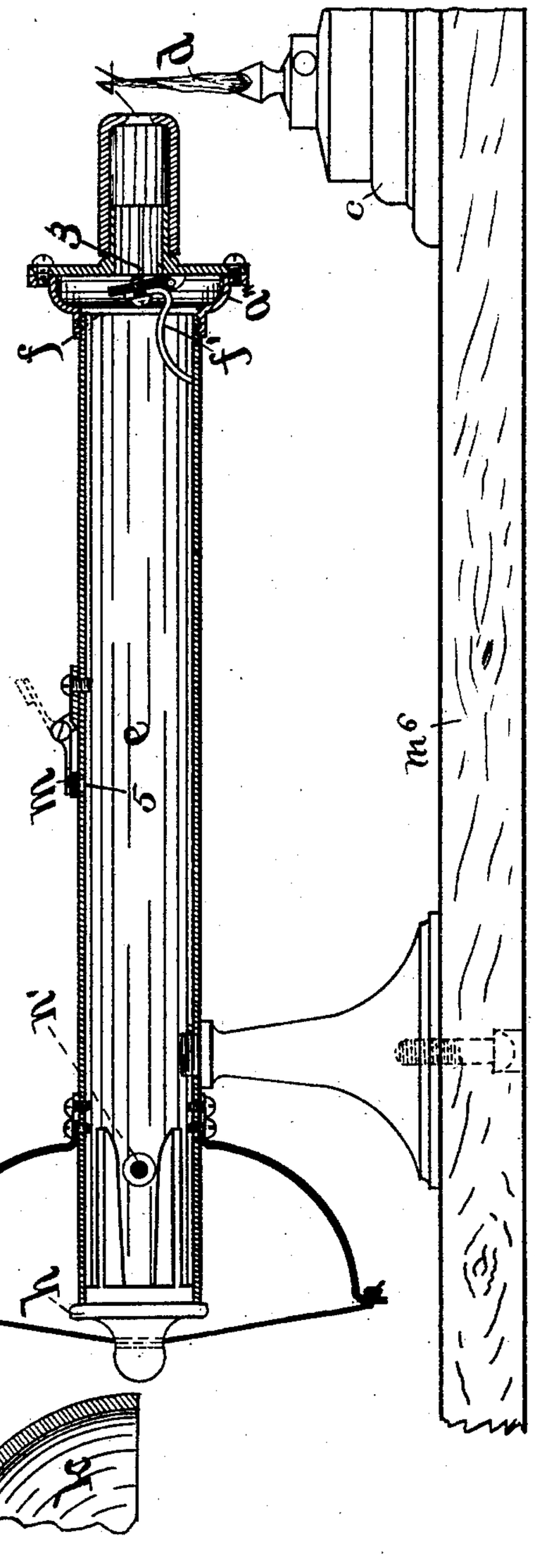

Fig. 4.

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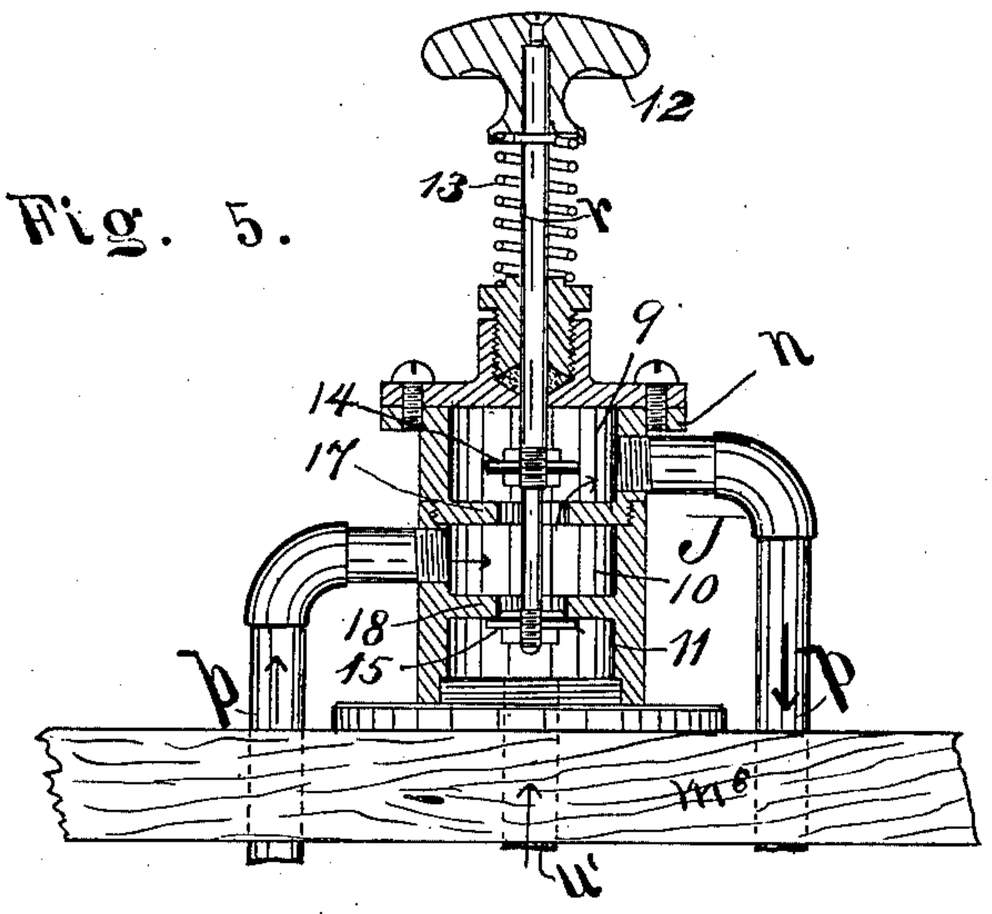
No. 359,102. Patented Mar. 8, 1887.

