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VALVE AND CONTROL ASSEMBLY

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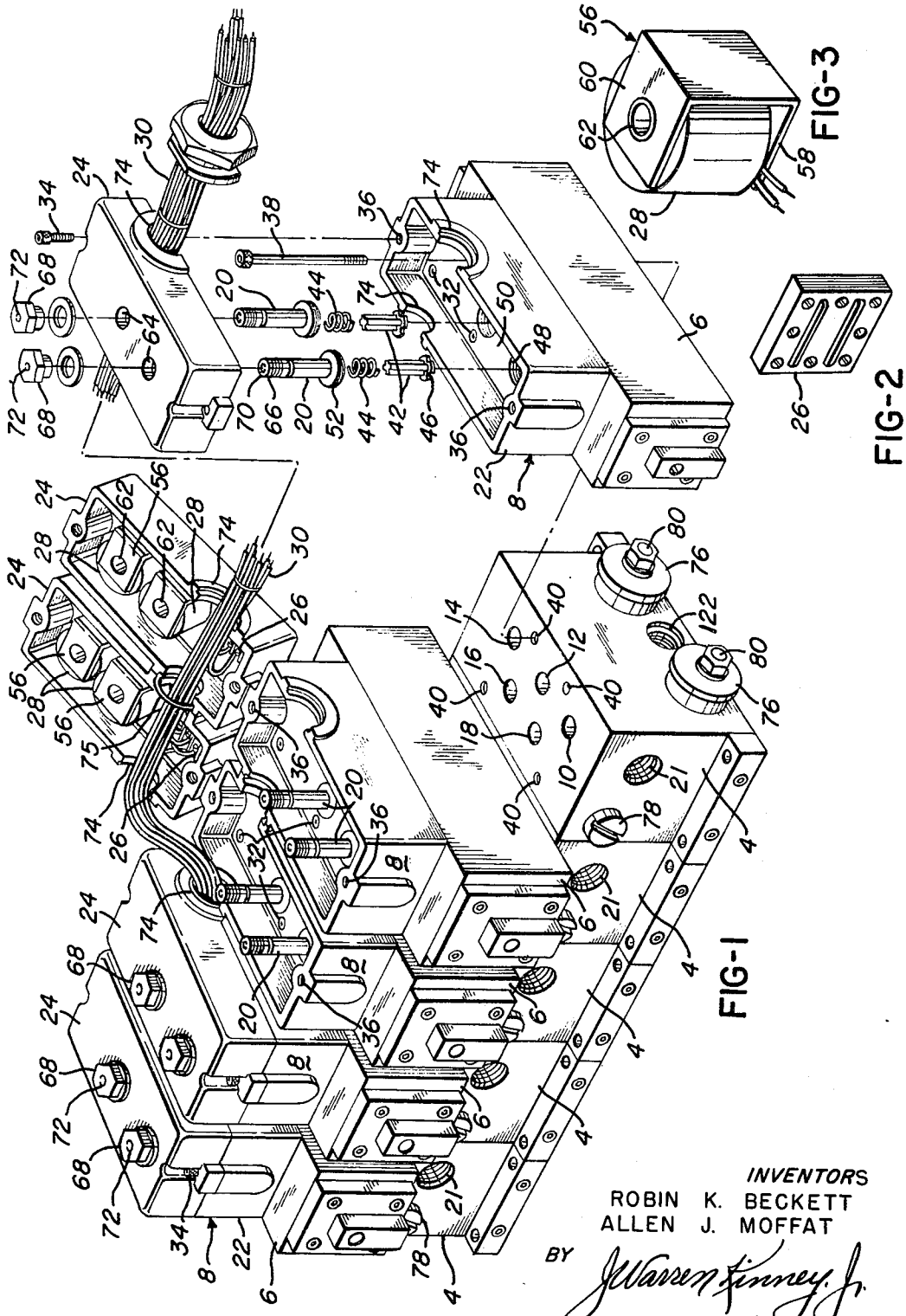


FIG-1

FIG-2

FIG-3

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VALVE AND CONTROL ASSEMBLY

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ABSTRACT OF THE DISCLOSURE

The valve and control assembly comprises three units in a vertical stack, with any number of stacks secured in side by side relation, to produce a compact integrated structure. The uppermost unit is constituted of an electrical section and a mechanical section easily separable, so that the electrical section containing solenoid coils, a terminal block, and a portion of a cable or conductor group, may be readily disassociated from the mechanical section without severing any electrical connections, to fully expose for inspection or replacement the mechanical constituents of the assembly.

