S. B. HILL.

AIR COMPRESSOR.

APPLICATION FILED SEPT. 16, 1916.

1,258,407.

Patented Mar. 5, 1918.

2 SHEETS—SHEET 1.

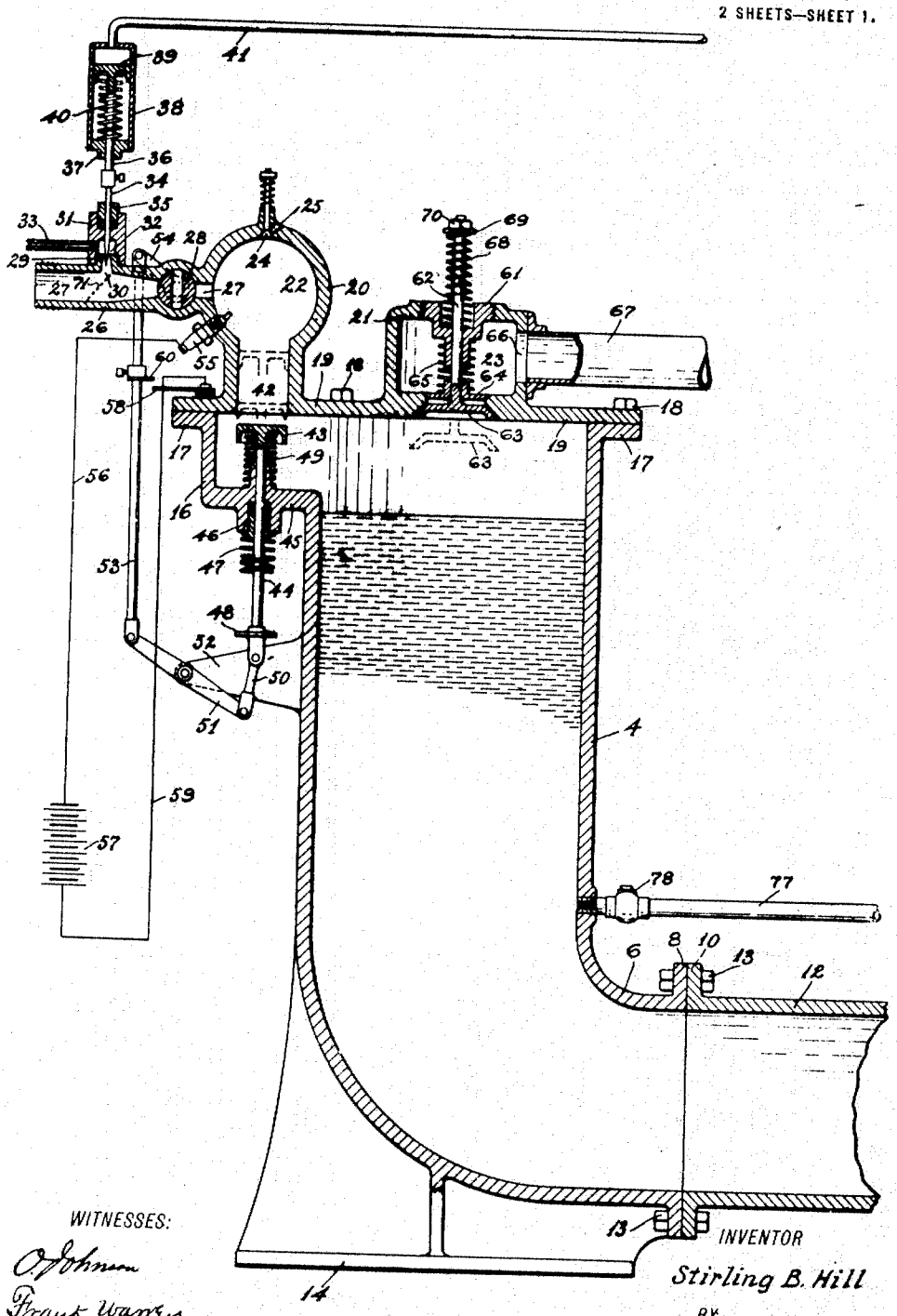


FIG. 1

WITNESSES:

O. Johnson

Frank Warren

INVENTOR

Stirling B. Hill

BY

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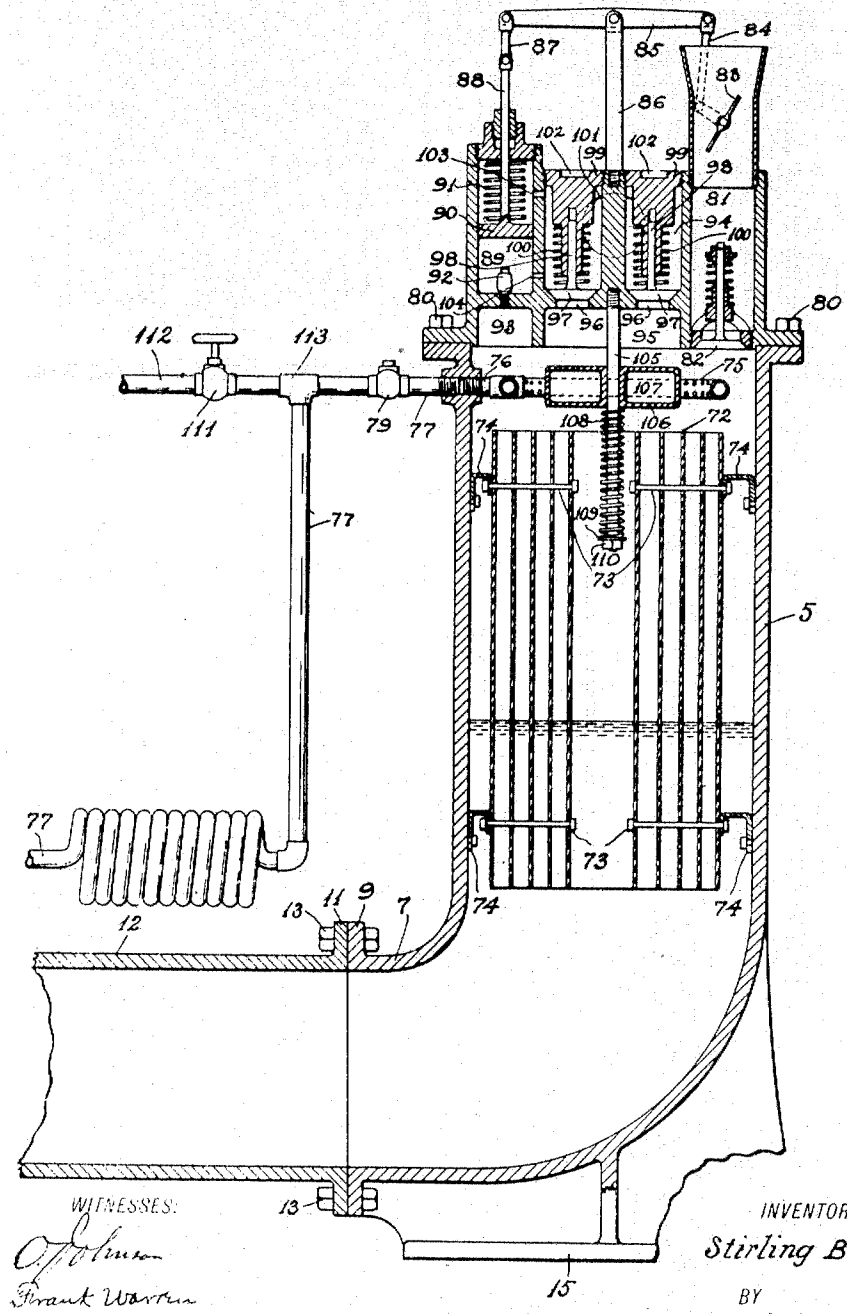


FIG. 2

WITNESSES:

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UNITED STATES PATENT OFFICE.

STIRLING B. HILL, OF SEATTLE, WASHINGTON.

AIR-COMPRESSOR.

1,258,407. Specification of Letters Patent. Patented Mar. 5, 1918.

Application filed September 16, 1916. Serial No. 120,568.

