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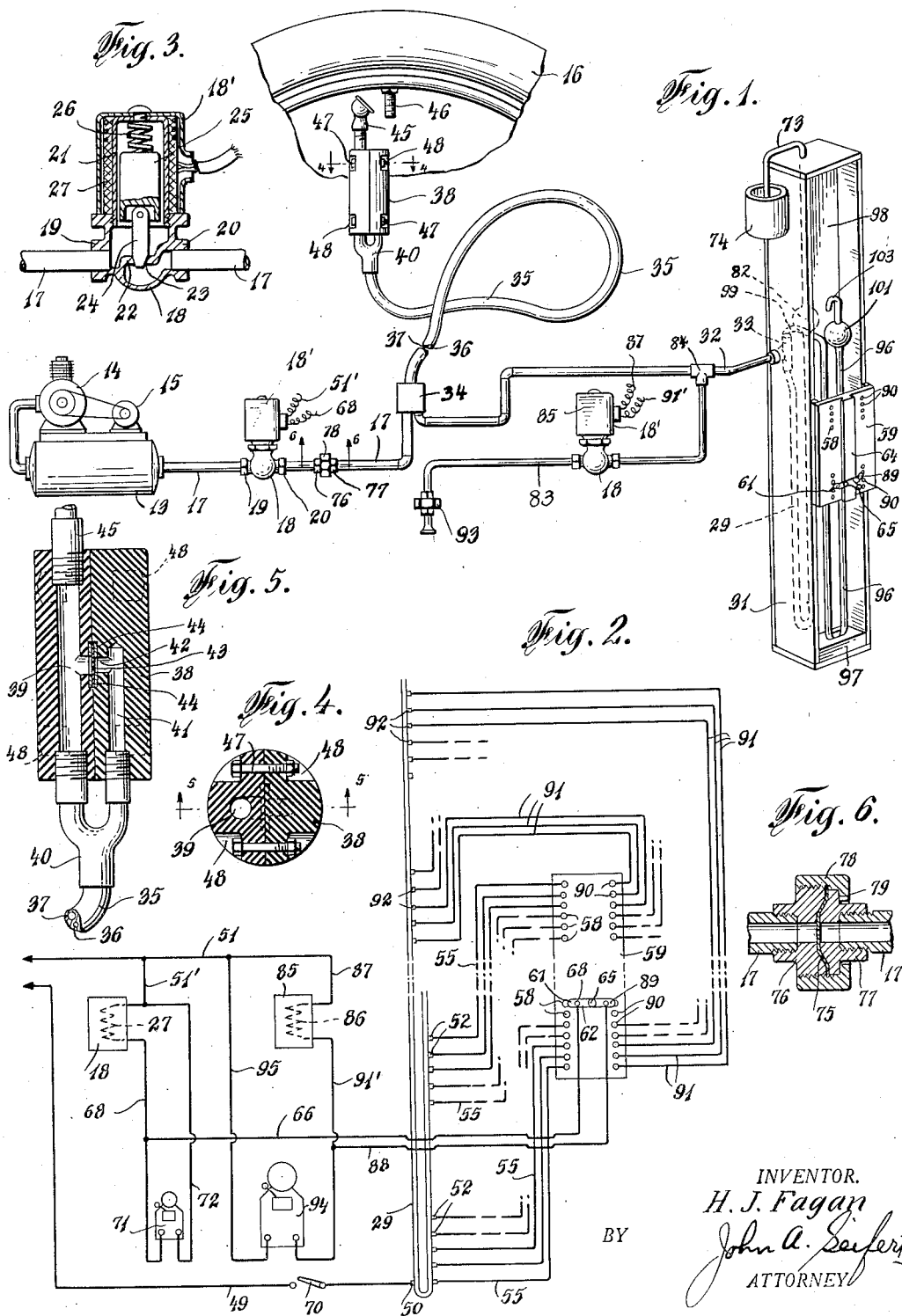
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MEANS FOR SUPPLYING AIR UNDER PRESSURE

