

June 11, 1968

J. C. E. FLINT ETAL

3,387,628

SLIDE VALVES

Filed Nov. 19, 1965

7 Sheets-Sheet 1

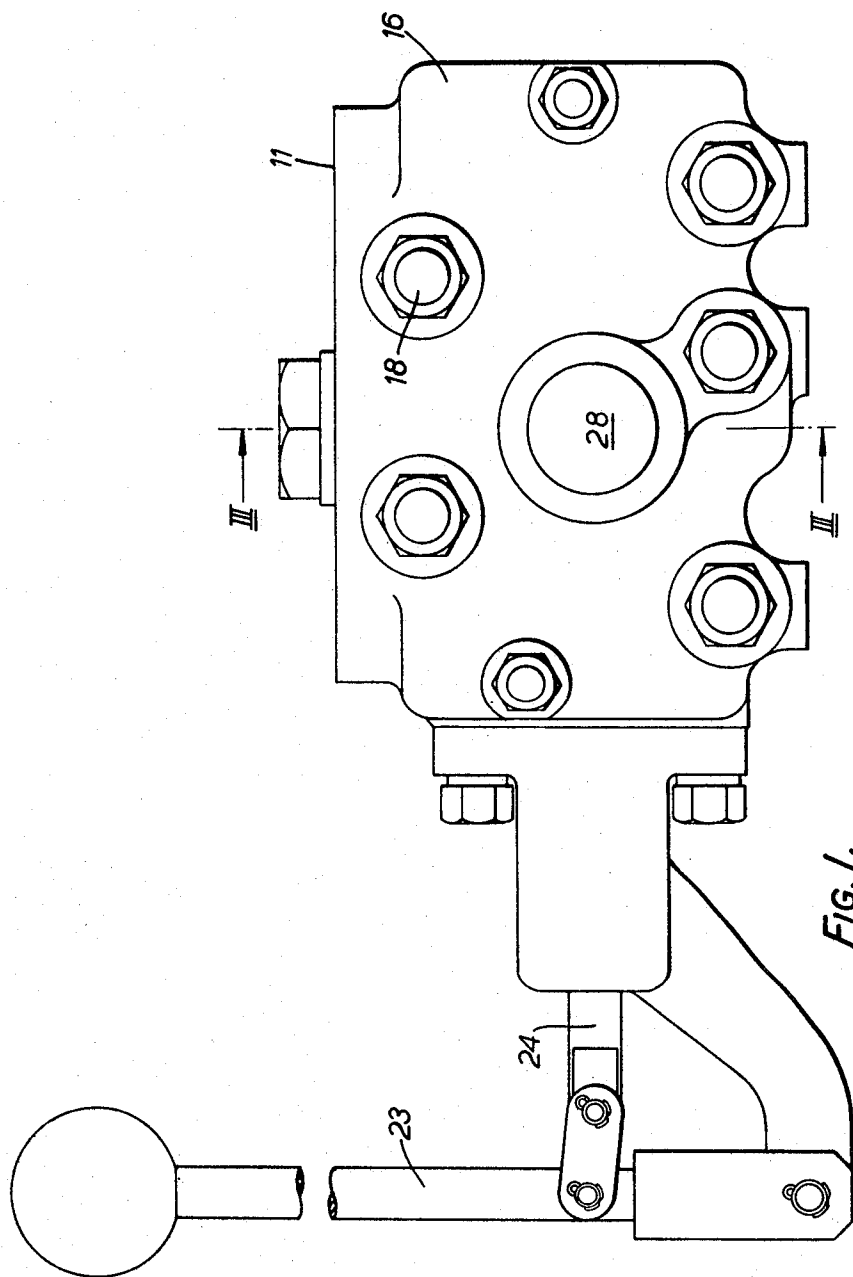


FIG. 1.

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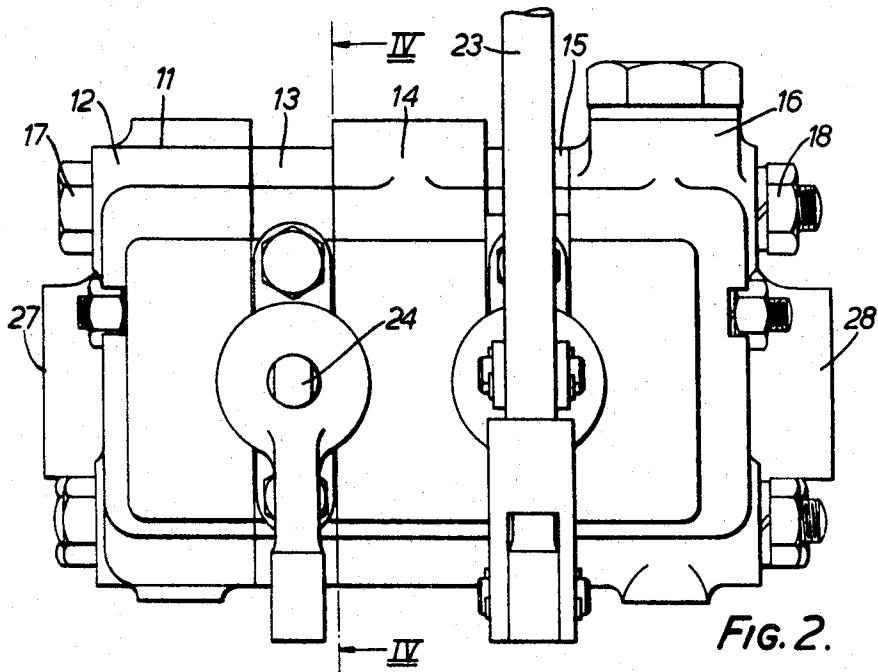