Fig. 5.



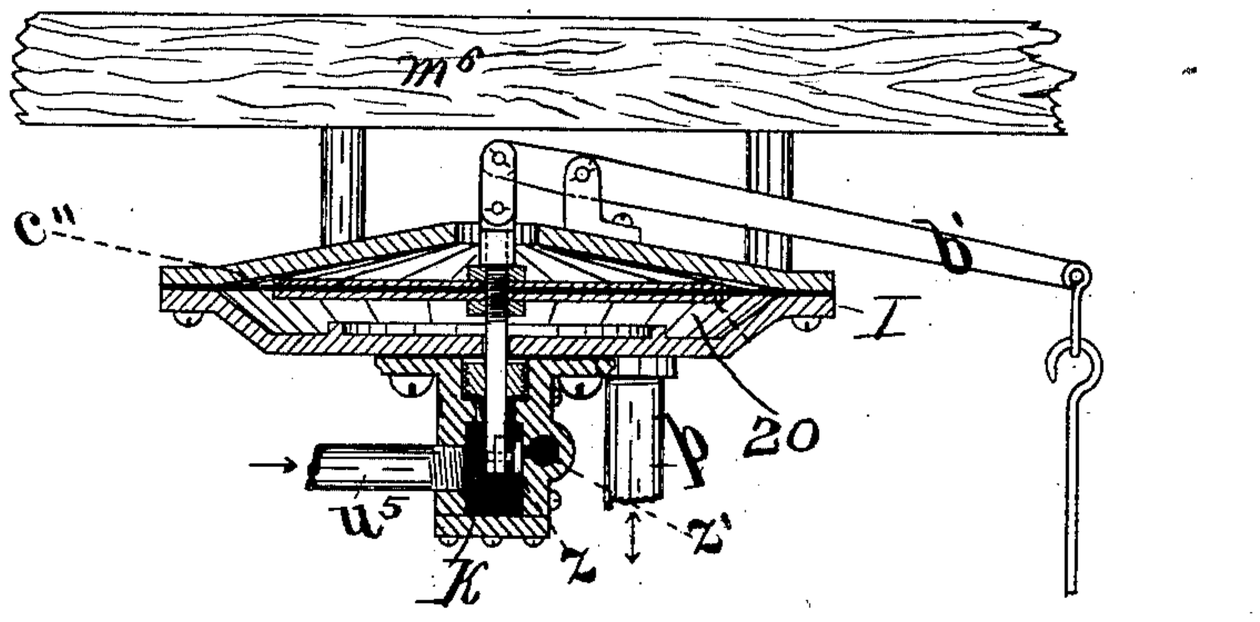


Fig. 6.

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(No Model.) 8 Sheets—Sheet 6.

