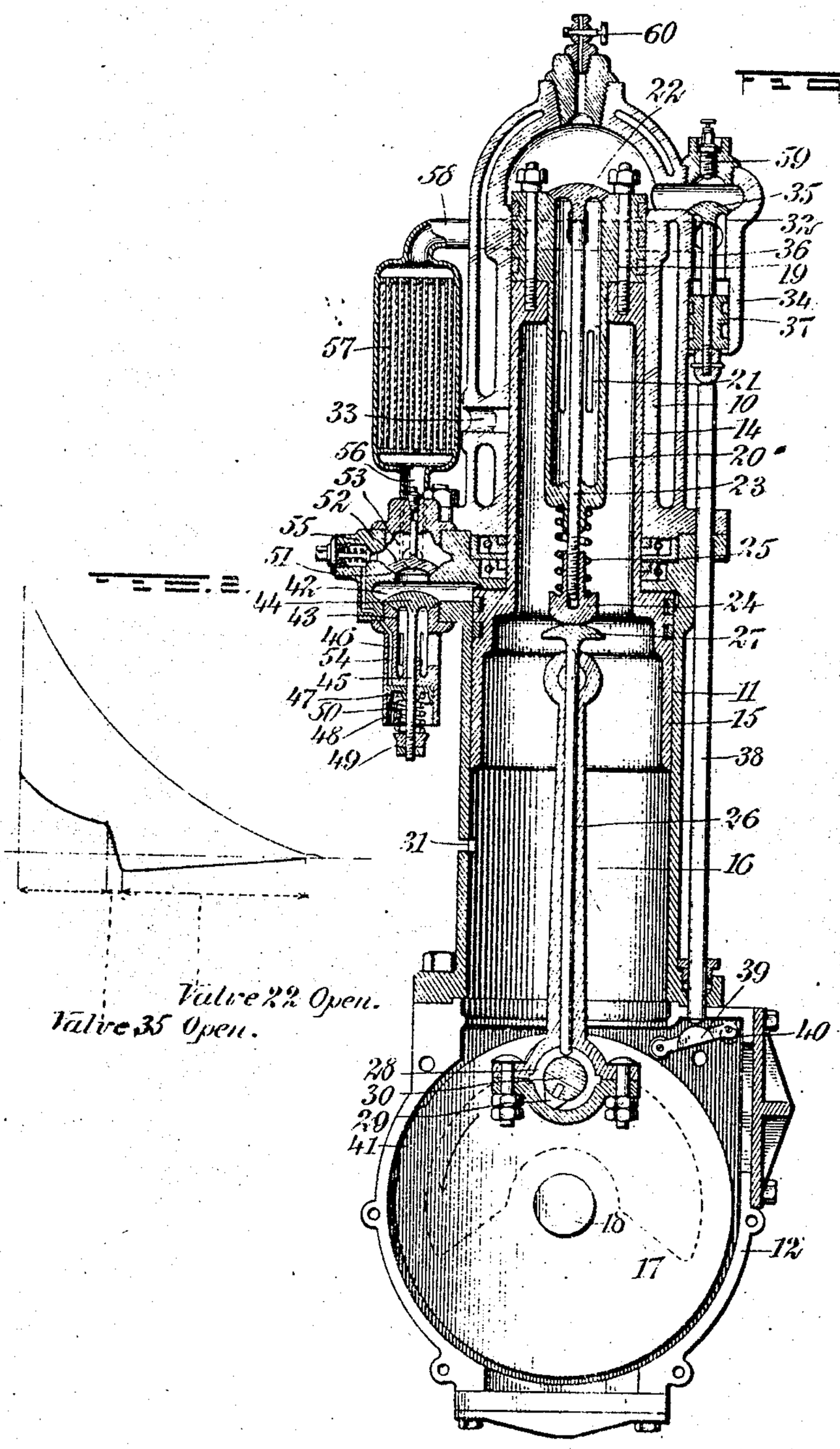
No. 881,040. PATENTED MAR. 3, 1908.

H. W. ADAMS.

COMPRESSOR FOR INTERNAL COMBUSTION ENGINES.

APPLICATION FILED JULY 11, 1905.

Fig. 1.



Valve 22 Open.

Valve 35 Open.