FIG. 2.

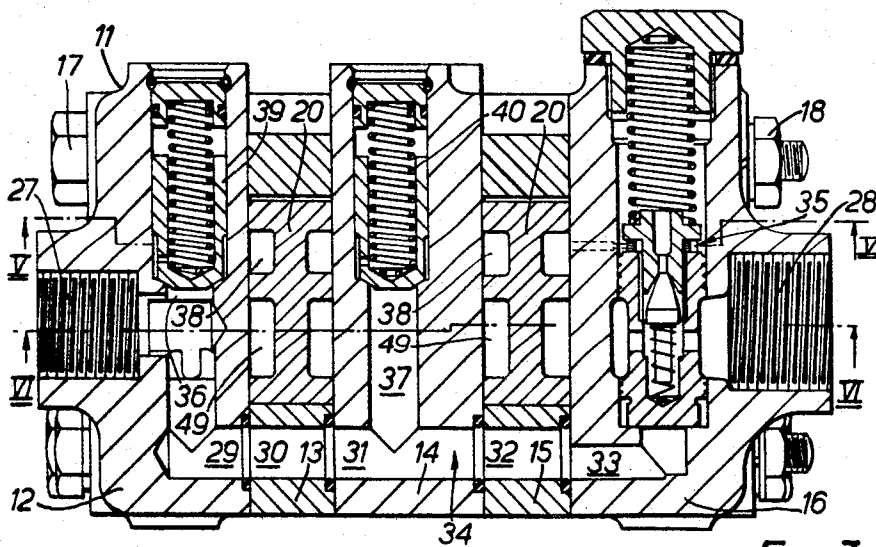


FIG. 3.

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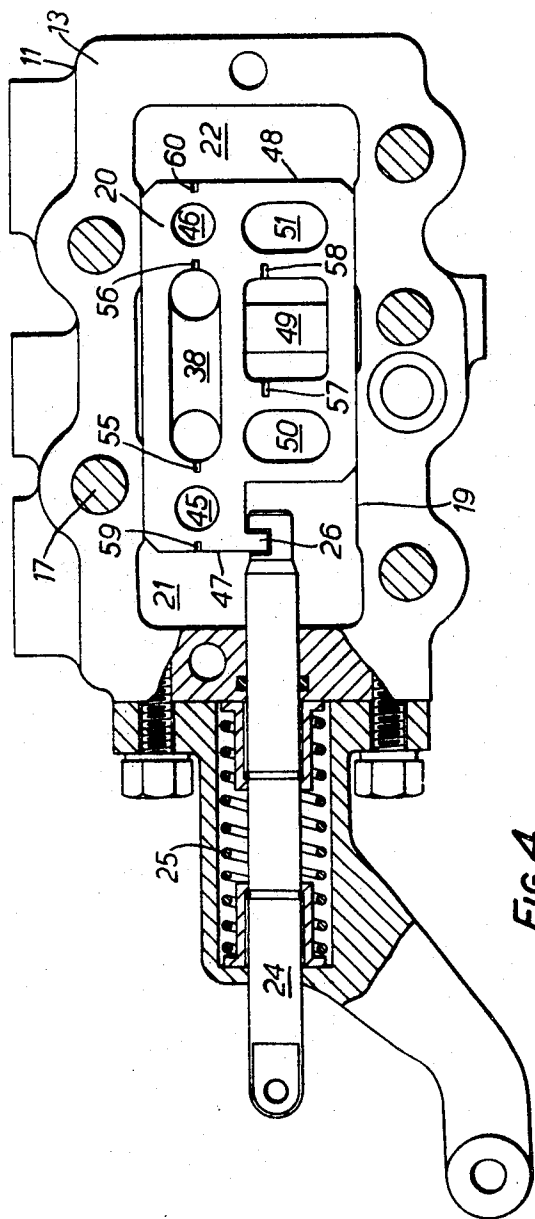


FIG. 4.

