Title: HYDRAULIC-OPERATED REGULATING ARRANGEMENT

Abstract: The invention comprises an hydraulic-operated regulating arrangement, adapted such that it can offer a remote control of a control device, in the form of a control valve (21), where it is to be possible to bring a part (21a), belonging to the control device, from a first position towards and onwards to at least one second position and vice versa, where said regulator displays a first piston/cylinder arrangement (31) and a second piston/cylinder arrangement (32) and two lines or conduits (33, 34), adapted to allow a hydraulic connection between said first piston/cylinder arrangement and said second piston/cylinder arrangement. Both the first piston/cylinder arrangement (31) and the second piston/cylinder arrangement (32) are selected to be double acting. A first means (37) is arranged such that it can prevent the entry of air into the said piston/cylinder arrangements (31, 32) and that said two lines or conduits (33, 34) are part of a hydraulic auxiliary system ("H") with two control circuits (301, 302), built up and interconnected as communicating vessels or chambers when the piston (32a) in the second piston/cylinder arrangement (32) is displaced to a predetermined position.
SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

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HYDRAULIC-OPERATED REGULATING ARRANGEMENT

Technical field
The present invention relates in general to a regulator, and more specifically to such a regulator that is adapted to be able to offer a remote control of a control or controlled device through a hydraulic auxiliary system for a control or controlling flow.

More precisely the present invention relates to a hydraulic-operated regulating arrangement for a remote control of said control device.

The said control device will be exemplified, in the following description, by a control valve, which is used as one component or part of a hydraulic system, which is adapted for using a working flow, in the form of hydraulic oil or similar liquid.

In particular, the invention is based on a regulator or a hydraulic-operated regulating arrangement, that is so arranged that it will be able to interact with a part, that belongs to the control device or control valve, in such a way that it will be possible to bring said part, which the use of a component in the form of a slave unit, that is in turn part of said auxiliary system, from a first position to at least one second position, and vice versa.

The invention proposes, as one particularly suitable embodiment, such a regulator or regulating arrangement that displays or makes use of a master unit and a slave unit, that forms components of the auxiliary system, hydraulically connected to each other by conduits, such as tubes or pipes, and where a predetermined gear ratio or exchange ratio is to apply between a displacing influence caused by the master unit and an equivalent or corresponding displacement of the slave unit, where it is an advantage if this exchange ratio can be selected to be equal and proportional.

The expression "line" or "lines" are to be interpreted as conduits in the form of hoses, tubes, pipes and the like, against a limited over pressure resistant however flexible fluid conducting means. The expression "fluid" is generally meant hydraulic oil.

The said regulator displays for this purpose a first piston/cylinder arrangement, which can interact with the part that belongs to the control device, and which functions as a slave unit, and a second piston/cylinder arran-
agement, which can be influenced or activated manually or in an equivalent manner, and which functions as a master unit and with at least one line adapted to allow the first piston/cylinder arrangement to be hydraulically interconnected with the second piston/cylinder arrangement, such that an influence or activation created or caused manually or in an equivalent manner and a displacement of the piston within the second piston/cylinder arrangement will cause, via the line or lines, an equivalent or corresponding influence and displacement of the piston within the first piston/cylinder arrangement and where a piston rod, within the first piston/cylinder arrangement, is adapted to interact with the part that has been assigned to the control device or control valve while a piston rod, within the second piston/cylinder arrangement is adapted to interact with a control lever and follow a movement that has been assigned to the control lever.

Expressions such as "double-acting" piston/cylinder arrangement are used in the following description.

This expression must be interpreted as covering at least one piston/cylinder arrangement in which:

a the plus side and the minus side may exchange or shift positions depending on the motion of a control lever from a neutral position,

b the control lever can interact with two single-acting piston/cylinder arrangements functioning as master units,

c the piston/cylinder arrangement that functions as a slave unit can be constituted by two single-acting piston/cylinder arrangements.

The state of the art

Methods and arrangements having such properties or constructions and applications as those described above are previously known in a number of different embodiments.

Such hydraulic-operated arrangements or regulators have been principally used for and in a crane arrangement, mounted on a lorry, and can be named as a first example of the prior art in this respect, and this application can to a large degree be considered to describe known regulators also as they have been used for other applications.
Regulators, adapted such that they can offer a remote control of control devices, in the form of one or several control valves, in order to be able to control one or several functions within a crane arrangement, are also previously known.

