No. 810,759. PATENTED JAN. 23, 1906.

E. HILL.

VALVE FOR COMPOUND AIR COMPRESSORS.

APPLICATION FILED JAN. 24 1905.

Fig. 1.

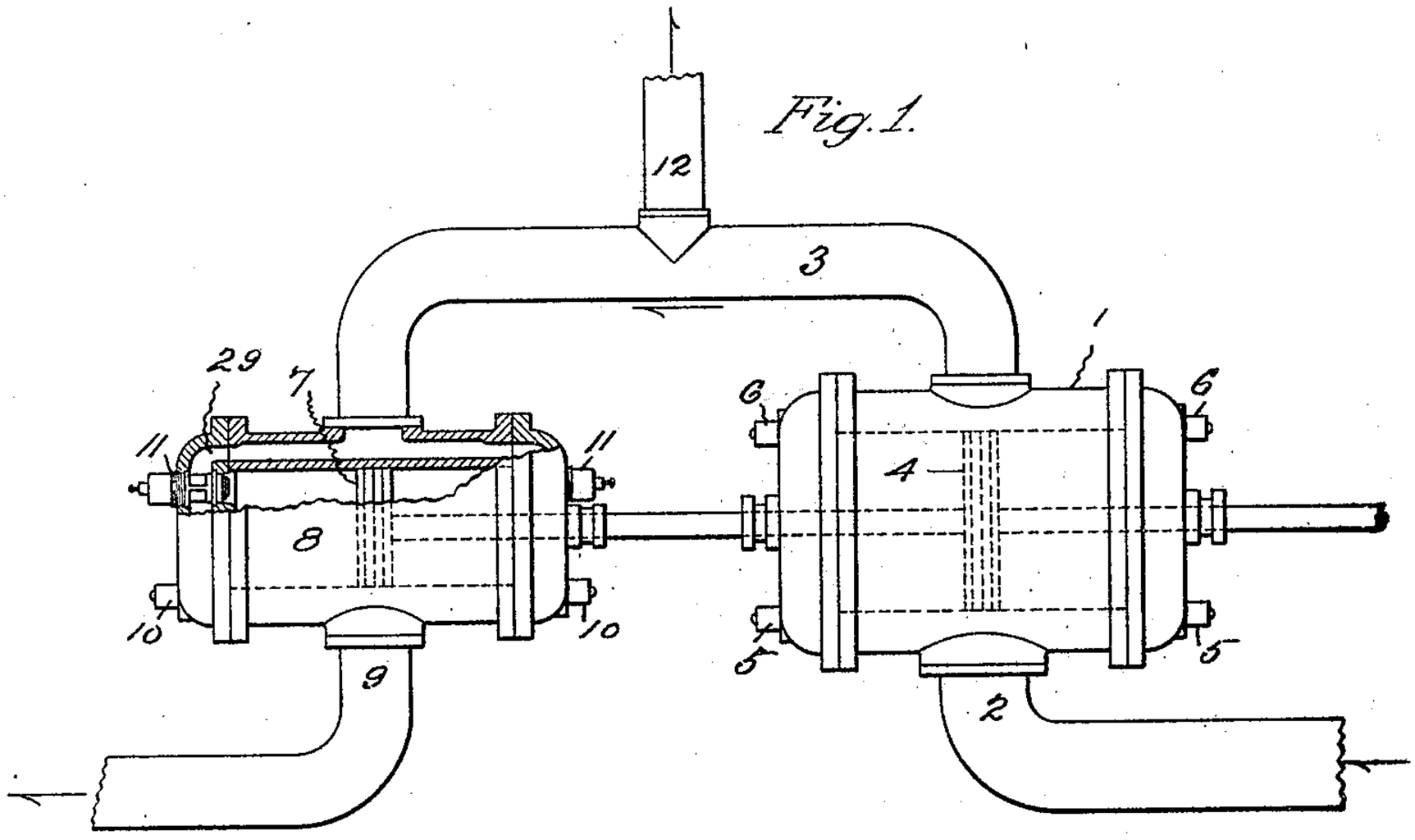
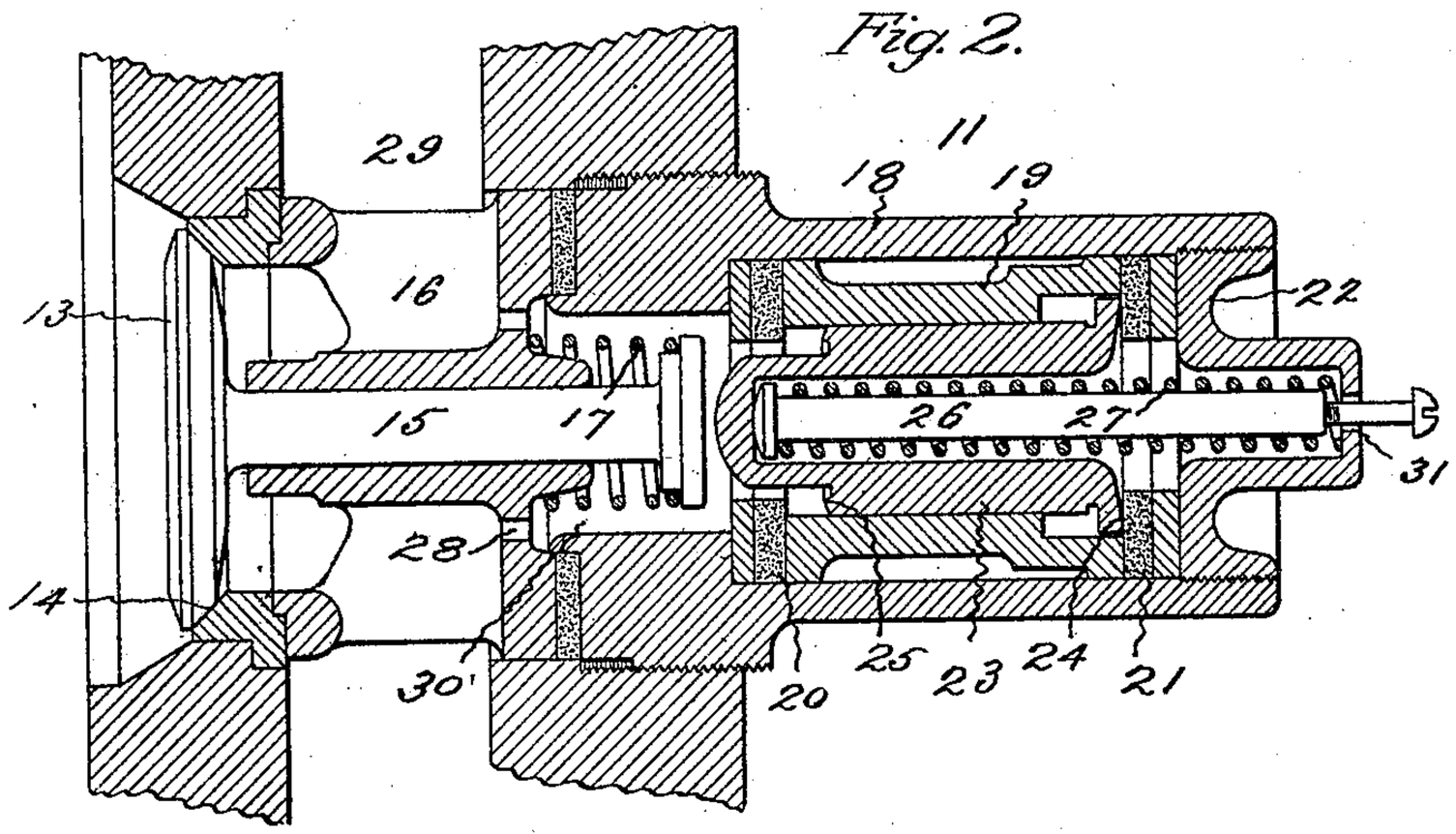