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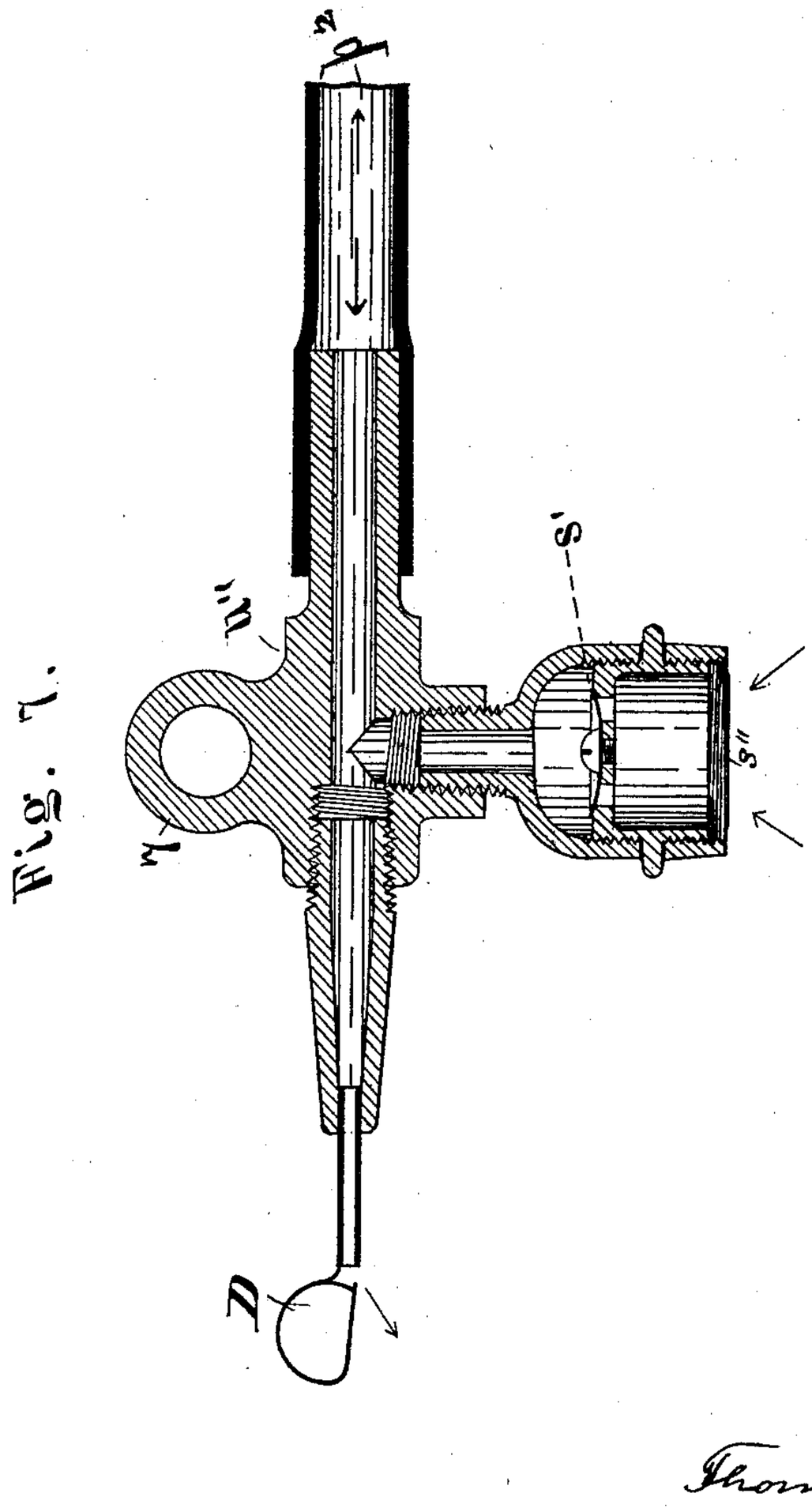

Fig. 1.