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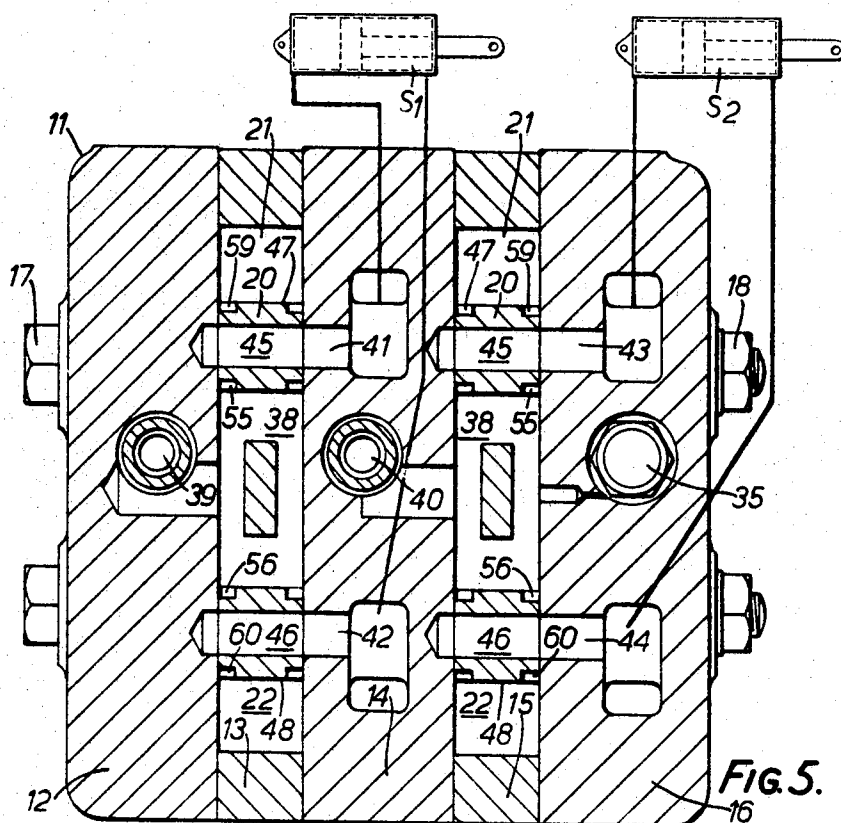
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SLIDE VALVES

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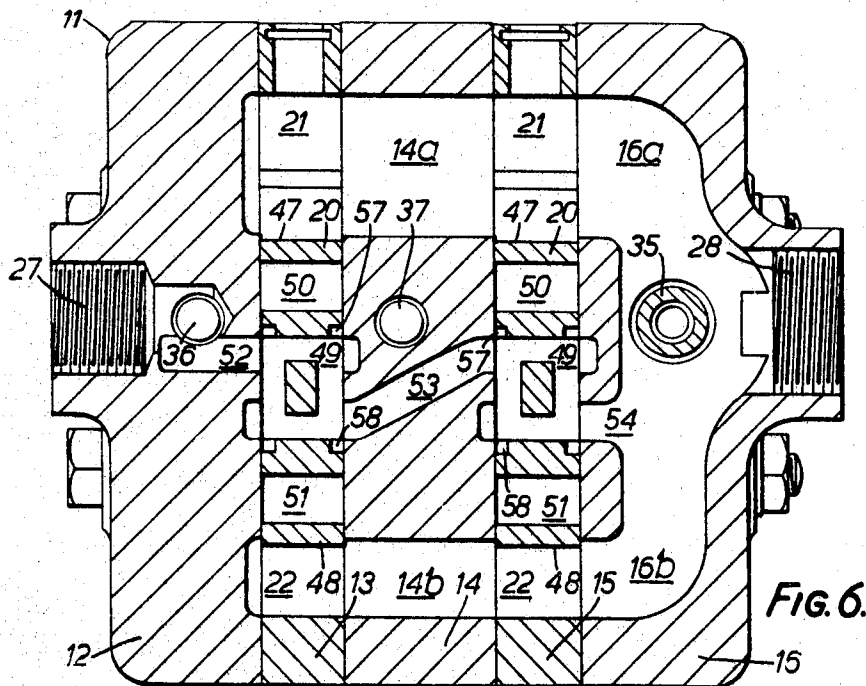
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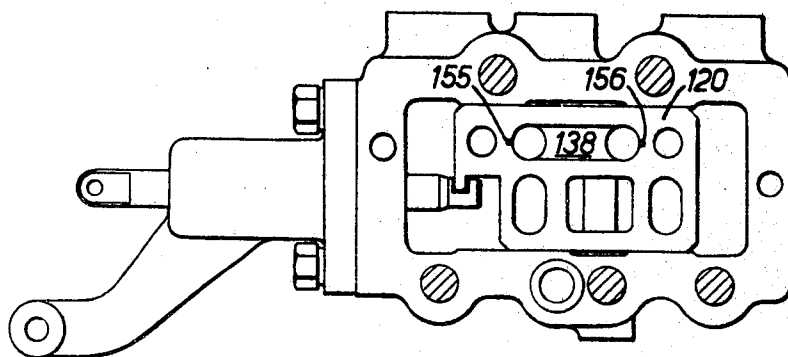


FIG. 7.