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2 Sheets-Sheet 1



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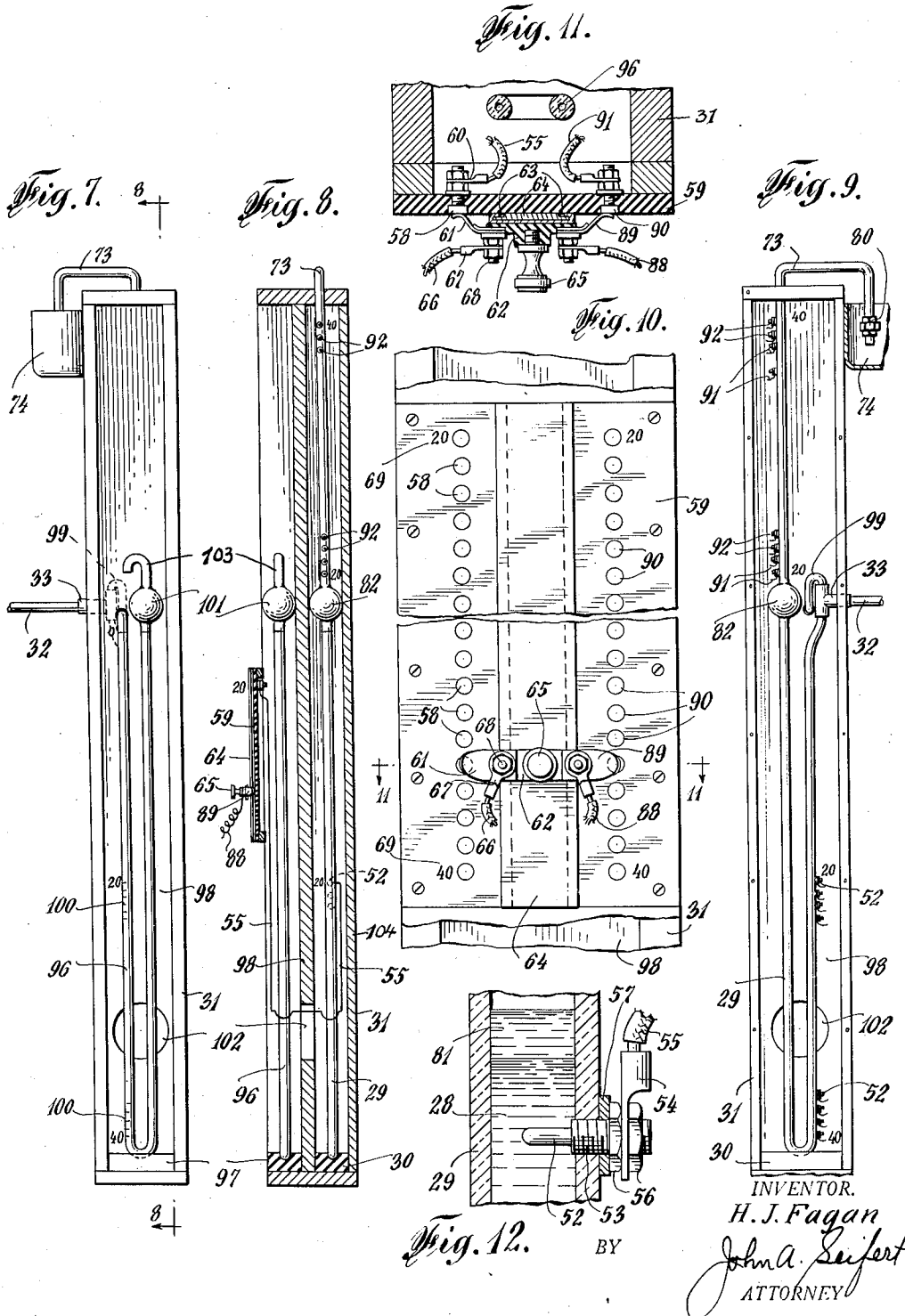
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2 Sheets-Sheet 2



UNITED STATES PATENT OFFICE

2,057,889

MEANS FOR SUPPLYING AIR UNDER PRESSURE

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17 Claims. (Cl. 221—73.5)

This invention relates to means for supplying to a receiver air under pressure from a source containing air under a higher pressure than that which it is desirable to deliver to the receiver and for regulating the pressure at which the air is delivered to said receiver. The invention is particularly adapted for use in connection with apparatus for supplying pneumatic vehicle wheel tires with air, and it is an object of the invention to provide in apparatus of this character means to eliminate the use of mechanical control devices that have been deemed necessary in apparatus of this character now in commercial use, and to provide means that is accurate in use and inexpensive to manufacture and maintain.

Another object of the invention is to provide in apparatus of this character means for indicating variations in the pressure of the air being delivered to and the pressure of the air in a receiver that may be readily observed.

A further object of the invention is to provide air pressure actuated control means that is sensitive to pressure and rendered instantly active when the air rises to a predetermined pressure in the receiver to control and accurately regulate the supply of air to the receiver.

A still further object of the invention is to provide means to automatically release excessive pressure or pressure above a predetermined degree.

It is another object of the invention to provide adjustable switch mechanism for preselecting the pressure at which the air is to be delivered to a receiver.

It is a further object of the invention to provide a novel unitary coupling for connecting a source of supply of air under pressure and air pressure actuated controlling means with a receiver.

The embodiment of the invention comprises a normally closed valve interposed in a conduit connecting a source of supply of fluid, such as air, under pressure with a receiver and adapted to be opened by an electromagnet when energized upon the closing of the circuit in which it is connected by a switch, the energizing of the electromagnet and the opening of its circuit after it is closed by the switch being controlled by the pressure of the air in the conduit and the receiver operating on a column of electric conducting liquid in the electric circuit of the electromagnet and normally positioned in contact with a series of contacts electrically connected in the circuit of the electromagnet through an electric switch

mechanism having a series of contacts corresponding to the series of contacts adapted to be contacted by the electric conducting liquid and a contact maker movable to place a predetermined contact to be contacted by the electric conducting liquid in the circuit of the electromagnet, so that should the pressure of the air in the conduit or receiver be greater than the weight of and move the electric conducting liquid out of contact with the contact which has been placed in the circuit of the electromagnet, said circuit will be automatically opened with the valve assuming closing position until the pressure of the air in the conduit and the receiver is less than or equal to the weight of the electric conducting liquid at said preselected contact when said liquid will contact with said contact and close the circuit. The column of electric conducting liquid, or another column of liquid having the same viscosity and density as the electric conducting liquid has a by-pass connection with the conduit and is moved by the pressure of the air in the conduit and receiver relative to graduations to indicate the pressure of the air in the conduit and the receiver. To prevent discharging excessive pressure into the receiver and the loss of the column of electric conducting material, an exhaust outlet is arranged in the by-pass connection normally closed by an electromagnetically operated valve electrically connected in circuit with the electric switch mechanism and a second series of contacts adapted to be contacted by the electric conducting liquid when said liquid is correspondingly positioned out of contact with the first series of contacts. Alarm devices are interposed in the circuit of the valves to indicate the energization of the electromagnets.

In the drawings accompanying and forming a part of this application, Figure 1 is a diagrammatic view of the means for supplying air under pressure to a receiver embodying the invention.