Regulators exploited and arranged for this application have thus comprised a number of manually activated control levers, each one of which has been directly attached to and exerts a direct influence on the control valve assigned to it.

Figure 1, in the attached drawing, is referred to as an example of the prior art in this respect, where a crane arrangement (1) displayed there can be controlled from an operator seat (2) with the aid of, among other things, a control lever, known as a linear lever (3), and which linear lever is arranged to be mobile or activated by a tilting motion forwards and backwards in a single plane in order to, when displaced in a selected first direction, influence a control valve to open.

The embodiment according to Figure 1 also offers the exploitation of directly influenced control valves by foot activated regulators, which are, however, not shown in detail in Figure 1.

Another type of directly influenced control valve can be offered within the application shown in Figure 1 with the aid of a control lever that is mounted such that it can be rotated or tilted and activated in a manner that allows it to be denoted as a "co-ordinate lever".

The control lever is here tilted in two different planes, perpendicular to each other, for activating four different control valves. The control lever may also be tilted in a direction where two control valves are more or less activated simultaneously.

A displacement of the control lever of such a "co-ordinate lever" forwards or backwards can influence a first control valve, with an equivalent or corresponding movement, and a displacement to the right or left can influence a second valve, with an equivalent or corresponding movement.

There has also been suggested, for the application displayed in Figure 1, although this is not shown here in detail, the possibilities of offering remote control of one or several control devices, in the form of one or several control valves, and where the opportunity is offered in this way of co-ordinating
several control valves in a assembly to one readily accessible location, intended for service and inspection, where said location is chosen on or beside the crane arm arrangement.

For this, regulators for remote control of the control valves are required for the control of the working flow, and for this purpose the control valves have been provided with devices or parts that control the valves, which in a first embodiment may be controlled electrically between one or two maximal settings.

Such electrical control normally takes place with the aid of what is known as a "joystick" located in the vicinity of the operator's seat.

A second embodiment for remote control is to exploit or use one or more servohydraulic systems for this purpose, which, with the aid of a hydraulic auxiliary system operating under low pressure for the transport of a control flow, exert an influence of piston/cylinder arrangements adapted for low pressure, in the form of slave cylinders or slave units, for the activation of one or several control valves from a neutral position towards and successively onwards one or several maximal settings.

It is not unusual to allow such a low-pressure system to work with a pressure of approximately 20 bar, in order to in this way control the control valves, which act to regulate a hydraulic pressure and/or the flow of the working media, where the pressure used is between 200 to 300 bar.

Regulators of the properties or constructions specified here may comprise of one first piston/cylinder arrangement, that functions as a slave unit, where this arrangement interacts with a hydraulic auxiliary system for the transport of and activation of a control flow.

Other regulators for the remote control of control valves are also known in which a wire system is exploited or arranged and in which the wires extend through associated tubes, serving as a cover between a control lever, controlled and activated by a hand or foot, and the device or part for controlling the control valves, and through an axial movement influence said device or part in an equivalent or corresponding axial movement.

The present invention can be regarded as a further development of an auxiliary hydraulic system that offers an indirect servohydraulic influence
of a control valve, with the aid of a motion or activation assigned by or caused by a control lever.

The prior art also includes the following patent publications:

5 GB-A-2 182 102,

This patent publication discloses an apparatus, which includes a master cylinder (10) having a piston (16) therein and which piston divides the master cylinder into first and second chambers (82, 83) and a slave cylinder (50) having a piston (49) therein and which piston divides the slave cylinder into first and second chambers (84, 85).

A first conduit (75) extends between a first chamber (82) of the master cylinder and a first chamber (84) of the slave cylinder and a second conduit (80) extends between a second chamber (83) of the master cylinder and a second chamber (85) of the slave cylinder.

A displacement of the piston axially in the slave cylinder in either direction will transfer working fluid through said conduits between the cylinders.

A fluid reservoir (13) is provided for maintaining a desired pressure in the working fluid in the cylinders (10, 50).