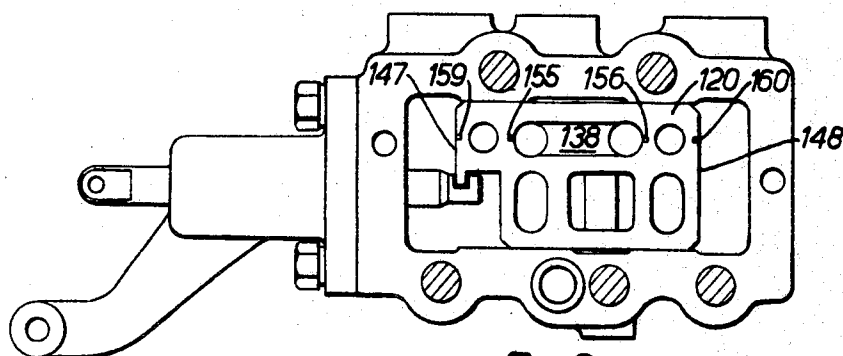


FIG. 8.

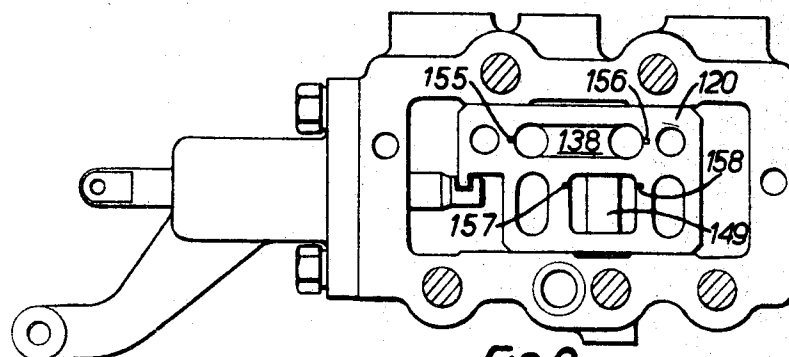


FIG. 9.

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SLIDE VALVES

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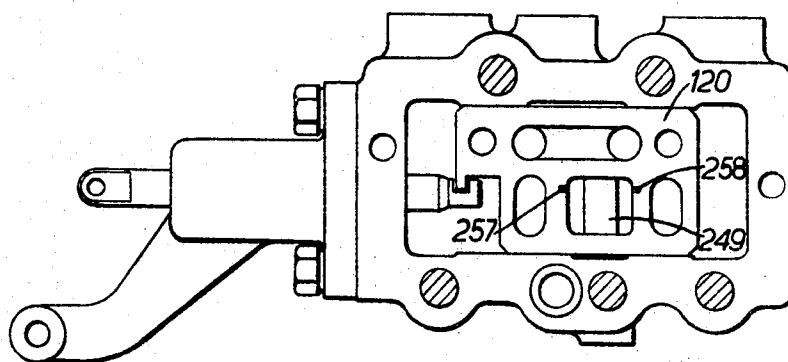


Fig. 10.

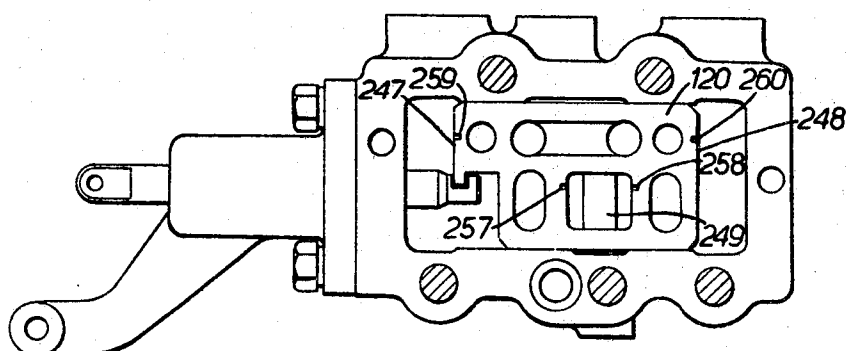


Fig. 11.

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3,387,628

SLIDE VALVES

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Filed Nov. 19, 1965, Ser. No. 508,795
Claims priority, application Great Britain, Mar. 3, 1965, 9,075/65; Apr. 23, 1965, 17,163/65, 17,164/65
19 Claims. (Cl. 137—596.12)

ABSTRACT OF THE DISCLOSURE

A slide valve assembly is disclosed which includes a casing and a slider of rectangular cross section. The straight end edges of the slider are disclosed as being cooperable with service ports in an arrangement which permits the length of the slider in the zone of the unloader porting to be shorter than the length thereof in the zone of the main porting. Thus the slider can be formed with a step, or to be undercut, in the lower portion thereof. Specific details of additional embodiments of the slider are disclosed.