The present invention relates to a valve and control assembly, and is applicable in situations where valves and control means therefor are desirably or necessarily stacked and assembled in banks, in the interests of compactness, and convenience of access for safety and economy in servicing. Each stack may include a valving means in a housing, a manifold block providing for circulation of fluid through the valving means, and an operator receptacle comprising a mechanical section and an electrical section easily separable from one another for servicing purposes.

An object of the invention is to provide a compact and orderly valve and control assembly in which all major parts are quickly and easily accessible for inspection or servicing.

Another object of the invention is to provide an assembly of the character stated, which upon servicing is automatically rendered inoperative in the interests of safety and accident prevention.

A further object of the invention is to provide in an assembly of the character stated, inexpensive yet durable and convenient means for quickly disassociating the electrical section from the mechanical section of the operating unit or receptacle, without the need for disconnecting any wires or terminals so that inspections or repairs may be effected with a minimum of expensive servicing time and labor, and with a minimal risk of improper re-assembly.

The foregoing and other objects are attained by the means described herein and illustrated upon the accompanying drawing, in which:

FIG. 1 is an exploded perspective view of several banks of valve and control assemblies, with parts displaced in accordance with the improvements of the present invention.

FIG. 2 is a perspective view of an electric terminal block forming a detail of the assembly.

FIG. 3 is a perspective view of a solenoid coil and holder employed in the assembly.

Referring to the accompanying drawing, FIG. 1 illustrates an orderly grouping of valve and control assemblies, each assembly comprising a manifold block **4**, a valve housing **6**, and an operator receptacle **8**. Each group of elements **4**, **6** and **8**, constitutes a stack, and any number of stacks may be assembled side by side to form a bank of valve and control assemblies. By way of example, FIG. 1 discloses five valve and control assemblies or stacks secured in side by side relation.

Within each housing **6** is a valve having a shiftable spool or equivalent valving member (not shown) for directing a pressurized fluid through selected ports of housing **6** which communicate with the several ports of manifold block **4** denoted by the numerals **10**, **12**, **14**, **16** and **18**. Some of the enumerated ports of manifold block **4** may connect with various exposed ports **21** and **22**, and possibly others at the rear of block **4** which are not seen in the drawing figure.

The valve means of housing **6** may correspond with that disclosed in our copending patent application Ser. No. 704,722 filed Feb. 12, 1968.

For the purposes of the present invention, it is sufficient so far as the manifold block ports are concerned, to note that some of the ports such as **21** and a similar port on the opposite face of block **4**, not illustrated, may be pipe-connected to a fluid motor or other mechanism to be pressure activated, whereas other ports of the block may register with ports in the underside of a superposed valve housing **6**. Ports such as **16** and **18** may convey pressured fluid alternatively to actuator means at opposite ends of the reciprocative valve spool in housing **6**, for shifting the spool which in turn controls the fluid motor mentioned. Shifting movements of the spool in the valve of housing **6**, is controlled by poppet valves indicated generally by the reference numerals **20**, **20**.

The operator receptacle **8** comprises a bottom section **22** and a top section **24**, which sections are separable to expose the interior thereof as shown. The bottom section **22** carries the poppet valves **20**, and may properly be referred to as the mechanical section, to distinguish it from the electrical section or top section **24** which carries an electric terminal block **26**, solenoid coils **28**, **28**, a cable or conductor group **30**, and branch wires which electrically connect the coils **28** with conductors of group **30**. The mechanical section **22** may be detachably mounted atop a valve housing **6** in any suitable manner, as by means of screws **32**; and the electrical section **24** may be detachably mounted atop the mechanical section by means of screws **34** or other fastening devices located at opposite ends of the sections. Screws such as **34** may enter tapped holes **36** provided at opposite ends of the mechanical section.

