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BOOSTER PUMP-EQUIPPED HYDRAULIC PRESSURE SYSTEM

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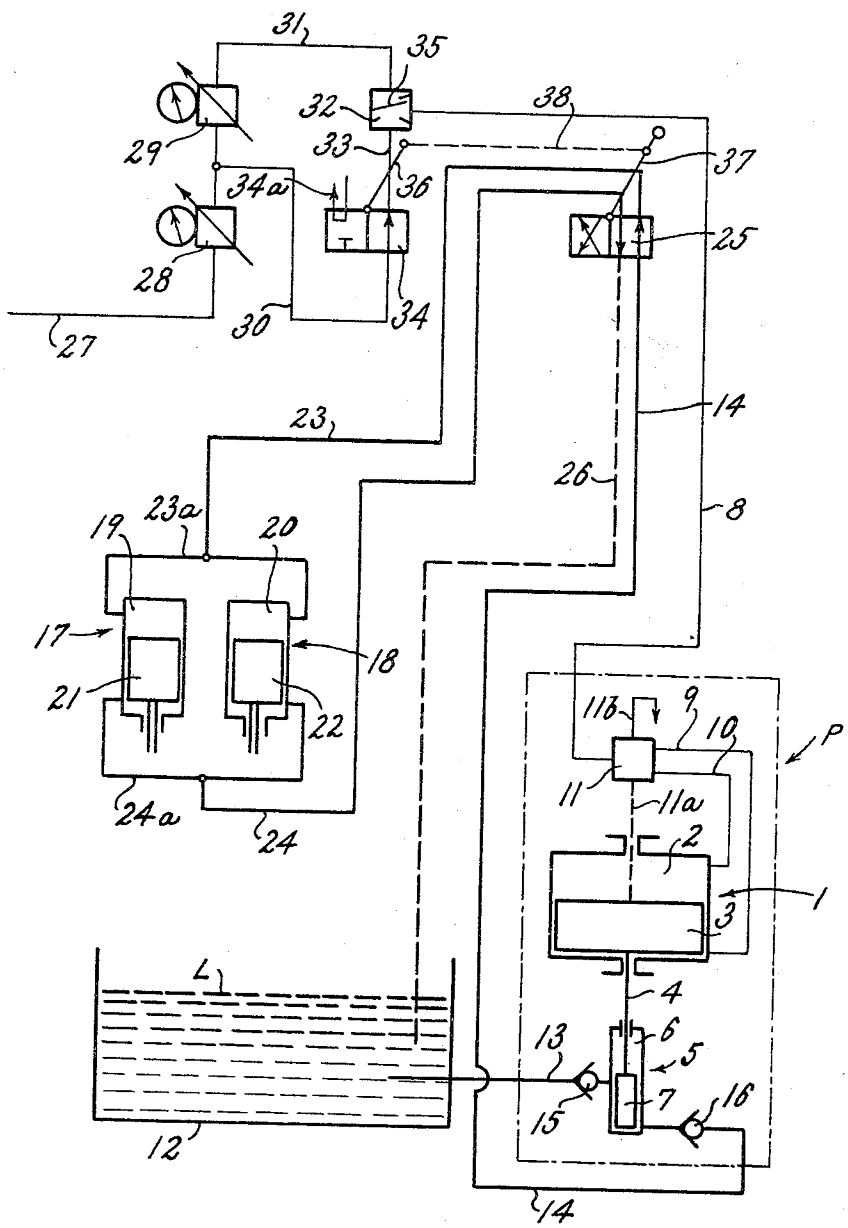

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BOOSTER PUMP-EQUIPPED HYDRAULIC PRESSURE SYSTEM

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ABSTRACT OF THE DISCLOSURE

A pneumatically actuatable hydraulic pressure system utilizing a booster pump for delivering either a higher or a lower hydraulic pressure to a respective one of a pair of working lines. The pump in two separate cylinders has a pneumatically driven large area piston and a small area hydraulic piston coupled to one another for joint movement. The pneumatic part of the system includes first control valve means for providing either a higher or a lower actuating pressure, and the hydraulic part of the system includes second control valve means coupled or otherwise synchronized with the first control valve means for selectively placing the pump outlet or discharge line into communication with the appropriate one or the other of the working lines.