According to this invention a slide valve includes a casing and a slider housed within the casing, the slider being of rectangular cross-section and having a main port to which pressure fluid is suppliable through a passageway in the casing, which port is permanently open to the passageway, the slider being capable of directing pressure fluid into at least one service line port itself formed in the casing and connectible to a service controllable by the slide valve, a chamber being provided at one end at least of the slider and in open communication with an exhaust connection, one at least of the end edges of the slider being co-operable with a service line port for controlling the passage of fluid from that service line port to exhaust, and the slider having at least one balance port cut therethrough in such position adjacent the main port as to align with a respective service line port when the slider is in its neutral position.

Where only one chamber is provided in open communication with exhaust, the slide valve is capable of controlling a single-acting service and in this case when the slider is in its neutral position the service line port is isolated from exhaust and from the main port, but when the slider is displaced in one direction the main port is placed in communication with a service line port, while when the slider is displaced in the opposite direction the main port is isolated from the service line port but the said one end edge of the slider opens said service line port to the chamber and thus to exhaust.

Where two chambers are provided, one at each end of the slider in open communication with exhaust, and where the casing is provided with two service line ports, the slide valve is capable of controlling a double-acting service. In this case when the slider is in its neutral position, both service line ports are isolated from exhaust and from the main port, but when the slider is displaced in one direction or the other, one service line port is placed in communication with the main port, while the appropriate end edge of the slider opens the other service line port to the respective chamber and thus to exhaust.

By so causing one or both end edges of the slider to control the passage of fluid to exhaust, a slider of relatively short length is provided.

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

The main port in the slider may be elongated in the direction of movement of the slider to afford the said per-

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manent opening thereof with respect to the said passageway.

Two balance ports may be provided in the slider, being so positioned and spaced from the end portions of the main port, as, when the slider is in its neutral position, respectively to align with the two service ports. Such balancing ports afford balancing means for the slider in the transverse sense when either service port is pressurised.

A slide valve may have a plurality of said sliders each being slidably mounted in a respective slider frame, and each being interposed between casing plates which incorporate the service port or ports, associated with one slider, and the pressure fluid supply passageway for the adjacent slider, such assembly forming a banked unit. Each passageway may include a check valve, all the passageways being branched from a common pressure supply passage provided along the length of the unit and opening from a single pressure fluid inlet connection for the unit. The pressure supply passage may communicate through the intermediary of a relief valve with a single exhaust connection for the unit.

The or each slider may also incorporate an unloader port cut transversely therethrough being spaced from and disposed beneath the main port. This unloader port may be co-operable with the end portions of passageways in the casing, whereby when the slider or sliders are in their neutral position, a direct route is provided between the inlet connection and the exhaust connection, thereby bypassing the relief valve, but when the or any one of the sliders is moved away from its neutral position, the respective unloader port closes this route so that full delivery pressure is available at the operative slider.

The or each slider may be also provided with two unloader balance ports, one spaced away from each end portion of the unloader port and thus also disposed in a plane beneath the main port and its balance port, such unloader balance ports affording balance of the slider when the slider is being moved away from its neutral position.

The or each slider may be provided with inching slots, cut in the direction of motion of the slider, in the operable edges of the main port and of the unloader port and also in the operable end edge or edges of the slider co-operable with said service port or ports for controlling the flow of fluid to exhaust.

Alternatively, inching slots may only be cut in the direction of motion of the slider, in the operable edges of the main port. Additionally, however, further inching slots may be cut in the direction of motion of the slider either in the end edges of the slider, or, alternatively, in the operable edges of the unloader ports.

Again, alternatively, inching slots may be cut only in the operable edges of the unloader port, but additionally inching slots may be cut in the end edges of the slider.

The or each slider may be displaceable linearly in said casing.

The or each slider may be operable by an axially slidable control rod with which said spring centering means is co-operable, this rod being coupled to the slider by a tongue-and-slot connection.

Six embodiments of the invention will now be particularly described by way of example with reference to the accompanying drawings, of which,

FIGURE 1 is a front elevation of a first slide valve assembly having two displaceable members,

FIGURE 2 is an end elevation of a slide valve assembly shown in FIGURE 1, viewed in the direction of the arrow II on FIGURE 1,

FIGURE 3 is a cross-section taken along the line III—III in FIGURE 1,

FIGURE 4 is a cross-section taken along the line IV—IV in FIGURE 2,

FIGURE 5 is a section taken along the line V—V on FIGURE 3,

FIGURE 6 is a section taken along the line VI—VI on FIGURE 3,

FIGURE 7 is a view similar to FIGURE 4 but with a slider in accordance with a second embodiment,

FIGURE 8 is a view again similar to FIGURE 4 but with a slider in accordance with a third embodiment,

FIGURE 9 is a view again similar to FIGURE 4, but with a slider in accordance with a fourth embodiment,

FIGURE 10 is a view again similar to FIGURE 4, but with a slider in accordance with a fifth embodiment, and

FIGURE 11 is a view yet again similar to FIGURE 4, but with a slider in accordance with a sixth embodiment.

