

Feb. 9, 1943.

F. B. AUBERT

2,310,504

CONTROL DEVICE

Filed May 21, 1941

2 Sheets-Sheet 1

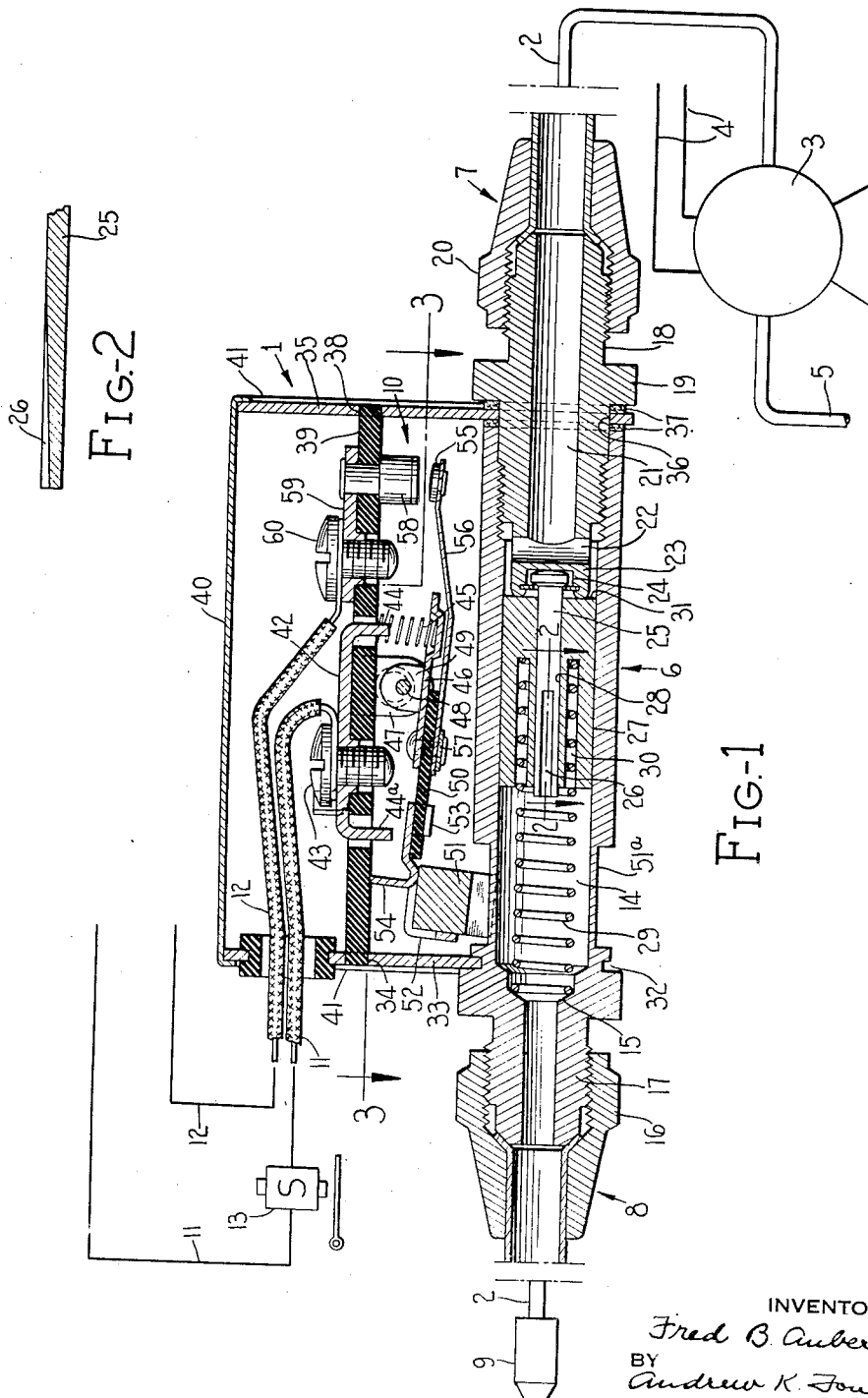


FIG-1

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2 Sheets-Sheet 2

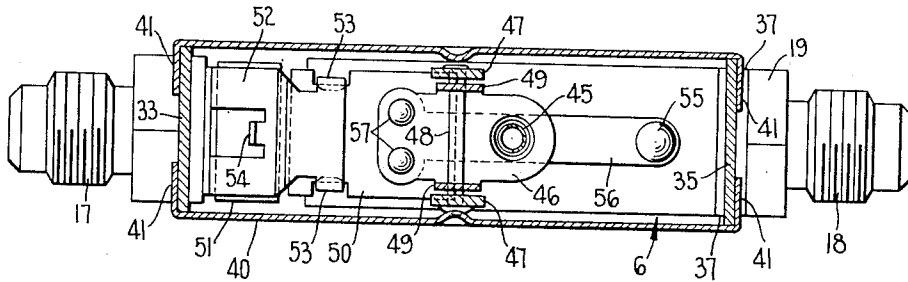


FIG. 3

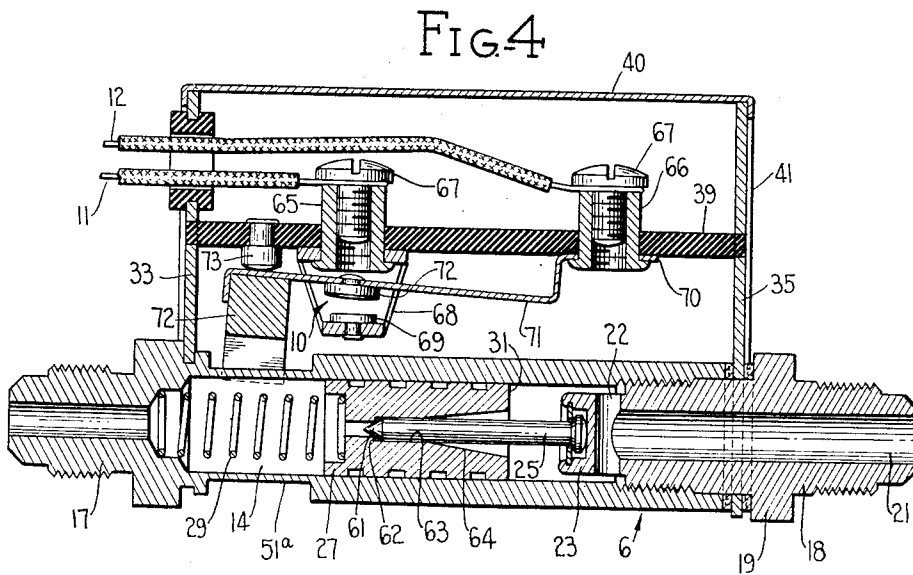
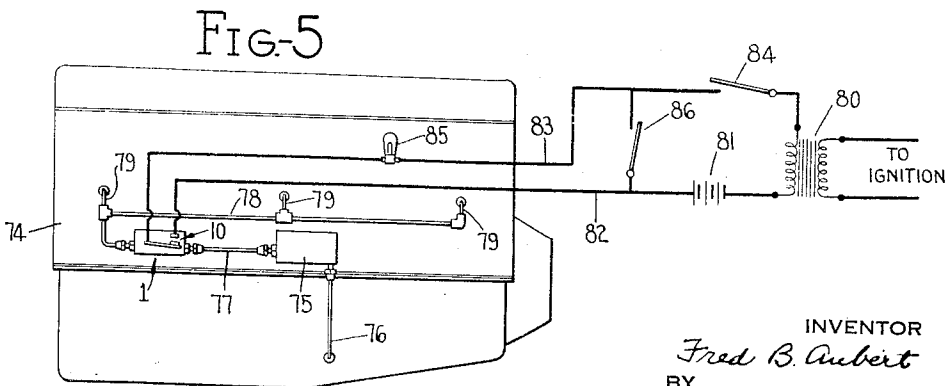


FIG. 4



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2,310,504

CONTROL DEVICE

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12 Claims. (Cl. 200—81)

This invention relates to new and useful improvements in control devices and more particularly to a device responsive to change in fluid pressure and which is adapted among other uses for indicating flow of fluid in a conduit or for actuating a control means upon the occurrence of fluid flow.