Fig. 2.



Witnesses.
C. H. Stone.
Ethel M. Lowe.

Inventor:
Ebenezer Hill
per
Harry P. Williams
Attorney.

UNITED STATES PATENT OFFICE.

EBENEZER HILL, OF NORWALK, CONNECTICUT.

VALVE FOR COMPOUND AIR-COMPRESSORS.

No. 810,759. Specification of Letters Patent. Patented Jan. 23, 1906.

Application filed January 24, 1905. Serial No. 242,498.

To all whom it may concern:

Be it known that I, EBENEZER HILL, a citizen of the United States, residing at Norwalk, in the county of Fairfield and State of Connecticut, have invented a new and useful Valve for Compound Air-Compressors, of which the following is a specification.

The invention relates to a valve for the high-pressure cylinder of a compound air-compressor which is so devised that when air is drawn from the low-pressure cylinder or from between the cylinders the piston of the high-pressure cylinder will without interrupting its movement be automatically rendered wholly or partly ineffective for a part of a stroke, a whole stroke, or several strokes in succession or intermittently, depending upon the time the pressure between the cylinders is below normal.

The valve is applicable to the high-pressure cylinder of a compound compressor, also the high-pressure cylinders of compressors having more than two cylinders, and one or more of the valves may be arranged on the intake end of a single-acting cylinder or one or both ends of a double-acting cylinder, according to the conditions.

This valve is so constructed that when the pressure in the interduct drops below normal it will be quickly thrust inward and surely held open as long as the pressure is reduced, so that for the time being the stroke or strokes of the high-pressure piston will simply cause air to flow back and forth through the port and not force air forward beyond the high-pressure cylinder and cause a reduction of volume of air in the interduct.

