No. 638,460. Patented Dec. 5, 1899.

J. H. HOPPS.

AIR COMPRESSOR.

(Application filed Mar. 14, 1899.)

(No Model.) 3 Sheets—Sheet 1.

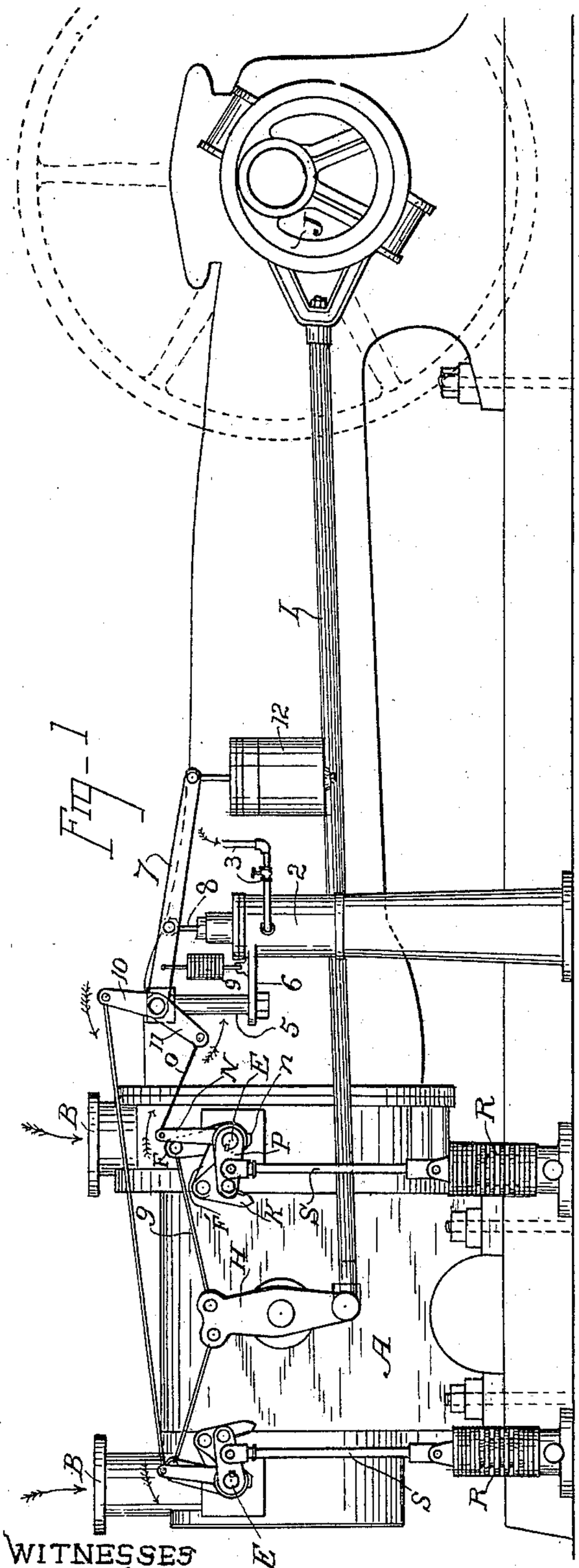

FIG. 1

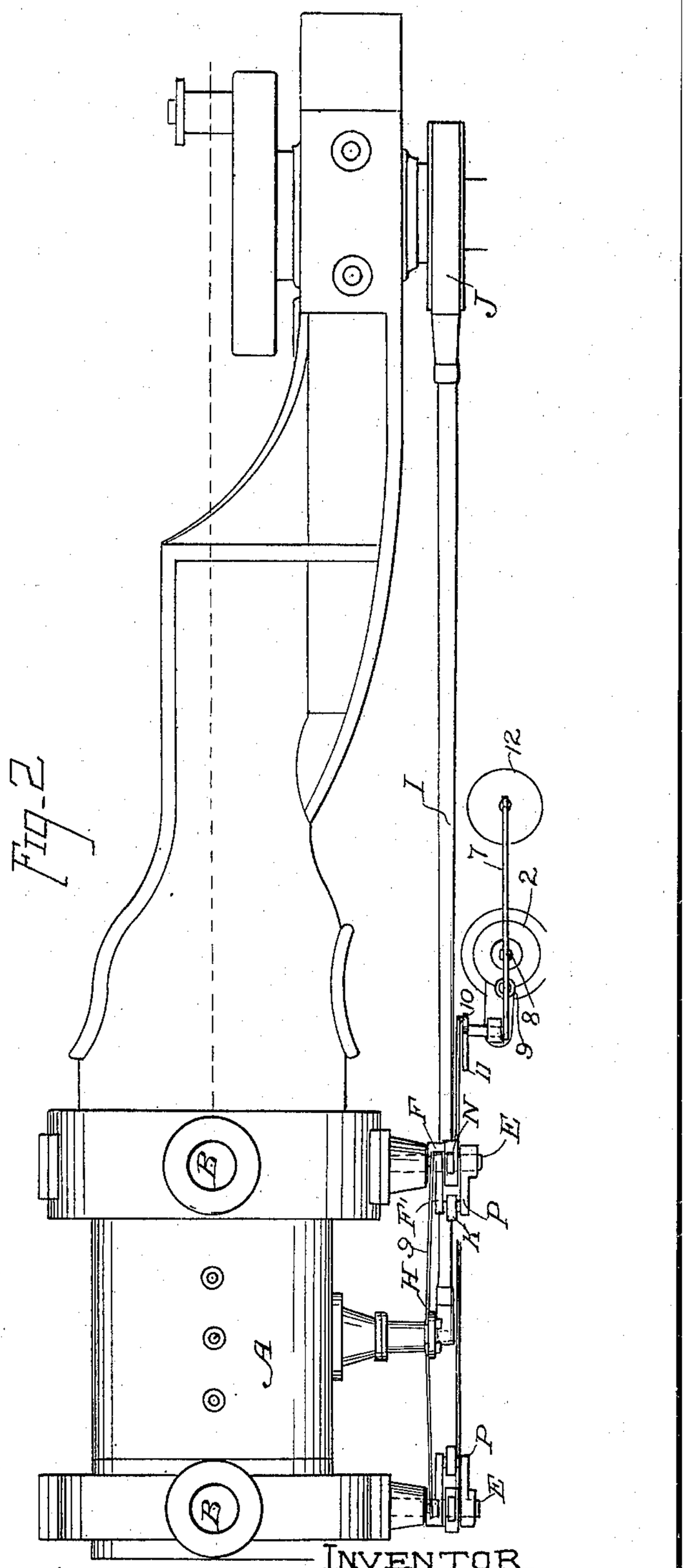

FIG. 2

WITNESSES

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