Referring to FIGURES 1 to 6 of the drawings, a multiple slide valve unit 11 for a fluid-pressure-operated system comprises five main parts 12, 13, 14, 15 and 16 all bolted together by means of bolts 17 and nuts 18. The parts 12, 14 and 16 are casing plates which are interspaced one from the other by parts 13 and 15 which take the form of slider frames. Each slider frame incorporates a chamber 19 of such shape as to provide a linear slide for a ported slider 20. Chambers 21 and 22 are provided at either end of the slider within the slider frame.

Each slider is of rectangular cross-section in a plane at right angles to its direction of sliding and is controllable by means of a pivoted lever 23 mounted externally of the casing assembly. The lever is connected to the slider by means of an axially slidable control rod 24 with which spring centering means 25, for biasing the slider to its neutral position, is co-operable, the control rod being coupled to the slider by a tongue-and-slot connection 26.

A slider is shown in its neutral position in FIGURE 4.

The casing plate 12 at one end of the banked assembly is provided with an inlet connection 27 for the entire assembly, while the casing plate 16 at the opposite end of the assembly is provided with a reservoir connection 28, also common to the entire assembly.

Aligned ports 29, 30, 31, 32 and 33 are provided in the parts 12, 13, 14, 15 and 16, respectively, thereby to form a pressure liquid supply passage generally indicated at 34 running the length of the bank and in communication with the inlet connection 27. This passage is also in communication with the reservoir connection 28 through a suitable relief valve 35 of two-stage type incorporated in the reservoir connection casing plate 16.

Branch passageways 36 and 37 are taken from the passage 34 and lead through the casing plates 12 and 14 respectively to each of the two sliders 20, the sliders themselves each including one webbed main port 38 elongated in the direction of sliding for receiving the pressure liquid, both when the sliders are in their neutral positions and when in their operative positions. The branch passageways 36 and 37 each incorporate a check valve 39, 40 respectively, to prevent reverse flow of liquid towards the inlet connection 27.

The chambers 21 and 22 are placed in communication with the reservoir connection 28 through openings 14a and 14b, and openings 16a and 16b, respectively formed in the casing plates 14 and 16.

Each casing plate on that side of the respective slider remote from the inlet connection is provided with a pair of service ports 41, 42 and 43, 44, respectively, which are connectible by means of piping shown diagrammatically in FIGURE 5 to respective double-acting services S_1 and S_2 to be controlled by the associated sliders 20. The service ports 41, 42 and 43, 44 are so positioned in relation to the slider that when the slider is in the neutral position, balance ports 45, 46, cut in the slider are in alignment with the service ports. With the slider so positioned, the service is held in an hydraulically-locked condition. These balance ports are provided in the same plane as the elongated main port 38 and when the slider is moved away from its neutral position to either one of its operative positions, these ports provide means for afford-

ing hydraulic balance of the slider in the transverse sense.

The two end edges 47 and 48 of each slider are straight as shown in FIGURE 4 and co-operable with the two service ports 41, 42 and 43, 44 so that when the slider 20 is moved away from its neutral position to enable liquid under pressure present in the main port 38 to pass to one of the service ports, and thus to pass to one side of the double-acting service S_1 or S_2 controllable thereby, the other service port is opened by the respective end edge of the slider so that that service port is placed in communication with the chamber 21 or 22 formed in the end of the slider adjacent that service port, and thus in communication with reservoir.

Each slider 20 is also provided with an unloader port 49 which is disposed in a plane parallel with, but spaced from and beneath the plane containing the main port 38 and balance ports 45 and 46. Each unloader port 49 has a pair of associated balance ports 50 and 51, one provided on each side thereof in the same plane, and thus also lying beneath the main port and balance ports. The unloader port 49 and unloader balance ports 50 and 51 are cut transversely through the slider 20 and are co-operable with the end portions of unloader passageways 52, 53 and 54 in the adjacent casing plates 12, 14 and 16 respectively, so that when the slider is in its neutral position these passageways are placed in communication. Thus in the embodiment being described, when both sliders 20 are in their neutral positions, a route is provided between the unloader passageways so interconnected, which places the inlet connection 27 in direct communication with the reservoir connection 28, thereby by-passing the relief valve 35. When, however, one or the other of the sliders 20 is moved away from its neutral position, the respective unloader port is positioned so that the direct route between the inlet and reservoir connections is closed off, full delivery pressure being then available at the operative slider.

The unloader balance ports 50 and 51 provided in association with the unloader port 49 afford hydraulic balance of the respective slider 20 when it is being moved away from its neutral position.

In order to provide precise and accurate control by the slider for the operation of the associated service S_1 or S_2 , inching slots 55 and 56 are provided at both end portions of the main port 38. Inching slots are also provided at 57 and 58 at both end portions of the unloader port and at 59 and 60 upon the straight end edges 47 and 48 of the slider, which edges are co-operable with the service ports 41, 42, 43, 44, for control of the passage of liquid to reservoir.

