March 5, 1968 J. C. E. FLINT 3,371,682

SLIDE VALVES

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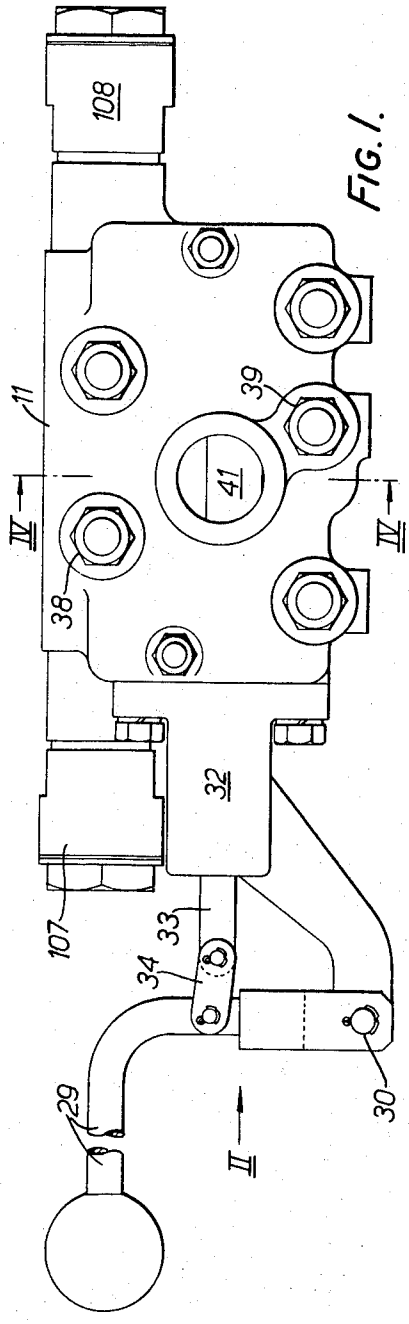


FIG. 1.

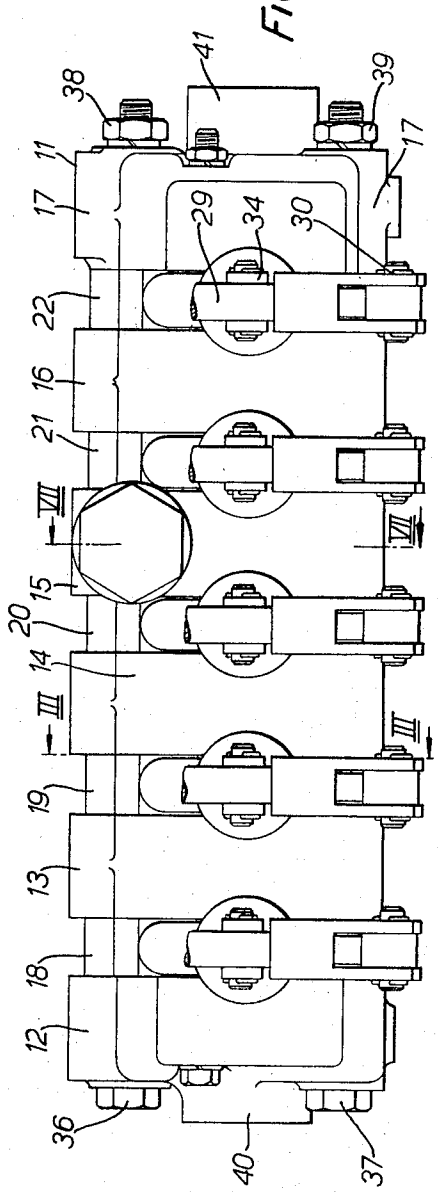


FIG. 2.

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SLIDE VALVES

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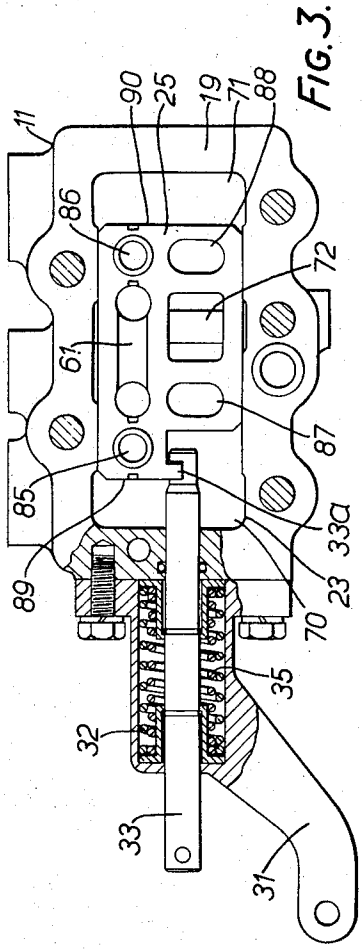


FIG. 3.