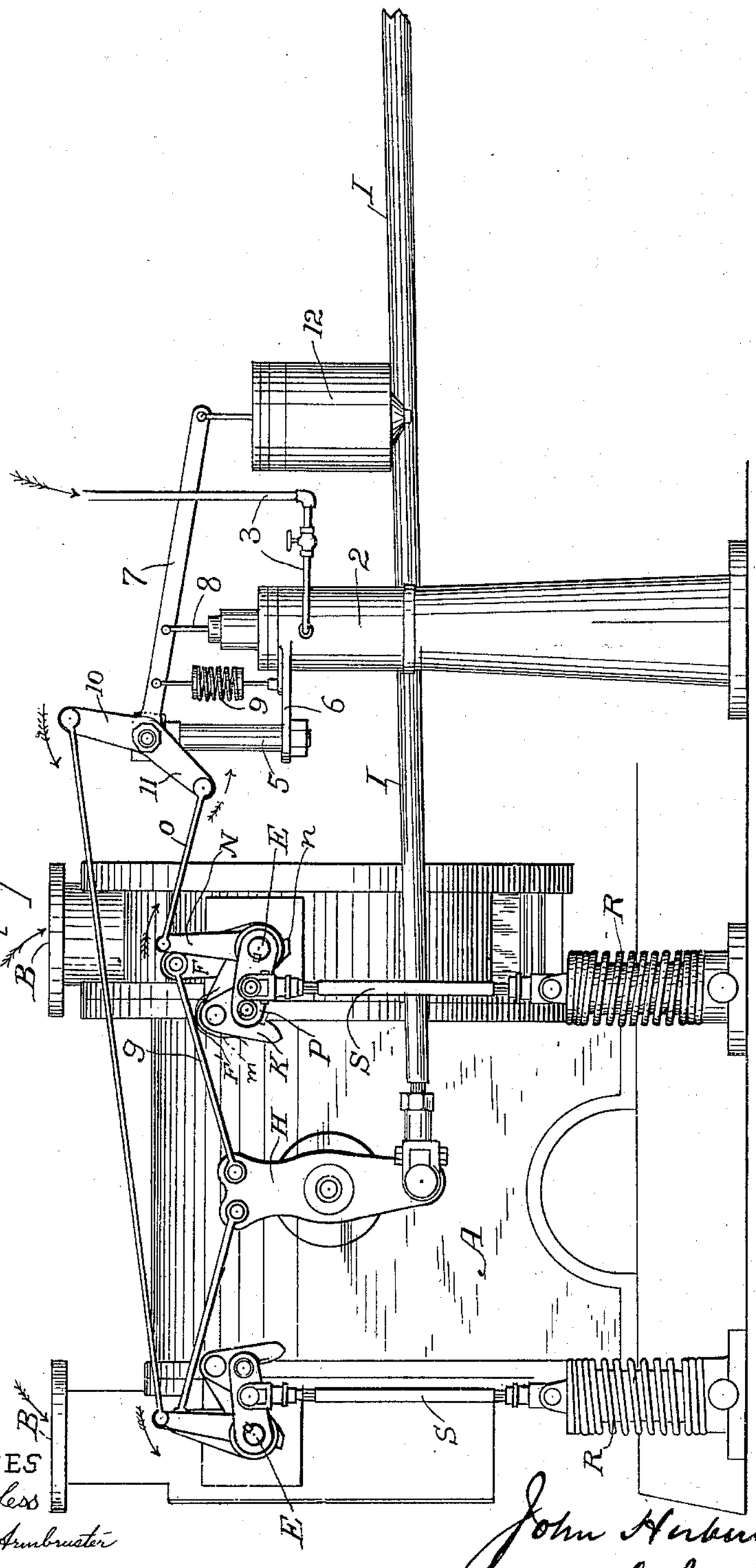
Fig. 3



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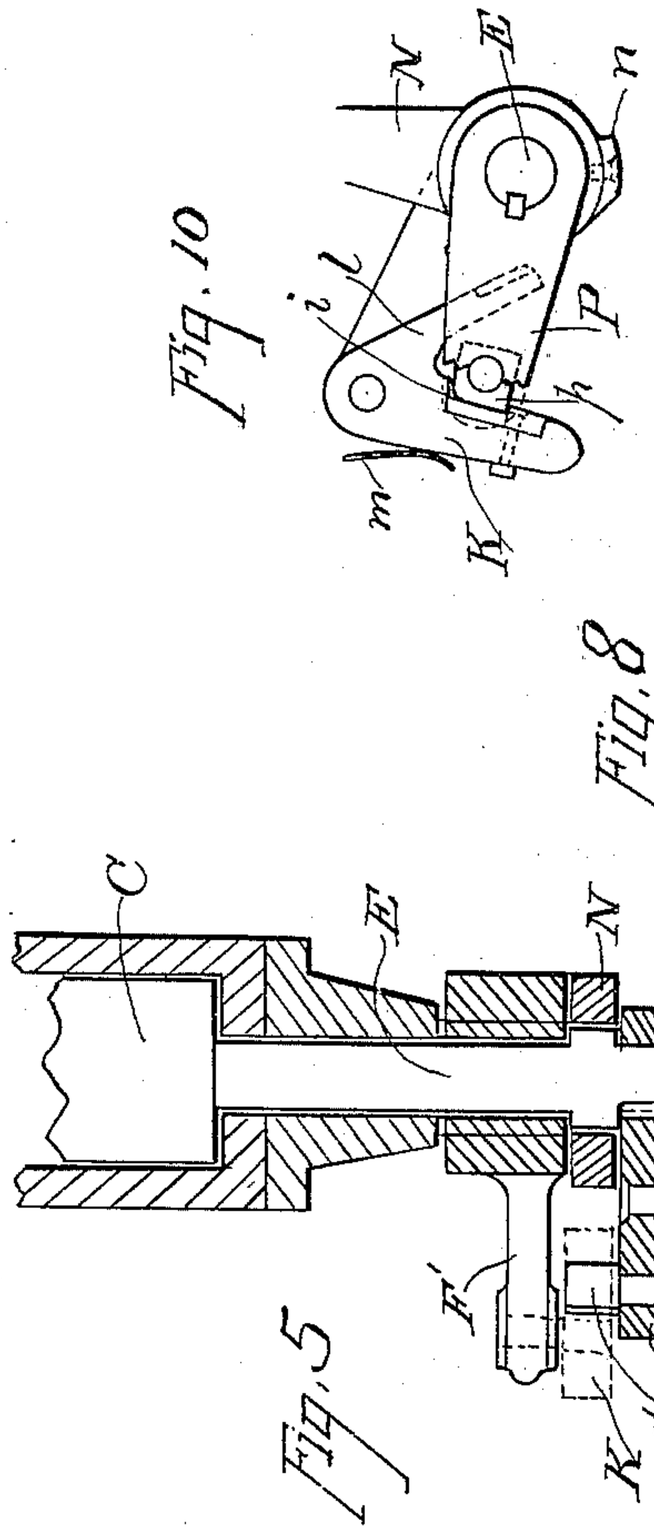