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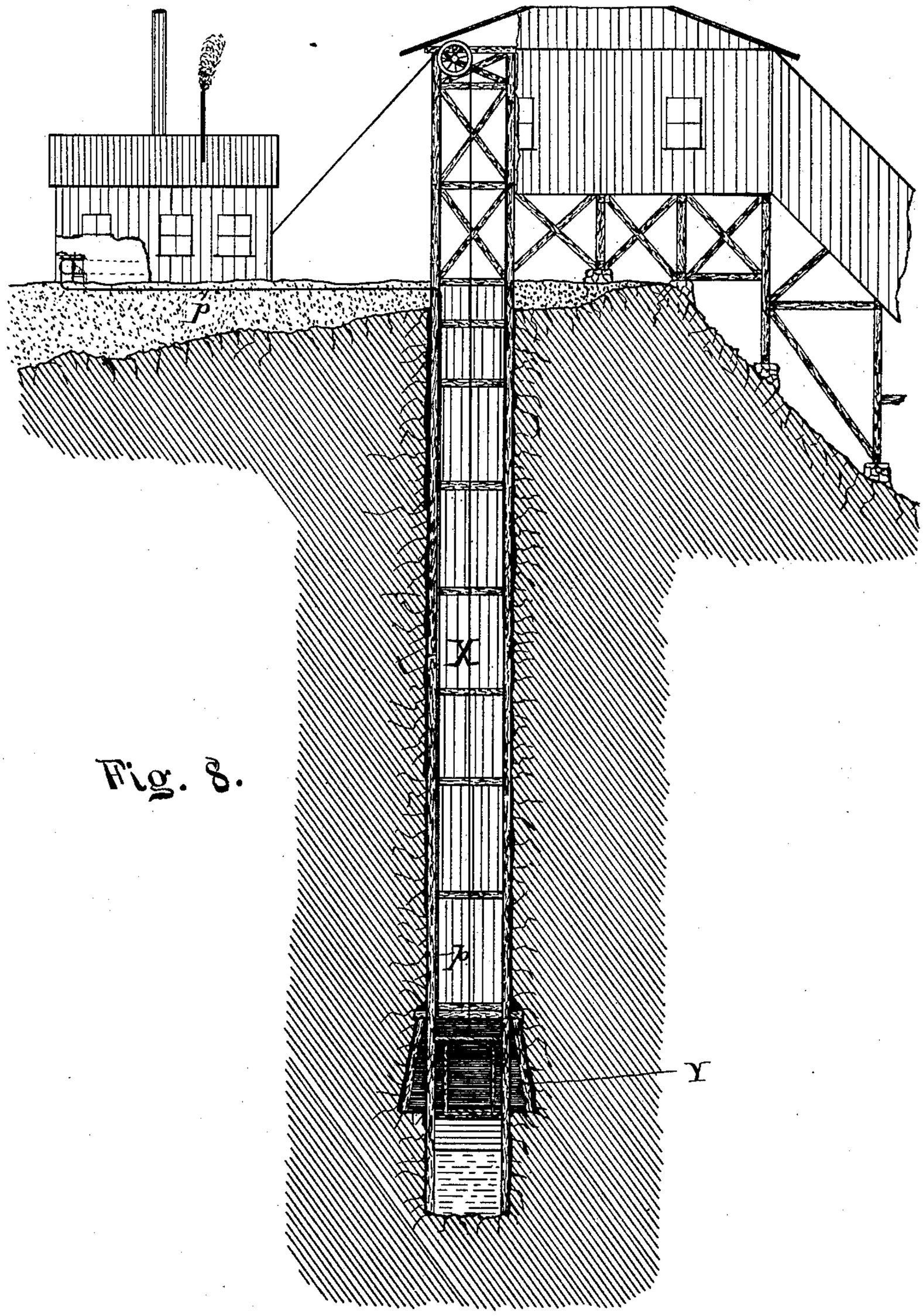

Fig. 8.

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T. SHAW.