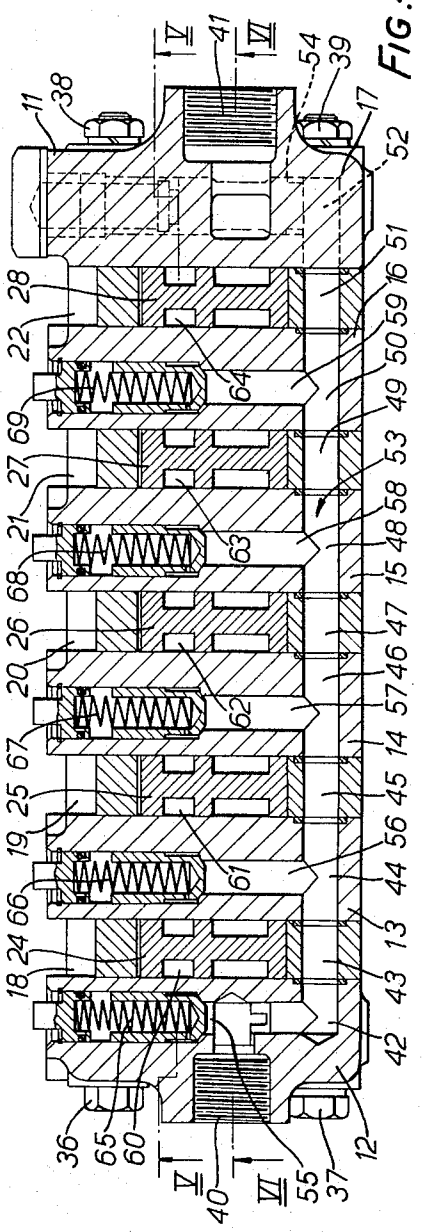


FIG. 4.

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SLIDE VALVES

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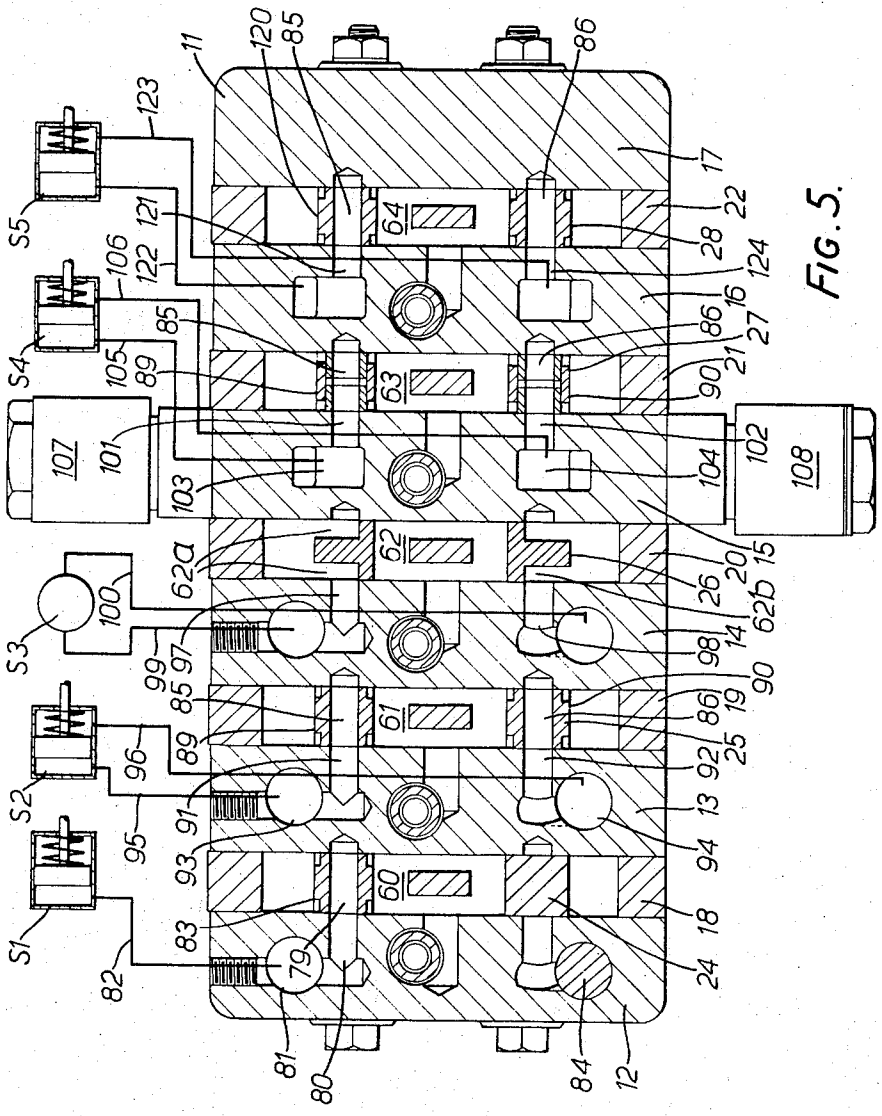