FIG. 5

FIG. 5

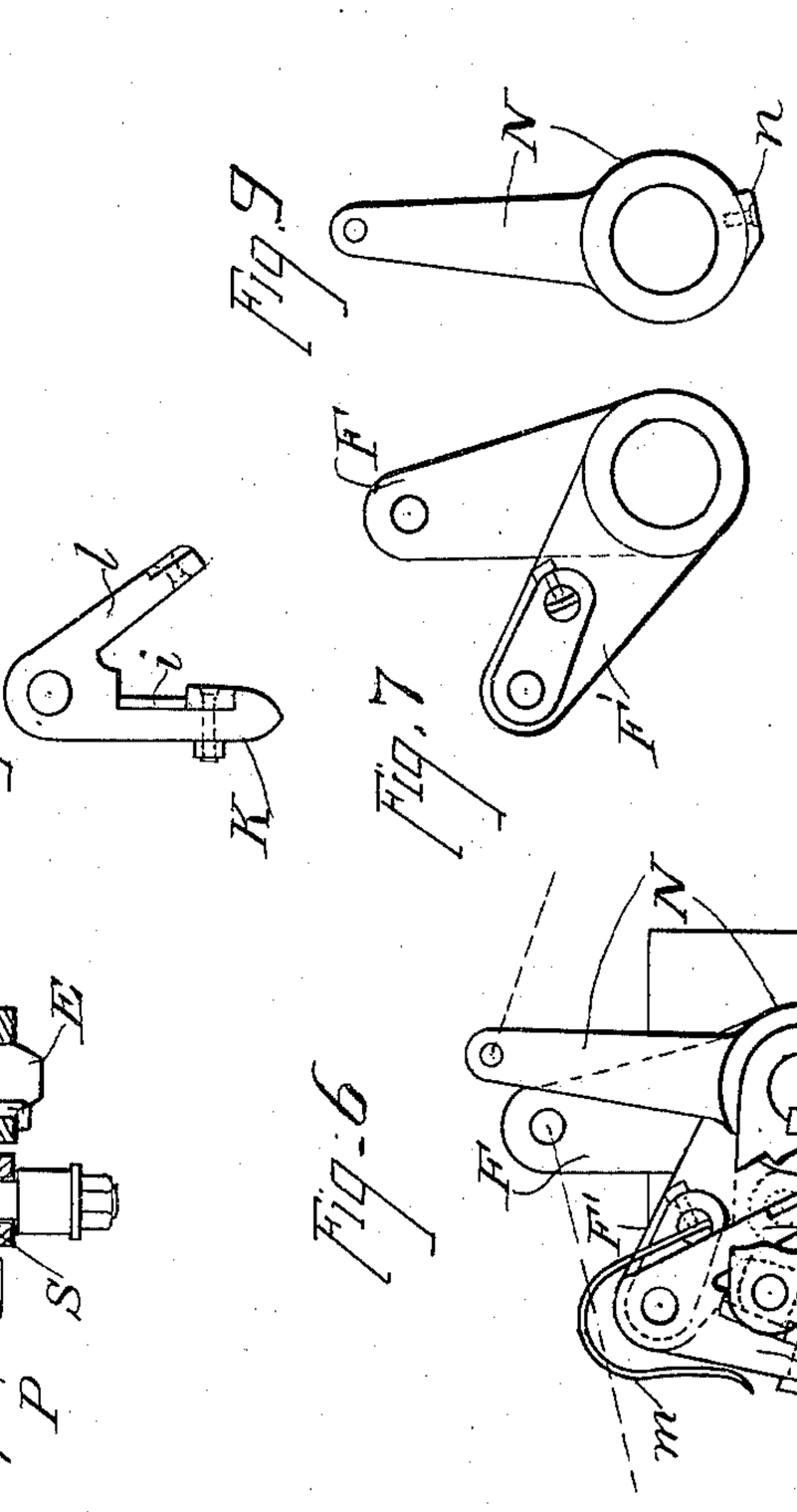

FIG. 10

FIG. 8

FIG. 9

FIG. 7

FIG. 6

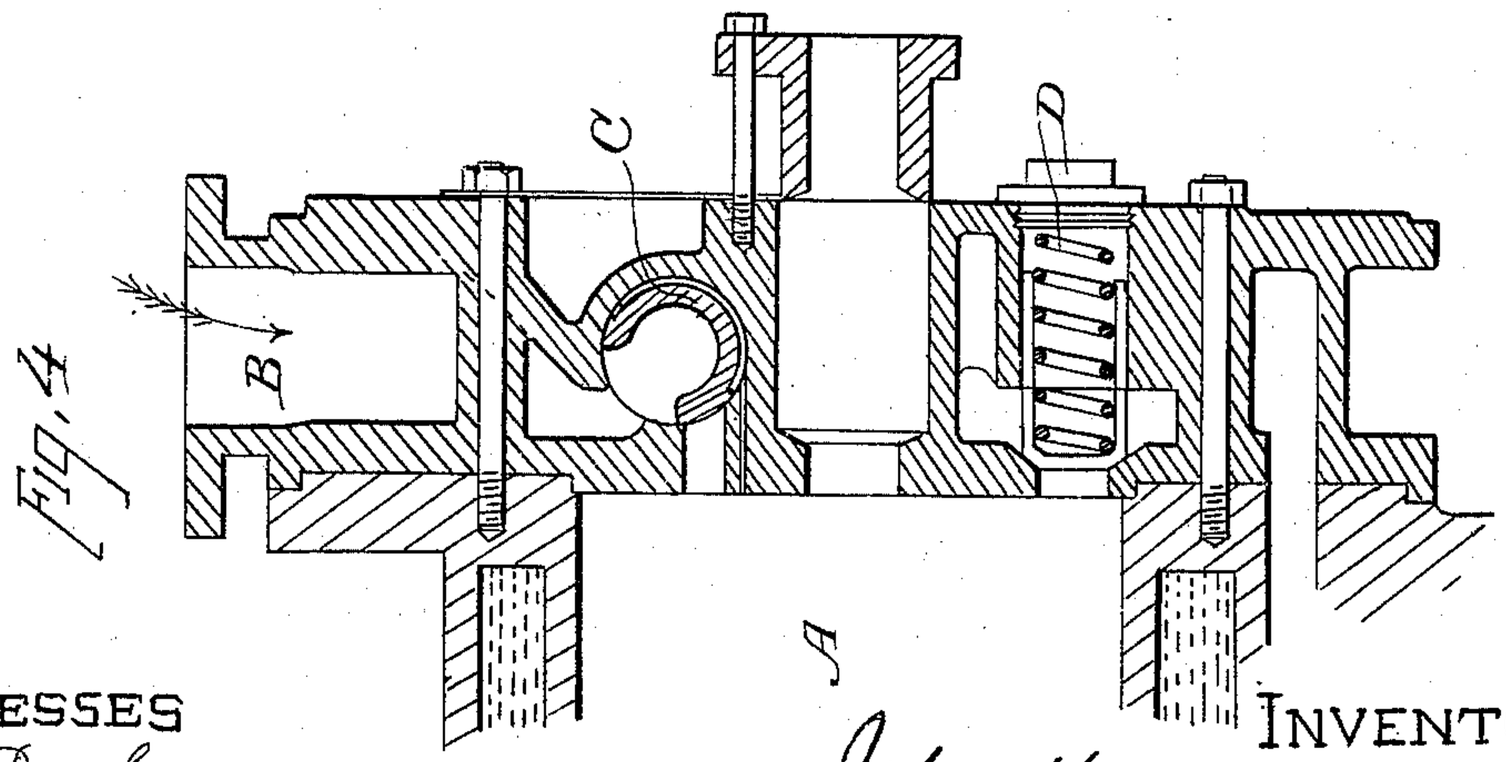

FIG. 4

WITNESSES

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UNITED STATES PATENT OFFICE.

JOHN HERBERT HOPPS, OF SAN FRANCISCO, CALIFORNIA, ASSIGNOR TO THE FULTON ENGINEERING AND SHIP-BUILDING WORKS, OF SAME PLACE.

AIR-COMPRESSOR.

SPECIFICATION forming part of Letters Patent No. 638,460, dated December 5, 1899.

Application filed March 14, 1899. Serial No. 709,086. (No model.)

To all whom it may concern:

Be it known that I, JOHN HERBERT HOPPS, a subject of the Queen of Great Britain, residing in the city and county of San Francisco, State of California, have invented certain new and useful Improvements in Air-Compressors; and I do hereby declare the following to be a full, clear, and exact description of said invention, such as will enable others skilled in the art to which it most nearly appertains to make, use, and practice the same.