An object of the invention is to provide a control device in which fluid flow is restrained prior to the occurrence of a predetermined operating pressure or pressure differential.

Another object is to provide a novel magnetic actuator for a control means.

Another object is to provide a control means which may be intercalated a fluid conveying conduit.

Another object is to provide a control device which will assure delivery of conveyed fluid prior to operation of a controlled means.

The invention consists in the novel construction and arrangement of parts to be more fully described hereinafter and the novelty of which will be particularly pointed out and distinctly claimed.

In the accompanying drawings to be taken as a part of this specification there are fully and clearly illustrated several preferred embodiments of the invention in which drawings—

Figure 1 is a diagrammatic view of a portion of an oil burner control circuit and showing the control device of this invention in vertical longitudinal central section;

Fig. 2 is a detail view in section on the line 2—2 of Fig. 1;

Fig. 3 is a view in horizontal section of the control device and taken on the line 3—3 of Fig. 1;

Fig. 4 is a view in vertical longitudinal section of another form of control device embodying the invention, and

Fig. 5 is a diagrammatic view showing the control device as applied to the lubricating system of an internal combustion engine.

Referring to the drawings, Figs. 1 to 3, by characters of reference the numeral 1 designates generally the control device of this invention which is intercalated in a conduit or pipe line 2 having an electrically driven fuel supply pump 3 supplied with electric energy from the mains 4. The pump 3 is connected on its inlet side to a fuel source by an inlet pipe or conduit 5. The device 1 includes a conduit element 6 connected at its opposite ends by an inlet fitting 7 and an outlet fitting 8 into the conduit 2 so that the element 6 receives fuel from the pump 3 through

the fitting 7. The outlet fitting 8 is connected by the discharge portion of the conduit 2 to a discharge nozzle 9 such as is customarily employed in gun type oil burning apparatus. The control device 1 includes an electric switch 10 operable to control the circuit 11, 12 of a relay 13, for example, which may function to control the oil burner ignition circuit, or which might be a flow indicator.

The conduit element 6 is of non-magnetic material, such as brass, and is preferably in the form of a short pipe section having an enlarged cylindrical bore 14 providing an internal annular shoulder 15 adjacent its outlet end. The fitting 8 which connects the outlet end of the element 6 to the conduit 2 is preferably of the well known form of flared coupling having a sleeve nut 16 for securing the flared end of the conduit 2 to the outlet end portion 17 of the conduit element.

The inlet fitting 7 comprises a conduit fitting 18 which has an external clamping flange 19 in opposition to the end face of element 6 and has an end portion screw-threaded into the inlet end of the element bore 14. The inlet end of the fitting 18 is externally screw-threaded to receive a coupling nut 20 for securing the flared end portion of the conduit 2 to the inlet end of the element 6. The fitting 18 has a longitudinal bore 21 which terminates at its inner end within the bore 14 in a cross passageway 22 which communicates at its opposite ends with the bore 14. The inner end portion 23 of the fitting 18 is of reduced external diameter to provide an annular flow passageway therearound into which the ends of passageway 22 discharge. Extending from the fitting end portion 23 and universally secured in a socket 24 therein, there is a valve member 25 of cylindrical rod form having a tapered metering slot 26 which increases in depth in the direction of flow and to the free end of the valve member as shown in Fig. 2. Longitudinally reciprocal and slidably fitting within the bore 14 there is a piston 27 of magnetic material having a longitudinal bore 28 therethrough slidably receiving and fitting the valve member 25. Within the bore 14 there is a compression spring 29 of helical form which seats at one end against the bore shoulder 15 and at its other end extends into an annular recess 30 in the piston 27 for abutment with the base of the recess to urge the piston 27 against the fitting end portion 23. The piston 27 is movable by fluid pressure acting against its end face 31 in opposition to spring 29. The piston 27, upon predetermined movement, will uncover the inlet end of metering slot 26 to per-

mit flow through the piston bore 28 and the conduit 2 to the nozzle 9.