FIG. 5.

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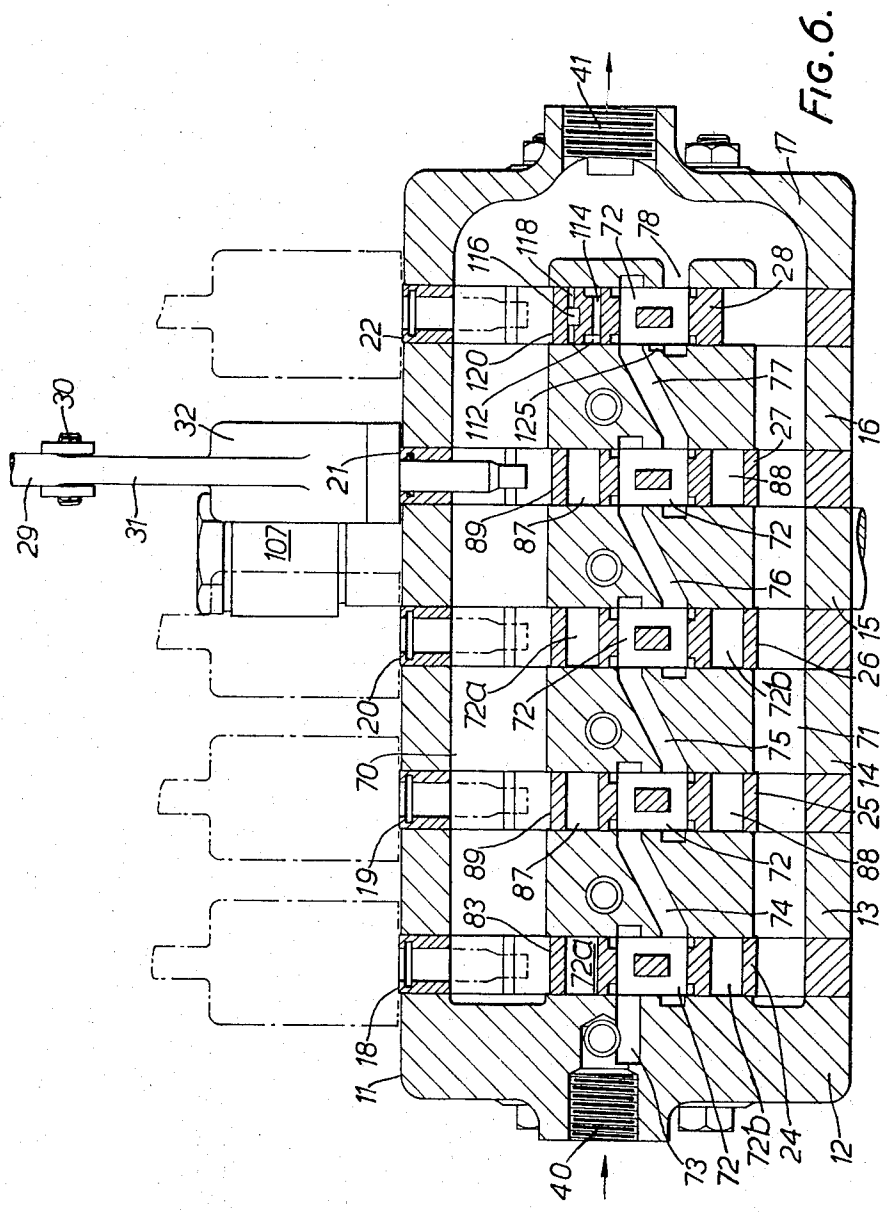
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SLIDE VALVES

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FIG. 6.



