No. 837,327. PATENTED DEC. 4, 1906.

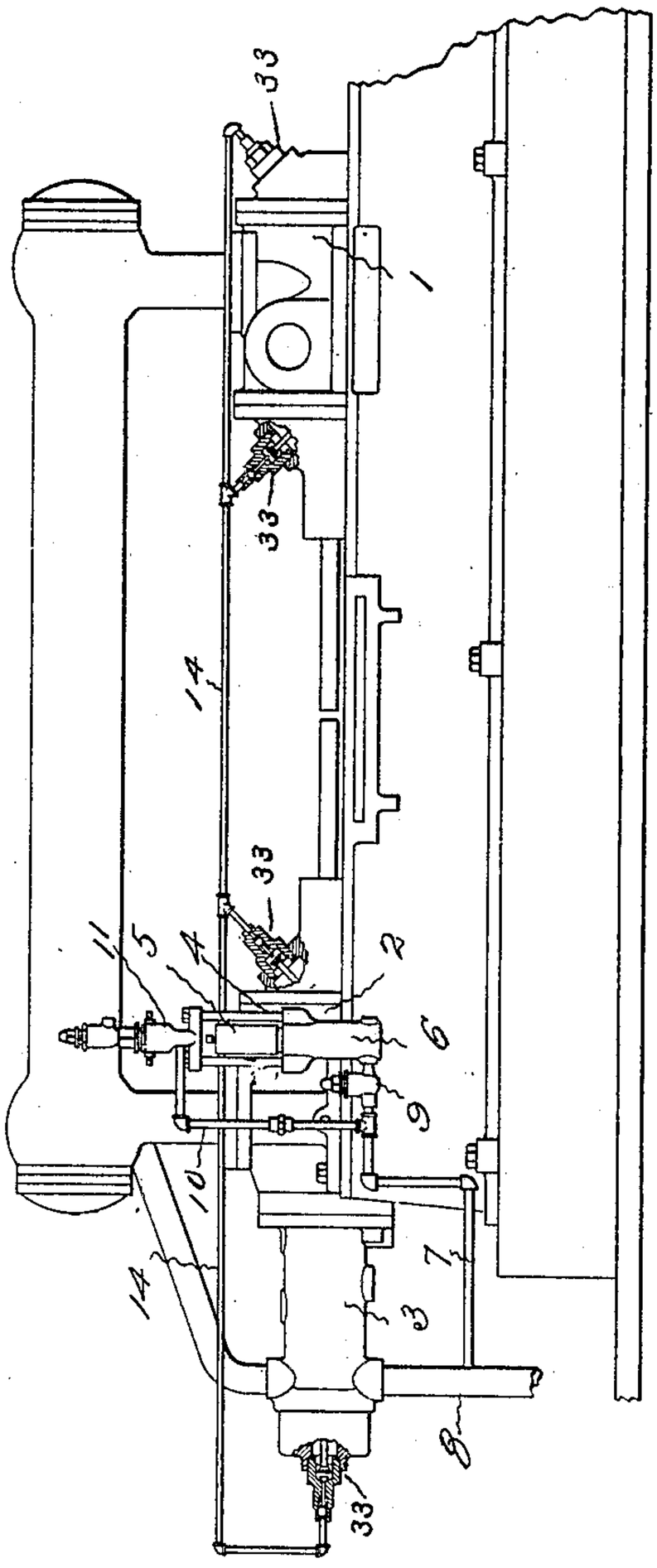
H. P. MORGAN.

MECHANISM FOR UNLOADING AIR COMPRESSORS.

APPLICATION FILED AUG. 12, 1905.

4 SHEETS—SHEET 1.

Fig. 1.



Witnesses.

C. F. Storm.

F. C. Fallow

Inventor:

Henry P. Morgan

per

Harry T. Williams

Attorney.