Figure 2 is a diagrammatic view of the electric circuit for connecting the controlling valves in circuit with the electric conducting liquid, the series of contacts, the electric switch mechanism and the alarm devices.

Figure 3 is a sectional view of the valves for controlling the connection of the source of supply of air under pressure with the receiver and the exhaust outlet.

Figure 4 is a cross sectional view, on an enlarged scale, of a coupling for connecting a receiver with the conduit and the by-pass connection, taken on the line 4—4 of Figure 1 looking in the direction of the arrows.

Figure 5 is a longitudinal section of the coupling taken on the line 5—5 of Figure 4 looking in the direction of the arrows.

Figure 6 is a sectional view, on an enlarged scale, taken on the line 6—6 of Figure 1 looking in the direction of the arrows to show means for restricting the connection and reducing the flow of the air from the valve in the conduit to a receiver.

Figure 7 is an elevational view of a device for holding the column of liquid to indicate the pressure of the air in the conduit and receiver.

Figure 8 is a sectional view taken on the line 8—8 of Figure 7 looking in the direction of the arrows showing devices for holding separate columns of liquid to indicate the pressure and control the actuation of the valves in the conduits and the by-pass connection, and the electric switch mechanism mounted relative to the device for indicating the pressure.

Figure 9 is a view similar to Figure 7 but showing a device for holding the column of electric conducting liquid and supporting the series of contacts to be contacted by said liquid.

Figure 10 is a fragmentary elevational view of the electric switch mechanism for preselecting a predetermined pressure at which the air is to be delivered into a receiver.

Figure 11 is a cross sectional view of the switch mechanism taken on the line 11—11 of Figure 10 looking in the direction of the arrows; and

Figure 12 is a sectional view of the device shown in Figure 9 to show the mounting of a contact of a series of contacts carried thereby.

In carrying out the embodiment of the invention illustrated in the accompanying drawings there is provided a tank 13 for containing air under a pressure maintained by a compressor 14 connected in communication with the tank and actuated by an electric motor 15, the air being maintained in the tank at a much higher pressure than it is desirable to supply to a receiver, such as a pneumatic tire, as indicated at 16. The supply tank and the compressor are of the usual structure now in commercial use and detail illustration and description of the same is not deemed necessary.

The tire 16 is connected to the supply tank 13 through a conduit or pipe 17 and said connection is controlled by a valve normally closed and adapted to be opened by the pressure in the conduit between said valve and the tire, comprising a casing 18 arranged with opposed pipe coupling openings 19, 20, the opening 19, constituting the inlet of the valve casing, being connected to a section of the conduit 17 connected to and leading from the tank 13 and separated from the opening 20, constituting the outlet of the valve casing, by a transverse wall 22 having an opening 23 arranged with a seat for a valve 24 pivotally suspended from one end of a plunger 25 slidable in a housing 21 connected to the valve casing in communication with the inlet 19. A coiled spring 26 interposed between the opposite end of the plunger and the end wall of the housing 21 to normally urge the valve 24 into engagement with the valve seat 23, the pressure of the air entering the housing 21 through inlet 19 from the supply tank also urging the valve 24 into engagement with the seat 23, thereby assuring the shutting off of the section of the conduit 17 connected to the outlet opening 20 from the supply tank 13. The valve 24 is actuated from the valve

seat 23 to open communication between the inlet and outlet openings 19, 20 by a solenoid 27 to which the plunger 25 serves as an armature, said solenoid encircling the housing 21 within a hood 18' mounted on the valve casing 18, the armature being actuated in a direction against the force of the spring 26 and moving the valve 24 to open position when electric current is passed through the winding of and the solenoid is energized.

The energizing of the electromagnet, constituting the valve carrying plunger 25 and the solenoid 27, is controlled by the pressure of the air in the section of the conduit 17 between the valve casing 18 and the tire through pressure responsive circuit making and breaking actuating means actuated by said pressure, comprising a column of liquid having electric conducting properties, in the present instance mercury has been selected as such material has a viscosity and density that is readily and critically responsive to variations in pressure. The mercury, as indicated at 28, is carried in a U-tube of dielectric material, such as glass or "bakelite", supported by the U-portion thereof in a block 30 of resilient material, such as rubber, to absorb any shock that may be transmitted to the U-tube, said supporting block being mounted at one end of a rectangular frame 31. One leg of the U-tube 29 is connected to the conduit 17 through a conduit or pipe 32 connected at one end with a T-coupling 33 having one arm connected to the open end of said leg of the U-tube, as clearly shown in Figures 1 and 9, the opposite end of said conduit 32 being coupled through a passage in a dual coupling member 34 with a passage 36 of a pair of air passages in a flexible hose 35. The other passage 37 of the flexible hose has a by-pass connection with the passage 36 through a coupling member 38 composed of two mating sections, one of said sections having a passage 39 extending longitudinally therethrough connected at one end to one branch of a Y-coupling 40 connected to the flexible hose 35 with the passage 37 of the hose 35 in communication with the passage 39 of the coupling member 38. The hose passage 36 communicates with a passage 41 in the other mating section of the coupling 38 through the other leg of the Y-coupling 40. The passage 41 midway of the coupling member 38 communicates with the passage 39 through a transverse passage 42 in the mating faces of the sections of the coupling member 38. To reduce the pressure of the air entering the passage 41 from the passage 39 and prevent undue movement of the mercury in the U-tube 29 should the valve become inoperative, the transverse passage 42 is provided with pressure reducing means in the form of a disk 43 having a restricted central opening and mounted in recesses in the mating faces of the sections of the coupling member 38 with packing material disposed about the periphery of the disk and recesses, as shown at 44 in Figure 5. The passage 39 is connected in communication with a tire chuck connection 45 of the usual construction having a spring influenced valve normally closing the outlet of said chuck and adapted to be actuated to open position by the engagement of the chuck connection on a tire valve stem casing 46 when the chuck is applied thereto to supply the tire 16 with air from the tank 13. The section of the conduit 17 between the valve casing 18 and the coupling member 34 is at all times in communication with the conduit 32. The mating sections of the cou-

pling member 38 are secured together by bolts 47 engaged in alined openings extending transversely of said sections from recessed portions, as clearly shown at 48 in Figures 1 and 4.