WITNESSES:

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HARRY WALTER ADAMS, OF FARGO, NORTH DAKOTA, ASSIGNOR OF ONE-HALF TO PHILIP W. FARNHAM, OF FARGO, NORTH DAKOTA.

COMPRESSOR FOR INTERNAL-COMBUSTION ENGINES.

No. 881,040. Specification of Letters Patent. Patented March 3, 1908.

Application filed July 11, 1905. Serial No. 269,154.

To all whom it may concern:

Be it known that I, HARRY WALTER ADAMS, a citizen of the United States, and a resident of Fargo, in the county of Cass and State of North Dakota, have invented a new and Improved Compressor for Internal-Combustion Engines, of which the following is a full, clear, and exact description.

This invention relates to a compressor, and more particularly to means for controlling the inlet valve according to the pressure created in the delivery pipe from the compressor.

My improved construction is particularly applicable to two-cycle internal combustion engines, and in the accompanying drawings I have illustrated an engine provided with a differential piston having a valve controlled port therein, and operating with a differential cylinder and closed crank chamber in such a manner that at the end of the expansion or working stroke the said piston valve will be opened, and the compressed air in the crank case admitted to the working cylinder to scavenge the same, and so that upon the in-stroke of the piston the air in the crank case will be rarefied, and upon opening the piston valve by means provided for this purpose atmospheric pressure will force into the crank case such products of combustion as may still reside in the working cylinder of the engine. Simultaneously with these operations, the larger diameter of the differential piston serves in connection with certain peculiar devices to compress a body of air which is led to the admission port of the working cylinder, and during the in-stroke, after the piston valve is closed, the valve controlling the admission port is opened and the whole or a part of this compressed air mixed with the fuel is entered into the working cylinder, the charge being compressed during the latter portion of the in-stroke of the piston and ignited and burned in the usual manner.

The construction of the engine of which my improved compressor forms a part, is described and claimed in my co-pending application No. 344,393, filed November 21, 1906, while the piston valve and its operating mechanism is described and claimed in my co-pending application No. 344,394, filed November 21, 1906.

The invention resides in certain special features of construction and relative arrangement of elements which will be fully set forth hereinafter and particularly pointed out in the claims.

Reference is had to the accompanying drawings which illustrate as an example the preferred embodiment of my invention, in which drawings

Figure 1 is a vertical section of the engine; and Fig. 2 is a diagram illustrating the cycle of operations and the approximate relative pressures in the working cylinders.

Referring to Fig. 1, 10 indicates the working cylinder, 11 the enlarged extension thereof forming the compressor cylinder, and 12 indicates the closed crank case or chamber. 14 indicates the working piston, and 15 the compressor piston, which pistons are formed as one as the drawing shows. The piston is connected by a rod 16 with the crank disks 17 of the shaft 18. The working piston 14 has a cap 19 bolted thereto, and this cap is formed with a tubular stem guide 20 which projects through an opening in the piston toward the crank case. Said guide has openings 21 therein, placing it in communication with the crank case. The upper end of the guide 20 is open and is commanded by a valve 22 which opens into the working cylinder. The stem 23 of this valve passes through the guide 20, and has a nut 24 on its lower end engaged by a spring 25 which bears between the nut and the lower end of the guide 20 so as yieldingly to seat the valve 22. Fitted loosely in and extending longitudinally through the connecting rod 16 is a valve operating rod 26 having a button 27 on its upper end which engages the nut 24. The lower end of the connecting rod is formed with an annular channel 28 which receives loosely a cam 29 fastened to a wrist pin 30 and adapted to engage the lower end of the valve rod 26. It will thus be seen that the valve 22 is yieldingly seated; is capable of opening automatically upon superior pressure in the crank chamber, and is periodically opened mechanically by the cam 29 striking the valve rod 26, lifting the same, and open-

ing the valve 22 through its stem 23. This periodic mechanical operation of the valve 22 occurs only during each revolution of the crank shaft.

The enlarged compressor cylinder 11 has an air admission port 31 therein. This port is located near the top center or inward-most position of the piston, so that it is uncovered only when the piston is at or near the top center position. Upon the downward stroke of the piston air is compressed in the crank case, after the port 31 is closed and when pressure is relieved in the working cylinder the valve 22 is automatically opened, permitting this air to flow into the working cylinder to scavenge it. Upon the upward movement of the piston the air in the crank case is rarefied, until the port 31 is uncovered, and during the inward stroke the valve 22 is mechanically opened through the action of the cam 29 and its appurtenant parts, thus permitting such products of combustion as may yet reside in the working cylinder to flow into the crank case.

