

Nov. 19, 1963

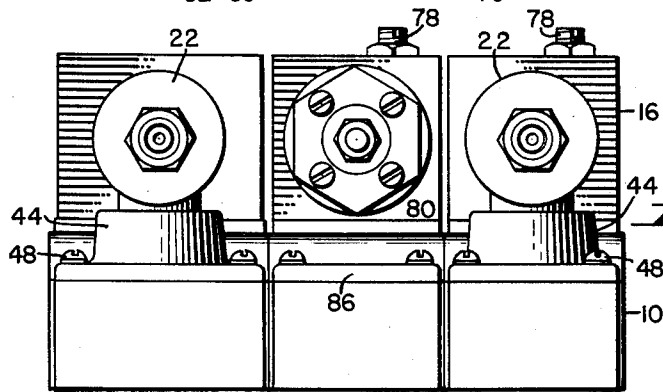
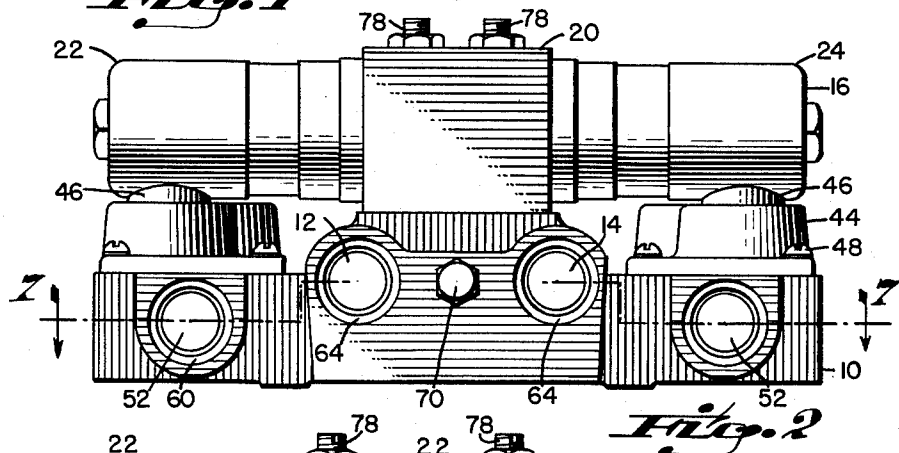
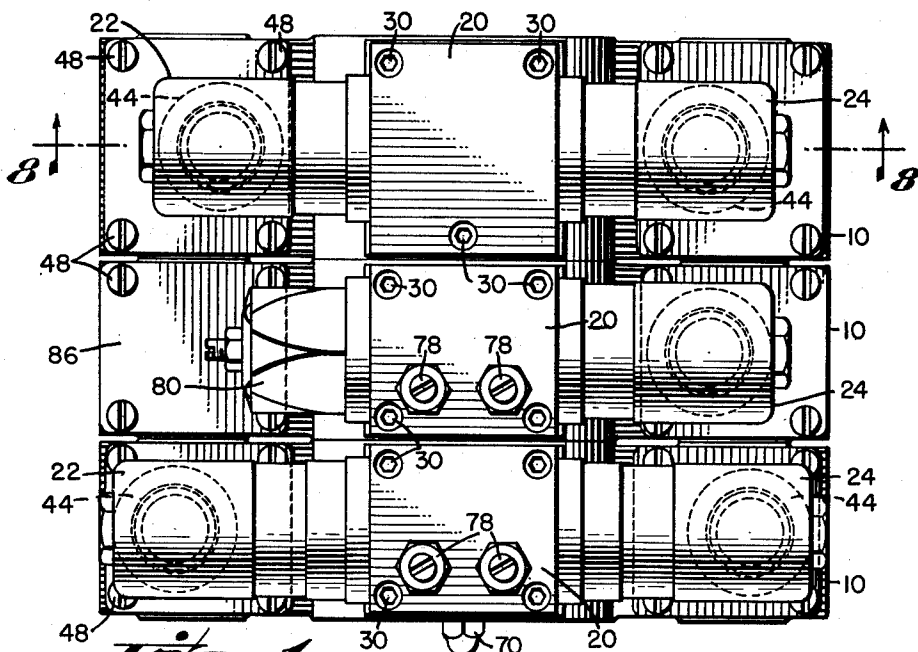
D. E. BECKETT ET AL