Valve housing **6** may be detachably secured atop a manifold block **4** in any suitable manner, as by means of several long screws **38** which may pass through openings in the valve housing **6** to threadedly engage tapped holes **40** provided in the upper face of the manifold block and held captive by openings in section **22**. Thus, by the removal of certain screws, the constituent units of a stack or assembly may readily be demounted, and replaced or repaired if necessary, with a minimum expenditure of time and labor.

When it appears necessary to have access to poppet valves **20**, the removal of two screws **34** and two nuts **68** permits displacement of electrical section **24** and all the electric apparatus for magnetically actuating the poppet valves, without requiring any electrical disconnection. Accordingly, displacement of the electrical apparatus is accomplished without the assistance of an electric serviceman.

The poppet valves **20**, **20** normally are magnetically actuated by the solenoid coils **28**, **28**, which in the assembled condition of parts **22** and **24**, surround the upstanding stems of the valves. Within each valve stem is slidably supported an iron armature **42** backed up by a compression spring **44** which normally projects the head **46** a limited distance into a well **48**. The well may be an opening in the bottom wall **50** of the mechanical section **22**, which accommodates the valve stem flange **52**. In order to support the valve stem rigidly in upstanding position within section **22**, the well

opening 48 may be internally screw-threaded to receive the complementarily threaded perimeter of stem flange 52.

Within each well opening is a valve seat (not shown), upon which the valve head 46 of an armature 42 may be projected by spring 44, to maintain a closed condition of the poppet valve. To open the poppet valve, an electric circuit is to be completed through a coil such as 28 which, in the assembled condition of sections 22 and 24, surrounds the stem of valve 20. Energization of the coil 28 results in magnetic lifting of armature 42 and its valve head 46 against the resistance of spring 44, to uncover the valve seat within well 48, thereby opening the poppet valve. Opening of the poppet valve releases pressure of fluid which acts to shift the valve spool within valve housing 6. In a preferred construction, one of the poppet valves 20 in a receptacle 8 controls shifting of the valve spool in one direction, and the other poppet valve 20 in the same receptacle controls shifting of the spool in the opposite direction.

Each solenoid coil 28 may be embraced by a U-shaped bracket 56, one leg 58 of which may be secured against the inner face of the top wall of receptacle section 24. The bracket legs 58 and 60 are each provided with an aperture 62 aligned with the core aperture of the coil, so that a valve stem 20 may be loosely accommodated therein. The arrangement is such that an electrical section 24 after displacement to expose the valves 20, may be replaced upon section 22 as at the extreme left in FIG. 1, with the solenoid coils surrounding the stems of valves 20. The replacement immediately renders the valves operative. The valves 20 are rendered inoperative automatically upon displacement of an electrical section 24, because of the inability of the solenoid coils to actuate the valves when uncoupled from the valve stems. This constitutes a desirable safety feature preventing unexpected machinery operation by inadvertent operation of the poppet valves.

Preferably, though not necessarily, the stems of valves 20 may be long enough to extend through holes 64 in the top wall of electrical section 24. In that event, the stems may be provided with screw threads 66 to be engaged by nuts 68 applied exteriorly of the receptacle. If the valves are of a type which exhaust through a bore 70 in the stem, the nuts 68 may be provided with communicative openings 72 exhausting to atmosphere.