To all whom it may concern:

Be it known that I, STIRLING B. HILL, citizen of the United States, residing at Seattle, in the county of King and State of Washington, have invented a certain new and useful Improvement in Air-Compressors, of which the following is a specification.

My invention relates to improvements in air-compressors, and the object of my invention is to provide an air-compressor which shall be adapted to operate efficiently to compress air within a reservoir connected therewith, in response to the surging movement of a body of water contained in an inclosure associated therewith, which surging movement shall be effected by the combustion of separate amounts of fluid fuel successively admitted through a valve-controlled passageway into an explosion chamber communicating with said inclosure, and which air-compressor shall be so constructed that said separate amounts of fluid fuel so admitted into said explosion chamber shall be ignited automatically at proper instants of time and the valve controlling such admission shall be actuated automatically at required times in response to the effect of the combustion of said successive amounts of fluid fuel so admitted into said explosion chamber, and which air-compressor, further, shall be adapted automatically to control the admission of fluid fuel into said explosion chamber in response to changes in the pressure of air within said reservoir.

I accomplish this object by devices illustrated in the accompanying drawings wherein Figure 1 is a view in vertical mid-section of portions of a structure embodying my invention, while Fig. 2 is a view in vertical mid-section of the remaining portions of said structure.

Referring to the drawings, throughout which like reference numerals indicate like parts, 4 and 5 are containers, preferably of cast iron, having curved lower end portions 6 and 7, respectively, which project from one side to terminate each in an opening whose wall is provided with a flange, as flanges 8 and 9, respectively, which flanges 8 and 9 are adapted to engage with and be fastened by bolts 13 to the flanges 10 and 11, respectively, provided on opposite ends of a conduit 12 through which water may flow to and fro between said containers 4 and 5.

Each of said containers 4 and 5 is provided with an integral supporting base portion, as base portions 14 and 15, respectively, and the upper end portion of the container 4 has its wall provided on one side with an outwardly projecting off-set portion 16 and the upper end of said wall is provided with a flange 17 that extends thereabout.

Secured to the top surface of the flange 17, by bolts 18, is a cover 19 from the top side of which project upwardly integral walls 20 and 21 which serve to form two chambers 22 and 23, respectively.

In the topmost portion of the wall 20 is disposed an inlet check-valve 24 which may permit air to be drawn into the chamber 22 through a passageway 25, but which will prevent an outward flow of fluid through said passageway 25.

As shown in Fig. 1, integral with the wall 20 is a horizontally extended nipple 26 through which is a passageway 27 which is controlled by a rotary valve 28, the outer end of said nipple 26 being provided with a screw-thread to adapt it to be connected with an air supply pipe, not shown, which may conduct air under pressure into the passageway 27 through said nipple 26.

On the top side of the wall of the nipple 26 is an externally screw-threaded boss 29 through which is an inlet passageway 30 and to which is secured a needle-valve case 31 whose interior chamber 32 is connected with a fluid fuel supply pipe 33 that may be extended to a source of supply of fluid fuel.

The inlet passageway 30 is controlled by a needle-valve 34 whose shank is disposed to extend upwardly through a packing gland 35 to connect with a piston-rod 36 that extends downwardly through the bottom head 37 of a hollow cylinder 38.

Within said hollow cylinder 38 the piston-rod 36 is integrally connected with a piston 39 which is adapted to be depressed against the force of a helical compression spring 40

in response to the force of compressed air that may be admitted into the cylinder 38 at a point above the piston 39 through a valve-controlled pipe 41 that may be extended to a reservoir of compressed air not shown.

I have not shown any supporting means for maintaining the cylinder 38 in its required fixed position with relation to the needle-valve case 31, since suitable means for such purpose will readily suggest themselves to one skilled in the art.

Extending from the chamber 22 downwardly is a cylindrically formed passageway 42 and concentrically disposed therewith is a circular valve 43 provided with an integral valve-stem 44 that is slidably disposed to extend downwardly through bearings formed in the horizontal wall 45 of the off-set portion 16; said valve-stem 44 being thus adapted to be vertically movable whereby the circular valve 43 may be projected upwardly into the passageway 42 and be wholly withdrawn downwardly therefrom.