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SLIDE VALVES

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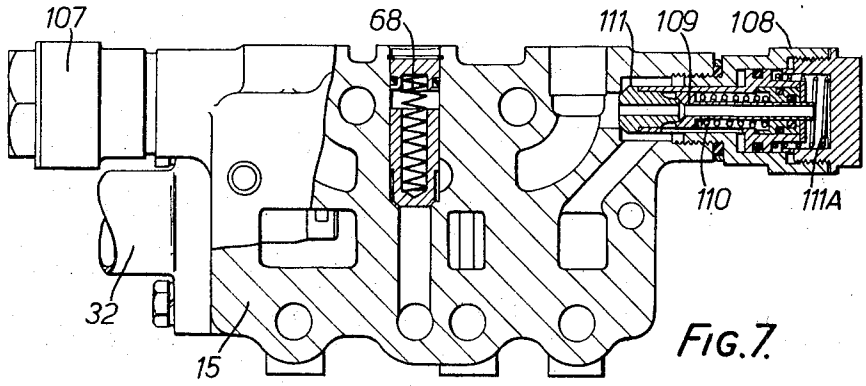


FIG. 7.

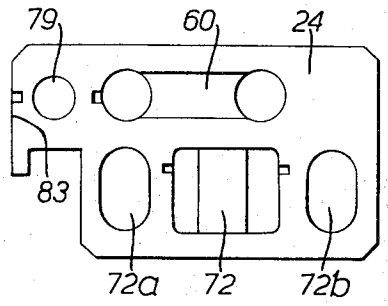


FIG. 8.

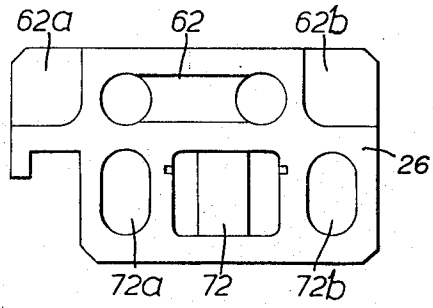


FIG. 9.

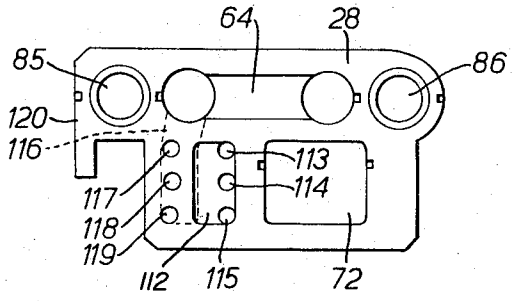


FIG. 10.

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United States Patent Office 3,371,682
Patented Mar. 5, 1968

3,371,682

SLIDE VALVES

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Filed Nov. 19, 1965, Ser. No. 508,793
Claims priority, application Great Britain, Mar. 3, 1965, 9,075/65
13 Claims. (Cl. 137—596.12)

ABSTRACT OF THE DISCLOSURE

This application discloses a multiple slide valve assembly including a plurality of casing plates, each pair of plates being separated one from the other by a slider frame housing a ported slider which is of rectangular cross-section, the casing plates and slider frames being removably connected together (to allow the interchange of one casing plate and/or slider frame and/or slider for a casing plate and/or slider frame and/or slider already in the multiple slide valve), passageways in the plates and/or frames enabling fluid supplied to the multiple slide valve to be available at each slider for direction to a respective service, and each slider being capable of controlling exhaust of fluid from the service, one plate, frame and slider combination, at least, having an operating characteristic different from that of at least one other such combination.

By virtue of such interchangeability of components of the multiple slide valve, any one of a number of different modes of control can be afforded a service associated with the respective slider, such modes depending upon the precise shape of the slider and/or its porting and/or its range of displacement and/or upon the porting of the associated slider frame and/or casing plates.

However, although the components are designed for different modes of operation of the associated service, certain at least of the casing plates and slider frames have such similarity as to enable them to fit together in banked manner, in any desired position in the bank one with respect to the other. Preferably, these plates and frames are held together by bolts common to all and passing through suitable holes therein.

Further, the casing plate at one end portion of the valve assembly may constitute an inlet casing which incorporates a single inlet connection for the whole valve, while the casing plate at the other end portion may constitute an exhaust casing, which incorporates a single exhaust connection for the whole valve.