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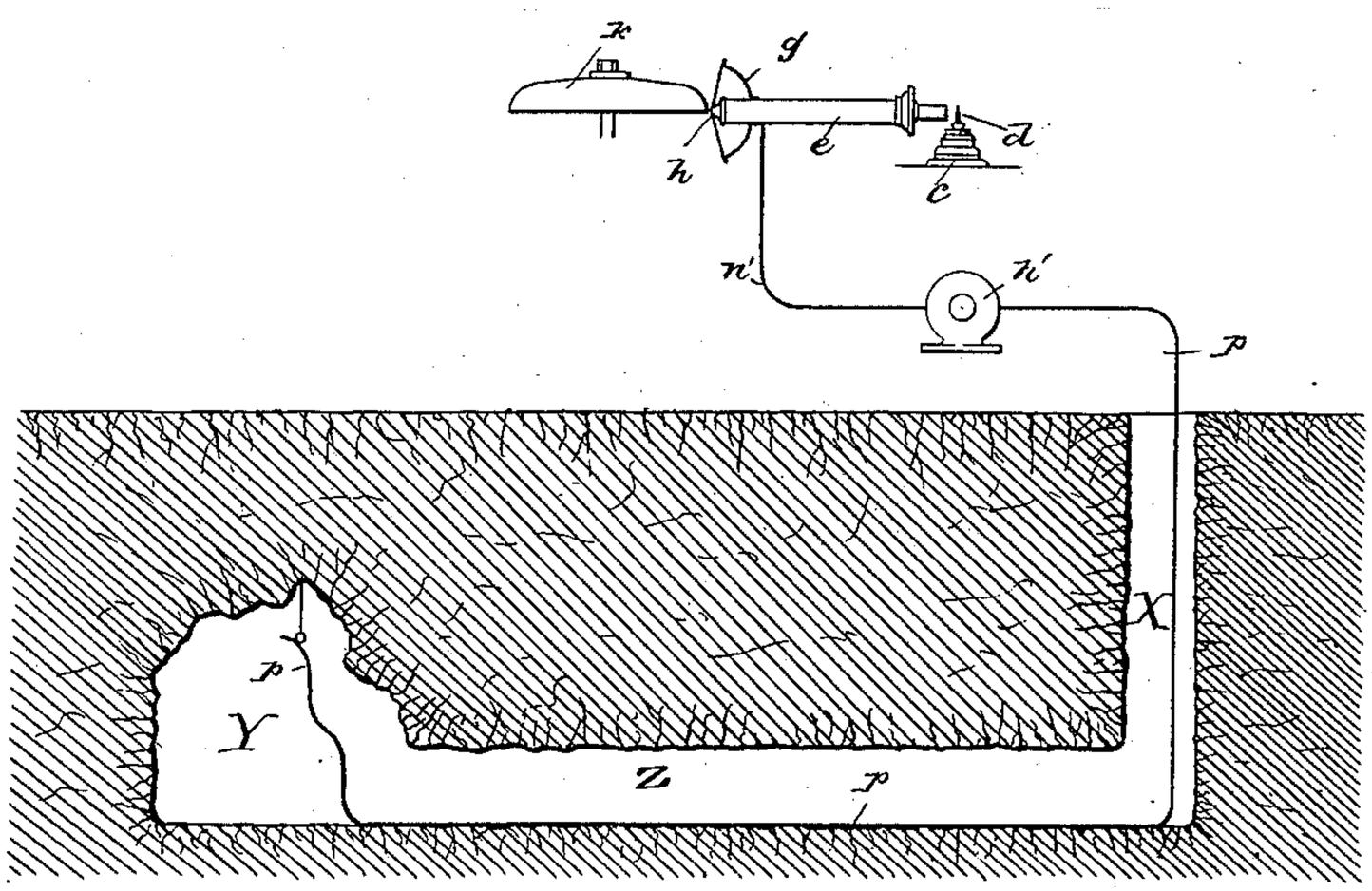
Fig 10.



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Jno. Ashton Jr.
F. T. Chapman.

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UNITED STATES PATENT OFFICE.

THOMAS SHAW, OF PHILADELPHIA, PENNSYLVANIA.

APPARATUS FOR AUTOMATICALLY TESTING MINE-GASES.

SPECIFICATION forming part of Letters Patent No. 359,102, dated March 8, 1887.

Application filed June 3, 1886. Serial No. 204,096. (No model.)

To all whom it may concern:

Be it known that I, THOMAS SHAW, M. E. of the city and county of Philadelphia, Pennsylvania, have invented a new and Improved Apparatus for Automatically Testing Mine-Gases; and I hereby declare the following to be a full, clear, and exact description of the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

My invention is an apparatus whereby the gases from mines are automatically carried to a testing-station, and automatically tested, and whereby, when said gases are dangerous, the fact is indicated, all as hereinafter claimed.

In order to enable others to use and practice my invention, I will proceed to describe its construction and operation.

On reference to the accompanying drawings, which form part of the specification, Figure 1 represents an end view of all the apparatus used above the mines; Fig. 2, a side view of the same; Fig. 3, a top view of the same; Fig. 4, a vertical section through the center of the gas-tester; Fig. 5, a vertical section of the valve for reversing the gas or air currents; Fig. 6, a vertical section of the mechanism actuated by the partial vacuum; Fig. 7, the pneumatic signal and valve, &c., to be located in the mines; and Fig. 8 represents the apparatus in position and in connection with the mines, all for the purpose hereinafter explained; Fig. 9, a perspective view of the whistle and indicator, and Fig. 10 a diagram illustrating the general features of an apparatus for carrying out my invention.

Similar letters refer to similar parts throughout the several views.

When explosive gases, or gases which on combining with air form explosive gases, first enter a mine or a chamber therein, they rise to the upper part of the chamber and gradually fill the latter from the top, so that the lower strata of air in which the men work will only indicate danger after the chamber is so full of gas that it is difficult to avoid the consequences of its presence.