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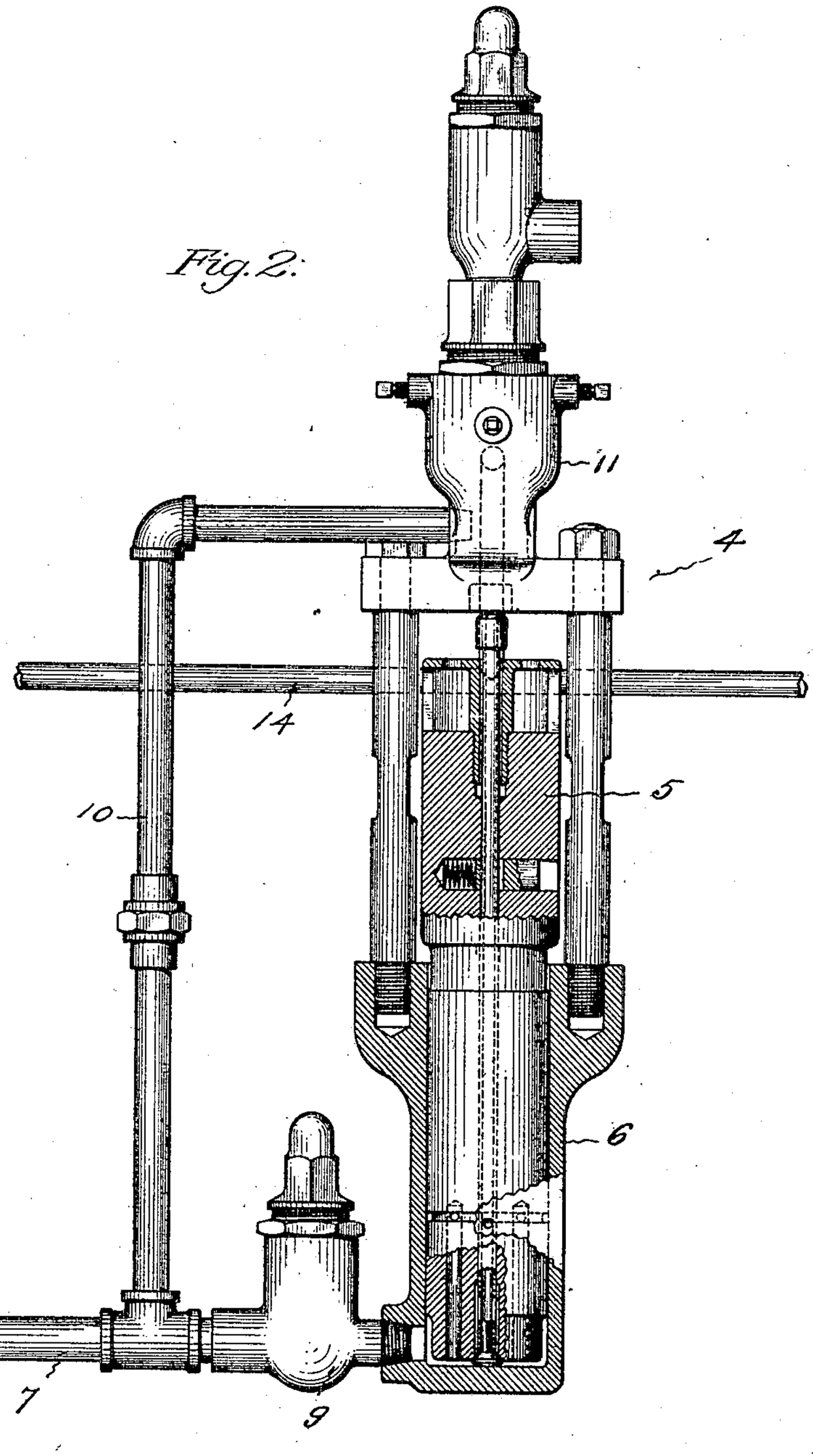
4 SHEETS—SHEET 2.

Fig. 2.



Witnesses.

C. H. Stone.

G. C. Fallow

Inventor.

Henry P. Morgan

per

Harry P. Williams

Attorney.