3,111,139

STACK TYPE VALVES

Filed Sept. 29, 1961

4 Sheets-Sheet 1



Nov. 19, 1963

D. E. BECKETT ET AL

3,111,139

STACK TYPE VALVES

Filed Sept. 29, 1961

4 Sheets-Sheet 2

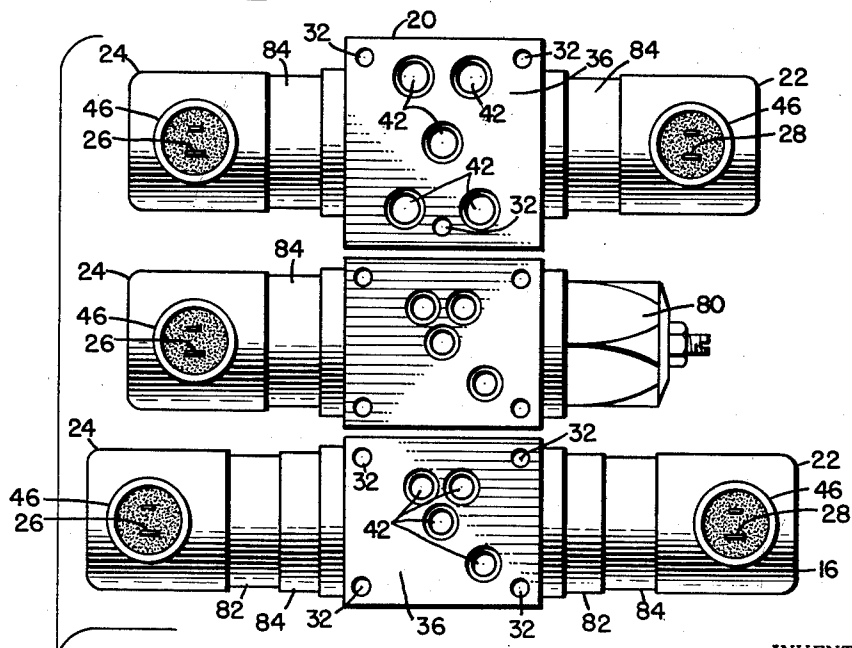
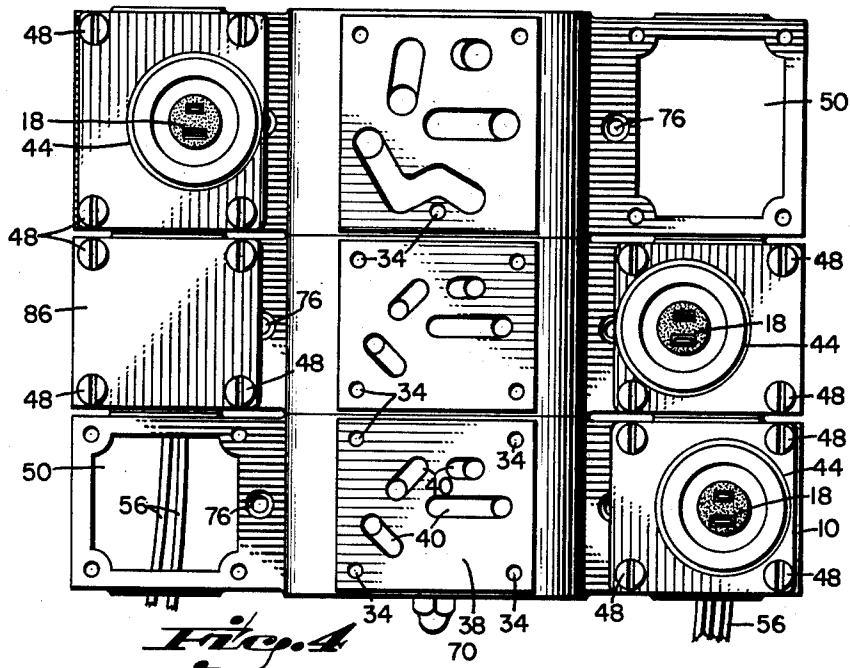