The object of the invention is to provide a valve of this nature which will act quickly and surely. This object is attained by arranging a differential plunger which is moved in one direction by a spring and in the other direction by the air-pressure in such manner that it will cause the valve to skip its regular function when the pressure in the interduct is below normal, as more particularly hereinafter described.

Figure 1 of the accompanying drawings represents two cylinders of a compound air-compressor which has the high-pressure cylinder provided with intake-valves that embody this invention. Fig. 2 shows a sectional view, on larger scale, of one of these intake-valves, which is held open when the pressure between the cylinders drops below the desired degree as the result of the drawing off of air at low pressure.

Air is drawn into the low-pressure cylinder 1 through the intake 2 and discharged into the interduct 3 by the reciprocations of the low-pressure piston 4, the intake-valves 5 and the discharge-valves 6 being of common construction. The reciprocations of the piston 7 draw air into the high-pressure cylinder 8 from the interduct 3 and force it into the discharge 9. The discharge-valves 10 of the high-pressure cylinder are of common construction; but the intake-valves 11 of this cylinder are what will be termed "skip-valves," as they fail to operate or skip when the pressure in the interduct drops below normal—as, for instance, when air is drawn through the outlet 12 for use at low pressure in order to render the high-pressure piston temporarily ineffective for drawing air out of the interduct. There may be one or more of these skip-valves at either or both ends of the high-pressure cylinder, and they skip action automatically a sufficient number of strokes of the high-pressure piston to reserve air enough in the interduct to keep the low pressure constant. The skip-valve disk 13 opens inwardly from its seat 14 as the high-pressure piston moves from it, so as to allow air to flow from the interduct into the cylinder, and closes outwardly against its seat when the piston moves toward it, so that the air cannot pass back into the interduct. The stem 15 of this disk is loosely supported by a hub that forms a part of a cage 16, which is inserted in an opening in the end of the cylinder, so as to hold the valve-seat in position. Thrusting between the head at the outer end of the stem and the cage is a spring 17, which tends to draw the disk to its seat.

A cylindrical case 18 is screwed into an opening in the cylinder-head against a packing between the case and the cage, so as to hold the packing, cage, and valve-seat securely in place. In the case is a sleeve 19. At the inner end of the sleeve is a packing 20, and at the outer end of the sleeve is a packing 21. These packings and the sleeve are held in place by a plug 22, which is screwed into the outer end of the case. A hollow plunger 23 fits loosely in the sleeve. This plunger at its outer end has a flange 24, which is larger in diameter than the body of the plunger, and at its inner end has a knife-edge or rib 25, which is smaller in diameter than the body of

the plunger. The flange is adapted to seat tightly against the outer packing when the plunger is at the outer limit of its movement, and the edge is adapted to seat tightly against the inner packing when the plunger is at the inner limit of its movement. In the plunger and plug is a rod 26, and thrusting between the head of this rod and the plug is a spring 27. This spring and rod tend to force the plunger inwardly toward the end of the disk-stem. Passages 28 are made through the cage, so that the intake-passage 29, which communicates in the usual way with the interduct, will communicate with the chamber 30 in the case and the plunger be subjected to the intake-pressure. As the plunger does not fit the sleeve perfectly tight, air can leak outwardly between the plunger and the sleeve and exert its force against the inner face of the flange on the end of the plunger, which flange loosely fits the enlarged part of the sleeve, so that air can escape around it into the plug and through the opening 31 in the end of the plug to the atmosphere. When the pressure in the intake-passage, which is the same as in the interduct between the two cylinders, is normal, that pressure is exerted against the inner end of the plunger and the plunger-flange and forces the plunger back against the thrust of the spring, so that the flange seats tightly against the outer packing. With the plunger in this position the spring inside is under its greatest tension, and as the flange seats tightly against the outer packing air cannot escape around the flange and through the plug to the atmosphere. When the pressure in the intake-passage drops below normal—as, for instance, when air is being drawn at low pressure from the interduct—the pressure on the inner end of the plunger and the plunger-flange becomes reduced to such an extent that the spring will drive the plunger inwardly and cause it to force the valve-disk away from its seat. The plunger remains in this positon, holding the valve open, as long as the pressure in the intake-passage is below normal. As soon as the plunger starts inwardly and the flange moves away from the outer seat the pressure becomes equal against the opposite sides of the flange, for the reason that the edge of the flange does not fit the wall of the sleeve closely. As the result of this the pressure opposing the thrust of the spring, which naturally becomes weaker as it expands, is only that on an area having the diameter of the body of the plunger. After the plunger has moved way in and the inner edge is seated against the inner packing the pressure which is exerted against the thrust of the spring is only that on an area which has the same diameter as the inner seating edge, so that when the spring has expanded to its full extent and is weakest it is required to resist a much less pressure than it did when the plunger was at the outer limit of its movement. When the pressure in the intake-passage rises to normal, that pressure is first exerted against an area having the diameter of the seating edge and then when that edge has moved away from its seat against an area having the diameter of the body of the plunger and finally when the plunger is way out and the flange is seated against an area having the diameter of the flange. As long as a skip-valve is held open by the plunger the reciprocations of the piston in the high-pressure cylinder merely cause air to flow in and out the port, and thus the piston will not perform its usual function. The reduction of pressure in the interduct may be such as to cause the valve to skip—that is, to remain open—for only an instant or for some time, and the piston may thus be rendered ineffective for a part of a stroke, a whole stroke, or several strokes in succession, or intermittently, and when thus rendered ineffective the piston does not draw air from the interduct and force it forward, so as to reduce the volume of air between the cylinders, and thus cause a variation of the pressure of the air which is being drawn off from between the cylinders for low-pressure use. As a result of the differential areas of the seats at the ends the plunger is held back when the spring is the stiffest by pressure on a large area, and when the spring is weakest it only has to overcome a pressure on a small area. This also causes the plunger to act quickly, for when moving inwardly the areas of pressure diminish and when moving outwardly the areas of pressure increase.