The unloader porting is designed so that the main portion of the unloader port is closed off leaving only the inching slot area. This area can be designed to pass the full pump flow and to give at that condition a predetermined pressure which can be the working pressure of the system. Then further movement of the slider will progressively close off the inching slots, thus directing progressively more and more of the pump flow to the respective service.

The inching slots are of sufficient length to give a relatively large movement of the slider for this diversion of flow, thus making operation of the service very precisely controllable.

Similar precise controlling characteristics are afforded in the control of the respective service by the inching slots cut in the main port and/or the end edges of the slider.

When the slider is in its neutral position, the inching slots in the main port and/or the end edges of the slider do not carry liquid from pressure to a service nor from a service to drain.

By so arranging that no reservoir porting is provided in the slider itself, and also by so providing that the unloader port 49 and its associated balance ports 50, 51 are disposed beneath the main port 38 and its balance ports 45, 46, a relatively compact slider is achieved. The provision of the balance ports ensures low hysteresis operation of the slider,

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thereby requiring only low operational effort and a relatively light-weight spring centering means 25 for returning the slider to its neutral position.

Further, the precise shape of the porting and of the slider is such that the unloader route can be made of relatively large cross-sectional area in relation to the pressure liquid supply passage 34. Thus the pressure drop through the unloader passage 52/53/54 in a multiple bank is relatively small.

With reference now to FIGURE 7 of the drawings, the construction of the banked valve assembly is very similar to that of FIGURES 1 to 6 except that the slider 120 only has inching slots 155 and 156 cut in the operable edges of the main port 138.

Thus, precise and accurate control, by the slider 120, of the direction of pressure fluid from the main port 138 to either side of the associated double-acting service is afforded, but in this embodiment it is not necessary for such precise and accurate control to be applied to the flow of liquid from the service to reservoir or to be applied to the function of loading and unloading. Thus inching slots are not provided in the straight end edges of the slider or in the unloader port.

With reference now to FIGURE 8 of the drawings, this shows a slider suitable in cases where it is desirable to have precise and accurate control by each slider, not only on the flow of pressure liquid to the service, but also on the flow of liquid from the service to reservoir. Thus, this slider is similar to the slider of FIGURE 7 except that additionally inching slots 159 and 160 are cut in the straight end edges 147 and 148 of the slider.

With reference to FIGURE 9, the slider is again similar to the sliders in the previous embodiments except that in order to have precise and accurate control by each slider upon the flow of liquid to the associated service and also upon the flow of liquid in the loading function, inching slots 157 and 158 are provided, in the direction of motion of the slider in the operable edges of the unloader port 149, these in addition to the inching slots 155 and 156 provided in the main port 138.

With reference to FIGURE 10 of the drawings, this shows a slider where it is only desired to have precise and accurate control of liquid flow with inching movement of the slider for the loading and unloading functions. Therefore inching slots 257 and 258 only are provided in this slider, in the direction of motion of the slider, in the operable edges of the unloader port 249, effective only when the direct route between the inlet connection and the reservoir connection is being opened or closed.

With reference to FIGURE 11 of the drawings, the slider is similar to that shown in FIGURE 10 except that additionally inching slots 259 and 260 are provided in the straight end edges 247 and 248 of the slider. In this way, as well as providing for precise and accurate control of liquid flow in the loading and unloading function, accurate and precise control is afforded in the passage of liquid from the service associated with the respective slider, to reservoir.

In the constructions of both FIGURES 9 and 10 the main port is not provided with inching slots on the operable end edges of the main port.

Although in the above-described embodiments the sliders are arranged and ported in a manner whereby they are suitable for controlling a double-acting service, in alternative embodiments of the invention the sliders are arranged and ported in a manner whereby they are suitable for controlling single-acting services. In this case only one chamber 11 in communication with exhaust, need be provided at one end of the slider. Also only one balance port need be provided in the plane of the main port, this port and the appropriate end edge of the slider being co-operable with the porting in the casing which connects with the single pipe to the single-acting service.

Further, in other alternative embodiments, the sliders are arranged and ported whereby they are suitable for

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controlling reversible or non-reversible rotary motors and like devices.

Although in all the previously described embodiments the sliders are of the type linearly displaceable within their casing, in other embodiments the invention may with advantage be applied to sliders of other form, for example, sliders capable of displacement in angularly adjustable or semirotary manner about a fixed rotational axis.

The invention is in no way limited to slide valves for liquids, as with advantage it can be applied to slide valves for pneumatic and other gaseous systems.

We claim as our invention:

1. A slide valve including a casing having a single inlet connection and a slider, controllable by an axially slidable control rod and housed within the casing, the slider being of rectangular cross-section and having a main port capable of receiving pressure fluid, supplied to said inlet connection and passed to said port through a passageway in the casing, the port being permanently open to the passageway and the slider being capable of directing pressure fluid into at least one service line port itself formed in the casing and connectible to a service controllable by the slide valve, a chamber being provided at one end at least of the slider and in open communication with a single exhaust connection on the casing, one end edge of the slider being cooperable with said service line port for controlling the passage of fluid from that service line port to exhaust, and the slider further including an unloader port cut transversely therethrough and cooperable with unloader passageways in the adjacent casing parts when the slider is in its neutral position, said unloader port being so spaced from, and so positioned beneath, the main port as to enable the length of the slider in the zone of the unloader port to be shorter in length than in the zone of the main port, a step thereby formed at one end portion at least of the slider permitting a tongue-and-slot connection to be made, within the overall length of the slider, between said control rod and the slider.