The casing plates and slider frames may include aligned ports which together form a pressure fluid supply passage common to all sliders of the valve, the inlet connection communicating with this passage. Further, this passage may be placed in communication with the sliders by branch passageways, one in each respective casing plate, each branch passageway incorporating a check valve.

The passage may open into the exhaust casing plate, relief valve means being then provided, capable of relieving pressure in the passage to exhaust through the exhaust connection.

The arrangement of the components is such that controlling movement of one slider in the bank has little or no adverse effect upon the desired operation of any one of the other sliders in the bank.

Spring centering means may be provided for affording bias of each slider to its neutral position.

One embodiment of the invention will now be particularly described, by way of example with reference to the accompanying drawings, of which:

FIGURE 1 is a side elevation of a multiple slide valve bank,

FIGURE 2 is an end elevation of the multiple slide valve bank shown in FIGURE 1, viewed in the direction of the arrow II,

FIGURE 3 is a cross-section taken along the line III—III on FIGURE 2,

FIGURE 4 is a cross-section taken along the line IV—IV on FIGURE 1,

FIGURE 5 is a cross-section taken along the line V—V on FIGURE 4,

FIGURE 6 is a cross-section taken along the line VI—VI on FIGURE 4,

FIGURE 7 is a cross-section taken along the line VII—VII on FIGURE 2,

FIGURE 8 shows a slider operable to control a single-acting service, and suitable for use in the multiple slide valve bank shown in FIGURES 1 to 7,

FIGURE 9 shows a slider operable in double-acting manner for control of a rotary hydraulic motor and suitable for use in the multiple slide valve bank shown in FIGURES 1 to 7, and,

FIGURE 10 shows a slider operable in double-acting manner and capable of affording an associated service a float condition, which slider is suitable for use in the multiple slide valve bank shown in FIGURES 1 to 7.

Referring to FIGURES 1 to 7 of the drawings, a multiple slide valve bank **11** comprises six casing plates **12, 13, 14, 15, 16** and **17**, interspaced one from the other by five slider frames **18, 19, 20, 21** and **22**, each of which incorporates a chamber **23** of rectangular shape and of rectangular cross-section thereby to provide a linear slide for a ported slider. The ported sliders **24, 25, 26, 27** and **28** are each of rectangular cross-section in a plane at right-angles to the direction of sliding and each is controllable by means of its own pivoted lever **29** which is mounted at **30** upon a bracket **31** formed integrally with a cover member **32**. A control rod **33**, tongue-and-slot connection **33***a* and link **34** connect the respective slider with the lever **29**, and spring centering means **35** housed within the cover member **32** are provided in association with the control rod **33** for biasing each slider to its neutral position. A slider **25** is shown in its neutral position in FGURE 3 of the drawings.

The casing plates **12, 13, 14, 15, 16** and **17** and the slider frames **18, 19, 20, 21** and **22** are held in sealing engagement in banked manner by means of bolts as at **36** and **37**, which pass through suitable apertures formed in these components, having nuts as at **38, 39**, applied to the bolts.

The casing plate **12** at one end of the banked assembly is provided with a liquid inlet connection **40** for the entire assembly, while the casing plate **17** at the opposite end of the assembly is provided with a drain connection **41**, also common to the entire assembly.

Aligned ports **42, 43, 44, 45, 46, 47, 48, 49, 50, 51** and **52** (FIGURE 4) are provided in the casing plates and slider frames thereby to form a pressure liquid supply passage generally indicated at **53** running the length of the bank and in communication with the inlet connection **40**. This passage is also in communication with the drain connection **41** through a suitable relief valve, generally indicated at **54**, incorporated in the drain casing plate **17**.

Branch passageways **55, 56, 57, 58**, and **59**, are taken from this passage **53** and lead through the casing plates respectively to each of the sliders **24, 25, 26, 27** and **28**. The sliders themselves each have webbed ports **60, 61, 62, 63** and **64** elongated in the direction of sliding and cut through the thickness thereof, for receceiving the pressure liquid both when the sliders are in their neutral positions and when in their operative positions. The branch passageways each incorporate a check valve **65, 66, 67,**

68 and 69, respectively to prevent reverse flow of liquid towards the inlet connection 40.

The chambers 23 in which the sliders are mounted are placed in communication with the drain connection 41 so that both end portions of each slider are subjected to drain conditions. The through passage ways on either side of the block provided for this purpose are indicated generally at 70 and 71 in FIGURE 6.