A small head of sealing liquid, such as a water and alcohol solution, is placed on both ends of the column of mercury in the U-tube, as shown at 81 in Figure 12, to prevent the oxidation and the resulting discoloring of the mercury.

The flow of the air under pressure from the supply tank to the coupling member 38 and the column of mercury 28 is further restricted by passage reducing means in the form of a disk 75 having a small central opening and interposed in the section of the conduit 17 between the valve casing 18 and the passage 37 of the flexible hose 35 by a pair of pipe coupling members 76, 77, the coupling 76 being screw threaded to the end of the section of conduit 17 connected to the valve casing 18 and the other coupling 77 screw threaded to the section of conduit 17 connected to the coupling member 34 with the perforated disk 75 clamped between said couplings by a sleeve 78 having an inwardly extending flange at one end to abut a shoulder on the coupling 77, as at 79, and screw threaded onto the coupling 76, as clearly shown in Figure 6.

The mercury 28 is electrically connected in the circuit of the solenoid 27 of the valve 24 by an electric conductor 49 connected at one end to a contact terminal 50 mounted in the leg of the U-tube opposite to the leg connected to the conduit 32 to be contacted by the mercury, and the other end of the conductor being connected to one side of a source of electricity having the other side directly connected to one end of the solenoid coil through electric conductors 51, 51'. The circuit of the coil 27 is completed through either one of a series of contacts 52 mounted in spaced relation to each other in the leg of the U-tube 29 connected to the conduit 32 with the spaces between the contacts equal to the distance the mercury is moved by one pound of pressure of air in the conduit 32. In the present instance there are provided twenty contacts to control the pressure at which the air is to be supplied to the receiver 16 from the tank 13 ranging from twenty to forty pounds, as indicated in Figures 8 and 9. The contacts 52 are mounted in the wall of the U-tube in any suitable manner, and shown as by screw threading the same into screw threaded holes in the U-tube, as shown at 53 in Figure 12, with one end of the contact extending into the tube to be contacted by the mercury in said tube leg and the opposite end projecting exteriorly of the U-tube for the engagement of a terminal 54 of one of a series of electric conductors 55 equal in number to the number of contacts 52. The terminals 54 are secured to the exterior ends of the contacts 52 by a pair of lock nuts 56 and the contacts are sealed in the tube as by a washer 57 to prevent leakage of the mercury from the U-tube.

There is provided means, interposed in the electrical connection between the coil 27 of the valve 24 and the series of contacts 52, to preselect the pressure of the air to be supplied to the tire 16, comprising a series of contacts 58 corresponding to the number of the contacts 52 mounted on a board or plate 59 of insulating material, which is located close to the place where the tires are inflated so that the regulating of the pressure may be readily accomplished, and in the present instance for the purpose of illustration the board 59 is mounted on an edge of the side members of

the frame 31. The contacts 58 are arranged with a flat head engaged in a recess of a series of recesses in the front face of the board 59 to be flush with said face, and ends of the contacts projecting from the rear face of the board being connected to terminals at the ends of the conductors 55 opposite to the terminals 54 connected to the contacts 52, as at 60 in Figure 11. The flat heads of the contacts 58 are adapted to be selectively engaged by a contact maker in the form of a resilient finger 61 of conducting material fixedly mounted on and extended laterally from a side of a slider 62 of insulating material having opposed channels 63 at the opposite sides on the under face thereof slidably engaging grooved edges of a board 64 mounted on the front face of the board 59 midway of the sides thereof. To facilitate the actuation of the slider there is provided a finger grip 65 secured to the slider. The contact making finger 61 is electrically connected to the coil 27 of the valve 24 by an electric conductor 66 having a terminal 67 retained on a binding post 68 carried by the slider 62 in contact with the finger 61 and electrically connected to a terminal conductor 68 of the coil. The contacts 58 are arranged with indices on the supporting board 59, as shown at 69 in Figure 10, to indicate the amount of the pressure and what contact 52 they are connected to.

In the normally closed position of the valve 24 and when the chuck connection 45 is not engaged on a tire valve casing 46 with the valve of said chuck in closing position, the column of mercury in the U-tube 29 will be at equilibrium with equal amounts thereof in the opposed leg portions thereof and the mercury in contact with all of the contacts 52 closing the electric circuit of the coil 27 and opening the valve 24. To prevent this from occurring and air under pressure from entering the flexible hose 35 and conduit 32 and actuating the mercury when the apparatus is not in use, switch mechanism of any suitable structure is interposed in the conductor 49, as indicated at 70, and located at a place adjacent the preselecting pressure switch board 59 to facilitate the operation of the device. To place the device in operation the slider 62 is actuated to position the contact making finger 61 in contact with contact 58 arranged with index character "36", as shown in Figure 10, it being desired to inflate tire 16 with air at a pressure of thirty-six (36) pounds, and the switch 70 is actuated to close the circuit of the coil 27 energizing the electromagnet formed by said coil and the valve plunger 25 and moving the valve 24 to open position, and thereby permitting air under pressure from the supply tank 13 to enter passage 37 in the flexible hose 35 and through the coupling member 38 to passage 36 in hose 35 and thence to conduit 32 which will introduce the air under the pressure to the top of the column of mercury in the leg of the U-tube 29 connected to the conduit 32, said air under pressure moving said column of mercury down the leg of the U-tube until the level thereof is below the contact 52 electrically connected to the contact 58 engaged by the contact making finger 61 when the circuit of the coil 27 is opened and the valve 24 is permitted to be actuated by the spring 26 to closed position. The engaging of the chuck connection 45 on the tire valve casing 46 of a tire 16 may be at any time after the switch 70 is closed and should said tire have air therein at a pressure less than thirty-six (36) pounds, the pressure of the air in the conduit 32 will decrease permitting the column