Adjacent the shoulder 15 there is a circumferential recess 32 around the element 6 and in which is positioned an end wall or support 33 having a transverse aperture 34 therethrough. At the opposite or inlet end of element 6 there is an end wall or support 35 which at its lower end has a circular aperture 36 therethrough to receive the fitting 18. The support 35 is rigidly clamped into position against the end wall of element 6 by the flange 19, suitable washers or gaskets 37 being provided to prevent leakage from the bore 14. The support 35 has an aperture 38 therethrough opposite the aperture 34, which apertures are spaced above or laterally from the element 6. Positioned in the apertures 34 and 38 are the opposite ends of a bridge supporting member 39 of electric insulating material. A removable cover or casing 40 of U-shaped form and having end flanges 41 is slip-fitted over the end walls 33, 35 to provide a housing and to hold the end walls and bridge member 39 in fixed position.

Supported on the top face of the bridge member 39 there is a plate-like metal terminal member 42 which receives a terminal screw 43 for clamping the end of the lead wire 11 to the member 42. The member 42 has downturned end portions 44, 44^a which extend through apertures in the bridge member 39 to aid in locating and positioning the member 42. The portion 44 extends through the bridge member 39 and serves as a centering and holding means for one end of a compression spring 45 which, at its other end, bears upon and is received in a recess in one end of a switch arm 46. The bearing member 42 has downward extending bearing ears or flanges 47 which fit against the sides of the bridge member 39 and receive and support the opposite ends of a bearing shaft 48. The switch arm 46 is provided with bearing ears or flanges 49 which are apertured to receive the shaft 48 so that the switch arm is pivotally supported by the bridge member 39. The arm 46 has an extension 50 of electric insulating material on which is mounted a U-shaped permanent magnet 51 which overlies a circumferential channel 51^a in the element 6. A bracket 52 of sheet metal is preferably soldered to the magnet 51 and is tightly clamped to the insulating member 50 by means of bentover ears 53. A projecting portion or stop finger 54 is stamped or formed out of the bracket 52 and is engageable with the underface of bridge member 39 to limit rotation of the switch arm under the force of spring 45. The switch 10 comprises a movable contact member 55 carried by the free end of a resilient blade 56 which is electrically connected and secured to the arm 46 by rivets 57 which also secure the insulating member 50 to the arm 46. The ears 47 and 49 together with the shaft 48 serve to establish in part the electric circuit from the terminal screw 43 to the contact member 55. The other contact member 58 extends downward from the bridge member 39 toward contact member 55 and has its upper end portion extending through the bridge member 39 and a terminal plate 59, the contact member being riveted or spun over so that it serves to clamp the plate 59 to the top face of the bridge member 39. A terminal screw 60 is screw-threaded into the plate 59 and serves to clamp an end of the lead wire 12 to the plate 59.

In the operation of the control device, Figs. 1, 2 and 3, when the pump 3 is started, pressure will