The sliders are each provided with unloader ports 72 and the casing plates are provided with unloader passageways 73, 74, 75, 76, 77 and 78 so that when all the sliders are in their neutral positions as shown in FIGURE 6, a direct route from the inlet connection 40 to the drain connection 41 is made, thus by-passing the relief valve 54.

All the casing plates, except those incorporating the inlet connection and the drain connection, and all the slider frames are so made as to be interchangeable as to position anywhere in the banked assembly. However, in this embodiment certain of the five sliders 24, 25, 26, 27 and 28 are somewhat different in their precise design of porting.

The first slider 24 in the bank is provided, as shown in FIGURE 8, with the elongated slot 60 and with a single auxiliary slot 79 to the left of the slot 60 in the drawing. Beneath the main port 60 is the unloader port 72 and to the left and right thereof balance ports 72*a* and 72*b*. This porting is suitable for controlling the operation of a service in the form of a single-acting telescopic jack S_1 shown in FIGURE 5. Thus, when the slider 24 is moved from its neutral position to the left in FIGURE 8, the slider permits pressure liquid passing through the associated check valve 65 from the common passage 53 to pass from its elongated slot 60 out through a port 80 in the plate 12 and into a connection 81 from which piping 82 is taken to the pressure side of the jack S_1. When the slider is moved back to its neutral position the service is held hydraulically locked in the selected position, but as soon as the slider is moved from its neutral position in the opposite direction, it permits exhausting of liquid from the pressure side of the jack back to drain, the left-hand edge 83 of the slider co-operating with the port 80 for such return flow entering the block at the connection 81. The port 84 is not required in such single-acting function and is suitably plugged.

The second slider 25 in the banked valve assembly is different from the first in that it has porting of the four-way type as shown in FIGURE 3, whereby the service S_2 associated therewith, which again is a telescopic jack, is instead operable in double-acting manner. When the slider 25 is moved away from its neutral position, pressure liquid is supplied to one side of the jack, while liquid on the other side of the jack is exhausted to return by the appropriate porting arrangement in the slider. As shown in FIGURE 3, as well as having the elongated slot 61, the slider has two auxilary ports 85 and 86 spaced away from either end of the elongated port. Also on either side of the unloader port 72 are provided unloader balance ports 87 and 88. The slider is provided with straight end edges 89 and 90 which are respectively co-operable with ports 91 and 92 formed in the casing plate 13 and which respectively lead to connections 93 and 94. These connections are in communication with the jack S_2 by way of pipes 95 and 96 respectively.

When the slider is in the neutral position the ports 85 and 86 are in exact registry with the ports 91 and 92, but when the slider is displaced away from the neutral position the slot 61 opens to either port 91 or 92, while the appropriate end edge 89 or 90 controls flow from the unpressurised port 91 or 92 to drain, the jack S_2 contracting or extending as the case may be.

The third slider 26 in the bank is intended for the operation of a reversible hydraulic motor S_3. In this case the porting in the slider is arranged as shown in FIGURE 9 and like the slider shown in FIGURE 8 has unloader balance ports 72*a* and 72*b* on either side of the unloader port 72. However instead of having auxiliary ports to the side of the elongated slot 62, the upper corner portions in the drawing of the slider are provided with substantially square recesses 62*a* and 62*b* formed therein. These recesses are co-operable with ports 97 and 98 in the casing plate 14, which respectively communicate with the motor S_3 through pipes 99 and 100.

The recesses of the slider 26 are such that when the motor S_3 is not operative and the slider is in its neutral position, the supply and return connections of the motor are both connected to drain. When the slider is displaced in a first direction the motor S_3 rotates in one direction, and when the slider is moved back through the neutral position in the opposite direction the motor rotates in the reverse direction.

The recesses ensure that when neutral is selected, the hydraulic lines are not sealed so that the motor is stopped abruptly in a manner which might cause mechanical damage, but instead are opened to drain to allow the motor to run down freely to its stationary state.

In the fourth slider 27 in the bank the porting is arranged as shown in FIGURE 3 and such that the associated service S_4, in the form of a telescopic jack, is operable in double-acting manner. The slider 27 has auxiliary ports 85 and 86 formed on either side of the elongated pressure slot 63, and also has unloader balance ports 87 and 88 formed on either side of the unloader port 72. The straight end edges 89 and 90 are arranged to be co-operable with ports 101 and 102 so as to control flow from the low pressure side of the jack to drain, these ports communicating with connections 103 and 104, respectively, which themselves are connected to the jack S_4 by pipes 105 and 106.