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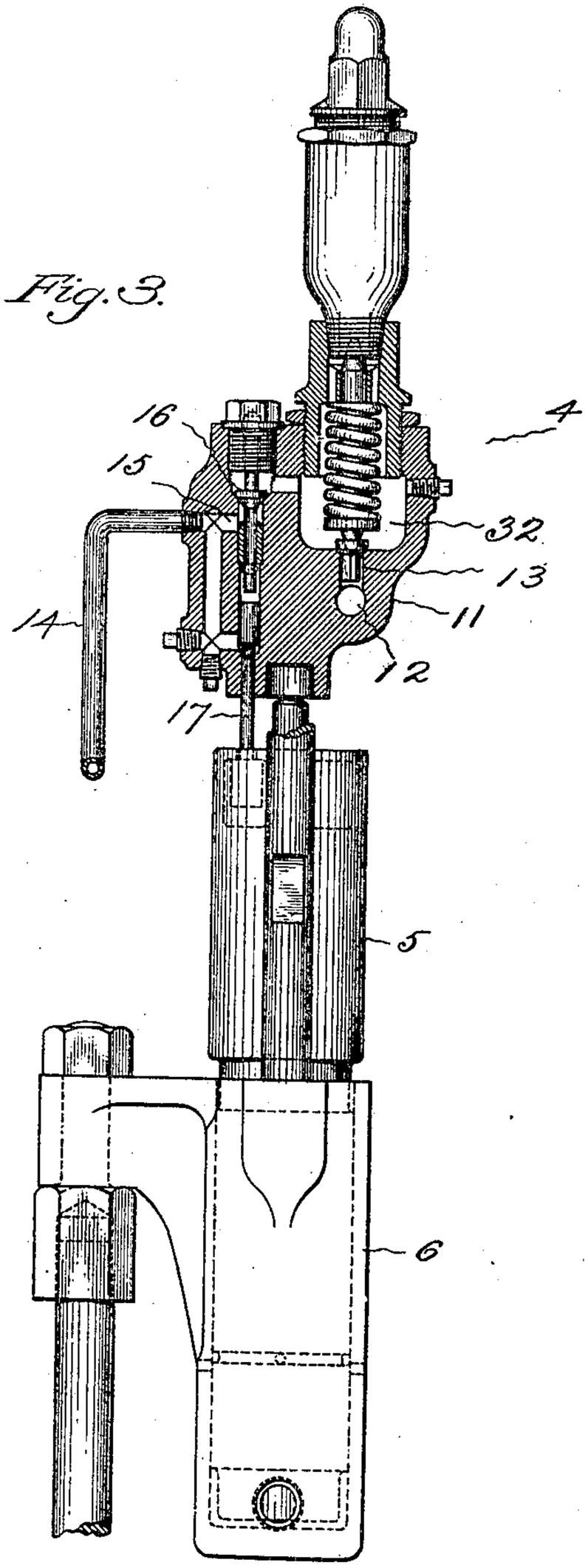
4 SHEETS—SHEET 3.

Fig. 3.



Witnesses.

C. F. Storrs.

F. E. Gallow

Inventor.

Henry P. Morgan

per Harry P. Williams

Attorney.

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4 SHEETS—SHEET 4.

Fig. 3.