This invention relates to hydraulic systems incorporating pneumatically driven pump means for the delivery of a liquid pressure medium, and in particular to such systems in which the liquid pressure medium is selectively delivered at one or another of a plurality of different pressures at least one of which is comparatively very high and is intended to be maintained unchanged for a long time, during which the amount discharged is to be very small.

One type of apparatus in which such a system is found to be very useful is an extruder having an openable die head structure at the head of the machine. Such an extruder is provided with means for clamping a movable member of the die head structure against both a stationary die head member and the head of the machine, for example as disclosed and claimed in my prior copending application titled "Die Head Clamping Means for Extruders." In the activation of these clamping means for the die head clamping and releasing operations, tensioning means in the form of double-acting hydraulic piston and cylinder combinations are used, with an appropriately higher or lower hydraulic pressure being selectively applied to one or the other of the respective piston faces, the high pressure serving to develop the very high clamping forces, and the low pressures serving to develop the much lower releasing forces. Quite obviously, it would be desirable to have these lower pressures supplied by the same pump as the high pressures. Although it might be assumed that hydraulic pressure-reducing valves could be used for this purpose in combination with a standard piston or rotary pump, this has not proved to be the case, since the susceptibility of such valves and pumps to trouble is fairly great when the starting pressure is comparatively very high.

I have determined that there are known pumps which are suitable for providing very high hydraulic output pressures, without being subject to the aforesaid drawbacks. A pump of this class, conventionally known as booster pumps, generally includes a first pump part, comprising a pneumatically driven first cylinder and piston, for the operation of a hydraulic pressure medium-delivering second pump part, comprising a second cylinder and piston, the two pistons being coupled to one another by a

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common piston rod, and the second piston (as well as its cylinder) having a notably lower cross-sectional area than the first piston (and its cylinder). The pump thus delivers an output hydraulic pressure the ratio of which to the pressure of the compressed gas or pneumatic actuating fluid is approximately equal to the ratio of the area of the first piston to that of the second.

The basic object of the present invention is the provision of a hydraulic pressure system equipped with a booster pump in such a way that it can selectively deliver even extremely high hydraulic pressure into a respective one or another of a number of independent working lines.

Another object of the present invention is the provision of such a system which is simple in construction and reliable in operation.

Generally speaking, the objectives of the present invention are attained by the provision of a hydraulic system having incorporated therein first reversing or control valve means connected in the pneumatic pressure line leading to the first booster pump part to enable the large diameter piston thereof to be selectively activated by a plurality of different gas pressures, and second control or reversing valve means connected in the outlet or discharge line of the second booster pump part to enable the selective connection of the discharge line to a plurality of different delivery positions or working lines for the hydraulic pressure medium, with the respective settings of the first control valve means for higher and lower actuating pressures corresponding to the respective settings of the second control valve means establishing communication between the outlet of the pump and the higher and lower pressure working lines.

In a particularly advantageous refinement of this arrangement, the system according to the present invention is further characterized by a direct coupling of the first control valve means with the second control valve means to ensure that their operations are synchronized with each other so as to effectuate the delivery of the liquid pressure medium at the desired hydraulic pressure into the appropriate one of the working lines when a correspondingly selected pneumatic driving pressure is applied to the larger piston of the first pump part. The desired pressures of each type will, of course, be determined in advance of any given operation, whereby upon any reversal of the first control valve means the hydraulic pressure output of the second pump part will be automatically changed accordingly and fed into the proper one of the working lines. A further advantage accruing from this aspect of the invention is the fact that only a single pump is required to carry out the generation and delivery of the various pressures in a simple and reliable manner.

Merely by way of example, in accordance with the present invention, the first reversing valve means may be designed for two positions adapted to deliver two gas pressures differing greatly from one another, e.g. being to one another in a ratio ranging from about 10:1 to about 50:1, for enabling the delivery of two hydraulic pressures, standing in approximately the same ratio to one another, at the outlet side of the second pump part. Concomitantly, the second reversing valve means which is connected to the outlet side of the second pump part may be designed for two positions which respectively correspond to the two positions of the first reversing valve means and enable communication to be established between one or the other of two working lines leading away from the second reversing valve means and a single discharge conduit feeding into the said valve means from the outlet side of the second pump part. The working lines may be connected into one or a plurality of parallel working cylinders each having a piston and piston rod reciprocally arranged therein, preferably with the higher pressure working line leading to the piston-bottom side of the cylinder, and with the lower pressure working line leading to the piston-rod side of the cylinder.