of mercury to rise in the leg of the U-tube arranged with the contacts 52 past the contact preselected by the contact making finger 61 when the circuit of the coil 27 is closed and remains closed until the air in the tire reaches a pressure of thirty-six (36) pounds and the air in the conduit 32 is at a slightly greater pressure that will move the column of mercury out of contact with the preselected contact 52. To inform the user that a tire he is inflating has already the desired amount of pressure, or that the desired amount of air pressure has been supplied to the tire, alarm means of any suitable type, such as visual or audible, in the present application an audible type is shown in the form of a bell 71 electrically connected in the circuit of the coil 27 by an electric conductor 72 and the terminal conductor 68, whereby the ringing of the bell will indicate that valve 24 is open and the tire does not contain the desired amount of air pressure and when the bell has stopped ringing the desired amount of air pressure has been supplied to the tire. It will readily be seen that the bell may be connected in the circuit of the coil 27 in such a manner that the ringing of the bell would indicate that the desired amount of air pressure is in the tire and that the user should remove the chuck connection 45 from the tire valve casing 46.

Should the normally closed valve 24 become inoperative and remain open the supply tank will be directly connected in communication with the hose coupling member 38 and the column of mercury 28 and the air under the great amount of pressure created by the compressor 14 will force the mercury from the U-tube 29 and render the device inoperative. To overcome this disadvantage the leg of the U-tube not arranged with the series of contacts 52 is extended for a distance to hold the amount of mercury that is normally carried by the other leg of the U-tube with a portion of said extended tube leg passing through the upper end of the U-tube supporting frame 31 and a portion positioned exteriorly of the frame formed to U-shape, as shown at 73, with the free end thereof terminating in a receptacle 74 carried by a side of the frame to catch any mercury that may be expelled from the U-tube. To create a cushioning effect on or resistance to the movement of the mercury in the U-tube under the influence of the air pressure entering the U-tube from the conduit 32 and prevent said movement from being spasmodic, the expelling of the air in the extended leg of the U-tube above the mercury from said leg of the U-tube is restricted by means similar to the structure of the air pressure restricting disk 75 interposed in the conduit 17, as indicated at 80 in Figure 9. To reduce the length of the extended leg of the U-tube, there is arranged therein a bulbous or spherical portion 82 opposite the connection 33 of the other leg of the U-tube with the conduit 32 and of a capacity to hold the quantity of mercury that is normally contained in said other leg of the U-tube above the uppermost contact of the series of contacts 52, so that when the level of the mercury is lowered below a contact of the series of contacts 52 the level of the mercury will be proportionally raised above the spherical portion 82. Excessive air pressure or pressure of a quantity that will blow the entire column of mercury from the U-tube is prevented from entering the U-tube by an exhaust outlet arranged in a pipe 83 connected to the leg portion of a T-pipe connection 84 in the conduit 32, and the outlet thereof being normally closed from the conduit 32 by an electro-

magnetically controlled valve 85 similar in structure to the valve interposed in the conduit 17, having a coil 86, Figure 2, connected to the source of electricity by conductor 51 through a terminal conductor 87 and connected by an electric conductor 88 to a contact making finger 89 carried at the side of the slider 62 opposite to the side carrying the contact finger 61 to be adjusted simultaneously with the adjustment of the contact finger 61 to contact individually a series of contacts 90 similar to the contacts 58 and mounted on the board 59 in opposed relation to the contacts 58 on the opposite side of the slide board 64 in a manner similar to the mounting of the contacts 58 on the board 59. The conductor 88 is connected to the coil 86 through a terminal conductor 91' thereof and the contacts 90 are connected through electric conductors 91 to a series of contacts 92 similar in structure to the contacts 52 and mounted in the leg portion of the U-tube extending above the spherical portion 82 in a manner similar to the mounting of the contacts 52 in the U-tube so that should the contact finger 89 be adjusted to engage the contact 90 indicated by the index numeral "36" the valve 85 will remain closed until the mercury in the portion of the U-tube extending above the spherical portion 82 comes into contact with the contact 92 connected to the contact 90 that is engaged by the contact finger 89 when the circuit of the coil 86 is closed and the valve 85 is opened permitting the excess pressure to escape through the outlet of the pipe 83. The contacts 92 correspond to the contacts 52 in reverse order, that is, the lowermost contact of the series of contacts 92 will correspond to the uppermost contact of the series of contacts 52, as indicated by the index numerals ranging from "20" to "40" in Figure 9. In the present instance the contacts 92 are spaced from the spherical portion 82 of the U-tube so that the mercury will not simultaneously contact corresponding contacts 52, 92 but will contact said corresponding contact 92 when the mercury is contacting the next subsequent contact 52 or several subsequent contacts 52. This differential in the pressure at which the valves 24 and 85 are actuated to open position is for the purpose of overcoming the tendency of the mercury to pass the preselected contacts and prevent the opening of both valves at the same time or in rapid sequence which would cause a continuous opening and closing of the valves. To prevent spasmodic movement of the mercury in the U-tube by the escape of the air through the exhaust outlet at a high rate of speed the pipe 83 is provided at the outlet end portion thereof with passage restricting means 93 similar in structure to the restricting means disclosed in Figure 6 and fully described hereinbefore. The abnormal condition of the device caused by the excessive pressure of the air in the conduit 32 is brought to the attention of the user by alarm means which may be visual or audible and is illustrated in the present instance as being an electric gong 94 to distinguish said alarm from the alarm 71 for indicating that the predetermined air pressure has been supplied to the tire. The gong 94 is connected in the circuit of the coil 86 through the terminal conductor 91' and an electric conductor 95 connected to the source of electricity conductor 51, whereby the closing of the electric circuit of the coil 86 will actuate the gong 94 and indicate the abnormal condition of the device. The actuation of the gong 94 will also indicate that a tire to which the chuck 45 is ap-