Attempts are made by inspectors to test the gases by elevating safety or indicating lamps to the tops of the mine-chambers; but they are then so far removed from the inspector that it is impossible for him to ascertain the indications which can only be properly understood. Any means of remedying these difficulties and affording a sure and immediate indication of the presence of dangerous gases must be of such a character as to be practically employed by unskilled labor and not liable to get out of order or useless from the necessary rough usage to which the same is subjected in mines. The means I have devised meet the requirements I have specified, and can be best understood in their general features by reference to the diagram, Fig. 10. In said diagram Y represents one of the chambers of a mine; X, the vertical shaft; Z, a communicating level or gallery, and *p* a pipe leading from a high point in the chamber Y to the surface. The pipe *p* is put into communication with an exhaust-pump, *h'*, Fig. 1, and a small pipe, *n'*, from the latter leads to a metallic gun or cylinder, *e*, having a contracted opening at one end opposite a flame or incandescent igniter, *d*, and at the other end a loose piston, *h*, opposite a gong, *k*, with a spring, *g*, for retracting the piston.

If the pump is now put into operation, the air will be exhausted from the pipe *p* by the pump, and will be drawn from the top of the chamber X and forced through the gun *e*. So long as air alone is thus conducted no other effect results; but should a gas which is explosive or an explosive mixture of air and gas be drawn into the tube *p* and forced into the gun *e* it will, upon meeting the flame *d*, be ignited, and the charge within the gun will explode, driving the piston outward against the gong and sounding the latter. The presence of a dangerous gas is thus indicated in a few moments after it begins to enter a chamber, and long before it can accumulate in dangerous quantities or be brought into contact with the lights at the miner's level. A separate pipe leads from each working-chamber of the mine to a separate gun or indicator at the surface.

As will hereinafter be explained, each gun is provided with means—as a self-closing valve or contracted passage-way—to prevent the gas and flame from traveling back to the mine-chamber, and it will be understood that the parts indicated in said diagram may be

variously constructed to automatically propel and conduct the gases and afford an automatic indication of their presence. For instance, the pump may be constructed in different ways, and the gas may be ignited by an incandescent body, a flame, or an electric spark. The indicator, instead of being a gong, may be a piece of traveling paper, which is punched by the piston; or the gases may be blown against a chemically-prepared surface, which becomes colored only on the presence of a dangerous gas. In either case, however, it will be seen that there is a constant automatic withdrawal of gas or air from an elevated point in each working-chamber of the mine, and the character of the gas thus withdrawn is indicated at the surface in a manner to convey immediate information to the attendant at a central point.

While the apparatus having the general features specified will effect the indication at the surface of the character of gas in the mine, it has the further advantage of also affording means of signaling from the central station and back to the chamber. Thus by obstructing the flow of air from the pump h', or by reversing the current by air-pressure from another pump or a reservoir through the pipe u', the current may be forced back through the pipe p and out of the inner end through a whistle, D, and by closing the inner end of the pipe p the increased pressure in said pipe may be made the means of sounding a whistle at the central station.

Having stated the general features of my invention, I will now set forth in detail the construction of the various parts as I have used them, it being understood, however, that such constructions may be greatly varied without departing from the essential features of my invention.

In Fig. 8 the central station is shown as arranged in an engine-house, to which all the pipes p lead from the different chambers Y of the mine. Within this house is arranged the indicating and signaling apparatus, more fully illustrated in Figs. 1, 2, 3, 4, 5, 6, and 9. Said apparatus is supported by a frame-work having two platforms or tables, m' m^6. On the table m^6 are supported the gong k and the gun e, the construction of which is more fully illustrated in Fig. 4. The gun is a hollow cylinder, and the piston h constitutes, also, a valve, closing the rear end of the cylinder and held in its closed position by the bow-spring g i. At the opposite end of the cylinder is a valve-casing, a'', containing a port, 3, and hinged valve f, provided with a stop-arm, f', limiting its outward movement and tending to keep it open. Beyond the port extends a nozzle having a small terminal port, 4, opposite the flame d of a lamp, c.

There is a port, 5, in the top of the cylinder, and a hinged arm falls over the same, so as to be swung back to the position shown in Fig. 4, when an explosion occurs, thereby indicating to the attendant the signaling device which has been operated by the dangerous gases. Such an indicator is generally advisable, as two signals may be simultaneously operated in a gang of a dozen or more, and without such indication the attendant would be at a loss to determine the chamber in which the gases are present.

The gases are driven into the gun e through a small pipe, n', communicating with the rotary pump or blower h', with which the pipe p communicates, and when an explosive gas or mixture is thus introduced it flows out of the port 4 and is ignited, the force of the explosion closing the valve f and forcing out the piston h against the gong and throwing back the indicator m, and this will be repeated at short intervals so long as repeated charges of explosive gas are introduced into the gun.

The entire amount of gas drawn from the chamber by the pump is not thrown into the gun; but I provide the pump with an overflow-pipe, p', through which the surplus gas escapes, a valve at o' controlling the amount of escape.