Fig. 5

INVENTORS
DONALD E. BECKETT
WILLIAM N. BECKETT
BY

William Finney, Jr.
ATTORNEY

Nov. 19, 1963

D. E. BECKETT ETAL

3,111,139

STACK TYPE VALVES

Filed Sept. 29, 1961

4 Sheets-Sheet 3

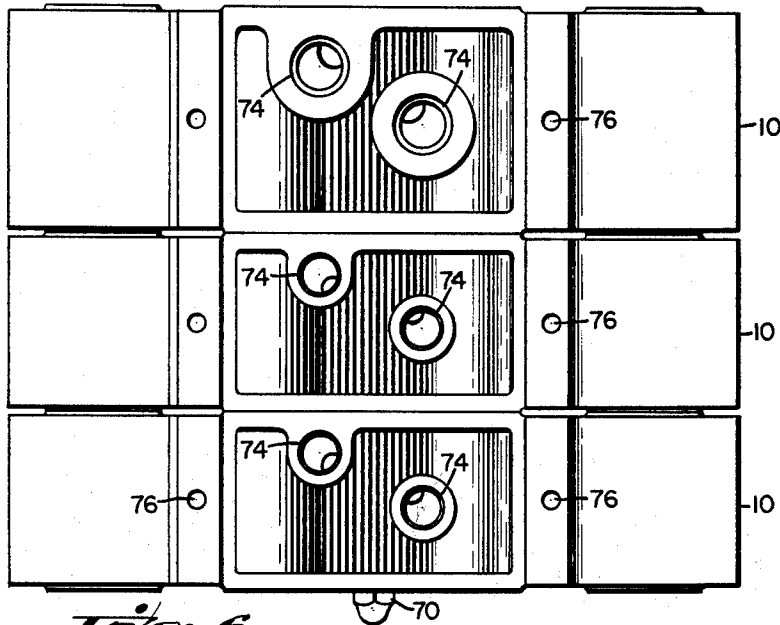


Fig. 6

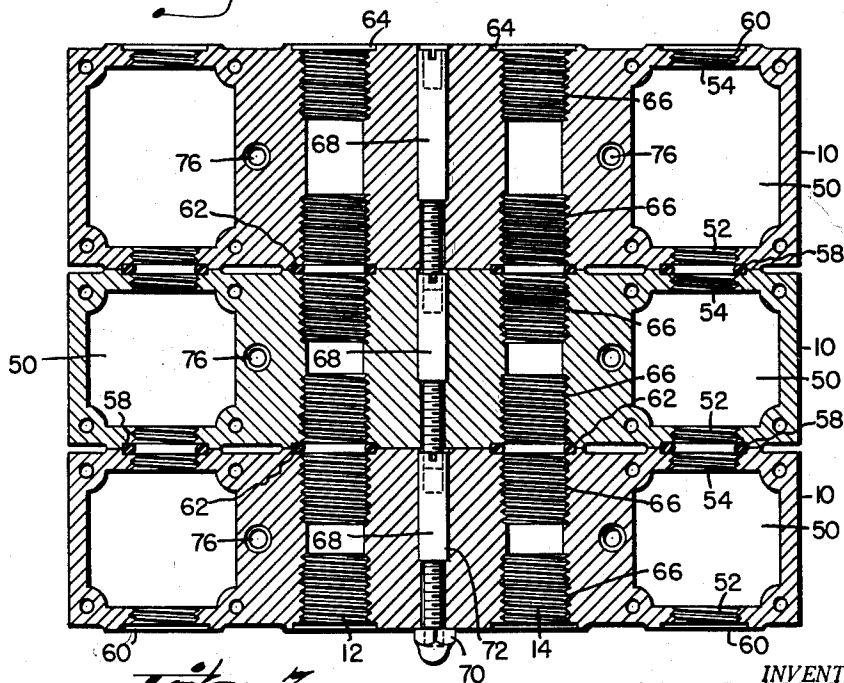


Fig. 7

INVENTORS
DONALD E. BECKETT
WILLIAM N. BECKETT
BY

Warren Kinney, Jr.
ATTORNEY

Nov. 19, 1963

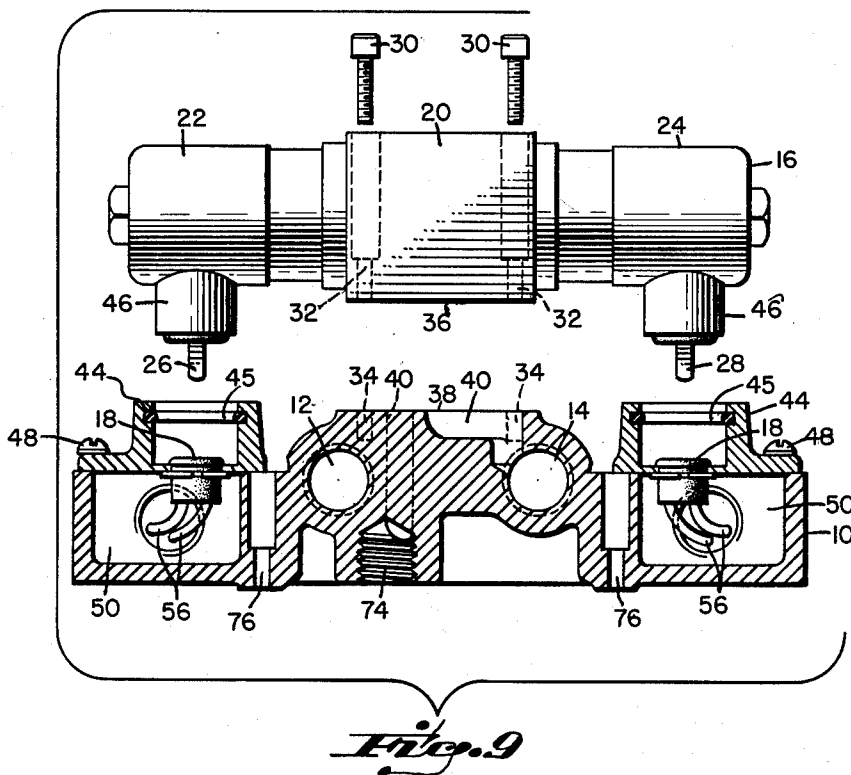
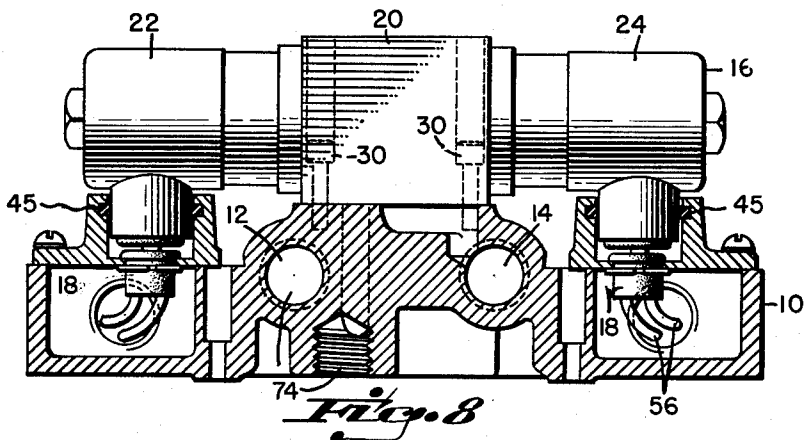
D. E. BECKETT ET AL

3,111,139

STACK TYPE VALVES

Filed Sept. 29, 1961

4 Sheets-Sheet 4



1

3,111,139

STACK TYPE VALVES

Donald E. Beckett and William N. Beckett, Wilmington, Ohio, assignors to Beckett-Harcum Co., Wilmington, Ohio, a corporation of Ohio

Filed Sept. 29, 1961, Ser. No. 141,835

20 Claims. (Cl. 137-608)

The present invention relates to stack-type valves, that is, valves which may be stacked or connected one against another to form a bank of valves each adapted to divert and control fluid from a common source of supply feeding the valves. The invention contemplates the grouping of any number of valve units each complete with a valve spool reciprocable within a chamber, electro-magnetic actuating means therefor, electrical plug-ins for said actuating means, and a manifold base, the bases of all the valve units normally being in constant fluid communication with one another and with a source of fluid under pressure, so that any selected unit or units may be operated to divert fluid from the source of supply independently of other units in the group.