A filament (43) connects the pistons, whereby during displacement of the master cylinder piston (16) the filament (43) controls the position of the slave cylinder piston (49) in relation to the master cylinder piston (16).


This patent publication discloses a remote control of functions related to lorries and working machines.

In Figure 2 it is shown a first piston-cylinder arrangement (1) interconnected with a second piston-cylinder arrangement (18) by two conduits (22, 23) and by two other conduits (9, 10) these conduits (22, 23) are coupled to a further piston-cylinder arrangement.

This patent publication discloses a gearshift apparatus for bicycles by using a master cylinder and a slave cylinder.


This patent publication discloses a hydraulic circuit (32) for remotely controlling a work element (14) and contains a master cylinder (42), which passes a fluid pressure signal through a fluid pathway (38, 40) in response to an input signal.

A slave cylinder (44) correspondingly delivers an output signal for controlling the work element (14).

As temperature variations can cause fluid volume changes with disrupt synchronized operation of the master and slave cylinders (42, 44) a third apparatus (74) is introduced.

This apparatus (74) positions the fluid pathway (38, 40) in fluid communication with a tank (28) in the absence of a fluid signal.

However if such a signal passes through one pathway (38, 40), that pathway (38, 40) is automatically blocked from communication with the tank (28).

Thus, when the fluid signal is absent from the fluid pathways (38, 40), volume compensation occurs because of dilution of the fluid in the circuit (32) with the tank fluid.

Description of the present invention

Technical problems

When taking into consideration the technical deliberations that a person skilled in this particular art must make in order to provide a solution to one or more technical problems that he/she encounters, it will be seen that it is necessary initially to realise the measures and/or the sequence of measures that must be undertaken to this end on the one hand, and on the other hand to realise which means is/are required to solve one or more of said problems. On this basis, it will be evident that the technical problems listed below are highly relevant to the development of the present invention.
When considering the prior art, as described above, it should therefore be regarded as a technical problem to be able to realise the significance of and the advantages associated with being able to provide for and to offer a hydraulically operated regulator, for a remote control of a control device, exemplified in a control valve, using a separate servohydraulic auxiliary system that does not require fluid connection and communication to a hydraulic system that displays high pressure, the working flow of which is to be controlled through control valves or similar.

A technical problem also resides in being able to create a servohydraulic auxiliary system that can exploit or use advantageously not only oil but also water, and to be able, in the latter case, to provide or offer an auxiliary system, in which the water is to be mixed with an agent that depresses its freezing point.

A technical problem also resides in being able to provide and offer a servohydraulic auxiliary system, with one slave unit, in the form of a first double-acting piston/cylinder arrangement, which is connected to a control valve, in order to control a working flow, and which can bring this control valve from a neutral position successively towards and onwards to at least one, of two, end positions, at which maximal influence of the associated control valve can take place.

A technical problem also resides in being able to provide the exploitation of a master unit, in the form of a second double-acting piston/cylinder arrangement, which is influenced by hand or by foot from a neutral position towards and successively onwards to reach at least one, of two, maximal set or setting positions, for an indirect influence (through conduits as tubes or pipes) of a double-acting slave unit, also in the form of a piston/cylinder arrangement.

A technical problem also resides in being able to provide a second piston/cylinder arrangement, that it is not only possible to influence in a simple manner by a control lever but that can also offer functions in which an increasing force, active on that function that is controlled by a control valve, influenced in this manner can be experienced in the control lever.

A technical problem also resides in being able to provide a second piston/cylinder arrangement with its associated control lever, in which
vibrations in the control lever during transport can be limited and even elimi-
nated, by, for example, locking or blocking fluid within or between cylinder
volumes, belonging to the second piston/cylinder arrangement, on each side
of a piston, preferably adopting a neutral position.

A technical problem also resides in being able to create, in a very
simple manner and with narrow or small and readily bent conduits, such as
hoses, tubes and/or pipes, a hydraulic connection between one or several first
piston/cylinder arrangements, co-ordinated with a number of, also co-ordina-
ted, control valves, and one or several second piston/cylinder arrangements,
co-ordinated and located in the vicinity of one or several control levers.