It will be noted that the cable or conductor group 30 extends through all successive electrical sections 24, by way of openings 74 in opposite sides of the sections. The openings 74 may be formed partly in an upper section 24 and partly in a lower section 22, as shown, to accommodate the cable or conductor group. Each opening 74 may carry an elastic O-ring such as 75, to embrace the cable or conductor group, preferably with such intimacy as to effect a seal thereabout. Within each electrical section 24, the solenoid coils 28 may be electrically connected with appropriate conductors of the cable, preferably by way of a conventional terminal block 26 (FIG. 2), which may be fixedly mounted within the electrical section near the openings 74, as suggested at 26 of FIG. 1. The electrical connections for the coils, as previously explained, need not be disturbed in any way when disconnecting the electrical section 24 from a mechanical section 22 and displacing the electrical section to expose the valves 20. Similarly, repairs and inspections may easily be made in the electrical section without interference from the section housing the valves.

In FIG. 1, the reference characters 76 indicate mufflers for reducing noise of air exhaust from the valve assembly, this being of no consequence to the present invention. The screws indicated at 78 are adjusting screws for regulating the rate at which a fluid passes through the valve assembly in actuating a fluid motor or similar machine to be controlled, and this likewise is of no concern to the present invention. Screws such as 80 may be employed in securing successive stacks of units in side by side relationship.

To summarize the invention, it is noted that the valve and control assembly comprises three units which may be arranged and stacked to provide an orderly compact grouping, with all the units easily accessible for inspection or servicing without extensive dismantling of a costly nature. Any of the units 4, 6 or 8 which might require service or replacement, may quickly and easily be removed from the grouping if necessary, without disconnecting any of the electrical elements associated with the cable or conductor group 30. The services of an electrician are thereby dispensed with incident to overhauling the purely mechanical parts of the assembly.

On the other hand, should trouble develop in the electrical system of the assembly, all of the electrical equipment is easily rendered accessible by very simply loosening and partially displacing one or more of the upper sections 24 of the receptacles 8. In this way, any portion of the electrical system may be exposed for inspection, repair, or replacement of parts, without in any way disturbing the mechanical elements of the assembly. As a safety feature, displacement of an upper electrical section 24 automatically renders inoperative any valves normally covered by the displaced section, due to removal of the solenoid coils from operative proximity to the valve stems.

Any number of vertical stacks consisting of units 4, 6 and 8 may be placed in side by side relationship, and joined together to provide a bank or cluster of units. Screws or threaded rods such as are shown at 80, or any other appropriate means, may be employed to produce an integrated assembly having all the advantages herein set forth.

What is claimed is:

1. A valve and control assembly comprising in combination: a manifold block having formed therein a plurality of fluid ports; a valve housing including a valve having a shiftable valving member and means connecting the valve with some of the ports of the manifold block for the control of a fluid therethrough; an operator receptacle box-like of form and comprising a lower mechanical section, and a bodily displaceable upper electrical section to normally cover said lower section; electromagnetically operative valve means mounted within the lower mechanical section, and including means to control shifting of the valving members within the valve housing aforesaid; electro-magnetic coil means mounted within the displaceable upper electrical section, said coil means being movable with said upper section into and out of operating relationship with the electro-magnetically operative valve means; and means for detachably clamping the valve housing between the manifold block and the lower mechanical section of the operator section, to produce a vertical stack.

2. The combination as specified by claim 1, wherein is included means for detachably joining a plurality of said vertical stacks in side by side relationship.

3. The combination as specified by claim 2, wherein is included means associated with the upper electrical sections of the stacks, for supporting a group of electric conductors; and means within the confines of each upper electrical section for electrically connecting certain of said conductors with the coil means of the several electrical sections.

4 A valve and control assembly comprising in combination: a manifold block including an upper wall, said block having formed therein a plurality of fluid ports; a valve housing including a ported upper wall, and a lower wall to abut the upper wall of the manifold block, said lower wall having ports therein to register with some of the ports of the manifold block; a valve within said valve housing including a valving member reciprocable by fluid pressure to control flow of a fluid through some of the registering ports aforesaid; an operator receptacle box-like