In a typical arrangement, a machine tool such as a lathe may include several double-acting hydraulic cylinders, one to traverse the carriage, one to feed and withdraw the tool, and one to lock and release the chuck; for example, a bank of valves may be provided, in accordance with the present invention, to control each of the three hydraulic cylinders of the machine tool, by feeding fluid under pressure to the cylinders at one end and exhausting fluid from the opposite end. The valve bank may be fed by a single source of fluid under pressure, and may be located either upon the machine itself or upon a panel or support remote from the machine. The several valves may be electro-magnetically actuated, each independently of the others, if desired, by means of electric control switches, which are responsive either to automatic or manual operation. In automated plants, the switches for control of the electro-magnetic valve actuating means may be operated in accordance with predesigned characteristics of a tape or other form of automatic control pattern.

A primary object of the present invention is to provide for a rapid and effortless substitution of electro-magnetic valves in a bank or stack of valves used for the control of fluids, without enlisting the aid of skilled mechanics and electricians to locate and eliminate mechanical or electrical faults in operation while the machine under control of the valves remains idle for an extended period of time.

Another object is to provide simple and inexpensive means for stacking or grouping any number of independently controllable valve units for the control of a fluid in either gaseous or liquid form, and for simplifying and expediting maintenance thereof by unskilled attendants.

A further object of the invention is to greatly minimize the idle time of a hydraulically or pneumatically operated machine disabled due to control failures.

Another object is to provide a greatly improved valving mechanism for the control of a fluid under pressure.

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

FIG. 1 is a top plan view of a stack or bank of valve units constituting the present invention.

FIG. 2 is a side elevational view of the assembly illustrated by FIG. 1.

FIG. 3 is an end elevational view of the same.

FIG. 4 is a view similar to FIG. 1, with the valve sections removed to disclose the manifold bases of the units.

FIG. 5 is a composite view of the valve sections removed from FIG. 4, the under sides of the valve sections being illustrated in plan.

FIG. 6 is a bottom plan view of the FIG. 1 assembly.

2

FIG. 7 is a cross sectional view taken on line 7-7 of FIG. 2.

FIG. 8 is a cross section taken on line 8-8 of FIG. 1.

FIG. 9 is an exploded view showing the manifold base of a valve unit in cross-section, and a valve section of the unit in side elevation lifted and displaced from the manifold base.

A fluid control unit, or valve unit, as constructed in accordance with the present invention, is best illustrated by FIGS. 8 and 9, wherein the reference character 10 indicates generally a manifold base incorporating fluid feed and exhaust passages 12 and 14, through which a flow of pressured fluid is controlled by a valve section 16 that is readily displaceable from the manifold base 10, FIG. 9. Valve section 16 contains a spool valve communicable with main fluid passages 12 and 14, and one or more electro-magnetic actuators or solenoids receiving their operating current from electric receptacles 18 carried by the manifold base 10.

Spool valves of the general character herein referred to are revealed in various prior patents, such as U.S. Patent No. 2,586,906.

In the present disclosure, such a valve is slidably supported within the cylinder block or box 20 of the valve section 16, for reciprocation by means of opposed solenoids indicated generally by the reference characters 22 and 24, and adapted to be alternately energized for shifting the spool valve in opposite directions. The characters 26 and 28 indicate pairs of electrical contacts or plug prongs, connected with opposite ends of the solenoid windings, and adapted for insertion into the electric receptacles 18 of the manifold base. Electrical connection between the solenoid contacts and the receptacles, may be broken by simply lifting the valve section 16 bodily off the manifold base 10, as suggested by FIG. 9.

From the foregoing, it will be understood that a fluid control unit or valve unit, such as 16, may readily be replaced by an identical new one, in the event of faults developing in the valve or in the solenoids of the unit. Such a replacement may be effected in a minute or two, with a correspondingly brief shut-down of the machine controlled by the unit. The faulty unit may then be sent to the shop for repair and subsequent emergency re-use if and when required.

Suitable means may be employed for detachably mounting the valve section 16 upon the manifold base 10, to establish the necessary fluid and electrical connections between these elements. Such means may be in the form of screws or bolts 30, which pass through bores 32 in the cylinder block or box 20 and threadedly engage tapped holes 34 in the manifold base. The complementary bearing faces 36 and 38 of the separable sections are machined for accurate contact, and may accommodate between them a suitable gasket, not shown, to avoid fluid leakage from the various complementary ports and passages formed in the bearing faces 36 and 38.

The various complementary ports and passages above mentioned are best illustrated upon FIGS. 4 and 5. For example, in FIG. 4, face 38 has emerging therefrom a series of fluid passages 40 which communicate with the main passages 12 and 14, FIG. 8, which convey fluid under pressure to and from a source of fluid supply. In FIG. 5, bearing face 36 is shown provided with ports or passages 42 leading to various chambers or sections of the spool valve that reciprocates within the cylinder block or box 20. When a valve section such as 16 is superimposed upon a manifold base 10, with the bearing faces 36 and 38 in firm contact, the ports or passages of the bearing faces register to properly convey fluid through the sections 10 and 16 under the control of the spool valve. Registration is also effected and maintained between the

electrical connections 26—28 and 18—18, FIGS. 8 and 9, for operating the solenoids 22 and 24.

It may be noted by reference to FIG. 9, that manifold base 10 preferably carries a pair of snuffer shields 44 in the form of upstanding sleeves, adapted to snugly receive the cylindrical bosses 46 of the valve section for sealing in the electrical contactors 26—28 and 18—18 against possible hazard of explosion due to arcing, when substituting a valve section upon the manifold base 10. The shields 44 may be provided with interior gasket rings 45 to perfect the seal. The electrical outlets or receptacles 18 may be mounted upon the shields, as shown, for easy replacement or rearrangement by detaching the shields at the screws 48.