A technical problem also resides in being able to create with simp-
le means the conditions that are required such that the hydraulic interaction
between a first double-acting piston/cylinder arrangement and a second dou-
ble-acting piston/cylinder arrangement can take place such that it is possible to
exert an influence on the second piston/cylinder arrangement through a mech-
anical progressive control.

A technical problem also resides in being able to create different
gear ratios or exchange ratios between the first and the second piston/cylinder
arrangements solely by offering a change in diameter of the piston/cylinder ar-
rangements or by the aid of a cam wheel.

A technical problem also resides in being able to realise the signi-
ficance of and the advantages associated with allowing the separate hydraulic
auxiliary system, comprising a first double-acting piston/cylinder arrangement
and a second piston/cylinder arrangement, to be subject to a very small ex-
cess pressure, such that the exploited or used servohydraulic auxiliary system
tends to create an oil leakage rather than allowing the entry of air, which thro-
ugh its compressible nature would place the function of the auxiliary system
and the control of the control flow at serious risk.

For a regulator with a first piston/cylinder arrangement, func-
ning as a slave unit, and a second piston/cylinder arrangement, functioning as
a master unit, and lines (hoses, tubes, pipes or the like conduits) that intercon-
nect these arrangements as a hydraulic auxiliary system, in the form of com-
unicating chambers or vessels, it must be seen as a technical problem to
realise the significance of and the advantages associated with the simple de-
sign measures that are required in order to, in a neutral position of the slave unit and the control devices, be able to create relevant conditions required for a pressure equalisation between the two interacting hydraulic systems or control circuits that are separated by the pistons in the piston/cylinder arrangements.

Furthermore, the ability to provide measures related to the control unit, when a slave unit, that is following an influence or an activation has been brought from a neutral position by external means, is to recover the said neutral position, that are not only able to equalise the pressures in the pressure differences that arise in the two hydraulic systems or control circuits but are also able to create this pressure equalisation only after the piston in the second piston/cylinder arrangement adopts its neutral intermediate position should be regarded as a technical problem.

The ability to create the conditions required for an automatic air excavation from or bleeding of the two hydraulic systems or control circuits should also be regarded as a technical problem.

A technical problem also resides in being able to realise the significance of and the advantages associated with, in order to achieve the required bleeding of and equalisation of prevailing different pressures in the two interacting and co-ordinated hydraulic systems, allowing the cylinder surface within the second piston/cylinder arrangement, namely that cylinder surface that within the selected position for the piston faces the piston and its associated ring or gasket when the piston takes up or is oriented in a neutral position, to be locally worked.

**Solution**

The present invention thus takes its starting point in the prior art described in the introduction and is based on a hydraulically operated regulator, adapted such that it can offer a remote control of a control device, in the form of, for example, a control valve, in which it should be possible to bring a part, that belongs to the control device, from a first position towards and successively onwards to at least one second position, and vice versa.

The said regulator displays or uses a first piston/cylinder arrangement, that can interact with said part that belongs to a control device and that
functions as a slave unit, and a second piston/cylinder arrangement, that can be influenced manually or in an equivalent or corresponding manner and that functions as a master unit, and at least one line or conduit, in the form of a hose, tube or pipe, adapted to allow a hydraulic connection of the first piston/cylinder arrangement with the second piston/cylinder arrangement.

From this, the function is offered by which an influence that has been created or activated manually or in a similar manner, and an equivalent or corresponding displacement of the piston within the second piston/cylinder arrangement, it is to be possible to cause, via said line, an equivalent or corresponding influence on and a displacement of the piston, within the second piston/cylinder arrangement.

The present invention provides and offers that not only the first but also the second piston/cylinder arrangements are to be selected as double-acting arrangements, that a first line or conduit is adapted to interconnect a first cylinder volume within the first piston/cylinder arrangement with a first cylinder volume within the second piston/cylinder arrangement and that a second line or conduit is adapted to allow the interconnection of a second cylinder volume within the first piston/cylinder arrangement with a second cylinder volume within the second piston/cylinder arrangement.

Furthermore, the exploitation of and the use of a first means as described and provided, said means is arranged such that it can prevent the entry of air into said piston/cylinder arrangements and the said two lines, that are part of the hydraulic auxiliary system.