My invention relates to a novel mechanism and arrangement for causing an excess of pressure in the receiver of an air-compressing machine to automatically throw open one or more of the inlet-valves of the air-compressor cylinder, so as to relieve the engine or motor that drives the compressor from unnecessary work when the draft on the receiver is curtailed or cut off.

It consists of an arrangement for connecting the spindles of the several inlet-valves of the compressor-cylinder with the engine or motor that drives the compressor and with a regulator or governor which is controlled by the atmospheric pressure in the reservoir or receiver, so that when the pressure in the receiver exceeds a fixed point first one inlet-valve will be thrown wide open and then another as long as the pressure in the receiver keeps increasing; but the instant the draft on the receiver is greater than the supply of air to the receiver the valves will be successively and automatically started again into action.

For a further explanation of my invention reference is had to the accompanying drawings, in which—

Figure 1 is a side elevation of an air-compressor with my improvements attached thereto, showing its connection through the eccentric-rod and eccentric with the power-shaft of the engine or motor. Fig. 2 is a top or plan view of the same. Fig. 3 is an enlarged exterior view, in side elevation, of the air-cylinder and operating parts. Fig. 4 is an enlarged vertical cross-section of one of the cylinder-heads, showing the valves and valve-openings. Fig. 5 is an enlarged horizontal section of the inlet-valve and its spindle with the loose and fixed levers applied thereto, showing their arrangement on the spindle. Figs. 6 and 10 are enlarged side views of the operating-levers, parts of which are broken away to show the construction and action of the same; and Figs. 7, 8, and 9 are detail views of the different levers separated.

Let A represent the cylinder of an air-compressor, and B B the inlet-openings through which air is admitted at each end of the cylinder.

C is the inlet-valve. (Shown plainly at Fig. 4.) D, same figure, is the outlet-valve, which is connected with the receiver. (Not shown.)