This type of an arrangement is found to be very advantageous especially when used in the clamping and tightly sealing of the separable parts of an extruder die head or the like, even if these parts are under very high internal pressures such as arise in the extrusion or injection of rubber, plastics or other viscous materials. The reason is that the releasing of the clamping elements can take place at a very much lower hydraulic pressure, i.e. one which may be as low as about 1/10 to 1/50 of the clamping pressure. The higher hydraulic pressure is fed into the piston-bottom side of the cylinder which is always easier to seal, since it has only one sealing point (around the piston), whereas the lower pressure is fed into the piston-rod side of the cylinder which has two sealing points (around the piston and around the piston rod). For this arrangement, too, it is of particular advantage that the booster pump can be utilized in a double manner and can be shifted from one of its operational stages to the other simply by the shifting of only a single lever to effect the joint and synchronized reversal of the two control or reversing valve means.

An advantageous embodiment of the system according to the present invention is characterized by a construction of the first reversing valve means to include a double check valve into which the pressurized pneumatic actuating fluid is fed either at a relatively lower pressure, e.g. at about 0.5 to 0.1 atm. gauge pressure, or at a relatively higher pressure, e.g. at about 5 atm. gauge pressure. The latter pressure is fed into the said double check valve with the aid of a cut-off valve connected so that when the cut-off valve is closed, the low pressure opens the check valve at the low pressure side and is admitted to the first pump part, whereas when the cut-off valve is opened, the high pressure closes the check valve at the low pressure side, opens it at the high pressure side and is admitted to the first pump part. Preferably, the cut-off valve is such that when it is closed, it allows the excess pressure to be vented to the outside, so as to permit the lower gas pressure to come into play. A corresponding contruction for the reversal from the lower gas pressure to the higher gas pressure is not necessary, however, since the higher gas pressure can always operate the valve flap of the double check valve even against the lower gas pressure.

This control of the booster pump thus operates at comparatively low pressures. Even though the comparatively very high hydraulic pressures delivered by the pump may be 100 times as great, therefore, the control elements, namely the double check valve in particular, only have to handle the comparatively low gas pressures, whereby a reliable operation is insured with low construction expenses.

A further advantageous embodiment of the system according to the present invention is characterized by a construction of the second control or reversing valve means as a four-way valve in such a way that one of the two working lines which at any given time is not connected with the line coming from the outlet of the pump, is connected with a drain line, in order to make it possible for the depressurized liquid stll present in the then inactive working line to be discharged therefrom. Where it is desired to reuse the liquid medium continually, of course, the drain line can be allowed to empty into a tank or reservoir from which the second pump part draws the liquid medium again as needed. The four-way valve thus is the only reversing element which is in the high-pressure part of the system, but this creates no problems since making such a four-way valve in a sufficiently sturdy construction is comparatively simple and requires no delicate adjustments, valve seats, etc.

Preferably, the system according to the invention is also characterized by third reversing valve means interposed between the first pump part and the first reversing valve means for enabling the first piston to be subjected to the pneumatic driving pressure alternatingly from one side and the other. Thus, as the first piston executes its to and fro movement, the second piston also executes an identical to and fro movement, as a result of which the liquid pressure medium is pumped into the outlet or discharge line of the second pump part. When ultimately the volume of the respective working cylinder space into which the liquid pressure medium is then being fed is filled up completely, the amount of such medium thereafter discharged by the pump becomes nil. The pump movement then ceases of itself, and the desired hydrostatic pressure develops in the pump outlet line and in the working line leading to the said cylinder space.

The foregoing and other objects, characteristics and advantages of the present invention will be more clearly understood from the following detailed description of a preferred embodiment thereof when read in conjunction with the accompanying drawing the sole figure of which is a diagrammatic representation of a hydraulic system for an extruder die head clamping arrangement such as is disclosed in my aforesaid copending application.