The working cylinder 10 is provided with an admission port 32 and with an exhaust port 33. The port 32 communicates with the compression space of the working cylinder, while the port 33 is at the outer or bottom center position of the piston so that it is uncovered only when the end of the working stroke is reached. The port 32 communicates with a cylindric extension 34, and said port is commanded by a valve 35 which opens into the working cylinder. The stem 36 of this valve projects into the cylindric extension 34 and carries a piston 37 which is fitted fluid tight in said extension. By this means the admission valve 35 is balanced against any pressure tending to move it into open position. The lower end of the stem 36 is engaged by a valve operating rod 38 which passes down into the crank case, and has its lower end engaged by a lever 39. This lever is fulcrumed on an eccentric pin 40, said pin being mounted in the crank case and having a portion extending to the outside thereof, to permit turning the pin, thus adjusting the position of the fulcrum of the lever 39 and consequently adjusting the movement which is imparted to the valve rod 38 through said lever. At its free end the lever 39 is engaged by a cam 41 which is formed on the periphery of one of the crank disks 17 so as periodically to lift the lever and throw the rod 38 and stem 36 to open the valve 35. By means of the adjustable eccentric pin 40, the time during which the valve is held open and consequently the volume of the working charge may be regulated.

Communicating with the upper end of the compressor cylinder 11 is a chambered extension 42 which has an air admission port 43 therein. This port is commanded by an inwardly opening valve 44, the stem 45 of which passes through a cage 46 projecting from the port 43, and extends loosely through a piston 47. This piston is mounted in a cylindric extension 48 of the cage 46. At its lower extremity the stem 45 carries a stop nut 49, and engaged between said nut and the piston 47 is a spring 50 which tends yieldingly to seat the valve 44. Said chambered extension 42 has a discharge port 51 therein, and this port is commanded by a check valve 52 which opens against pressure in the chambered extension 42. Said valve 52 permits the discharge from the chamber 42 into a chamber 53. Passing from the chamber 53 to the cylindric extension 48 of the cage 46 is a pressure duct 54, and this passage or duct is commanded by a spring seated valve 55. The spring of the valve 55 is intended to hold said valve seated against the pre-determined pressure of the chamber 53. When this pre-determined pressure is exceeded, the valve 55 opens and said pressure passes through the duct 54 into the cylinder 48 to move the piston 47 downward, thus increasing the tension of the spring 50. By means of the nuts 49 the tension of the spring 50 may be increased so as to restrict the opening of the valve 44, or it may increase until said valve is held closed at all times. This diminishes or cuts off, as the case may be, the air admitted to the compressor cylinder, and thus automatically regulates the compression therein. When the pressure in the chamber 53 falls, the piston 47 moves back and relaxes its pressure on the spring 50. Leading from the chamber 53 is a passage 56 which extends to a cooler 57 through which water or other cooling medium is circulated. From the cooler 57 a duct 58 leads to the tubular extension 34 communicating with the interior thereof between the valve 35 and piston 37.

59 indicates an igniting device of any desired sort, and 60 indicates a relief cock which may, if desired, be placed in the head of the working cylinder. The portion 15 of the piston working in the part 11 of the cylinder, and coacting with the valves 44 and 52, serves, therefore, to compress atmospheric air into the cooler 57 and ducts 56 and 58, this air being retained and constantly cooled until needed to form part of the combustible or explosive mixture entered into the working cylinder.