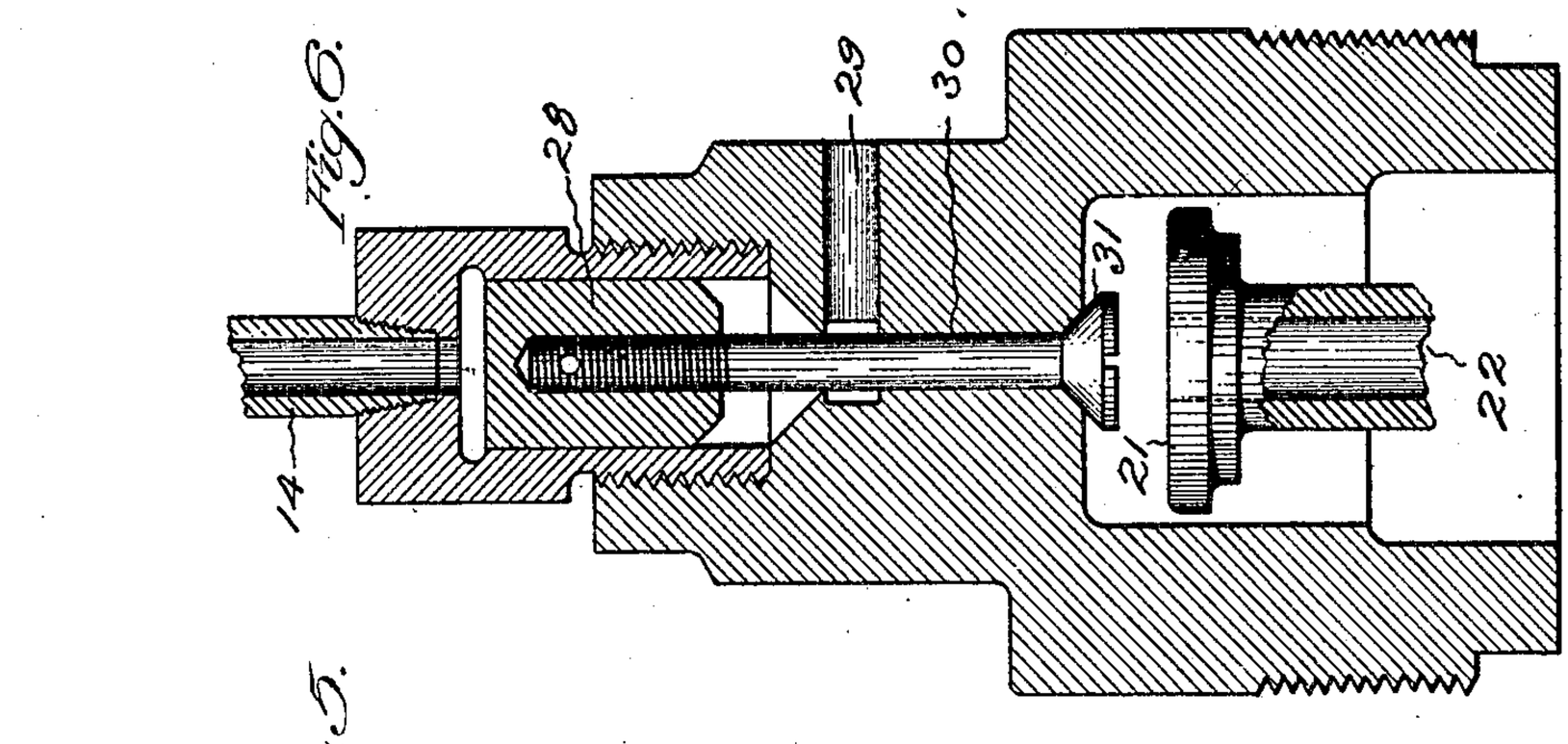


Fig. 5.