Referring now to the drawing in greater detail, the booster pump **P** for the hydraulic system according to the present invention includes a first pump part **1** having a first cylinder **2** and a first piston **3** reciprocal therein, and a second pump part **5** having a second cylinder **6** and a second piston **7** reciprocal therein. The pistons **3** and **7** (the latter of which may be small enough to be in essence merely a plunger) are coupled to each other by a common piston rod **4**. The first pump part **1** is adapted to be pneumatically activated by compressed air or other pressurized gaseous fluid for reciprocation of the piston **3**, the fluid pressure being alternatingly admitted into the opposite ends of the cylinder **2** through a pair of conduits or lines **9** and **10** under the control of a switching or reversing valve **11**, the latter being synchronized with or operated in response to the position of the piston **3** in a manner well known per se and indicated schematically by the broken line **11***a*, to direct the fluid into one of said conduits or the other. The pressure fluid is fed into the valve **11** by a conduit or line **8** from a source still to be described. The reversing valve **11** is further provided with means **11***b* for venting to the atmosphere at any given time that one of the lines **9** or **10** and the corresponding end space of the cylinder **2** into which pressure is not then being admitted.

The piston **3** thus moves alternately to and fro as a result of being alternatingly acted on at its opposite faces by the admission of compressed air or other gas. The piston **7** necessarily executes the same movements, since it is firmly connected with the piston **3** by the piston rod **4**. The cylinder **6** of the second pump part **5** has an intake conduit or line **13** controlled by a check valve **15** in communication with a reservoir or tank **12** containing a supply of hydraulic fluid L, such as oil or a similarly incompressible liquid, and a discharge conduit or line **14** controlled by a check valve **16**. Upon reciprocation of the piston **7**, therefore, the liquid L is pumped from the tank **12** by way of the line **13** into the line **14**, the valves **15** and **16** preventing any reverse flow of the liquid.

The cross-sectional area of the piston **3** may, for example, be about 100 times as great at the cross-sectional area of the piston **7**. A pneumatic pressure of about 5 atmospheres gauge in the line **8** thus will produce a hydraulic pressure of about 500 atm. gauge in the line **14**, while a pneumatic pressure in the line **8** of about 0.5 to 0.1 atm. gauge will produce in the line **14** a correspondingly lower hydraulic pressure of about 50 to 10 atm. gauge.

Merely by way of example, the delivery positions for the hydraulic pressure are shown in the form of two parallel-connected force-generating devices **17** and **18** constituted, respectively, of double-acting cylinders **19** and **20** housing respective pistons **21** and **22.** A representative use for such devices would be as the tensioning elements for the extruder die head clamps disclosed in my aforesaid copending application, with the piston-bottom end space in each cylinder being the higher pressure working chamber for developing the clamping forces, and with the piston-rod end space in each cylinder being the lower pressure working chamber for developing the clamp-releasing forces. Accordingly, there is provided in the hydraulic system of the present invention a high pressure working line **23** connected via branches **23***a* to the piston-bottom sides of the cylinders **19** and **20**, and a low pressure working line **24** connected via branches **24***a* to the piston-rod sides of the cylinders. Both working lines are adapted to communicate via a four-way valve **25**, constituting the previously referred to second control or reversing valve means, with either the pump discharge or delivery line **14** or a cylinder discharge or drain line **26** leading to the reservoir or tank **12.** In particular, the four-way valve **25** is so designed that in one operating position thereof it connects the delivery line **14** with the working line **23** and at the same time connects the working line **24** with the drain line **26**, while in the other operating position it connects the delivery line **14** with the working line **24** and at the same time connects the working line **23** with the drain line **26.**