E are the spindles of the inlet-valves. (Shown plainly at Fig. 5.) Upon the projecting spindle of each of the inlet-valves I place the following levers: F F′ (shown in detail at Fig. 7) is a two-armed lever, the arms of which stand at such an angle to each other that when one of them, F, stands in a vertical position the other, F′, will stand at an angle of about forty degrees to the perpendicular, or a single sector might be substituted for the two arms. This compound lever or sector has a hole bored through its angle or junction of sufficient size to slip loosely upon the spindle of the valve, as shown at Fig. 5, so that it will rotate freely on the spindle. The outer end of the vertical spindle F of this lever is connected by a rod *g* with one end of the centrally-pivoted operating-lever or wrist-plate H. The opposite end of this lever or wrist-plate is connected with the engine or motor through the medium of the eccentric-rod I and eccentric J, so that a reciprocating motion is transmitted from the engine to the operating-lever and through the operating-lever to the lever or sector arm F, thereby imparting to the two-armed lever or sector a constant reciprocating movement when the engine or motor is in operation.

Pivoted loosely to the outer end of the angular lever F′ is a hook or catch K, which I call a "crab," (shown in detail at Fig. 8,) and this crab has an arm *l* extending at an angle from it, as shown. The point of suspension is at the angle where the hook or crab and its lever-arm meet, so that the hook or crab will hang vertical while its lever-arm *l* extends downward at an angle toward the spindle. A bent spring *m* has one end secured to the arm F′, while its opposite end presses against

the back of the hook or crab, as shown at Fig. 6.

Fig. 9 represents a trip-lever N, the lower end of which is formed with a hole large enough to slip loosely upon the valve-spindle and fit against the hub of the two-armed lever F F′. It has a projection *n* on its lower portion below the spindle in a position to strike against the end of arm *l* when the trip-lever is thrown far enough back to cause the rotation of its hub to bring them in contact. The front end of this projection is inclined, so that when it is forced against the end of arm *l* it will press the catch or crab outward against the spring *m*. The upper end of this lever is connected by a rod *o* with the governor or regulator, hereinafter described.

On the outer end of the valve-spindle I secure an arm P, which is keyed firmly to the spindle. Its outer end is adapted to engage with the catch or crab K and be carried by it in its movement with the two-armed lever F F′.

The device which I use for engaging the outer end of the arm P with the catch or crab is the square head of a bolt *p′*, which is secured on the inner side of the arm and which engages with a corresponding notch or recess *i* on the inner face of the catch or crab K, thus forming a latching device, which is kept in engagement by the pressure of spring *m* against the back of the catch and which is released by the unlatching action of the projection *n* on the arm *l;* but various latching devices could be used, as will suggest themselves to any ordinary mechanic.

R is an accumulator-spring, which is firmly fixed to the floor or base upon which the compressor stands at a point below the fixed lever-arm P. This spring is connected by a rod S with the arm P midway between the spindle and outer end of the arm, so that when the outer end of the arm is engaged with the catch or crab K the spring is continually in action; but when the trip-lever N is drawn back by the governor or regulator far enough to cause its projection *n* to disengage the outer end of the fixed arm P from the catch or crab the valve-spindle and its fixed arm will be released from their connection with the moving levers, and the contraction of the spring will draw the arm down, and thus throw the valve to its wide-open position, where it will remain out of action until the governor or regulator shows a decrease of pressure sufficient to carry the trip-lever and its projection *n* out of reach of the arm *l*, when the catch or crab will again engage with the fixed arm P and set the valve in motion again.

The governor or regulator consists of a vertical cylinder 2, supported at a proper height and which is connected by a pipe 3 with the air receiver or reservoir, into which the air is delivered by the compressor. In this cylinder is a piston, which is actuated by the air-pressure thus admitted.