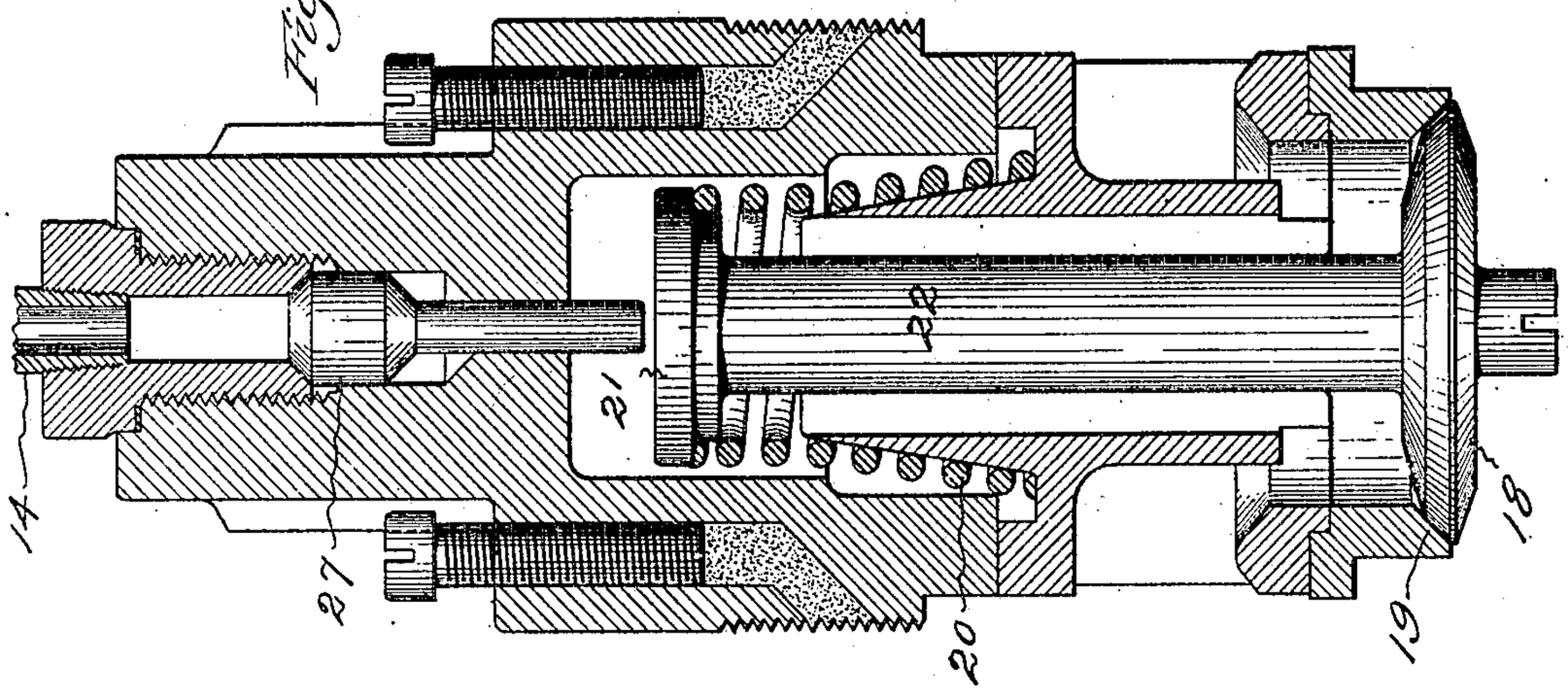
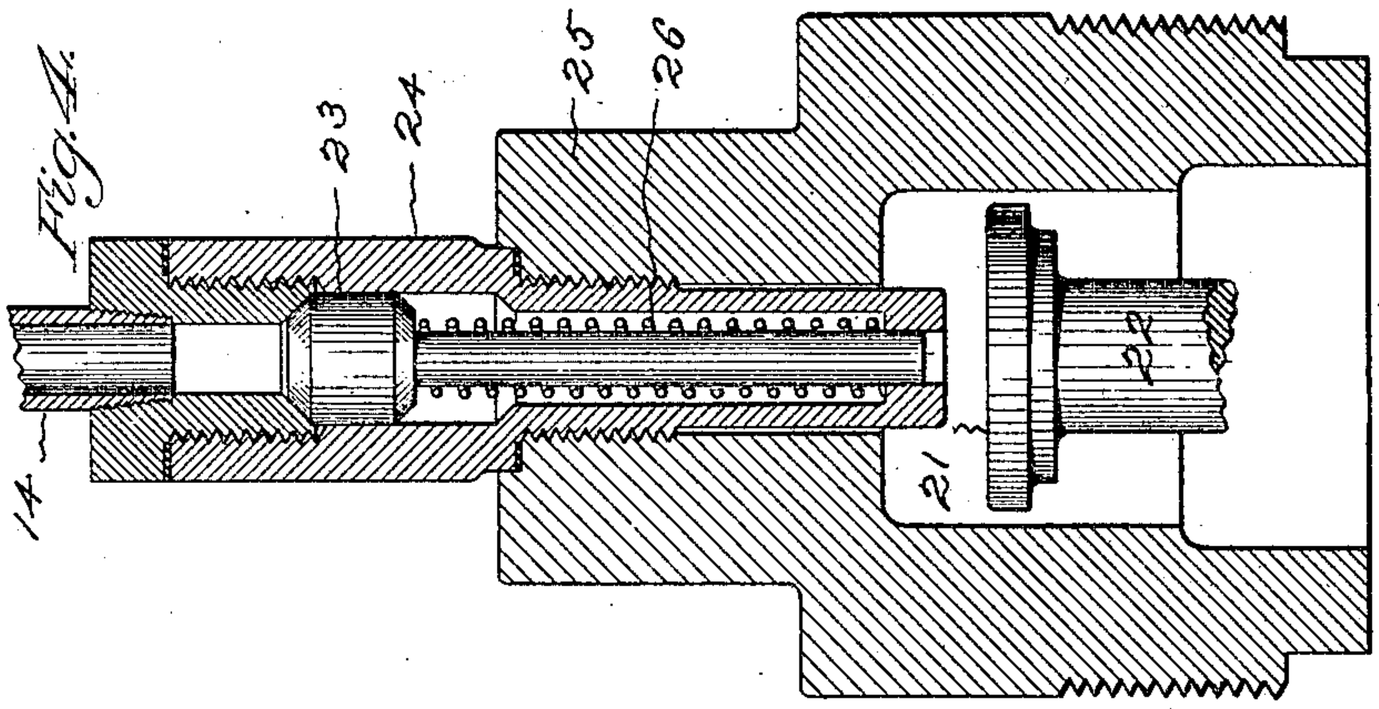