be built up in the conduit 2 against the inlet face 31 of piston 27 thereby creating a differential of fluid pressure on the opposite sides of the piston. When the fluid pressure on the piston face 31 overcomes any fluid pressure on the outlet side of the piston and the opposing force of spring 29 against the piston 27, which serves as an armature, the piston will be moved toward magnet 51. However, before the armature or piston 27 has been moved by fluid pressure to decrease the air gap sufficiently for movement of magnet 51, the metering slot 26 will have been uncovered thereby permitting flow of fluid to the nozzle 9. The parts are so related that the armature 27 must move to a position substantially completely under the magnet 51 before there is sufficient change in the magnetic force between the members 51 and 27 to overcome the spring 45 and move the switch contact 55 relative to and against contact 58. Before the armature 27 reaches the position for operation of the switch, the metering slot 26 will be substantially wide open, that is, the end wall 31 will have been moved to a position for full flow through the conduit member 2. By providing for continued movement of armature 27 after flow starts to the nozzle 9 and before switch 10 is actuated, a proper discharge from the nozzle 9 will be occurring before closure of switch 10 and operation of the relay 13. When the armature 27 is moved beneath the magnet 51, the magnet will be snapped downward into the channel 51^a by its magnetic force until it is stopped by the wall of element 6. During the movement of the magnet 51, the contact 55 will have engaged contact 58 so that the continued magnet movement will have stressed the blade 56 thereby providing a firm electrical contact. Upon stoppage of the pump 3 or a predetermined decrease of pressure against the face 31, so that the spring 29 can act, the spring 29 will move armature 27 away from magnet 51 and toward the position shown so that the magnetic force holding switch 10 closed will be reduced thereby permitting spring 45 to open the switch. The spring 29 will then continue the movement of piston 27 until it cuts off flow through the metering slot 26 and stops further discharge from nozzle 9. It should be noted that pulsation of pressure or small change of pressure differential on opposite sides of piston 27 will not result in opening of switch 10 and the switch will not open until the piston 27 has moved substantially out from under the magnet 51.

In Fig. 4 the control device is generally similar to that of Fig. 1, but in this form the valve member 25 which is universally supported by the end portion 23 of the fitting 18 is provided with a conical valve head 61 which is engageable with the annular seat of a valve port 62 in the longitudinal passageway 63 through the piston or armature 27. The inlet portion of the passageway 63 is, for substantially half its length, of converging form, as at 64, in order to lead or guide the valve head 61 to the cylindrical portion of passageway 63. The length of the cylindrical portion of passageway 63 on the inlet side of the valve port determines the extent of movement of piston 27 under the fluid pressure against the inlet face 31 before the piston passageway is open for flow to the outlet fitting 8. In this form the bridge member 39 has internally threaded, binding posts 65, 66, secured in and extending through spaced apertures therethrough. The posts 65 and 66 are provided with screws 67 which secure the ends

of lead wires 11 and 12 thereto. The post 65 serves to clamp and secure a ring-like metal terminal block 68 to the under side of bridge member 39. Within the ring or block 68 and secured thereto, there is an upward facing contact member 69 which is electrically connected to post 65 by the block 68. The post 66 receives the apertured end 70 of a resilient switch blade or arm 71 and serves to clamp it to the underface of bridge member 39. The arm 71 extends through the aperture in the block 68 in overlying relation to contact member 69 and carries a cooperable contact member 72 which is normally held out of engagement with the contact member 69 by the inherent resilience of arm 71. At the free end of arm 71 a U-shaped permanent magnet 72 is soldered or otherwise secured. A stop member 73 extends downward from bridge member 39 for cooperable engagement with the free end of the arm 71 to limit upward movement of the arm and prevent its contact with the terminal post 65.

It is believed the operation of this form of control device shown in Fig. 4 will be apparent from the description of the device of Fig. 1 but may be briefly stated as follows: When the pressure acting on the face 31 of the armature or piston 27 becomes great enough to overcome any fluid pressure acting against the outlet end or other face of the piston and the force of spring 29, the piston 27 will be moved toward the magnet 72 when sufficient pressure has been built up against face 31 to overcome the opposing force, the piston will be withdrawn from the valve member so that valve head 61 will be within the tapered portion 64 of passageway 63 and there will be flow through the conduit element 6. Such movement of the piston 27 will not, however, have positioned the piston sufficiently within the magnetic field of magnet 72 to attract the magnet and therefore switch 10 will remain in open position. As the pressure against face 31 increases, the piston 27 will be moved into opposed relation with magnet 72 thereby reducing the air gap to increase the magnet attraction between members 72 and 27 such that the inherent resilience of arm 71 will be overcome and contact member 72 will be pulled into engagement with contact member 69. The bowing of arm 71 as magnet 72 is pulled down against conduit element 6 will hold the contact members in good electrical contact. As in Fig. 1, the full flow through piston 27 will occur before the magnet 72 closes switch 10.