By way of suggested embodiments, lying within the framework of the fundamental or basic idea of the present invention, it is proposed that it should be possible to adapt the said means in order to create an excess pressure within the hydraulic system, such as an excess pressure that does not exceed a maximum value of 20 bar, preferably one that does not exceed a value of 2 bar.

According to the present invention it is proposed, among other things, that the said means is to be adapted such that when the piston, within the second piston/cylinder arrangement, adopts a selected position, such as a central position, it allows the creation of the same excess pressure in the two hydraulic systems, including the said lines.
As proposed developments, within the framework of the present invention, it is proposed that it should be possible to influence at least two parallel second piston/cylinder arrangements via one single control lever.

Furthermore, it is proposed that a second means is arranged in order to be able to position the piston within the first piston/cylinder arrangement in a predetermined position, such as a central position.

Furthermore, it is proposed that the cylinder within the second piston/cylinder arrangement is provided with a peripheral or non-peripheral track or groove that at a selected position of the piston, such as a central position, interacts with a peripheral or non-peripheral track or groove, a ring or gasket in the piston.

The piston in the said master unit is adapted such that it is displaced by a difference in pressure between the cylinder volumes within the said second piston/cylinder arrangement towards a predetermined position, such as a central position.

Furthermore, it is proposed that the cylinder within the said predetermined position, such as a central position, is assigned a passage for hydraulic fluid, whereby the passage has been assigned the form of a hole in the wall of the cylinder, and also adapted as a bleed hole.

**Advantages**

The advantages that can be primarily regarded as characteristic of the present invention and the particularly significant characteristics that are displayed or offered through these are that conditions have been created in this way that are required for, with the aid of a first piston/cylinder arrangement that functions as a slave unit, interacting with a control device, such as a control valve, and a second piston/cylinder arrangement, that functions as a master unit, the piston of which can be influenced, manually or in an equivalent or corresponding way, an axial displacement, and in which these two piston/cylinder arrangements interact with the aid of two lines or conduits, to allow these piston/ cylinder arrangements with said two lines to be part of a hydraulic auxiliary system for a control flow, built up and interconnected as communicating vessels or chambers, when the piston in the second piston/ cylinder arrangement is displaced to a predetermined position.
This auxiliary system has been particularly adapted such that it can regulate one or several control valves, belonging to a crane arrangement. In particular, the present invention can offer co-ordination of control valves, in which they are readily accessible and in which remote control or remote influence of these control valves, with the aid of a first piston/cylinder arrangement, can take place via a line or conduit, drawn with thin hydraulic lines, such as tubes or pipes, interacting with a second piston/cylinder arrangement, the latter being applied as a master unit next to an operator, in order to be able, with the aid of a control lever or similar, to influence the forward and backward motion of the piston within the second piston/cylinder arrangement for an equivalent or corresponding displacement or control via the slave unit of an associated control valve, and thus the working flow.

The thin hydraulic lines, at relatively low pressure, that are exploited and suggested for this can thus be a line pathway via tubes or pipes that significantly facilitates more or less freely chosen placement of a required set or assembly of control valves with consequent shorter line pathways for the hydraulic lines or pipes for the hydraulic control system and its working flow with its higher hydraulic pressure.

That primarily can be regarded as characteristic features of the present invention are specified in the characterising clause of the accompanying claim 1.

**Brief description of the drawings**

A number of currently suggested embodiments, displaying the significant characteristics associated with the present invention will now be described in more detail for the purposes of exemplification, with reference to the attached drawings, in which:

**Figure 1** is a side view of a previously known crane arm system, mounted on a lorry, and in which the crane arm system is controlled with the aid of an operator and control levers or pedals, located in the vicinity of the operator,
Figure 2 is a perspective illustration of a previously known arrangement, in which a control lever is to interact directly with control valves and in which the lever can be moved in two different perpendicular directions and which has thus been denoted as a "co-ordinate lever".

Figure 3 shows the principle of a first auxiliary hydraulic system, proposed by the invention, that exploits a control flow, during the exploitation or use of a first piston/cylinder arrangement, functioning as a slave unit, and a second piston/cylinder arrangement, functioning as a master unit, and lines that connect them together.