Fig. 4.



Witnesses.

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E. E. Fallow

Inventor.

Henry P. Morgan
per
Harry T. Williams
Attorney.

UNITED STATES PATENT OFFICE.

HENRY P. MORGAN, OF NORWALK, CONNECTICUT, ASSIGNOR TO THE NORWALK IRON WORKS COMPANY, OF SOUTH NORWALK, CONNECTICUT, A CORPORATION OF CONNECTICUT.

MECHANISM FOR UNLOADING AIR-COMPRESSORS.

No. 837,327. Specification of Letters Patent. Patented Dec. 4, 1906.

Application filed August 12, 1905. Serial No. 273,905.

To all whom it may concern:

Be it known that I, HENRY P. MORGAN, a citizen of the United States, residing at Norwalk, in the county of Fairfield and State of Connecticut, have invented a new and useful Mechanism for Unloading Air-Compressors, of which the following is a specification.

This invention relates to a mechanism for unloading air or gas compressors—that is, for rendering the compressing-pistons temporarily ineffective without stopping their play back and forth in the cylinders in order to relieve the motor of work when there is sufficient air at the maximum pressure for the work required.

It is particularly designed for multiple-stage compressors built for very high pressures, although it is applicable to compressors built for low pressures.

The object of the invention is to provide a simple and efficient mechanism which will unload all of the cylinders simultaneously, so that neither piston will continue to be effective after another has been relieved, and thereby produce different degrees of pressure in the different cylinders and develop excess quantities of heat by reason of widely-varying degrees of compression.

Stated in general terms, this invention is carried out by locating a small plunger adjacent to an inlet-valve of each cylinder and arranging connections between the chambers containing these plungers and the discharge of the high-pressure cylinder in such manner that when the receiving-reservoir is full and it is desirable to unload the compressor, so as to relieve the motor of work without shutting it down or stopping the reciprocations of the pistons, the excess air-pressure in the discharge will cause the small plungers to simultaneously force in and temporarily hold open the inlet-valves, so that the air each piston takes in when moving in one direction will be immediately rejected when the piston moves in the reverse direction. As a result of this the discharge-valves of each cylinder remain seated and retain on the discharge side the same pressure that existed previous to the operation of the unloading mechanism.

The invention is illustrated and will be described as applied to a three-stage compressor of the general proportions of a machine designed to compress air to about one thousand pounds pressure, the first or intake cylinder compressing to about fifty pounds, the second or intermediate cylinder compressing to about three hundred pounds, and the third or high-pressure cylinder compressing to about one thousand pounds.