plied contains air at a pressure greater than that selected by the user through the setting of the contact fingers 61, 89 in contact with the contacts 58, 90 representing the preselected pressure.

5 The user may keep the chuck on the tire valve casing 46 permitting the excessive air pressure in the tire to escape through the exhaust outlet of the pipe 83, and the stopping of the gong indicating that the excessive pressure in the tire has
10 been released and that the chuck should be removed from the tire valve casing.

The pressure of the air in a tire 16 having the valve casing 46 thereof engaged by the chuck 45 and in the conduit 32 is clearly and readily indicated to the user by the movement of the mercury in the U-tube 29 should said tube be of transparent material, such as glass, relative to graduation marks arranged on the exterior of the tube corresponding to the contacts 52 and indicating
15 pressure from twenty (20) pounds to forty (40) pounds in the present illustration. But due to the difficulty of mounting the contacts 52 and 92 in glass, a separate U-tube 96 of transparent material, such as glass, is mounted in the frame
20 31 on a cushioning block 97 and separated from the U-tube 29 in the frame by a wall 98 extending the length and separating the frame 31 into two longitudinal compartments for the U-tubes. One leg of the U-tube 96 is connected in air communication with the conduit 32 by a pipe 99
25 engaged in the wall 98 and connected at one end with the arm of the T-coupling member 33 opposite to the arm connected to the U-tube 29, and the opposite end of the pipe 99 being connected to the end of said leg of the U-tube 96. The leg of the U-tube 96 connected to the pipe 99 is arranged with indices, as shown at 100 in Figure 7, corresponding in number and spacing to the contacts 52 to indicate pressure ranging from twenty (20) to forty (40) pounds.
30 The end of the opposite leg of the tube 96 is arranged in the form of a receptacle 101 having a capacity equal to that of both the legs of said U-tube so that the indicating medium contained therein, which is a liquid corresponding in viscosity and density to the liquid carried by the U-tube 29, will not be blown out of the U-tube 96 when an excessive pressure exists in the conduit 32. The receptacle is open at the top
35 through a U-shaped vent 103 to permit air in the U-tube 96 to escape when the liquid therein is moved by the pressure of the air in conduit 32, and if the liquid in said U tube 96 is mercury or other oxidizing liquid, the opposite ends of the column thereof are sealed by a small head of suitable material, such as a solution of alcohol and water, similar to that used in the column of mercury in U-tube 29. For the purpose of simply ascertaining the pressure of the air in a tire, the chuck 45 may be engaged on the tire valve casing 46 without closing the switch 70, the applying of the chuck to the tire opening communicating between the U-tube 96 and the air in said tire, and the pressure of the air in the tire actuating the column of liquid in said U-tube relative to the indices 100.
40 45 50 55 60 65

U-tube 29 is closed by a panel 104 to prevent tampering with and injury to said U-tube and the contacts mounted therein.

Having thus described my invention, I claim:

1. In means for supplying air under pressure 5 to a receiver, a source of air under pressure, a conduit leading from said source and adapted to be connected with a receiver, and means for controlling the pressure delivered to the receiver comprising a valve in the conduit between the source of air pressure and the receiver, electro-
10 magnetic means for actuating the valve, a column of electric conducting liquid in communication with the conduit and electrically connected in the circuit of the electromagnetic means, and
15 a contact fixedly mounted in the path of movement of the column of electric conducting liquid and connected in the circuit of the electromagnetic means, the column of electric conducting liquid being moved into and out of contact with
20 the fixed contact by varying pressure at the receiver permitting the valve to remain closed when the air in the conduit is above a predetermined pressure and open the valve when the air is below said predetermined pressure.
25

2. In means for supplying air under pressure to a receiver, a source of air under pressure, a conduit connecting the source of air under pressure to a receiver, a valve interposed in the conduit and normally closed, an electromagnet connected to the valve to open the valve upon the energization thereof, a U-tube of transparent material having one leg connected in communication with the conduit between the valve and the receiver, electric conducting liquid in the tube adapted to be moved by the pressure in the conduit and connected in the circuit of the electromagnet, and a contact fixedly mounted in the tube to be contacted by the liquid and connected in the circuit of the electromagnet to permit energization of the electromagnet when the liquid is in contact therewith.
30 35 40 45

3. Means for supplying air under pressure to a receiver as claimed in claim 2, wherein the contact is fixedly mounted in the leg of the tube connected to the conduit.
45