Figure 4 shows the principle of a second hydraulic auxiliary system, proposed by the invention, during the exploitation or use of a first piston/cylinder arrangement, functioning as a slave unit, and a second piston/cylinder arrangement, functioning as a master unit, and lines that connect them together.

Figure 5 is a perspective view of a first piston/cylinder arrangement,

Figure 6 shows the first piston/cylinder arrangement, functioning as a slave unit, with its piston adopting, by means not shown in the drawing, a central position or a neutral position,

Figure 7 shows, at a larger scale, an interaction between the cylinder wall and the piston, in the said position shown in Figure 6, in order in this way to be able to offer a mobile and displaceable dividing wall between two separate hydraulic systems or control circuits,

Figure 8 shows, at an enlarged scale, an interaction between the cylinder wall and the piston, in the said position of the master unit shown in Figures 3 and 4, the second piston/cylinder arrangement, whereby means, in the form of a track or groove, in the cylinder wall will be able to offer an equalisation of pressure between the two hydraulic systems or control circuits, and
**Figure 9** shows, at an enlarged scale, similar to that specified and shown in Figure 8, an interaction between the cylinder wall and the piston, in the said position of the master unit shown in Figures 3 and 4, the second piston/cylinder arrangement, in order to be able to offer, by means of a hole in the cylinder wall, an equalisation of pressure between the two separate hydraulic systems or control circuits.

**Description of the prior art according to figures 1 and 2**

With reference to Figure 1, a crane arrangement 1 is shown there mounted on a lorry 4, where one forward part 1a is attached in a manner that allows it to be rotated to an intermediate part 1b, via an axis of rotation 1a', and the rotational position of the arm 1a relative to the arm 1b is controlled with the aid of a piston/cylinder arrangement "A", that is part of a hydraulic control system in a manner that is previously known.

The arm 1b is attached to a post 1c, via an axis of rotation 1b', in a manner that allows it to be rotated, and the rotational position of the arm 1b relative to the post 1c is controlled with the aid of a piston/cylinder arrangement "B".

The reference numeral 2 illustrates a seating position for an operator, not shown in the drawing, and an additional drawing, at a larger scale, illustrates that a number of control levers are present next to the seating position, one of which has been given the reference numeral 3.

This control lever 3 is placed in a direct interaction with a control valve 3a, that allows it to be rotated or tilted, which control valve is connected via heavily or largely dimensioned conduits, as pipes or tubes 3b, to a hydraulic system for a working flow, with a pressure that lies between values of 200 and 300 bar, in order to be able through this system to control the piston/cylinder arrangements "A" and "B".

The tubes or hoses 3b must, therefore, be dimensioned resistant to high pressures and adapted for a high flow rate of hydraulic fluid.

The operator normally also has at his or her disposal pedals, not shown in detail here, although they have been given the reference symbol or numeral 3', and where the movement of the pedals, as also the movement of
the control lever 3, is to influence a control valve 3a′, which interacts via equally heavily or largely dimensioned pipes or tubes with one of the piston/cylinder arrangements "A" or "B", for regulation of the working flow.

With reference to Figure 2, a number of control valves are shown there in a perspective view, co-ordinated to one collection or assembly, and where a lever 3", via movements in two perpendicular planes P1 and P2, can influence one, two or three control valves, in a manner that is previously known.

With reference to Figure 1, it is also to be illustrated that it is perfectly possible for a collection or assembly of valves, according to Figure 2, and which has been assigned the reference numeral 20, to be collected into one area or place that has been given the reference numeral 20′ in Figure 1.

The control valves in the valve collection or assembly 20 are now to be subject to remote control. This remote control can take place according to the alternatives given in the introduction, whereby it should be possible for an influence of one lever (3) in the plane P1, or of one pedal (3′) in a depressed or elevated position, or an influence of one lever (3") in a direction represented by the plane P1 or P2 to influence in a remote manner the control valves in the manner that has been previously described in the introduction, according to the prior art.

*Description of a preferred embodiment suggested here*

It must initially be pointed out that in the following description of an embodiment suggested here that displays or offers the significant characteristics associated with or related to the invention and that are made clear in the figures that are presented in the drawings, we have chosen to use terms and a special terminology with the primary aim in this way of illustrating the innovative principle more clearly.