Associated with the underside of the horizontal wall 45 and surrounding the valve-stem 44 is a packing gland 46, to the lower end of which is attached a helical compression spring 47 which surrounds the valve-stem 44 and which serves as a buffer against which a disk 48 may engage, which disk 48 is concentrically secured to the lower end portion of said valve-stem 44.

Extending between the underside of the circular valve 43 and the top side of the horizontal wall 45 is a compression spring 49 whose force tends to cause said valve 43 to be projected upwardly into the passageway 42.

The lower end of the valve-stem 44 is articulated with one end of a link 50 whose other end is articulated with one end of a lever 51 which is fulcrumed to a bracket 52 while its other end is articulated with the lower end of a connecting rod 53 whose upper end is articulated with a crank-arm 54 provided on an end of the rotary valve 28, as clearly indicated in Fig. 1, whereby when the valve 43 rises into the passageway 42 the crank-arm 54 will be moved downwardly to open the passageway 27, and vice versa.

Extending through the wall of the chamber 22 at a point beneath the nipple 26 is a spark-plug socket within which is disposed a spark-plug 55, to which spark-plug 55 is a conducting wire 56 which is extended to connect with one terminal of a battery 57 whose other terminal is connected to an insulated contact spring 58 by conducting wire 59.

The contact spring 58 is disposed so that its free end shall be in the path of a contact member 60 which is adjustably mounted on the connecting rod 53, in the manner indicated in Fig. 1, whereby vertical movements of said connecting rod 53 may actuate said contact member 60 to open and close the spark-plug circuit at required instants of time.

The horizontal top portion of the wall 21 which incloses the chamber 23 is provided with a screw-threaded hole within which is disposed a valve-stem guide 61, and slidably disposed to extend through such guide 61 is a valve-stem 62 upon whose inner lower end is an integral beveled disk valve 63 which is adapted to be seated on the lower beveled edge of a passageway extending from the chamber 23 to the interior of the container 4 through the cover 19 whereby when said valve-stem 62 moves to its uppermost position, as indicated in Fig. 1, then such passageway will be closed, while a downward movement of said valve-stem 62 will cause said disk 63 to be disengaged from its seat to move downwardly into the interior of the chamber 4 to its position indicated by dotted lines in Fig. 1.

Within the chamber 23 is another beveled disk valve 64 which is slidably disposed on the valve-stem 62 and whose edges may engage with the upper beveled edge of the passageway extending between the chamber 23 and the interior of the container 24, and such disk valve 64 is normally maintained in its seat by a helical compression spring 65 which extends between the surface of said disk valve 64 and the under portion of the valve-stem guide 61.

Extending through the wall 21 of the chamber 23 is an exhaust passageway 66 which leads into an exhaust pipe 67 which may be extended to a desired distant point.

Surrounding the valve-stem 62 is a helical compression spring 68 which extends between the valve-stem guide 61 and a washer 69 fixed on the upper end portion of the valve-stem 62 where it is secured by a nut 70; said helical compression spring 68 serving normally to counteract the force of gravity exerted by the weight of said valve-stem 62 and its attached parts and hold the valve 63 to its seat.

Within the nipple 26 adjacent to the passageway 30 is diagonally disposed a strainer 71, indicated in dotted line, which strainer 71 serves to spray the fluid that passes through said passageway 30 into the chamber 22.

Referring now to Fig. 2, within the container 5 is a metal coil 72, preferably of sheet copper, whose spirally formed convolutions are spaced apart to admit water therebetween, and whose form is maintained by stay-bolts 73 which are secured to brackets 74 that are fastened to the inner surface of the vertical walls of said chamber 5.

The metal coil 72 serves to absorb heat from air that may be compressed within the upper portion of the container 5 in response to the rising of water that may be contained therein and such coil 72 may be cooled by such water aided by water that may be sprinkled upon it by a sprinkler 75 made of a perforated pipe bent into the form of a circle and disposed above the top end of said coil 72 and there supported by a nipple 76 that is screwed into a hole which extends through the vertical wall of said container 5 adjacent to its upper end portion, there being a pipe 77 connected with the outer end of said hole which pipe 77 is extended to connect with the lower portion of the interior space within the container 4, as indicated in Fig. 1, whereby water, under pressure, may flow from said container 4 into said sprinkler 75, said pipe including a coiled portion which may be subjected to contact with ice or with a cooling mixture in a well known manner, whereby the water passing therethrough may be cooled.