The body portion of the manifold base 10 is preferably of one-piece casted or molded construction, having formed therein the main fluid passages 12 and 14, the auxiliary passages 40, and the electric wiring conduits 50 which flank the central portion carrying the fluid passages. As shown in FIG. 7, the wiring conduits 50 of all the units have interconnection through registering openings 52—54 in opposite sides of the manifold bases, to receive conductors 56 threaded continuously through the conduits for feeding current to the various electrical receptacles 18. Gasket rings 58 may be interposed between adjacent units about the registering openings 52—54, to seal the conduit system. Cover plates 60 may be applied over the endmost openings of the assembly to complete the sealing of the conduit.

FIG. 7 best illustrates the nature of the main fluid passages 12 and 14, which are seen to extend transversely through each base 10 so as to register one with another to form a continuous fluid passageway. In butting the parts 10 against one another, gasket rings 62 may be interposed to preclude leakage of fluid between the parts. Annular seats for reception of the gasket rings are indicated at 64, FIG. 2. The passages 12 and 14 of the several base parts may be internally threaded as at 66, so that pipe connections may be made to the endmost bases of a group assembled as in FIG. 7, for conveyance of fluid to and from the passages.

Means are provided for securing the bases 10 in side-by-side relationship according to FIG. 7. A simple and effective means for the purpose may comprise a series of axially aligned binding posts 68 having opposite ends internally and externally threaded complementarily, so that any number of posts may be threadedly connected in line to span the group of bases 10 and clamp them together. A line of connected posts may terminate in a nut as at 70, to be tightened for holding the several bases 10 in rigid assembly. The posts pass through transverse bores 72, formed in each base in parallelism with passages 12 and 14 and adapted for axial alignment to clamp together any number of bases 10. As will be appreciated, the clamping of the bases in assembled relationship may be effected with the use of means other than that illustrated. The means shown is simple and inexpensive, and serves at once to secure all the connections at 58 and 62.

In the bottom plan view of FIG. 6, the characters 74 indicate bottom ports internally threaded to receive pipes for fluid leading to and from motors such as double-acting hydraulic cylinders to be controlled by the several spool valves of the units. Adjusting needles for flow are indicated at 78. The transverse bores designated 76 may be provided to receive screws or other fasteners for securing the valve assembly to a panel or other form of support therefor.

On FIGS. 1, 3 and 5, the middle valve section therein shown has but one solenoid actuator, whereas the valve sections flanking it have two solenoid actuators. In the case of the single solenoid actuator, there may be placed in opposition thereto a housing 80 containing a dash pot mechanism and a valve-return spring, not of importance to the present invention, whereby the spool valve incor-

porated in the unit is constantly biased in one direction of reciprocation. This form of valve is shown simply to illustrate that all the valve units need not be identical in minor respects in order to qualify for incorporation into a group or stack according to the invention.

It may be noted especially by reference to FIGS. 1 and 5, that some of the valve sections are longer than others, this being due to the interpositioning of spacer rings or cylinders 82 and 84 of different lengths, between the valve boxes 20 and the solenoid housings. This is done for the purpose of altering the stroke of the solenoid armatures and the position of the spool valves within the boxes, to obtain different combinations of fluid feeds within the valves for accommodating them to varying conditions of motor or hydraulic cylinder operations which may be desired.

Whenever spacer rings or cylinders 82 and 84 are inserted or removed as above explained, the outward reach of the electric plugs or contacts 26 or 28 is correspondingly altered, making it necessary therefore to relocate the receptacles 18 of the base 10 in order to obtain registry of these electrical components. Such relocating of a receptacle 18 is readily accomplished by removing the screws 48 which mount the receptacle and its associated shield member 44 upon the base, and then rotate the shield member a half turn to increase or decrease the distance between the receptacle and the valve box. In FIG. 4 at the right, one shield member 44 is shown rotated a half turn relative to an adjacent shield member, to place their receptacles 18 at different distances from the center of the assembly. The adjustment thus obtained is, of course, due to the off-setting of the receptacles from the center points of the shield members, as shown.

Further, in FIG. 4, two shield members 44 are shown removed from the assembly, at the upper right and lower left corners of the assembly. A plain cover member for a wiring conduit or chamber is indicated at 86, this being sufficient as a closure for the conduit when no receptacle 18 is needed, as beneath the spring housing 80 of FIG. 5 which, in assembly, overlies the plate 86. This is plainly indicated upon FIG. 3, at 86.

The receptacles 18 are adapted to be rotated a half turn with relation to their respective shield members, in order to ensure proper registration thereof with selected prongs of the plugs extending from bosses 46. In this way a predetermined or desired direction of current flow through the solenoids is assured, whenever it becomes necessary to bodily rotate the shield members a half turn upon the base 10.

Electric current delivered to the solenoids by way of the several receptacles 18 and the conductors 56, is to be under the control of conventional switches or contactors, not shown. Such switches or contactors may be conveniently located near or upon a machine which is under the control of the valve stack embodying the present invention, and may be either manually or automatically actuated.

From the foregoing explanation, it will be understood that the manifold bases 10 of the several valve units constituting the stack, are maintained in rigid assembly by the connecting means 68 which pass through all the bases. Since the wiring and fluid conduits incorporated in the bases are non-moving parts rarely subject to servicing or replacement, any need to disassemble the bases is quite improbable.