Referring to Fig. 5, the control device 1 of either Fig. 1 or Fig. 4 is shown intercalated in the lubricant supply line of an internal combustion engine 74. A pump 75 driven by the engine in any suitable manner, draws lubricant from the crankcase through a pipe 76 and discharges the lubricant through pipe 77 to the control device. From the control device 1 the lubricant flows to and through a header 78 from which branch conduits 79 lead to the points to be lubricated. The switch 10 controls the circuit of the ignition transformer 80 having a battery or other source of electromotive force 81. One contact of the switch 10 is connected by a lead wire 82 to the battery 81 and the other contact of switch 10 is connected by a lead wire 83 to an ignition switch 84. In the lead wire 83 there is a signal device or alarm 85 which may be a signal lamp, a gong, or the like. In parallel with the switch 10 there is a manual starting switch 86. In operation of the system of Fig. 5

the switches 84 and 86 are closed which will complete the battery circuit through the ignition transformer in order to provide ignition for the engine 74. When the engine 74 is running in normal operation and assuming that the pump 75 is functioning properly and is delivering oil to the header 78, the switch 10 will be closed by automatic magnetic action as heretofore described. With the switch 10 closed the switch 86 will be manually opened so that thereafter ignition will be maintained only as long as both switches 10 and 84 remain closed. It will be apparent that after opening of switch 86 the engine will remain in operation only if there is lubricant supplied by the pump and supplied in sufficient quantity and at proper pressure to maintain switch 10 closed. It will also be noted that the indicator 85 will be in operation only if the pump is supplying the necessary quantity of lubricant and will indicate failure of the lubricant supply even though switch 86 should not have been opened after starting of the engine.

It will be apparent to those skilled in the art that the control devices of Figs. 1 and 4 are capable of use in other types of fluid flow systems such, for example, as water sprinkler systems for extinguishment of fires, wherein the control device would indicate the flow line which is automatically placed in operation as by fusing of the usual sprinkler head.

What is claimed and desired to be secured by Letters Patent of the United States is:

1. A control device comprising a conduit element, cooperable magnet and armature members, one of said members slidably fitting within and being longitudinally slidable upon change of fluid pressure in said conduit element, the other of said members being movably supported external of said conduit element and being movable by change in magnetic force between said members upon movement of said slidable member, and means operable upon movement of said external member.

2. A control device comprising a conduit element, cooperable magnet and armature members, one of said members slidably fitting within and being movable by change of fluid pressure in said conduit element, the other of said members being movably supported external of said conduit element and being movable by change in magnetic force between said members upon movement of said slidable member, said slidable member having a passageway therethrough, a valve member within said conduit element and cooperable with said slidable member to control flow through said passageway, and means operable upon movement of said external member.

3. A control device comprising a conduit element, cooperable magnet and armature members, one of said members slidably fitting within and being movable by change of fluid pressure in said conduit element, the other of said members being movably supported external of said conduit element and being movable by change in magnetic force between said members upon movement of said slidable member, said slidable member having a passageway therethrough, a valve member in said passageway and secured to said conduit element, said valve member having a longitudinal portion fitting said passageway and determining the extent of movement of said slidable member before occurrence of flow through said passageway, and means operable upon movement of said external member.

4. A control device comprising a conduit ele-

ment having a portion of non-magnetic material, cooperable magnet and armature members, said armature member being slidable within and being movable by change of fluid pressure in said conduit element, a movable control arm supported external of said conduit element, said magnet member being secured to said control arm and being movable by change in magnetic force between said members upon movement of said armature member, said magnet member being limited in its movement by engagement with said conduit portion, and a control member operable by said arm.