As shown more particularly in FIGURES 5 and 7, the casing plate 15 has, in association with the connections 103 and 104, service line relief valves 107 and 108. Thus although the slider controls the double-acting jack S_4 in a manner similar to that of the second slider 25, the relief valves 107 and 108 so provided in the casing plate 15 in association with both pipes 105, 106 from the slider to the jack S_4 afford protection for the valve assembly from subjection to heavy shock or inertia loads. Such an arrangement is suitable for the operation of a service required to displace relatively heavy equipment. Without such service-line relief valves, because the main relief valve 54 of the valve block is only effective when any one or more of the sliders is operable, damage to the control valve assembly could occur upon the occasioning of shock or inertia loads on the jack S_4 when the associated slider is in the neutral position.

Each relief valve 107 and 108 has an element 109 of inverted conical form and openable against the effort of a coil spring 110. The relief valve is combined with an anti-cavitation valve 111 of hollow form with a conical seating portion openable against the effort of the coil spring 111A when the pressure differential across it increases due to cavitational tendency in the associated service line. Such opening admits liquid into the service line from drain to prevent cavitation.

In the fifth and last slider 28 of the bank, the porting is as shown in FIGURE 10, and is such that although the service S_5 controlled thereby is a double-acting jack, the slider 28 is movable to a position beyond one of its normal pressurising positions, such as those described with reference to FIGURE 3 on either side of the neutral position, into a further and "float" position. Here, the service S_5 controllable by the slider 28 is a scoop-operating jack of an earth-moving vehicle and by moving the slider into this "float" position, both sides of the jack placed in communication with drain so that the scoop can drag or slide along the ground with the piston of the jack free-stroking in its cylinder as the scoop follows the undulations of the ground. This slider has an elongated slot 64 and auxiliary ports 85 and 86 similar to those of the second and fourth sliders in the bank, but the unloader port 72 has only one balance port 112 to the left

of it. This balance port comprises a pair of recesses of rectangular form provided on the side faces of the slider and in communication through vertically-spaced transverse holes **113, 114** and **115**.

A substantially vertically-directed passage **116** is provided internally of the slider **28**, and transverse ports **117, 118** and **119**, vertically spaced, place this passage in communication with the side faces of the slider.

When the slider **28** is in its "float" position, that is its extreme lowest position in FIGURES 5 and 6 and its extreme right-hand position when viewed in FIGURE 10, the end edge **120** opens the port **121** to drain, and since the port **121** is connected through pipe **122** to the left-hand side of the jack S_5, this side of the jack is in communication with drain. At the same time the right-hand side of the jack is in communication with the slot **64** through a pipe **123**, a port **124**, and through the passage **116** with the ports **117, 118** and **119**. With the slider in its "float" position the passageway **77** is such that, in conjunction with a recess **125** alongside thereof, the ports **117, 118** and **119** are placed in communication with the recesses of the unloader balance ports **112** and also with the unloader port **72** and finally drain through pasageway **78** and connection **41**.

Thus both sides of the service are open to drain.

With the slider in the "float" position, it has little or no restrictive effect upon the normal operation of any of the other sliders in the bank.

The arrangement of the unloader ports **72** and of the co-operable unloader passageways **73, 74, 75, 76, 77** and **78** in the casing plates are such that when all the sliders are in their neutral positions a direct route from the inlet connection **40** to the drain connection **41** is established thereby by-passing the relief valve **54** so that pressure liquid entering the slide valve assembly is directed straight to drain without any generation of heat which would otherwise occur had the liquid passed through the relief valve.

It will be seen that the arrangement of the unloader porting in the fifth slider **28** in the bank is such that when this is in its "float" position and all the other sliders are in their neutral positions, the said direct communication through the unloader porting from the inlet connection **40** to the drain connection **41** is still maintained.

If any one of the first four sliders in the bank is moved away from its neutral position, the direct communication between the inlet connection **40** and the drain connection **41** is closed off so that pressure is immediately raised in the passageway **53** and is available via the respective check valves in the elongated pressure slots in each of the sliders.

In order to suit installation requirements, at any time re-positioning of any of the sliders and/or casing plates, and/or slider frames other than that associated with float can quickly be accomplished because of their readily interchangeable nature.