4. In means for supplying fluid under pressure to a receiver, a source of fluid under pressure, a conduit to connect the source of fluid pressure with a receiver, an electromagnetically operated valve interposed in the conduit connected in a normally open electric circuit and urged to close said conduit and open said conduit upon closing the circuit thereof, a U-tube one leg of which has a by-pass connection with the conduit, an electric conducting liquid in the tube connected in the circuit of the valve, a contact terminal connected in said circuit and normally in electric connection with the liquid in the one leg of said tube with the liquid at a predetermined level therein and the fluid pressure by-passed to said U-tube when the fluid discharged into the receiver reaches a predetermined pressure and lower the level of the liquid in the one leg of the U-tube out of contact with the contact terminal and open the circuit of the valve and permit actuation of the valve to shut off the source of fluid pressure from the receiver.
50 55 60 65

5. In means for supplying fluid under pressure to a receiver, a source of fluid under pressure, a conduit connecting the source of fluid pressure with a receiver, a valve in the conduit controlling the connection of the receiver with the source of fluid pressure normally urged to position to close said connection, an electromagnet connected with
70 75

The pressure selecting switch board 59 is shown as being mounted to extend transversely of the compartment of the frame 31 in which the U-tube 96 is mounted and an opening 102 is provided in the wall 98 to permit the passage of the conductors 55, 91 from the contacts 58, 90 of said board to the contacts 52, 92 in the U-tube 29.

75 The compartment of the frame 31 housing the

said valve operative when energized to actuate the valve to open the connection of the receiver with the source of fluid pressure, circuit making and breaking means having a by-pass connection with the conduit and connected in the circuit of the electromagnet including a fixed contact terminal and a contact movable into and out of contact with the fixed contact terminal by the fluid pressure, and means interposed in the conduit between the valve and receiver and in the by-pass connection of the circuit making and breaking means arranged to reduce the volume of the fluid under pressure delivered to the receiver and circuit making and breaking means.

6. In means for supplying air under pressure to a receiver, a conduit connecting a source of supply of air under pressure to a receiver, a valve interposed in the conduit to control the air under pressure from the source of supply to the receiver and normally shutting off the air from the receiver, an electromagnet connected with said valve operative when energized to actuate the valve to permit the flow of air to the receiver, a U-tube having a by-pass connection with the conduit between the valve and the receiver, a series of contacts fixedly mounted in the U-tube, an electric conducting liquid in the tube adapted to be moved by the air pressure into and out of contact with the contacts and connected in the electric circuit of the electromagnet, a series of contacts corresponding to the contacts mounted in the tube and electrically connected to corresponding contacts mounted in the U-tube, and a contact maker mounted to successively contact the second series of contacts and electrically connected in the circuit of the electromagnet to permit predetermined selection of the pressure below which pressure the valve is opened by the closing of the electric circuit of the electromagnet.

7. In means for supplying air under pressure to a receiver as claimed in claim 6, alarm means electrically connected to the contact maker and in the circuit of the electromagnet.

8. Means for supplying air under pressure to a receiver as claimed in claim 6, wherein the end of one leg of the U-tube is connected with the conduit and the first series of contacts is mounted in said leg of the U-tube below the connection with the conduit.

9. In means for supplying air under pressure to a receiver, a source of air under pressure, a conduit connecting the source of air under pressure with a receiver, a valve interposed in the conduit between the source of air under pressure and the receiver and normally urged to shut off the receiver from the source of air under pressure, an electromagnet connected to the valve and operative when energized to open the valve and the receiver with the source of air under pressure, a U-tube, a by-pass connection between one leg of the U-tube and the conduit having an outlet to the atmosphere, a valve in the by-pass connection normally closing the outlet from the atmosphere, a second electromagnet connected to the valve in the by-pass connection and operative to open the valve when energized, a series of contacts in the leg of the U-tube connected to the conduit electrically connected in the circuit of the first electromagnet, a second series of contacts in the other leg of the U-tube electrically connected to the second electromagnet, mercury in the U-tube connected in the circuits of the electromagnets and adapted to be moved by the pressure in the conduit in and out of contact

with the first series of contacts to actuate the valve in the conduit, and abnormal pressure at the receiver moving the mercury into contact with the second series of contacts to energize the second electromagnet and permit excessive pressure to be released through the outlet in the by-pass connection.

10. Means for supplying air under pressure to a receiver as claimed in claim 9, wherein the leg of the U-tube connected to the conduit is shorter than the other leg and the second series of contacts is in the portion of said other leg extending beyond the first leg.

11. In means for supplying fluid under pressure to a receiver, a source of fluid under pressure, a pipe to connect the source of fluid pressure with a receiver, an electromagnetically operated valve connected in a normally open electric circuit interposed in said pipe and normally urged to position to close said pipe, and said valve actuated to open position upon the closing of the circuit thereof, circuit making and breaking means connected in the circuit of the valve normally assuming circuit closing position including a pipe having a by-pass connection with the pipe connecting the source of fluid pressure with the receiver and actuated to open the circuit by the fluid pressure when the fluid in the receiver and pipes reaches a predetermined pressure, said latter pipe having a discharge outlet, an electromagnetically operated valve for said outlet of the second pipe connected in a normally open electric circuit and normally urged to outlet closing position and actuated to outlet opening position upon the closing of the circuit of said valve, and circuit closing means in the circuit of said latter valve normally assuming circuit opening position and actuated to circuit closing position by the fluid in the receiver and pipes when said fluid exceeds a predetermined pressure.