Check-valves 78 and 79 are associated with said pipe 77 in such manner as will permit water to flow therethrough only in the direction toward the sprinkler 75.

Disposed to rest upon the flanged upper end of the container 5 and secured thereto by bolts 80 is a structure embodying mechanism and valves adapted automatically to control the flow of air into and out from the interior of the container 5, through which structure is an inlet passageway 81 for air that extends downwardly into the top portion of the interior space of the container 5, said passageway 81 being provided with a check-valve 82 which serves to prevent the passage of air from the container 5 upwardly therethrough and also being provided with a damper 83 which is operatively connected by a connecting rod 84 with one end of a lever 85 which is fulcrumed on the top end portion of a vertically disposed stud 86 which extends upwardly from the top of said structure, while the other end of said lever 85 is articulated with a connecting rod 87 which connects with a piston-rod 88 which extends downwardly into a cylindrically formed chamber 89 where its lower end is provided with a piston 90.

Extending between the piston 90 and the top wall of the chamber 89 is a helical compression spring 91 whose force tends to move the piston 90 downwardly.

Through the bottom wall of the chamber 89 extends a screw-threaded hole into which is screwed the nipple of a check-valve 92 whereby air from the container 5 may flow only in an upward direction through a recess 93 and through said check-valve 92 into the chamber 89.

Between the walls of the chamber 89 and of the passageway 81 of the structure is an annular chamber 94 and extending through the bottom wall of said annular chamber 94 into a circular recess 95 are two oppositely disposed passageways 96, whose upper edges are beveled to provide seats for beveled disk valves 97 each of which is provided with an upwardly projecting valve-stem 98 fixed thereto, which valve-stems 98 are slidably disposed within guide sockets 99 which are screwed downwardly into and through the top wall of said annular chamber 94 thus to adapt said disk valves 97 to open and close said passageways 96, there being provided helical compression springs 100 which are disposed to extend between the top surfaces of said disk valves 97 and said guide sockets 99 whereby said disk valves 97 are normally maintained in a position to close said passageways 96.

Extending outwardly through the wall of the annular chamber 94 is a passageway indicated by a circular line 101 with which passageway may be connected a conduit pipe leading to a compressed air storage reservoir, not shown, such storage reservoir being identical with the storage reservoir with which the pipe 41 of Fig. 1 is connected.

The guide sockets 99 are each provided with a recess 102 on their top ends, which recesses 102 are of a form to adapt them to receive a socket wrench of suitable form for communicating rotary movements to said guide sockets 99 in the operation of removing and replacing said guide sockets 99.

Extending through the wall between the annular chamber 94 and the chamber 89 are two holes, one being larger than the other, the larger hole 103 being disposed above the piston 90 at the upper end portion of the chamber 89, while the lower smaller hole 104 is disposed at a point lower than the downwardmost position of the piston 90 at the lower end portion of said chamber 89.

The larger hole 103 is large enough to permit the passage of air therethrough quickly to equalize the pressure of air within the annular chamber 94 and within the space between the chamber 89 above the piston 90, but the smaller hole 104 is of such smaller size as will take a much longer time for the passage of enough air therethrough to equalize the pressure of air in said annular chamber 94 and in the space below said piston 90.

Extending downwardly into the container 5 from the under side of the bottom wall of the annular chamber 94, and through the circular recess 95 and concentrically with the side walls thereof, is a fixed rod 105 upon which is concentrically mounted a vertically slidable float 106 of drum-like

form which embodies an airtight chamber 107 of annular form which float 106 is normally supported by a yielding helical compression spring 108 upon the top end of which it rests, the lower end of which spring 108 rests upon a washer 109 which is supported by a nut 110 that is screwed on to the lower end of said rod 105.

The float 106 is of a diameter to adapt it to enter the circular recess 95 and slidably fit within the side walls thereof when it is moved upwardly on the rod 105 to a position where its top surface engages with the under side of the bottom wall of the annular chamber 94.