Further, the bank may be enlarged by the incorporation of additional sliders, casing plates and slider frame combinations.

Again, supposing an operator to be controlling various services on an earth-moving vehicle with the five slider control bank in accordance with the embodiment above described, if he requires to incorporate a different service replacing another on the vehicle, or again if he wishes to operate a service on the vehicle in a different manner, the particular slider and/or slider frame and/or casing plate can quickly be removed from the banked valve assembly and the appropriate component or components substituted.

Although in the embodiment described above five different forms of control in combination are mentioned, there are many other controlling functions to which the slider/slider frame/casing plate combination can with advantage be applied within the general interchangeable structure.

Such other controlling functions can be such as to require the provision of detents on the frame and slider, the provision of microswitches in association with the slider, the provision of sliders with special face seals, and other forms of slider and/or slider frame and/or casing plate designed specifically for any required special purpose application.

The invention is in no way limited to use in liquid systems as it can with advantage be used in pneumatic or other gaseous systems.

Again, the invention is in no way limited to sliders which are displaceable in linear manner within the banked casing, as in other embodiments the invention is wth advantage applied to slide valves of rectagular cross-section which are angularly-displaceable or semi-rotatable about a fixed rotational axis.

The invention is in no way limited to the number of sliders incorporated in the embodiment above described with reference to the drawings, as in other embodiments of the invention a banked slide valve assembly can have any desired number of sliders in dependence upon the associated requirements.

I claim as my invention:

1. A multiple slide valve comprising: a plurality of casing plates disposed in spaced parallel planes; a slider frame interposed between each pair of casing plates, each slider frame being formed with a chamber; a ported slider of generally rectangular cross-section guided in said slider frame for linear sliding movement to and fro within its chamber; means releasably joining the casing plates and slider frames, whereby a given plate, slider and frame combination may be interchanged for a different combination, the several plates and frames having passageways for the supply of pressure fluid from a source to and from each slider; each said slider having ports arranged for direction by the slider of such fluid to a respective service, and for controlling the exhaust of fluid therefrom, at least one cooperating plate, frame and slider combination being arranged to have an operating characteristic differing from that of another such combination.

2. A multiple slide valve according to claim **1**, wherein a plurality of the combinations are similarly constructed and arranged whereby they may fit together as a bank, in varied positions with respect to one another.

3. A multiple slide valve according to claim **1**, wherein the casing plate at one end portion of the valve forms an inlet casing ported to receive a single inlet connection for the whole valve, and the casing plate at the other end portion forms an exhaust casing having a single exhaust connection for the whole valve.

4. A multiple slide valve according to claim **3**, wherein the several casing plates and slider frames include aligned ports communicating with the inlet connection to define a pressure fluid supply passage common to all sliders of the valve.

5. A multiple slide valve according to claim **4**, wherein each casing plate is formed with a branch passageway that communicates with said common passage, and a check valve in each branch passageway arranged to prevent reverse flow.

6. A multiple slide valve according to claim **5**, wherein the common passage opens into the exhaust connection of said exhaust casing, and relief valve means in said exhaust casing communicating with the common passage and with the exhaust connection and arranged to relieve pressure in the passage through the exhaust connection.

7. A multiple slide valve according to claim **1**, including spring centering means operatively connected to the several slides and urging each toward a neutral position.

8. A multiple slide valve as claimed in claim **1**, wherein at least one of said sliders is so ported as to be capable of controlling a single-acting service.

9. A multiple slide valve as claimed in claim **1**, wherein at least one of said sliders is so ported as to be capable of controlling a double-acting service.

10. A multiple slide valve as claimed in claim **1**, wherein at least one of said sliders is so ported as to be capable of controlling a rotary fluid-pressure-operated motor.

11. A multiple slide valve as claimed in claim 1, wherein at least one of said sliders is so ported as to be capable of controlling a double-acting service through fluid conduits, each such conduit having a fluid-pressure relief valve.

12. A multiple slide valve as claimed in claim 1, wherein at least one of said sliders is so ported as to be capable of controlling a double-acting service, at least said one slider being displaceable beyond a normal range of movement to a further position whereby the service is allowed to free-stroke, permitting independent movement of the device it otherwise powers.

13. A multiple slide valve as claimed in claim 1, wherein further porting, comprising unloading porting, is provided in each of the sliders and so arranged that when all the sliders are in their neutral positions a direct route is provided between the inlet connection and the exhaust connection, thereby to by-pass said relief valve.

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