In order to permit the end of the pipe p to be readily carried to the top of the mine-chamber and there secured, I provide such end with a flexible terminal pipe-section, p^2, and at the end of this flexible section I secure a nozzle, u'', provided with an eye, 7, by means of which to suspend it in an elevated position or to secure a cord for raising and lowering it, and at the end of the nozzle I place an ordinary whistle, D. A valve-casing containing a valve, s', opening inward and covered by gauze 23, to keep out dirt, communicates with the nozzle, so as to admit the air or gases through the nozzle to the conducting-pipe when the pump is started. When a reverse current is sent through the pump, the whistle is sounded, and by intermitting the current distinct sounds may be made in accordance with any desired prearranged system, so as to afford a means of sending messages of any character back into the mine.

The reverse current may be forced back by the pump; but I prefer to use a reservoir, i', containing air under pressure, and a valve device, J, whereby to cut off the flow to the pump through the pipe p, and at the same time put the reservoir into communication with the pipe.

In the construction shown the valve device J is in the line of the pipe p, and consists of a casing, n, divided by two perforated partitions, 17 18, into three chambers, 9 10 11. The valve-stem r has a terminal head, 12, and is surrounded by a spring, 13, which lifts it and carries two valves, 14 15, one adapted to a seat on the partition 17 and the other to a seat on the partition 18.

The pipe p communicates through an inlet-port with the chamber 10, and through an outlet-port with the chamber 9, and a pipe, u', leads from the reservoir i' to the chamber 11. The valves 14 15 are so arranged that when one

is on its seat the other will be off its seat. So long as the parts are in the positions shown in Fig. 5 the gas or air flows freely along the pipe *p* and through the chambers 10 9 of the valve device and to the pump; but should it be desired to signal back to the mine the valve-stem is depressed, when the valve 14 will take its seat, cutting off communication with the pump, and the valve 15 will be carried from its seat, and the air will flow from the pipe *u'* and chamber 11 to the chamber 10 and back through the pipe *p* to the inner end of the pipe, when the whistle will be sounded. Thus as soon as the attendant is automatically notified by the signal device that there is dangerous gas in a chamber, he can by depressing the valve-stem send a back-current through the pipe *p* and at once notify the miners of their danger, or send any desired instructions.

The apparatus may also be the means of signaling from the mine to the station. Thus the variation of pressure in the pipe *p* may be made the means of admitting air to a whistle, *r'*, at the station, and the compressing of the flexible section p^2 of the pipe *p* will serve to prevent the entrance of air or gas, and by causing an exhaust or partial vacuum vary the pressure and make the signal. A device for this purpose is shown in Fig. 6, in which I is a casing containing a chamber, 20, covered by a flexible top or diaphragm, *c''*, connected to a pivoted weighted lever, *b'*, by a link, and to the stem of a valve, *z*, covering a port, *z'*, from which a pipe, *m''*, leads to the whistle *r'*. The port *z'* leads from a chamber in a valve-casing, K, Fig. 5, with which a branch, u^5, of the pipe *u'* communicates, so that when the valve *z* uncovers the port *z'* air under pressure will pass from the reservoir *i'* to the whistle *r'*, and will sound the latter. The pipe *p* communicates with the chamber 20, and if the inner or mine end of said pipe *p* is closed by temporarily compressing the flexible section p^2, the exhaustion of the air by the pump will decrease the pressure in the pipe and in the chamber 20, and the diaphragm *c''* will sink, moving the valve *z* from the port *z'*, when the air from the reservoir will escape to and sound the whistle *r'*, and by alternately compressing and releasing the pipe-section p^2 a series of signals may be made, according to any predetermined system, which will enable the miners to send any desired information to the central station. The same result will ensue if the air is traveling back through the pipe, the stoppage of the flow increasing the pressure in chamber 20, lifting the diaphragm, and raising the valve above the port *z'*.

To prevent any confusion of signals, each whistle *r'* is provided with a hinged indicator, *n''*, Fig. 9, like the indicator *m*, which is thrown back by the air-current, and indicates that a whistle has been sounded.

I do not limit myself to the precise construction of signaling and indicating and blowing apparatus shown, as any skilled mechanic will be able to supply differently-constructed devices which will effect the same results as those set forth, which, however, have proved most effective in actual operation. Neither do I here claim, broadly, the method of signaling by a single pipe with sounders at opposite ends, and means for operating said sounders by varying the flow in the pipe, as this will constitute the subject of a separate application for Letters Patent.