The organized operation of the engine may be traced as follows: Assuming the parts to be in the position shown in Fig. 1 and revolving in the direction of the arrow applied thereto, upon a down-stroke or working stroke of the piston, the port 31 is covered and compression takes place in the crank case. This continues until the piston reaches its bottom center. At this time the exhaust

port 23 is uncovered and the pressure in the working cylinder falls to atmospheric. The valve 22 then automatically opens, and the compressed air in the crank case blows into the working cylinder to scavenge it. During this working stroke of the piston the valve 44 will be opened and a charge of atmospheric air drawn into the compressor cylinder 11. Upon the following in-stroke of the piston the air in the cylinder 11 will be compressed into the storage chamber provided by the elements 56, 57 and 58. At this time the inward movement of the piston rarefies the air in the crank case and the cam 29 will then act to open the valve 22 permitting such products of combustion as may yet reside in the working cylinder to flow into the crank case. At or approximately at the middle of the in-stroke the valve 22 is closed, and at this time the admission valve 35 is opened and the air under pressure in the elements 56, 57 and 58 enters the working cylinder, this air carrying with it a proper proportion of the combustible which is introduced into the air on its way to the admission port.

In the case of a hydrocarbon oil engine, the oil may be supplied, for example, through a nozzle in the pipe 58 so that it will be picked up by the air and vaporized, and instantly thereafter admitted to the cylinder. In this connection it will be observed that the working charge enters the working cylinder under and by reason of its pressure, and that this action is to some extent assisted by the rarefied condition of the air in the working cylinder during the period instantly following the closure of the valve 22 and the opening of the valve 35. After this, the remainder of the in-stroke of the piston is employed to compress the charge, and at or near the top center the charge is ignited and burned in the usual manner. The cycle of operations and relative pressures are well illustrated in the theoretical diagram given in Fig. 2. This diagram represents the pressures in the working cylinder. It will be seen that starting at the atmosphere line on the in-stroke the pressure falls below the atmosphere, while the valve 22 is opened. When this valve closes and the valve 35 is opened the compressed charge is admitted into the working cylinder causing the pressure to rise above the atmosphere, and when the valve 35 is closed compression begins until the top center is reached. At the ignition point the pressure rises rapidly and will expand during the whole of the working stroke of the engine. It will be observed that in this manner expansion of the burning gases may be carried as near to atmosphere pressure as may be deemed expedient, since the compression of the charge occurs during only a part of the in-stroke, and expansion throughout the whole of the out-stroke. By properly proportioning the area of the compression space any desired initial pressure may be secured.

Having thus described the preferred form of my invention, what I claim as new and desire to secure by Letters Patent is:

1. A compressor having an inlet valve, a conduit for the delivery of compressed fluid, an exhaust valve controlling said conduit, a coil spring for normally holding the inlet valve in its closed position, and a movable member having one surface thereof subjected to the pressure of the gas in said delivery conduit beyond said exhaust valve and for increasing the tension of the spring and increasing the resistance to the opening of the inlet valve as the pressure within said delivery conduit increases.

2. A compressor, an admission valve therefor, a cylindrical chamber, a piston within said chamber, a valve stem carried by said valve and extending through said chamber, resilient means connecting said piston and said valve stem, and means having a passage therein communicating to said chamber the pressure developed by the compressor, whereby to automatically govern the admission valve.

3. A compressor, an admission valve therefor, a cylindrical chamber, a piston within said chamber, a valve stem carried by said valve and extending through said chamber, resilient means connecting said piston and said valve stem, means having a passage therein communicating to said chamber the pressure developed by the compressor, whereby to automatically govern the admission valve, and a yieldingly seated valve normally closing said passage and opening upon the attainment of a predetermined pressure.

4. A compressor provided with an inlet port, a valve for controlling said port, a cylindrical chamber, a piston movably mounted therein and resiliently connected to said valve, means having a passage therein to communicate to said chamber the pressure developed by the compressor, whereby the resistance to the opening of said valve is increased upon an increase of pressure beyond a predetermined limit, and a spring-pressed valve within said passage for controlling said limit.

5. A compressor provided with a single passage communicating therewith, said passage being provided with inlet and exhaust ports, valve controlling said ports, a cylindrical chamber adjacent said inlet port, a piston within said chamber and slidably mounted upon the valve stem of the inlet valve, a coil spring surrounding said valve stem and in engagement with said piston, whereby the spring offers a resistance to the opening of said valve, means forming a pas-

sage delivering the pressure created by the compressor to said piston, whereby upon the movement of said piston the resistance to the opening of said valve is increased, and a spring-pressed valve normally closing said passage and preventing the application of pressure to said piston until a predetermined limit has been reached.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

HARRY WALTER ADAMS.

Witnesses:
SIGURD LARSEN,
W. J. PRICE.