12. In means for supplying air under pressure to a receiver, a source of air under pressure, a pipe to connect said source of air with a receiver having a valve to control said connection normally urged to shut off the source of air pressure from the receiver, an electromagnet connected in a normally open electric circuit operative to actuate said valve to and hold it in open position upon the closing of the circuit thereof, a U-tube one leg of which has a by-pass connection with the pipe and an opening to the atmosphere, a contact terminal carried by the U-tube connected in the circuit of said electromagnet, an electric conducting liquid in the U-tube connected in the circuit of the electromagnet normally assuming a predetermined level and in contact with the contact closing the circuit of the electromagnet and moved out of contact with said contact opening the circuit of the electromagnet and permitting closing of the valve when the air in the receiver reaches a predetermined pressure, a valve to control the opening to the atmosphere normally urged to position to close said opening, a second electromagnet connected in a normally open electric circuit adapted when energized to actuate said latter valve to and hold it in position to open said opening, a contact carried by the tube normally out of contact with the conducting liquid in the U-tube, and said liquid being moved into contact with said latter contact and closing the circuit of and energizing the second electromagnet to move the valve for the opening to the atmosphere to open position when the air exceeds a predetermined pressure in the receiver.

13. In means for supplying air under pressure to a receiver, a source of supply of air under pressure, a conduit connecting the source of supply with a receiver, a valve interposed in the conduit normally positioned to shut off the receiver from the source of supply, an electromagnet connected to the valve and operative to open the valve when energized, a U-tube having a by-pass connection with the conduit and said by-pass connection being arranged with an outlet to the atmosphere, a series of contacts in the U-tube, a valve in the by-pass connection normally positioned to shut off the by-pass connection from the atmosphere, a second electromagnet connected to the valve in the by-pass connection and operative to open said valve when energized, a second series of contacts in the U-tube, mercury in the U-tube connected in the electric circuits of the electromagnets and normally positioned in contact with the first series of contacts and adapted to be moved by excessive pressure in the conduit proportionally out of contact with the first series of contacts and into contact with the second series of contacts, and pressure regulating switch mechanism comprising a series of contacts corresponding to and electrically connected to the first series of contacts in the U-tube, a second series of contacts corresponding to and electrically connected to the second series of contacts in the U-tube, and a pair of contact makers adapted to be actuated simultaneously into and out of contact with the respective series of contacts of the switch mechanism, the contact maker making contact with the series of contacts connected to the first series of contacts in the U-tube being connected in the electric circuit of the first electromagnet and the other contact maker being connected in the electric circuit of the second electromagnet.

14. Means for supplying air under pressure to a receiver as claimed in claim 13, wherein one leg of the U-tube is arranged with the by-pass connection with the conduit and has the first series of contacts mounted therein below the by-pass connection, and the second series of contacts is mounted in the other leg of the U-tube above the by-pass connection.

15. In means for supplying air under pressure to a receiver, a source of supply of air under pressure, a conduit connecting the source of supply to a receiver, an electromagnetically operated valve interposed in the conduit connected in a normally open circuit urged to close said conduit and open said conduit when the circuit thereof is closed, a second conduit having a by-pass connection with the first conduit, a U-tube of transparent material connected to the second conduit and having a liquid therein to indicate the amount of pressure of the air in the first conduit and receiver, a second U-tube of dielectric material connected to the second conduit and having an electric conducting liquid therein connected in the electric circuit of the valve, and a contact fixedly mounted in the second U-tube to be contacted by the electric conducting liquid therein and electrically connected in the circuit of the valve, the contacting of the electric conducting liquid with the contact closing the circuit of the valve and maintaining the valve open until a predetermined pressure is at the receiver when the electric conducting liquid is moved by an amount of pressure over the predetermined pressure out of contact with the contact opening the circuit of the valve.

16. In means for supplying air under pressure to a receiver, a source of supply of air under pressure, a conduit connecting the source of supply to a receiver, a valve in the conduit normally shutting off the receiver from the source of supply, an electromagnet connected with the valve and operative to open the valve when energized, a second conduit having a by-pass connection with the first conduit, a U-tube of transparent material connected to the second conduit and having a liquid therein to indicate the variation of pressure in the conduit, a second U-tube of dielectric material connected to the second conduit and having an electric conducting liquid therein electrically connected in the circuit of the electromagnet, a series of contacts mounted in the second U-tube to be successively contacted by different levels of the electric conducting liquid, and a pressure regulating switch comprising a series of contacts corresponding to and electrically connected with the series of contacts in the second U-tube and a contact maker movable relative to the series of contacts of the regulating switch and electrically connected in the circuit of the electromagnet.

17. In means for supplying air under pressure to a receiver, a source of supply of air under pressure, a conduit connecting the source of supply to a receiver, a valve in the conduit normally shutting off the receiver from the source of supply, an electromagnet connected with the valve and operative to open the valve when energized, a second conduit having intermediate the ends thereof a by-pass connection with the first conduit and one of the ends arranged as an outlet, an electromagnetically operated valve in the second conduit adjacent the outlet end thereof normally closing said outlet and adapted to be opened by the closing of the circuit thereof, a transparent U-tube having one leg connected to the end of the second conduit opposite to the outlet end and a liquid normally balanced in the legs to indicate variations in the pressure of the air in the conduits, a dielectric U-tube having a leg connected with the second conduit and an electric conducting liquid normally balanced in the legs thereof and electrically connected in the circuit of the electromagnet and the electromagnetically operated valve, a series of contacts mounted in the leg of the dielectric U-tube connected to the second conduit normally contacted by the electric conducting liquid, a second series of contacts mounted in the other leg of the dielectric U-tube to be proportionally contacted by the electric conducting liquid when said liquid is proportionally out of contact with the first series of contacts, and a pressure regulating switch comprising separate series of fixed contacts in opposed relation to each other, one of said series of contacts being connected to the first series of contacts in the dielectric U-tube and the other series connected to the second series of contacts, and a pair of contact makers simultaneously actuated to contact opposed contacts of the separate series of fixed contacts, the contact maker making contact with the series of contacts connected with first series of contacts being connected in the circuit of the electromagnet and the other contact maker being connected in the circuit of the electromagnetically operated valve.

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