On the other hand, the sections 16 which contain the movable spool valves and solenoids, may at times develop mechanical or electrical failures due to wear and other factors, and may therefore require servicing or replacement from time to time. In order to avoid lengthy shutdowns of the machine by the valves, a faulty valve section 16 is to be summarily bodily removed from the stack and replaced with one which is in working condition. Such replacement is quickly effected without enlisting the services of skilled electricians or mechanics, as replace-

ment involves merely the removal of the attachment screws 30, which permits bodily lifting of the faulty valve section 16 from its base, and substitution of a similar valve section in working order. There is no need for the services of a skilled electrician, since the plug and socket connections at 18 will separate incident to lifting of the valve sections as in FIG. 9, and no electrical labor is therefore involved. The faulty valve section replaced may be repaired or reconditioned at a later time, and kept in reserve for future use.

From the foregoing, it will be appreciated that very little time is lost in restoring a solenoid valve controlled machine to operation. Heretofore, the waste of time in restoring a machine to operation was prohibitive, particularly when certain rules required the dispatch of a skilled electrician, and a skilled mechanic, to determine whether the machine required electrical or mechanical attention for restoring operation. In many instances, correction of the fault at the site required the services of both the electrician and the mechanic, each performing his own particular skill in the course of repair, with a resultant extensive down-time of the machine.

The improvements incorporated in the valve unit of the present invention result in substantial simplification of servicing, and great savings of time and labor, all contributing to economy and increased productivity of machine operation.

It is to be understood that various modifications and changes may be made in the structural details of the apparatus disclosed, within the scope of the appended claims, without departing from the spirit of the invention.

What is claimed is:

1. One of a series of valve units adapted for stacking one against another in fluid intercommunicating relationship, said unit comprising a manifold base and a valve section for detachable mounting thereon, the base having a chambered middle portion and a pair of flanking open-topped hollow boxes each including an electric receptacle in the open top thereof, each of the boxes having opposite sides with openings therein for accommodating electric conductors feeding the receptacles, and the said middle portion having opposite sides corresponding to said opposite box sides, a top bearing face, and a lower face, the chambered middle portion including a pair of main fluid-conducting passages each exposed and open at the said opposite sides of said middle portion of the base for registry with similar passages of another valve unit base to be stacked thereon, and secondary passages communicable with the main passages and terminating in the top bearing face and the lower face of the base middle portion, the detachable valve section of the unit comprising a pair of encased electro-magnetic valve actuators and an intermediate hollow valve box having a lower bearing face complementary to the top bearing face of the unit base, said lower bearing face being channeled to register with the secondary passages of the base middle portion and adapted to communicate with the hollow interior of the valve box, the said hollow valve box being adapted to house an axially movable spool valve for controlling a flow of fluid through the said main and secondary passages of the base in correspondency with energization of said electro-magnetic actuators connected therewith, electrical contact means supported upon the casings of the electro-magnetic valve actuators, said contact means being spaced apart to engage the electric receptacles of the base when the lower bearing face of the valve box is supported upon the top bearing face of the manifold base, means for detachably securing the valve section upon the manifold base with said bearing faces in abutment upon one another, and means for securing a side of the middle portion of the manifold base against a side of a second unit, with the main fluid passages of said manifold base in registry with fluid passages of a corresponding base and with the said electric conductor accommodating opening in a side of each of

the boxes in communication with corresponding openings of the said corresponding base.

2. The combination as set forth in claim 1, wherein means are provided for altering the spacing between the electrical contact means of the valve section, and for correspondingly altering the spacing between the electric receptacles of the manifold base.

3. One of a series of valve units adapted for stacking one against another in fluid intercommunicating relationship, said unit comprising a manifold base and a valve section for detachable mounting thereon, the base having a chambered middle portion and a pair of flanking open-topped hollow boxes each including an electric receptacle in the open top thereof, each of the boxes having openings therein for accommodating electric conductors feeding the receptacles, and the said middle portion having opposite sides corresponding to said opposite box sides, a top bearing face, and a lower face, the chambered middle portion including a pair of main fluid-conducting passages each exposed and open at the said opposite sides of said middle portion of the base for registry with similar passages of another valve unit base to be stacked thereon, and secondary passages communicable with the main passages and terminating in the top bearing face and the lower face of the base middle portion, the detachable valve section of the unit comprising a pair of encased electro-magnetic valve actuators and an intermediate hollow valve box having a lower bearing face complementary to the top bearing face of the unit base, said lower bearing face being channeled to register with the secondary passages of the base middle portion and adapted to communicate with the hollow interior of the valve box, said valve box being adapted to house a valve member for selectively opening and closing the channels through the main and secondary passages of the base by and upon energization of the associated electro-magnetic means, electrical contact means mounted upon the casings of the electro-magnetic actuators, said contact means being spaced apart to register with and engage the electric receptacles of the base when the lower bearing face of the valve box is supported upon the top bearing face of the manifold base, means for detachably securing the valve section upon the manifold base with said bearing faces in abutment upon one another, and means for altering the spacing between the electrical contact means of the valve section, and for correspondingly altering the spacing between the electric receptacles of the manifold base.

4. One of a series of valve units adapted for stacking one against another in fluid intercommunicating relationship, said unit comprising a manifold base and a valve section for detachable mounting thereon, the base having a chambered middle portion and a pair of flanking hollow boxes receptive of electric conductors, an electric receptacle mounted upon one of said boxes and having electrical connection with said conductors to charge the receptacle, the boxes having opposed side openings therein for the threading of conductors therethrough, and the middle portion having opposite sides corresponding to said opposite box sides, a top bearing face, and a lower face, the chambered middle portion including a pair of main fluid-conducting passages each exposed and open at the opposite sides thereof for registry with similar passages of another valve unit base to be stacked thereon, and secondary passages communicable with the main passages and terminating in the lower and top bearing faces of the base middle portion, the detachable valve section of the unit comprising a case including an electro-magnetic valve actuator, and a hollow valve box normally fixed to said case, said valve box having a lower bearing face complementary to the top bearing face of the unit base, said lower bearing face being channeled to register with the secondary passages of the base middle portion and adapted to communicate with the hollow interior of the valve box, said valve box being adapted to house a

7

valve member operative by said electro-magnetic actuator to close the channels selectively for controlling a flow of fluid through the main and secondary passages of the base, electrical contact means carried by the valve section adapted to engage the electric receptacle of the unit base when the lower bearing face of the valve box is in register with the top bearing face of the unit base, and means for detachably securing the valve section upon the base with said bearing faces abutting.