The pneumatic pressure fluid which may, for example, be compressed air taken from the general compressed air main **27** of the plant, is first passed through two pressure reducers **28** and **29.** The air main pressure in the line **27** may for example be 6 to 7 atm., and the reducers may be set to provide, respectively, a pressure of about 4 to 5 atm. in the line **30** connected with the pressure reducer **28** and a pressure of about 0.5 to 0.1 atm. in the line **31** connected with the reducer **29.** A double check or non-return valve **32** connected in the line **31** is thus acted on steadily from one side by the lower air pressure in the line **31**, and can be acted on from the other side by the higher air pressure in the line **30** via a line **33** and a cut-off valve **34** when the latter is opened. In the illustrated open condition of the valve **34**, the higher pressure in the line **33** overcomes the effect of the lower pressure in the line **31** and forces the valve flap **35** of the double check valve **32** to close at the low pressure side of the latter, as shown, and enables the higher air pressure to be admitted into the line **8.** In the closed condition of the valve **34** (not shown), the line **33** is additionally vented to the atmosphere at **34***a*, whereby excess pressure can also escape from the line **33** at the high pressure side of the double check valve **32.** Thus, the lower air pressure in the line **31**, even though only about 0.5 to 0.1 atm. gauge, forces the valve flap **35** of the check valve **32** to close at the high pressure side and enables the lower pressure to be admitted into the line **8.** The valve combination **32–34** constitutes the herinbefore referred to first reversing or control valve means.

It should be noted that the construction of the pneumatic pressure part of the system according to the present invention as described, being characterized by an arrangement for simultaneously producing the desired higher and the lower air pressures from a single general compressed air main, with the arrangement consisting (a) of two pressure reducers connected in series, the first of which reduces the main pressure somewhat to the higher pneumatic pressure required, and the second of which reduces this pressure once more to the lower pneumatic pressure required, (b) of two pressure lines, one connected to the outlet side of the first pressure reducer, the

other connected to the outlet side of the second pressure reducer, and (c) of a reversing valve means composed of a cut-off valve in the high pressure line and a double check valve at the junction of the high and low pressure lines, is advantageous in a number of respects. Thus, only a single compressed air source is required to provide the desired pneumatic pressures and consequently the considerably higher desired hydraulic pressures with a minimum expenditure of energy. Moreover, the use of pressure reducers for obtaining comparatively low gas pressures, makes it possible to resort to very simple constructions which nevertheless operate very reliably. On the other hand, if pressure reducers had to be used directly in the pressure hydraulic lines, they would be very expensive in construction and yet not guaranteed to operate reliably.

The synchronization of the reversal of the pneumatic actuating pressures in the line **8** from higher to lower values and vice versa with the reversal of the hydraulic pressures in the line **14** and the connection of the latter to the appropriate one of the corresponding delivery positions, i.e. the lines **23** and **24**, is effected by coupling the operating levers **36** and **37** of the valves **34** and **25** with one another by means of any suitable connection, indicated schematically at **38.**

In operation, when the devices **17** and **18** are to be activated to provide a very high force, e.g. a force sufficient to clamp the openable die head structure of an extruder shut with tight sealing during the course of an extrusion operation, the reversing valve means **25** and **32–34** are in their illustrated positions. Higher pressure air, e.g. at 5 atm. gauge, is thus admitted from the source line **27** into the line **8** and, through the intermediary of the reversing valve **11**, alternatingly into the lines **9** and **10** to cause the piston **3** of the first pump part **1** to be reciprocated accordingly. Since at this time the discharge line **14** of the second pump part **5** is connected with the higher pressure working line **23**, the hydraulic fluid L is pumped into the piston-bottom sides of the two cylinders **19** and **20.** At the same time, any liquid displaced from the piston-rod sides of the cylinders flows by way of the lines **24** and **26** into the reservoir or tank **12.** At the start of this operation, the pistons **3** and **7** of the pump parts **1** and **5** first work with a maximum to and fro movement, until finally the piston-bottom spaces of the cylinders **19** and **20** and the lines **23** and **14** as a whole are filled and can accommodate no more liquid. The amount of such liquid discharged by the pump, maximum at first, thereafter becomes smaller and smaller and finally nil. The to and fro movement of the pistons **3** and **7** thus ceases, and the final hydrostatic pressure builds up in the lines **14** and **23** as well as in the said spaces of the cylinders **19** and **20** to the desired value, e.g. 500 atm. gauge in the case of a 100:1 area ratio of the pistons **3** and **7.** The pump valves **15** and **16** are then no longer under any major stress, since either no further flow of oil or other hydraulic liquid occurs or such flow as does occur is quite small, on the order of magnitude of the possibly present small leakage losses. Under the given operating conditions, therefore, no susceptibility of the system to trouble need be feared. Any leakage losses will, of course, be automatically replaced by the pump **P.**