It must, however, be taken into consideration that the expressions chosen here are not to be seen as limited solely to the terms chosen and used in the description, but it must be understood that each such selected term is to be interpreted such that it also includes all technical equivalents that function in the same or essentially the same manner in order in this way to achieve the same or essentially the same intention and/or technical effect.
Thus, with reference to Figure 3, there is schematically shown a
first embodiment of a hydraulic auxiliary system "H", with two hydraulic control
circuits for the control of a control flow, which displays and offers the signifi-
cant properties or features associated with the present invention and which, in
a general manner, have been exemplified by an embodiment that is here sug-
gested and which will be described in more detail in the following description.

Thus Figure 3 shows the principles of a diagram of connections
for a regulator, exploited or constructed according to the invention, displaying
two piston/cylinder arrangements 31 and 32 and two lines or conduits 33, 34,
that are and form parts of a hydraulic auxiliary system "H", built in and inter-
connected to form a system of communicating vessels or chambers.

A system of communicating vessels or chambers is a system
where two separately operative or co-ordinated hydraulic systems 301, 302
are interrelated by a passage, such as a hole, and through which passage a
pressure equalisation is caused between the two systems. This pressure
equalisation is to be activated when one or both pistons, in resp. piston/ cyl-
der arrangement in the two systems, is in a predetermined position, such as a
neutral position.

Thus, Figure 3 shows only the principle of a first hydraulic auxilli-
ary system according to the invention, during the exploitation or use of a first
piston/ cylinder arrangement 31, functioning as a slave unit, a second piston/
cylinder arrangement 32, functioning as a master unit, and with lines or condu-
ts 33, 34 that interconnect them in a manner previously known.

A container 37 is connected to the arrangement 32, which conta-
iner contains hydraulic fluid for the hydraulic auxiliary system "H" that is
shown, and its two control circuits 301, 302.

A piston 31a, included in the piston/cylinder arrangement 31, is
adapted as and serving as a mobile or displaceable intermediate part between
two, separate although collaborating, hydraulic systems or control circuits 301,
302, one control circuit 301 comprising the right hand volume 31b of the arran-
gement 31, the line 33 (tube or pipe) and the right hand volume 32b of the
arrangement 32.
The second control circuit 302 comprises the left hand volume 31c of the arrangement 31, the line 34 (tube or pipe) and the left hand volume 32c of the arrangement 32.

Said piston 31a and a similar piston 32a are separating the two systems or circuits 301 and 302 from each other, however a movement of one piston 31a in one direction causes a corresponding movement of the other piston 32a in an opposite or similar direction, depending upon the coupling of the lines.

The two separated hydraulic systems or circuits 301, 302 interact and are directly connected to each other only in a neutral position (illustrated as a central position) for the pistons 31a and 32a, in order to be able to offer, via this connection or lines, any pressure equalisation that is required.

In the event of a very small, the smallest possible, displacement of the piston 32a in either one of two opposite directions, the piston 32a and its ring, abutting against the wall of the cylinder, becomes a seal, and the two hydraulic systems or circuits 301, 302 in this way become separated from the interconnection to each other and the hydraulic systems 301 and 302 function separately from each other, where the first hydraulic system 301 can constitute the active hydraulic system while the second hydraulic system 302 is free and is connected to the container 37.

Means, that are not shown in the figures, but which are often available built into a control valve, are to influence the slave unit and are arranged in order to allow the piston 31a to be displaced to a predetermined position, a neutral position, after each displaced influence from this neutral position has transferred an corresponding influence of the control valve.

Means, that are not shown in Figure 3, are arranged in order to be able to displace successively the piston 32a from a neutral position, shown in the figure, and in this way to allow a control flow to displace the piston 31a an equivalent or corresponding degree, via line 33 or 34.

Figure 4 shows, with continuous lines, an alternative embodiment of a regulator to that shown in Figure 3, which regulator is adapted such that it can offer a remote control of a control device or controlled device, with allotted reference numeral 21, and which here has been assigned the form of a control valve and which is to control a working flow of a hydraulic fluid in a high-
pressure system or in a control system connected to the piston/cylinder arrangements "A" and "B" in Figure 1.