Figure 1 of the views shows a side elevation of so much of one of these compressors provided with an unloading mechanism as is necessary to illustrate the invention. Fig. 2 shows, on larger scale, a front elevation, with parts cut in section, of the controlling part of the unloading mechanism. Fig. 3 shows a side elevation, with parts cut in section, of the controlling means. Fig. 4 shows an enlarged sectional view of the means provided for rendering inactive an inlet-valve of the first cylinder. Fig. 5 shows a sectional view of the means provided for rendering inactive an inlet-valve of the second cylinder, and Fig. 6 shows a sectional view of the means for rendering inactive an inlet-valve of the third cylinder.

The first or intake cylinder 1, the second or intermediate cylinder 2, and the third or high-pressure cylinder 3 are of ordinary construction, are connected in the usual manner, and are provided with the ordinary pistons common to multiple-stage compressors.

The controlling part 4 of the unloading mechanism illustrated has a weighted plunger 5, that is movable in a casing 6, which is fastened to the side of the compressor. The inlet at the lower end of the casing may be connected by a pipe 7 with the discharge-pipe 8 from the high-pressure cylinder or with the reservoir or receiver into which the air is forced from the high-pressure cylinder. In this connection is a common safety or relief valve 9, which is set to allow air when it reaches the predetermined maximum pressure in the system above or beyond the discharge of the third or high-pressure cylinder—say one thousand pounds—to pass into the casing beneath the plunger. Air that passes this safety-valve exerts a pressure against the lower end of and lifts the plunger. A branch 10 leads from the high-pressure pipe 7 to a chamber 32 in a head 11, that is supported above the plunger-casing. The passage 12 in the head from this branch to the chamber is controlled by a reducing-valve 13, which may be set so as to maintain air in the chamber at

about one hundred pounds pressure. A pipe 14 leads from the passage 15, that communicates with the chamber in the head, to a chamber adjacent to an inlet-valve 33 of each of the compressor-cylinders. A puppet-valve 16 is arranged in the head to control the passage 15 from the chamber to the pipe that leads to the inlet-valves. When the weighted plunger is lifted by the excess air, which may be under a pressure of, say, five pounds, that passes the safety or relief valve, it causes a tappet 17 to strike and lift the puppet-valve 16, thus allowing the air-pressure which is in the chamber in the head to be exerted in the pipe 14, that leads to the inlet-valves. The inlet-valves for the several cylinders are of common construction and, as shown in Fig. 5, each has a disk 18, adapted to open inwardly from a seat 19 and is normally drawn to the seat by a spring 20, that thrusts against a head 21 on the end of the disk-stem 22. The air from beyond the high-pressure cylinder under reduced pressure when allowed to enter the pipe 14 forces small plungers inwardly against the heads of the valve-stems, so as to hold the disks open away from their seats during the time that the weighted plunger is held lifted by the excess pressure in the system above the high-pressure cylinder.

The plunger 23, arranged adjacent to the inlet-valve of the first cylinder, as shown in Fig. 4, is supported by a plug 24, that is screwed into the cap 25, that covers the inlet-valve. On the stem of this plunger is a spring 26, which normally forces it outwardly away from the head of the valve-stem. When the pressure is allowed to enter the pipe 14, this plunger is forced against the thrust of the spring in such manner that its inner end engages the head of the valve-stem and holds the disk open.

As the plunger 27 for holding open the inlet-valve of the second cylinder is subjected on the inside to the action of air under the pressure on the outlet side of the first cylinder, which in the instance cited is substantially fifty pounds, no spring is needed, as shown in Fig. 5, to lift the plunger away from the head of the valve-stem.