When the desired lower force in the opposite sense is to be generated, e.g. when the clamping elements of the extruder are to be released, the four-way valve **25** is reset so that the line **14** is connected with the line **24** which leads to the piston-rod sides of the cylinders **19** and **20**, while at the same time the cut-off valve **34** is opened, whereby the air pressure in the line **8** is reduced to the lower value afforded by the pressure reducer **29**, e.g. 0.5 atm. gauge. A correspondingly lower hydraulic pressure this is applied via the lines **14** and **24** into the piston-rod side spaces of the cylinders **19** and **20**, which pressure, though only 5 atm. gauge, is nevertheless sufficient to bring about the release. The liquid from the piston-bottom cylinder spaces at this time flows by way of the lines **23** and **26** into the reservoir or tank **12**.

It will be understood that the foregoing description of a preferred embodiment of the present invention is for purposes of illustration only, and that the various structural and operational features herein disclosed are susceptible to a number of modifications and changes none of which entails any departure from the spirit and scope of the present invention as defined in the hereto appended claims. Merely by way of example, although the preferred embodiment of the system of the present invention has been described as using two pneumatic pressures to generate two correspondingly different hydraulic pressures to be delivered to two respective working positions, all under the control of two reversing valve means, it will be apparent that analogous systems including appropriate multi-stage control valves for any larger plurality of different pressures and associated working positions can be readily devised. Moreover, some or all of the various elements of the system can be combined as a unit on a common chassis or in a common housing.

Having thus described my invention, what I claim and desire to protect by Letters Patent is:

1. In a hydraulic pressure system wherein hydraulic pressure is generated by a pneumatically actuated booster pump which has a first piston in a first cylinder into which a pressurized gaseous fluid is admitted for displacing said first piston, a second piston in a second cylinder for discharging a hydraulic pressure medium, and means coupling said second piston to said first piston for displacement of the former in response to displacement of the latter, with the cross-sectional area of said first piston being considerably greater than that of said second piston, so that the ratio of the developed hydraulic pressure to the pneumatic actuating pressure is approximately the same as the ratio of the cross-sectional area of said first piston to that of said second piston; the improvement comprising first control valve means connected in the pneumatic pressure line leading to said first cylinder for selectively admitting into the latter one or another of a plurality of different pneumatic actuating pressures each corresponding to a respective one of a plurality of different hydraulic pressures to be generated, and second control valve means connected in the discharge line of said second cylinder for selectively connecting said discharge line to one or another of a plurality of working lines, which are assigned for operation at the different hydraulic pressures, in dependence on the selected one of the several pneumatic actuating pressures.

2. In a hydraulic pressure system according to claim **1**; the further improvement comprising switching valve means connected in said pneumatic pressure line between said first control valve means and said first cylinder, the portion of said pneumatic pressure line between said switching valve means and said first cylinder being constituted by separate conduits connecting respective ports of said switching valve means to the opposite ends of said first cylinder, and means responsive to the arrival of said first piston at either end of said first cylinder for reversing said switching valve means so as to direct the selected pneumatic actuating pressure into that end of said first cylinder and cause said first piston to move toward the other end of said first cylinder.

3. In a hydraulic pressure system according to claim **2**; the further improvement comprising means for synchronizing the operations of both said control valve means with each other to ensure that the disposition of said first control valve means for admission of a given one of said pneumatic actuating pressures into said first cylinder, automatically engenders the disposition of said second control valve means for connection of said discharge line to a predetermined one of said working lines assigned to the respective hydraulic pressure developed by virtue of the use of said given pneumatic actuating pressure.

4. In a hydraulic pressure system according to claim **3**; the further improvement comprising a plurality of pressure reducers connected in series with each other in the portion of said pneumatic pressure line leading to said first control valve means, thereby to permit all of said pneumatic actuating pressures to be derived from a single source of said pressurized gaseous fluid.