5. The device as set forth in claim 5, wherein the combination includes detachable means for securing a side of the base middle portion against a side of a second similar unit base, with the main fluid passages of the bases in registry, and with registry of the side openings of the electric conductor boxes of said bases.

6. One of a series of valve units adapted for stacking one against another in fluid intercommunicating relationship, said unit comprising a manifold base and a valve section for detachable mounting thereon, the base including as an integral part thereof, a chambered middle portion and a pair of flanking electric receptacle supporting means, an electric receptacle on each supporting means, said electric receptacle supporting means being secured for adjustment relative to said middle portion, said middle portion having opposite sides, a top bearing face, and a pair of main fluid-conducting passages each exposed and open at the opposite sides thereof for registry with similar passages of another valve unit to be stacked thereon, and secondary passages communicable with the main passages and terminating in the top bearing face of the middle portion, the detachable valve section of the unit comprising a hollow valve box for housing a movable valve element and electro-magnetic means for connection with and for actuating said valve element, said valve box having a lower bearing face complementary to the top bearing face of the unit base, and having channels therein to register with the secondary passages of the base middle portion for communicating with the hollow interior of the valve box, the base including passage means for discharge of fluid under the control of the movable valve element, electrical contact means including prongs electrically connected with the electro-magnetic valve actuating means, said contact means being normally fixed upon the detachable valve section and spaced from the valve box a distance such as to dispose the prongs for registry and engagement in the receptacles of the base middle portion when the lower bearing face of the valve box is in register with the top bearing face of the base middle portion, said adjustment of said receptacle supporting means facilitating connection therewith of different valve sections having differently spaced contact means and means for detachably securing the valve section upon the base with the bearing faces thereof abutting.

7. The device as set forth in claim 6, wherein the combination includes detachable means for securing a side of the base middle portion in fluid tight joinder with a side of a second similar unit base, with the main fluid passages of the bases in registry.

8. One of a series of valve units adapted for stacking one against another in fluid intercommunicating relationship, said unit comprising a manifold base and a valve section for detachable mounting thereon, the base having a chambered middle portion and a pair of flanking electric receptacles normally fixed relative thereto, said middle portion having opposite sides, a top bearing face, and a pair of main fluid-conducting passages each exposed and open at the opposite sides thereof for registry with similar passages of another valve unit to be stacked thereon, and secondary passages communicable with the main passages and terminating in the top bearing face of the middle portion, the detachable valve section of the unit comprising a hollow valve box for housing a movable valve element and electro-magnetic means for connection with and for actuating said valve element, said valve box having a lower bearing face complementary

8

to the top bearing face of the unit base, and having channels therein to register with the secondary passages of the base middle portion for communicating with the hollow interior of the valve box, the base including passage means for discharge of fluid under the control of the movable valve element, electrical contact means including prongs electrically connected with the electro-magnetic valve actuating means, said contact means being normally fixed upon the detachable valve section and spaced from the valve box a distance such as to dispose the prongs for registry and engagement in the receptacles of the base middle portion when the lower bearing face of the valve box is in register with the top bearing face of the base middle portion, and means for detachably securing the valve section upon the base with the bearing faces thereof abutting, the combination including means for altering the spacing between the electrical contact means of the valve section, and for correspondingly altering the spacing between the electric receptacles of the manifold base.

9. One of a series of valve units adapted for stacking one against another in fluid intercommunicating relationship, said unit comprising a manifold base and a valve section for detachable mounting thereon, the base having a chambered middle portion including opposite sides, a top bearing face, a pair of main fluid-conducting passages each exposed and open at said opposite sides for registry with similar main passages of another valve unit to be stacked thereon, and secondary passages communicable with the main passages and terminating in the top bearing face of the base middle portion, the detachable valve section of the unit comprising a hollow valve box for housing a movable valve element and electro-magnetic means for connection with and for actuating said valve element, said valve box having a lower bearing face complementary to the top bearing face of the unit base, and having channels therein to register with the secondary passages of the base middle portion for communicating with the hollow interior of the valve box, the base including passage means for discharge of fluid controlled by the movable valve element, means for detachably securing the valve section upon the base with the bearing faces thereof abutting, and separable electric contact means carried by the base and by the valve section, adapted to engage and place the electro-magnetic valve actuating means in circuit with a source of current, incident to placement of the valve section upon the base of the unit, the combination including contact shielding means carried by the base for confining any arcing at the separable contact means induced by placement and displacement of the valve section relative to the unit base.

10. One of a series of valve units adapted for stacking one against another in fluid communicating relationship, said unit comprising a manifold base and a valve section for detachable mounting thereon, the valve section being adapted to have a fluid control valve and electrical actuating means therefor, said base and valve section being channeled and apertured complementarily to receive and discharge a flow of fluid under pressure subject to control by said valve, means for detachably mounting the valve section upon the base whereby to effect quick substitution of valve sections upon the base, cooperative separable electric contactors on the base and the valve section adapted to separate incident to displacement of a valve section from the base, and to make electrical contact incident to placement of a valve section upon the base, the contactors of the base being attachable to a source of electric current, and the contactors of the valve section being electrically connected to the electrical actuating means for the control valve, one of said separable contactors being carried by and projecting from an outer end of an elongated boss, the other of said contactors being housed in an inner end of, and enclosed by, a shield, the said shield having an open outer end and receiving said boss and the contactor carried thereby and

snugly encasing the boss and functioning to confine any arcing at the separable contactors, induced by placement and displacement of the valve section relative to the unit base.