In the apparatus shown the revolving shaft of the pump is driven by a belt, *w'*, passing round pulleys, as shown in Fig. 1, from a shaft, *x'*, to which motion is imparted from any adjacent driving-shaft; but this arrangement will be varied when a differently-constructed pump is used. In some cases the pump *h'* may be employed to fill and maintain the reservoir *i'* with air under pressure.

I find that mixtures of air and light carbureted hydrogen, in which the proportion of the latter varies from six to twenty-five per cent., are explosive to varying degrees, and that the above-described means suffice to indicate the presence of any such mixtures in a manner which is perceptible to the most ignorant and inattentive workmen or attendants and with apparatus that the most unskilled workmen can operate without danger of impairing its efficiency.

As before stated, it is intended that each part of the mine requiring to be tested shall be provided with a separate tube and automatic gas testing and indicating contrivances, all under the control of one operator at the testing station, so that all parts of the mine are under constant supervision, and constant, accurate, and infallible tests of the air or gases in each part of the mine are made, enabling the superintendent to know the workings of each section without the usual unavoidable and often fatal delays attending the use of testing means heretofore employed.

Without limiting myself to the precise construction and arrangement of parts shown, I claim—

1. In an apparatus for testing gases of mines, a series of automatic testing devices arranged at a testing-station, a series of pipes each extending from a mine chamber to one of the testers, and a pump whereby a continuous stream of gas is caused to pass from each chamber to each tester, all substantially as set forth.

2. The combination, in an apparatus for testing gases of mines, of a series of automatic testing devices at a station, each having an igniter, a series of pipes each leading from one of the mine-chambers to one of said apparatus, and a pump whereby the gases are caused to pass from each chamber to each tester, all substantially as set forth.

3. The combination of a tube leading from a mine-chamber, a pump for propelling the air through said tube, a gun connected by a pipe with said tube to receive a portion of the air thus withdrawn from the mine, and an igniter

whereby the contents of the gun are fired when the same are explosive, substantially as described.

4. The testing apparatus consisting of a hollow cylinder or gun receiving the air or gas to be tested, a port at one end, an igniter opposite said port, and a movable piston arranged to operate an oral alarm when the charge in the gun is fired, substantially as described.

5. The combination of a cylinder, a tube for conducting thereto gases to be tested, a piston sliding in the cylinders, a gong arranged to be struck on the outward movement of the piston, and an igniter arranged opposite an exit-port of the cylinder, substantially as described.

6. The combination of the testing-cylinder provided with an exit-port and valve at one end, an igniter opposite said port, a sliding piston in the cylinder, a spring retracting said piston, a gong arranged to be sounded on the movement of the piston, and an indicator arranged to be moved on the explosion of gases in the cylinder, substantially as described.

7. The combination of the testing-cylinder provided with a port, with a hinged indicating-arm for covering said port, and a gas inlet, escape, and igniter, substantially as set forth.

8. The combination of the testing apparatus, substantially as described, and a tube extending into the mine and provided at the inner end with a flexible section, and means for suspending the end thereof in an elevated position, substantially as and for the purpose set forth.

9. The combination of the tester, a tube extending into the mine, a terminal flexible section, and a nozzle constructed to be secured in an elevated position, substantially as described.

10. The combination of the tester, a tube extending into the mine, a whistle secured to said tube, and means for propelling the air outward and backward in said tube, substantially as and for the purpose described.

11. The combination of the tester, a tube extending into the mine, a whistle at the inner end of the tube, a pump for driving the air outward through said tube, an air-reservoir, and a valve whereby the air-reservoir may be put into communication with the tube to drive a current of air back through the same, substantially as and for the purpose set forth.

12. The combination of the tube, the testing apparatus at one end, a whistle at the other, a pump, an air-reservoir, and a valve whereby to cut the pump from communication with the tube and put the latter into communication with the reservoir, substantially as set forth.

13. The combination of the tester, the tube leading to the mine, the chamber, the pump, the air-reservoir, the whistle adjacent to the tester, a valve controlling the flow of air from the reservoir to the whistle, and a chamber covered by a flexible diaphragm connected to the valve and communicating with the tube, substantially as described.

14. The combination of the tester, a tube, a pump, a pressure apparatus communicating with the tube and connected with a valve, a whistle, and a port controlled by said valve for the passage of air to the whistle, substantially as described.

15. The combination of the tube, the tester, the whistle at the inner end of the tube, a whistle at the outer end of the tube, an air-reservoir, and a valve and connections constructed to control the flow of air to the outer whistle according to the pressure in the tube, and a second valve constructed to control the flow of air between said tube and the pump and between said reservoir and the tube, substantially as described.

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