5. In a hydraulic pressure system wherein hydraulic pressure is generated by a pneumatically actuated booster pump which has a first piston in a first cylinder into which a pressurized gaseous fluid is admitted for displacing said first piston, a second piston in a second cylinder for discharging a hydraulic pressure medium, and means coupling said second piston to said first piston for displacement of the former in response to displacement of the latter, with the cross-sectional area of said first piston being considerably greater than that of said second piston, so that the ratio of the developed hydraulic pressure to the pneumatic actuating pressure is approximately the same as the ratio of the cross-sectional area of said first piston to that of said second piston; the improvement comprising first reversing valve means connected in the pneumatic pressure line leading to said first cylinder for selectively admitting into the latter one or the other of two different pneumatic actuating pressures each corresponding to a respective one of two different hydraulic pressures to be generated, and second reversing valve means connected in the discharge line of said second cylinder for selectively connecting said discharge line to one or the other of a pair of working lines, each assigned for operation at a respective one of the two different hydraulic pressures, in dependence on the selected one of the two pneumatic actuating pressures.

6. In a hydraulic pressure system according to claim **5**; the further improvement comprising switching valve means connected in said pneumatic pressure line between said first reversing valve means and said first cylinder, the portion of said pneumatic pressure line between said switching valve means and said first cylinder being constituted by separate conduits connecting respective ports of said switching valve means to the opposite ends of said first cylinder, and means responsive to the arrival of said first piston at either end of said first cylinder for reversing said switching valve means so as to direct the selected pneumatic actuating pressure into that end of said first cylinder and cause said first piston to move toward the other end of said first cylinder.

7. In a hydraulic pressure system according to claim **6**; the ratio of the higher pneumatic actuating pressure to the lower one being between about 10:1 and 50:1.

8. In a hydraulic pressure system according to claim **6**; the ratio of the cross-sectional area of said first piston to that of said second piston being about 100:1.

9. In a hydraulic pressure system according to claim **6**; the further improvement comprising means for coupling said first reversing valve means with said second reversing valve means to ensure that the operation of the former for admission of a given one of said pneumatic actuating pressures into said first cylinder, automatically effects the operation of said second reversing valve means for connection of said discharge line to that one of said working lines which is assigned to the respective hydraulic pressure developed by virtue of the use of said given pneumatic actuating pressure.

10. In a hydraulic pressure system according to claim **9**; said second reversing valve means comprising a four-way valve arranged, when operated to connect said discharge line to either of said working lines, to connect the other working line to a drain line for said hydraulic pressure medium.

11. In a hydraulic pressure system according to claim **9**; the further improvement comprising a pair of pressure reducers connected in series with each other in the portion of said pneumatic pressure line leading to said first reversing valve means, thereby to permit both of said pneumatic actuating pressures to be derived from a single source of said pressurized gaseous fluid.

12. In a hydraulic pressure system according to claim 11; said first reversing valve means comprising a double check valve and a cut-off valve, said cut-off valve having an inlet port connected to the outlet of the first pressure reducer at the junction between the same and the second pressure reducer for receiving the higher of said pneumatic actuating pressures, said double check valve having one inlet port connected to the outlet port of said cut-off valve for receiving said higher pneumatic actuating pressure and another inlet port connected to the outlet of said second pressure reducer for receiving the lower of said pneumatic actuating pressures, and the outlet port of said double check valve being connected to that portion of said pneumatic pressure line leading to said switching valve means.

13. In a hydraulic pressure system according to claim

12; said cut-off valve being further provided with means for venting to the atmosphere the connection between said double check valve and said cut-off valve when the latter is closed.

14. In a hydraulic pressure system according to claim 12; said second reversing valve means comprising a four-way valve arranged, when operated to connect said discharge line to either of said working lines, to connect the other working line to a drain line for said hydraulic pressure medium.

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ROBERT M. WALKER, Primary Examiner

PO-1050
(5/69)

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,490,378 Dated January 20, 1970

Inventor(s) KARL VOSSEN

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

Column 6, line 13, after "the" read --high--; line 71, "this" should read --thus--; line 74, "5" should read --50--.

SIGNED AND SEALED
NOV 10 1970

(SEAL)
Attest:

Edward M. Fletcher, Jr.
Attesting Officer

WILLIAM E. SCHUYLER, JR.
Commissioner of Patents