11. The device as set forth in claim 10, wherein the channeled base has opposite sides and includes at least one main passage extending from side to side of the base and terminating as openings in said sides, and means for detachably securing a side of the base of the valve unit against a side of the base of a similar unit, with the main passage openings thereof in registry, for directing a flow of fluid through both bases as long as the units are so connected at their bases and means for forming a fluid seal between said sides of the bases.

12. The invention according to claim 10, wherein the shield has therein adjacent to the said open outer end thereof, a gasket for encircling engagement with the said boss and located to effect such engagement prior to the electrical joining of the contactors and to maintain such engagement until the contactors are electrically separated.

13. A manifold base for valve units adapted for stacking one against another in fluid communicating relationship, said base comprising a chambered middle portion and a pair of flanking open-topped hollow boxes each including an electric receptacle in the open top thereof, the boxes having opposed side wall openings therein for accommodating electric conductors to feed the receptacles, and the middle portion having opposite sides corresponding to the side walls, a top bearing face, and a lower face, the chambered middle portion including a pair of main fluid-conducting passages each exposed and open at said opposite sides, for registry with similar passages of another similar valve unit base to be stacked thereon, and secondary passages communicable with the main passages and terminating in the lower face and the top bearing face of the base middle portion, and means for detachably securing one of said opposite sides of said middle portion against a similar side of a second similar unit, with the main fluid-conducting passages in registry for transfer of fluid from one base to the other.

14. The device as set forth in claim 14, wherein the combination includes means for altering the spacing between the receptacles carried by the flanking boxes of the base, and means for detachable mounting of a valve section upon said base.

15. As a part of a valve unit for attachment to a manifold base, a valve section comprising a hollow valve box having a bearing face channeled and apertured for flow of a fluid therethrough, said box being adapted to house a movable valve member for controlling the flow, said box having end walls transverse to the bearing face, and a pair of electro-magnetic actuators supported one upon each end wall in operative relation to said valve member for shifting the latter, said actuators, flanking the valve box and each including a protective casing extending in opposite directions from the end walls of the box, electric contact elements supported by each casing and each having electrical connection with an electro-magnetic actuator, whereby electric current supplied to said contact elements may energize the actuators for shifting the valve member, and means for detachably securing the valve box upon a fluid supply manifold base carrying current supply means for the contact elements of the valve section.

16. The device as set forth in claim 15, wherein the combination includes means for selectively varying the distance from an electric contact element to its adjacent valve box end wall.

17. As a part of a valve unit for attachment to a mani-

fold base, a valve section comprising a hollow valve box having a bearing face channeled and apertured for flow of a fluid therethrough, said valve box being adapted to house a movable valve member for controlling the fluid flow, said box having an end wall transverse to the bearing face, and an elongate casing normally fixed upon the end wall for enclosing an electro-magnetic actuator for operative association with the valve member for controlling movement of the latter, means for detachably securing the valve box upon a fluid supply manifold base, and electric contact elements carried by and projecting laterally from the casing having electrical connection with the electro-magnetic actuator, to be supplied with electric current incident to mounting of the valve box upon such manifold base.

18. The device as set forth in claim 17, wherein the combination includes means for moving the contact elements in the axial direction of the casing for varying the distance of the contact elements from the valve box end wall.

19. The invention according to claim 17, wherein said elongate casing embodies an outer end portion and a spacer portion intermediate the outer end portion and said box end wall, the said spacer portion being removable for replacement by a similar spacer portion of a different length for changing the distance of the contact elements from the said valve box end wall.

20. One of a series of valve units adapted for stacking one against another in fluid intercommunicating relationship, said unit comprising a manifold base and a valve section for detachable mounting thereon, the base having a chambered middle portion including opposite sides, a top bearing face, a pair of main fluid-conducting passages each exposed and open at said opposite sides for registry with similar main passages of another valve unit to be stacked thereon, and secondary passages communicable with the main passages and terminating in the top bearing face of the base middle portion, the detachable valve section of the unit comprising a hollow valve box for housing a movable valve element and electro-magnetic means for actuating said valve element, said valve box having a lower bearing face complementary to the top bearing face of the unit base, and having channels therein to register with the secondary passages of the base middle portion for communicating with the hollow interior of the valve box, the base including passage means for discharge of fluid controlled by the movable valve element, means for detachably securing the valve section upon the base with the bearing faces thereof abutting, and separable contact means carried by the base and by the valve section, adapted to engage and place the electro-magnetic valve actuating means in circuit with a source of current, incident to placement of the valve section upon the base of the unit, one of said separable contact means embodying an elongate boss and the other of said means being enclosed by an elongate shield formed to snugly receive said boss and confine any arcing at the separable contact means induced by placement and displacement of the valve section relative to the unit base.

References Cited in the file of this patent

UNITED STATES PATENTS

2,057,088	De Millar	Oct. 13, 1936
2,655,940	Jackson	Oct. 20, 1953
2,879,788	Beckett et al.	Mar. 31, 1959
3,035,611	Collins	May 22, 1962

FOREIGN PATENTS

1,019,134	Germany	Nov. 7, 1957
-----------	---------	--------------