5 is a vertical standard which is shown in the present drawings to be supported upon a horizontal shelf or platform 6, which projects from and forms a part of the cylinder 2; but it might be an independent standard otherwise supported. To the upper end of this standard a three-armed lever is pivoted. The long arm 7 passes directly over the top of cylinder 2, and the upper end of the piston-rod 8, which extends upward from the piston in the cylinder, is pivoted to it, as shown. On its extreme outer end a weight 12 is suspended, and an accumulating-spring 9 is interposed between the pivotal point of the lever and the piston-rod attachment, so that as the piston rises in the cylinder it lifts the weight 12 and extends the spring 9. At the pivotal end of this lever are two short levers, one (marked 10) projecting vertically and the other (marked 11) extending in a downward direction. These three levers form one integral piece, so that as the long arm or lever 7 rises and turns on its pivotal point the other two short levers 10 and 11 are moved in an arc in opposite directions. The extreme ends of these short levers 10 and 11 are connected, respectively, with the trip-levers on the valve-spindles, before referred to, so that when the pressure in the regulator or governor cylinder increases sufficiently to raise the long arm 7 and move the outer ends of the short arms 10 and 11 far enough to move the trip-levers to a position that will cause their trip projections *n* to strike and press against the lever-arms *l* of the catch or crab lever the catch will be disengaged from the fixed arm of the spindle and the valve will be opened.

The object of having the two short arms 10 and 11 on the same lever-arm is to enable me to operate the engaging and disengaging levers or crabs on the valve-spindles at both ends of the compressor-cylinder from the same governor or regulator. In this case the arrangement of the levers on the spindles will be reversed, so that the oppositely-moving short arms 10 and 11 will operate them by direct connection, or I can operate the lever mechanism of the four valves of a duplex-cylinder compressor from a single governor by connecting the movement of the long arm or lever 7 to another set of short arms and then connecting these short arms with the trip-levers of the other valve-spindles.

An important feature of my invention is the arrangement of the tripping projections *n* on the trip-levers, which throw the catches or crabs out of engagement with the spindle-arms. These must be arranged and adjusted so that they act consecutively, and this is done by placing them at different points on the hub of the trip-levers. The adjustment must be such that one trip acts at a time, so that only one valve is thrown out of action at a time. If after one valve has been thrown out of action the pressure should still increase, the next tripping projection will act and open another valve, and so on until all the valves are open and the engine or motor is relieved. By a reverse action, therefore, when the pres-

sure in the receiver falls below the engine-pressure the tripping mechanism of the several valves will be successively withdrawn, and the catches or crabs will automatically engage the lever-arms, and the valves will resume their action. By this arrangement I am able to reduce the draft upon the engine or motor in proportion to the actual work it is called upon to perform, and the entire operation is performed automatically.

Having thus described my invention, what I claim, and desire to secure by Letters Patent, is—

1. In an air-compressor, a fixed arm on the spindle of the inlet-valve; a gripping device mounted loosely on the spindle and adapted to grip the outer end of the fixed arm; means for operating the gripping device from the motor or engine to move the inlet-valve; a tripping device mounted loosely on the spindle and operated by the air-pressure in the receiver or reservoir to disengage the gripping device from the fixed arm of the spindle when the supply of air to the receiver exceeds its exhaust; and a weight or spring connected with the fixed arm by which the valve is thrown wide open when the lever-arm is disengaged from the gripping device, substantially as described.

2. In an air-compressor an inlet-valve operated by the rotation of a spindle, means for automatically disconnecting the spindle of the inlet-valve from the mechanism and power that drives it when the air supplied to the receiver exceeds its exhaust; means for throwing the inlet-valve wide open when its spindle is disconnected from the driving power, and an automatic gripping device that couples and connects the valve-spindle with the power driving mechanism when the air supplied to the receiver is below the draft upon it, substantially as described.

3. In an air-compressor having two or more inlet-valves, each of which is operated through the medium of a spindle and mechanism connected with the motive power; gripping devices connected with the motive power and operated synchronously with the movement of the inlet-valves, said gripping devices being adapted to automatically engage or release the valve-spindles, means for operating the gripping device from the motor or engine to move the inlet-valve and a tripping mechanism adapted to act on each gripping device consecutively as the pressure in the receiver increases above a fixed point, substantially as described.

In witness whereof I have hereunto set my hand this 2d day of March, 1899.

JOHN HERBERT HOPPS.

Witnesses:
D. B. RICHARDS,
CHAS. J. ARMBRUSTER.