The containers 4 and 5 may be supplied with water at required times by opening a valve 111 which controls the passageway through a pipe 112 which may lead from a source of water, not shown, to connect with a T fitting 113 which is interposed in the pipe 77.

In the operation of my invention when constructed as described and shown, fluid fuel, as gasolene is admitted through the fuel supply pipe 33 and chamber 32 to drop downwardly on to the strainer 71 and when the rotary valve 28 is turned to open the passageway 27 then compressed air may pass from a source of supply, not shown, through said passageway 27 and through the strainer 71 carrying such fluid fuel in the form of a spray or vapor into the chamber 22 where at a proper time it will be ignited by a spark of the spark-plug 55 whereupon the expansive force of the gases and products of combustion will force the valve 43 downwardly to admit such expanded gases and products of combustion into the space within the container 4 above the water therein, thus to expend its force in causing the water to surge downwardly in said container 4 and horizontally through the conduit 12, thence upwardly into the container 5 causing the air in container 5, that is above the surface of the water therein, to open the valves 97 to pass into the annular chamber 94 and outward therefrom through the outlet opening 101 to be conducted thence to a reservoir for compressed air, not shown, and after said expanded gases above the surface of the water in the container 4 have spent their force such water continuing its movement, by its momentum, tends to form a vacuum in the container 4 whereupon the valve 63 will be drawn downwardly to the position shown by dotted line 63 in Fig. 1, and then the valve 64 will fall to close the passageway between the chamber 23 and the container 4, and after the water within the two containers 4 and 5 ceases its movement toward the top end of said container 5 it will then surge back toward and to the top of the container 4 to force the air therein into and through the chamber 23 out of the exhaust pipe 67, and its impact against the valve 63 will close such valve and will also force the valve 43 upwardly in the passageway 42 thus actuating the rotary valve 28 to admit another charge of compressed air and fuel which then will force downwardly the valve 43 to close the valve 28 and to make the connection that will produce a spark to ignite the explosive mixture which upon expanding will enter the container 4 again to cause the water to surge toward the container 5 thus repeating the operation of forcing the air out of the upper portion of said chamber 5 in the same manner; which air was drawn into such chamber 5 through the passageway controlled by the inlet check-valve 82; when the water last moved toward the chamber 4, the damper 83 in said passageway being actuated by the piston 90 to control automatically the amount of air so drawn into said container 5 in an obvious manner.

The sheet copper coils 72 serve to absorb heat from the air that may be compressed within the container 5 and such coils 72 will again be cooled by the rising water in the container 5 and by water issuing from the sprinkler 75 and the float 107 will be raised into the recess 95 by the impact of the water each time that the water rises in said container 5, thus to prevent water from entering the chamber 94 through the passageways controlled by the valves 97.

Other details of the operation of my invention will be so obvious to those skilled in the art that no further description is necessary.

Manifestly, changes may be made in the forms, dimensions and arrangement of parts of my invention without departing from the spirit thereof.

What I claim is:

1. In a hydraulic compressor of the type described, a main chamber having an offset portion, a head for said chamber carrying an upstanding explosive chamber and an exhaust chamber, the explosion chamber overlying the offset portion and spring pressed valve controlling communication between the main chamber and the explosion chamber, a valve controlled air inlet to said explosion chamber, connecting rods between the two valves to cause a simultaneous operation thereof, a tensioned valve for controlling communication between the main chamber and the exhaust chamber, air compressor means, and a surge pipe connecting the main chamber therewith.

2. In a hydraulic compressor of the type described, a main chamber and an explosive chamber associated therewith, a second chamber constituting an air compressor, a surge pipe forming communication between the two chambers, a heat absorbing sheathing positioned in the compressor chamber, a

pipe extending between the two chambers, a coil section in the pipe adapted to be cooled and an annular spray pipe positioned in said chamber above the heat absorbing sheathing to spray a cooling fluid thereon and in communication with the last named pipe.

In witness whereof, I, hereunto subscribe my name this 7th day of September, A. D. 1915.

STIRLING B. HILL.

Witnesses:
FRANK WARREN,
O. JOHNSON.