of form and comprising a lower mechanical section, and a bodily displaceable upper electrical section to normally cover said lower section, said upper section having a top wall; a pair of electro-magnetically operative valves to control reciprocation of the valving member aforesaid, said pair of valves each including an elongate hollow stem upstanding upon the bottom wall of the lower mechanical section; an armature longitudinally slidable in each hollow stem for opening and closing the valves of said pair of valves; a pair of solenoid coils each having a core aperture; means mounting said coils within the upper electrical section to receive in each core aperture one of said valve stems when the displaceable upper electrical section is placed in covering relation upon the lower mechanical section; a group of electric conductors supported by the displaceable upper section; means within said upper section for connecting the windings of the solenoid coils with certain conductors of the group aforesaid, to effect energization of said coils and consequent magnetic shifting of said armatures to actuate said electro-magnetically operative valves; and means for detachably securing the upper wall of the manifold block against the lower wall of the valve housing, and the bottom wall of the mechanical section against the upper wall of said valve housing, to produce a vertical stack.

5. The combination as specified by claim **4**, wherein is included means for detachably joining a plurality of said vertical stacks in side by side relationship.

6. The combination as specified by claim **5**, wherein the top wall of the upper electrical section is apertured to receive the uppermost ends of said upstanding valve stems when said upper section is in covering position upon the lower mechanical section.

7. The combination as specified by claim **6** wherein is included means for detachably securing said valve stem upper ends to the top wall of the upper electrical section.

8. The combination as specified by claim **4**, wherein the means last mentioned comprises a plurality of long screws clamping the valve housing between the manifold block and the lower mechanical section of the operator receptacle.

9. A valve and control assembly comprising in combination: a manifold block including an upper wall having formed therein a plurality of fluid ports, said block having additional fluid ports exposed for pipe-connection with a fluid-driven machine; a valve housing including a ported upper wall and a lower wall to abut the upper wall of the manifold block, said lower wall having ports formed therein to register with the ports of the manifold block; a valve within said valve housing including a valve spool reciprocable between opposite limits of travel to control flow of a fluid through some of the registering ports aforesaid; an operator receptacle box-like of form and comprising a lower mechanical section, and a bodily displaceable upper electrical section to normally cover said lower section, said upper section having a top wall, and opposed side walls provided with openings to accommodate an electric conductor group; the lower mechanical section including a bottom wall

having a pair of openings in fluid communication with the ports of the valve housing upper wall; a pair of electro-magnetic valves to control reciprocation of the valve spool, said pair of valves each including an elongate hollow stem upstanding perpendicularly upon the bottom wall of the lower mechanical section and in fluid communication with the aforesaid pair of openings therein; an armature longitudinally slidable in each hollow stem, and a valving member on each armature to open and close the openings of said pair of bottom wall openings upon shifting of the armatures in opposite directions; means yieldingly biasing said valving member to closing position relative to said bottom wall openings; a pair of solenoid coils each having a core aperture; means mounting said coils inside the upper electrical section with the core apertures perpendicular to the top wall thereof, said core apertures being spaced apart to each receive therein one of said valve stems when the displaceable upper electrical section is placed in covering relation upon the lower mechanical section; a group of electric conductors extending transversely of the upper electrical section through the openings in the opposite side walls thereof; means within the electrical section for connecting the windings of the solenoid coils with certain conductors of the group of conductors, whereby passage of an electric current through said certain conductors and the coils connected thereto energizes the coils to shift the armatures in one direction longitudinally of the valve stems, for opening the valves associated with the respective armatures; and means for detachably securing the upper wall of the manifold block against the lower wall of the valve housing, and the bottom wall of the mechanical section against the upper wall of said valve housing to produce a vertical stack.

10. The combination as specified by claim **9**, wherein is included means for detachably joining a plurality of said vertical stacks in side by side relationship.

11. The combination as specified by claim **10**, wherein the top wall of the upper electrical section is apertured to receive the uppermost ends of said upstanding valve stems when said upper section is in covering position upon the lower mechanical section; and means for detachably securing said valve stem upper ends to the top wall of the upper electrical section.

12. The combination as specified by claim **9**, wherein the means last mentioned comprises a plurality of long screws clamping the valve housing between the manifold block and the lower mechanical section of the operator receptacle.

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