2. A slide valve as claimed in claim 1, wherein said slider has at least one balance port cut therethrough in such position adjacent the main port as to align with a respective service line port when the slider is in its neutral position.

3. A slide valve as claimed in claim 1, having only one chamber in open communication with exhaust, such that the slide valve is capable of controlling a single-acting service so that when the slider is in its neutral position the service line port is isolated from exhaust and from the main port, but when the slider is displaced in one direction, the main port is placed in communication with the service line port, while when the slider is displaced in the opposite direction the main port is isolated from the service line port but the said one end edge of the slider opens said service line port to the chamber and thus to exhaust.

4. A slide valve as claimed in claim 1, wherein spring centering means are provided in association with said control rod for affording bias of the slider to its neutral position.

5. A slide valve as claimed in claim 1, wherein said main port is elongated in the direction of movement of the slider to afford the said permanent opening thereof with respect to the said passageway.

6. A slide valve as claimed in claim 1, and wherein two chambers are provided, one at each end of the slider in open communication with exhaust, and in which the casing is provided with two service line ports, said slide valve being capable of controlling a double-acting service, such that when the slider is in its neutral position, both service line ports are isolated from exhaust and from the main port, but when the slider is displaced in one direction or the other, one service line port is placed in communication with the main port, while the appropriate end edge of the slider opens the other service line port to the respective chamber and thus to exhaust.

7. A slide valve as claimed in claim 6, wherein two of

said balance ports are provided in the slider, being so positioned and spaced from the end portions of the main port, as when the slider is in its neutral position, respectively to align with the two service line ports.

8. A slide valve as claimed in claim 1, and having a plurality of said sliders, each being slidably mounted in a respective slider frame, and each being interposed between casing plates which incorporate the service line port or ports, associated with one slider, and the pressure fluid supply passageway for the adjacent slider, such assembly forming a banked unit.

9. A slide valve as claimed in claim 8, wherein the or each slider is provided with inching slots, cut, in the direction of motion of the slider, in the operable edges of the main port and of the unloader port, and also in the operable end edges of the slider co-operable with said service line port or ports for controlling the flow of fluid to exhaust.

10. A slide valve as claimed in claim 8, wherein each passageway includes a check valve, all the passageways being branched from a common pressure supply passage provided along the length of the unit and opening from the single inlet connection.

11. A slide valve as claimed in claim 10, wherein the pressure supply passage communicates through the intermediary of a relief valve with said single exhaust connection.

12. A slide valve as claimed in claim 11, wherein said unloader port is so cooperable with the end portions of said unloader passageways in the casing ports when the slider or sliders are in their neutral positions, that a direct route is provided between the inlet connection and the exhaust connection, thereby by-passing the relief valve, but when the or any one of the sliders is moved away from its neutral position, the respective unloader port closes this route so that full delivery pressure is available at the operative slider.

13. A slide valve as claimed in claim 12, wherein the or each slider is or are further provided with two unloader balance ports, one spaced away from each end portion of the unloader port and thus also disposed in a plane beneath the main port and its balance ports, such unloader balance ports affording balance of the slider, when the slider is being moved away from its neutral position.

14. A slide valve as claimed in claim 8, wherein inching slots are only cut, in the direction of slider motion, in the operable edges of the or at least one main port.

15. A slide valve as claimed in claim 14, wherein inching slots are additionally cut, in the direction of slider motion, in one or both end edges of the or at least one slider.

16. A slide valve as claimed in claim 14, wherein additionally inching slots are cut, in the direction of slider motion, in the operable edges of the or at least one unloader port.

17. A slide valve as claimed in claim 8, wherein inching slots are only cut, in the direction of slider motion, in the operable edges of the or at least one unloader port.

18. A slide valve as claimed in claim 17, wherein additionally, inching slots are cut, in the direction of slider motion, in one or both end edges of the or at least one slider.

19. A slide valve as claimed in claim 8, wherein the or each slider is displaceable linearly in said casing.

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HENRY T. KLINKSIEK, *Primary Examiner.*

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,387,628

June 11, 1968

John C. E. Flint et al.

It is certified that error appears in the above identified patent and that said Letters Patent are hereby corrected as shown below:

In the heading to the printed specification, line 8, "9,075/65" should read -- 9,076/65 --. Column 7, line 30, "ports" should read -- parts --.

Signed and sealed this 21st day of October 1969.

(SEAL)

Attest:

Edward M. Fletcher, Jr.

Attesting Officer

WILLIAM E. SCHUYLER, JR.

Commissioner of Patents