5. A control device comprising a conduit element, cooperable magnet and armature members, one of said members being slidable within and being movable by change of fluid pressure in said conduit element, a conduit flow fitting secured to and extending from said conduit element, supporting means external of and secured to said conduit element by said fitting, a movable control arm carried by said supporting means, the other of said members being secured to said arm and being movable by change in magnetic force between said members upon movement of said slidable member, a control member carried by said supporting means, and a control member cooperable with said control member and carried by said arm.

6. A control device comprising a conduit element of non-magnetic material, cooperable magnet and armature members, one of said members being slidable within and being movable by change of fluid pressure in said conduit element, a conduit flow fitting secured to and extending from said conduit element, supporting means secured to said conduit element by said fitting, a movable control arm carried by said supporting means, the other of said members being secured to said arm and being movable by change in magnetic force between said members upon movement of said slidable member, said slidable member having a passageway therethrough, a valve member carried by said fitting and extending into said passageway to control flow therethrough, a control member carried by said supporting means, and a control member cooperable with said control member and carried by said arm.

7. A control device comprising a conduit element of non-magnetic material, a piston of magnetic material slidably fitting the bore of said element and movable by fluid pressure, a spring acting on said piston and opposing movement of said piston by fluid pressure, a magnet movably supported and positioned adjacent said element, said piston having a passageway therethrough for flow through said element and being movable into a position to attract said magnet, a valve member secured to said element and extending into said passageway to determine the movement of said piston for occurrence of flow through said passageway, and switch means operable by movement of said magnet.

8. A control device comprising a conduit element of non-magnetic material, a piston of magnetic material slidably fitting the bore of said element and having a passageway therethrough, a spring acting on said piston and opposing movement of said piston by fluid pressure, a bridge member supported in spaced relation to said conduit element, a switch arm pivotally

mounted on said bridge member and positioned between said bridge member and said conduit element, a magnet carried by said arm and movable into engagement with said element, a spring acting to move said arm and said magnet away from said element, said piston being movable by differential of fluid pressure in said conduit element and into opposing relation to said magnet so that the magnetic force between said piston and said magnet will pull said magnet against said conduit element and actuate said switch arm, a valve member in said passageway, means securing said valve member to said conduit element, said piston cooperating with said valve member to control flow through said conduit element and acting to open said passageway prior to operation of said arm, and switch means operable by said arm.

9. A control device comprising a conduit element, a piston of magnetic material slidably fitting the bore of said conduit element and longitudinally movable therein by change of fluid pressure, a magnet cooperable with said piston, means supporting said magnet external of and for movement toward and from said element, said magnet being moved by change in the magnetic force between said magnet and said piston, and means operable by movement of said magnet.

10. A control device comprising a conduit element, a piston of magnetic material slidably fitting the bore of said conduit element and longitudinally movable therein by change of fluid pressure, a magnet cooperable with said piston, means supporting said magnet external of and for movement toward and from said element, said magnet being moved by change in the magnetic force between said magnet and said piston, a helical coil spring extending longitudinally within said element and abutting said piston to determine the fluid pressure at which said piston effects operation of said magnet, and means operable by movement of said magnet.

11. A control device comprising a conduit element, a pair of supports spaced longitudinally of and extending in opposed relation from said element, a bridge member extending between said supports in spaced relation to said conduit element, a magnet positioned between said bridge member and said conduit element, a movable operating arm carrying said magnet and mounted on said bridge member, a control means operable by said arm, and a pressure responsive piston of magnetic material cooperable with said magnet and reciprocal within said conduit element.

12. A control device comprising a conduit element, a pair of supports spaced longitudinally of and extending in opposed relation from said element, a bridge member extending between said supports in spaced relation to said conduit element, a magnet positioned between said bridge member and said conduit element, a movable operating arm carrying said magnet and mounted on said bridge member, a control means operable by said arm, a conduit flow fitting screw-threaded to said conduit element and clamping one of said supports to said conduit element, and a pressure responsive piston of magnetic material cooperable with said magnet and reciprocal within said conduit element.

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