The invention claimed is—

1. A valve for the intake-passage of an air-compressor having a valve-disk adapted to open and close the passage, a plunger movable toward and from the disk, said plunger having a surface at its inner end that is exposed to the air-pressure in the intake-passage when the plunger is at its inner limit, and a larger surface back from its inner end that is exposed to the air-pressure in the intake-passage when the plunger is moved from its inner limit, whereby the pressure against the smaller surface will tend to move the plunger away from the disk and pressure against the larger surface will tend to hold the plunger away from the disk, and a spring arranged to force the plunger against the air-pressure when the pressure drops below normal and cause the plunger to interfere with the ordinary action of the disk, substantially as specified.

2. A valve for an air-compressor having an inwardly-opening valve-disk, a spring tending to draw the disk to its seat, a plunger movable toward and from the disk, said plunger having surfaces with areas of different extent arranged to be subject to the air-pressure on the intake side of the disk, the

smaller surface only being subject to the air-pressure when the plunger is at its inner limit and both the smaller and larger surfaces being subject to the air-pressure when the plunger is back from its inner limit, and a spring arranged to force the plunger against the air-pressure when the pressure drops below normal and cause the plunger to interfere with the ordinary action of the disk, substantially as specified.

3. A valve for an air-compressor having a valve-disk, a plunger movable toward and from the disk and having surfaces with areas of different extent arranged to be subject to the air-pressure on the intake side of the disk, a seat at the inner limit of movement of the plunger against which the inner end of the plunger seats and leaves only the smaller surfaces exposed to the air-pressure when the plunger is at its inner limit, a seat at the outer limit of movement of the plunger against which the outer end of the plunger seats so that the air-pressure will be exerted against the smaller and the larger surfaces of the plunger when the plunger is at its outer limit, and a spring arranged to force the plunger against the air-pressure when the pressure drops below normal and cause the plunger to interfere with the ordinary action of the disk, substantially as specified.

4. A valve for an air-compressor having a valve-disk, a plunger movable toward and from the disk, said plunger having a seating edge at its inner end that is less in diameter than the diameter of the body of the plunger, and a seating-flange at its outer end that is greater in diameter than the diameter of the body of the plunger, a seat against which the inner edge seats when the plunger is at its inner limit, a seat against which the outer flange seats when the plunger is at its outer limit, and a spring arranged to thrust the plunger against the air-pressure when the pressure drops below normal and cause the plunger to interfere with the ordinary action of the disk, substantially as specified.

5. A valve for an air-compressor having a valve-disk, a spring tending to draw the disk to its seat, a case, a sleeve in the case, a seat at each end of the sleeve, a plunger movable in the sleeve toward and from the seats and subject to the air-pressure on the intake side of the disk, said plunger having a seating edge at its inner end and a larger seating-flange at its outer end, and a spring tending to thrust the plunger against the air-pressure toward the disk and cause an interference with the ordinary action of the disk, substantially as specified.

6. A valve for an air-compressor having a valve-disk, a spring tending to draw the disk to its seat, a case, a sleeve in the case, a packing at each end of the sleeve, a nut holding the sleeve and packings in position, a plunger movable in the sleeve toward and from the packings, said plunger being subject to the air-pressure on the intake side of the disk and having a reduced seating edge at its inner end adapted to seat against the inner packing and an enlarged seating-flange at its outer end adapted to seat against the outer packing, and a spring tending to thrust the plunger against the air-pressure toward the disk, substantially as specified.

EBENEZER HILL.

Witnesses:
E. HILL, Jr.,
HOWARD H. MOSSMAN.