The pressure about the stem of the inlet-valve of the third cylinder is equal to that on the discharge side of the second cylinder, which in the instance cited is substantially three hundred pounds, and the inner end of the stem of the plunger 28, which is arranged to open this valve, is subjected to the same pressure. As the outer end of the plunger is only subject to the action of the low pressure used for operating the plungers, which in the instance cited, is practically one hundred pounds, a vent 29 to the outer air is provided beneath the plunger, as shown in Fig. 6. In this case the inner end of the stem 30 of the plunger is provided with a head 31, made in the form of a valve, which under normal conditions is held closed by the air-pressure about the stem of the inlet-valve. In the instance cited when the valve 31 is closed and pressure is admitted above the plunger the plunger is subjected to one hundred pounds per square inch downward pressure on its large upper end and to three hundred pounds per square inch upward pressure on the valve-stem area. The areas are of such proportion that this causes the plunger to move downward; but in order to prevent the three hundred pounds pressure from accumulating under the larger area of the plunger and being exerted upward when the valve 31 is open the vent 29 is provided for the escape of the pressure when the valve 31 is open; otherwise the plunger would immediately be forced up away from the valve-stem, and thus fail to perform its function.

More than one inlet-valve may be provided with a plunger to be operated by the air-pressure, so as to render inactive the inlet-valve when the pressure beyond the discharge of the third cylinder exceeds the predetermined amount, as shown in Fig. 1.

With the construction described when the pressure in the system above or beyond the discharge of the high-pressure cylinder exceeds the predetermined amount the safety-valve opens and the weighted plunger is lifted and opens the puppet-valve, which admits the air at comparatively low pressure for operating upon the small plungers adjacent to the inlet-valves of the several cylinders. These plungers then hold inlet-valves of all of the cylinders open as long as the highest pressure exceeds the predetermined amount and the weighted plunger is held raised. When the pressure falls to normal, the weighted plunger drops and allows the puppet-valve to close. Then when the pressure in the pipe 14 drops as a result of leakage of air through the head the small plungers adjacent to the inlet-valves are forced out, so the inlet-valves may resume their normal functions.

When the inlet-valves are open, the pistons reciprocate without being required to do work, thus relieving the motor of its load and economizing power. With the inlet-valves open the discharge-valves of each cylinder remain seated and retain on the discharge side the same pressure as existed previous to the operation of the unloading mechanism, the reciprocations of the pistons merely sucking air through the inlet-valves and then ejecting it through the inlet-valves without forcing it forward.

The invention claimed is—

1. In an apparatus for relieving the pistons of a multiple-stage compressor, the combination with an inlet-valve of each cylinder, of a plunger located adjacent to and adapted to be actuated by air-pressure for rendering

inactive each inlet-valve, a connection for air extending between the discharge of the high-pressure cylinder and each plunger-chamber, a valve normally closing the air-passage through said connection, a piston adapted to open this valve, a connection for air for actuating said piston, and a valve set to open at the desired pressure in the connection to the piston-cylinder, substantially as specified.

2. In an apparatus for relieving the pistons of a multiple-stage compressor, the combination with an inlet-valve of each cylinder, of a plunger located adjacent to and adapted to be actuated by air-pressure for rendering inactive each inlet-valve, a connection for air extending between the discharge of the high-pressure cylinder and each plunger-chamber, a reducing-valve in this connection, a valve between the reducing-valve and the plunger-chamber normally closing the air-passage through said connection, a piston adapted to open this valve, a connection for air for actuating the said piston, a valve set to open at the desired pressure in the connection to the piston-cylinder, substantially as specified.

3. In an apparatus for relieving the pistons of a multiple-stage compressor, the combination with an inlet-valve of each cylinder, of a plunger located adjacent to and adapted to be actuated by air-pressure for rendering inactive each inlet-valve, a connection for air extending between the discharge of the high-pressure cylinder and each plunger-chamber, a reducing-valve in the connection, a valve between said reducing-valve and the plunger-chamber normally closing the air-passage through said connection, and means for opening said valve, upon the accumulation of an excess pressure beyond the discharge of the high-pressure cylinder, substantially as specified.

4. In an apparatus for relieving the pistons of a multiple-stage compressor, the combination with an inlet-valve of each cylinder, of a plunger located adjacent to and adapted to be actuated by air-pressure for rendering inactive each inlet-valve, a connection for air extending between the discharge of the high-pressure cylinder and each plunger-chamber, a valve normally closing the passage through said connection, and means actuated by excess pressure in the system beyond the high-pressure cylinder for opening said valve, substantially as specified.

HENRY P. MORGAN.

Witnesses:
E. HILL,
J. E. SLATER.