It is to be possible to bring a part 21a, that belongs to the control device or control valve 21, by the auxiliary system "H" or by the two control circuits 301, 302, successively from a first position, shown in Figure 4, to at least one second position, an upper position or a lower position or vice versa.

To be more specific, it is proposed that the hydraulic operated regulator, according to Figure 4, displays and makes use of a first piston/cylinder arrangement 31, that can interact with a part 21a, that belongs to the control device 21, and which functions as a slave device, and a second piston/cylinder arrangement 32, which can be influenced manually or in an equivalent or corresponding manner and with at least one line, such as a first line 33, adapted to connect hydraulically the first piston/cylinder arrangement 31 with the second piston/cylinder arrangement 32, such that an influence created manually or in an equivalent or similar manner and an equivalent or corresponding displacement of the piston 32a within the second piston/cylinder arrangement 32 will cause, via the line 33, an equivalent or corresponding responding successive influence and displacement of the piston 31a, within the first piston/cylinder arrangement 31.

To be specific, the invention proposes that not only the first piston/cylinder arrangement 31 but also the second piston/cylinder arrangement are to be selected as double-acting arrangements, according to the definition given above, such that in this way the said first line 33 will be adapted to connect a cylinder volume, within the first piston/cylinder arrangement 31, with a cylinder volume, within the second piston/cylinder arrangement 32.

It is shown here that a cylinder volume 32b is thus in direct contact with a cylinder volume 31b, via the line 33, and forms a first control circuit 301.

A second line 34 is adapted such that it allows the connection of a second cylinder volume 31c, within the first piston/cylinder arrangement 31, with a second cylinder volume 32c, within the second piston/cylinder arrangement 32, and forms a second control circuit 302.
Figure 4 also illustrates that a line 35 is connected, via a valve 35a, to the line 33, and that a line 36 is connected, via a valve 36a, to the second line 34.

The lines 35 and 36 lead to a tank or vessel 37, not shown in Figure 4, where this tank is located somewhat higher than the piston-cylinder arrangement 32 in order to, in this way, be able to create a small excess pressure in the auxiliary system, which has been assigned the reference numeral or symbol "H".

At least one of the valves 35a, 36a can be closed during transport, in order in this way to prevent, in a hydraulic manner, vibrations of the control lever 3, and prevent such vibrations from being propagated through the auxiliary hydraulic system "H".

An open valve 35a or 36a offers, in this case, first means, in order in this way to prevent the entry of air into the said piston/cylinder arrangement 31 resp. 32 and the two lines 33, 34.

The position of the tank or vessel 37 and its fluid surface is to be at least somewhat higher than the position of the piston/cylinder arrangement 32 in order to create a small excess pressure within the hydraulic auxiliary system "H".

The function and operation of the auxiliary system "H", according to Figure 4, can be described as follows.

Before use of the auxiliary system "H", with its control circuits, the valves 35a and 36a are closed, and it is an advantage if this closure can take place automatically, as soon as the hydraulic working system for the piston/cylinder arrangements "A", "B" in Figure 1 are activated.

When the control lever 3 is turned or tilted in the direction of the arrow P3, it is turned around an axis of rotation 3d and an angular formed part 3e, for causing an influence with and makes a contact with one end of an axis 32d, the central part of which is formed as the piston 32a in the second piston/cylinder arrangement 32.

The piston 32a is thus pressed downwards, in Figure 4, and this downward force reduces the cylinder volume 32c, and hydraulic fluid within the control circuit 302 passes through the line 34 to the cylinder volume 31c,
which in this way presses the piston 31a downwards in Figure 4 and in this way influences by an axis 31d the axis 21a of the control valve 21.

The downward displacement of the piston 31a reduces the cylinder volume 31b, and hydraulic fluid passes through the line 33 in the control circuit 301 to the cylinder volume 32b, within the second piston/cylinder arrangement 32. The valve 36a is to be closed and the valve 35a can be open.

The greater the rotation, motion or the tilting motion of the control lever 3 in the direction P3 is, the greater is the downwards displacement of the piston 32a and also the piston 31a and the greater is the influence on the displacement of the axis 21a in the control valve 21.

When the control lever 3 reaches its position of maximum travel or displacement, the valve 21 adopts a fully open position allowing full passage of the working flow, not shown.

It is possible, with a linked and fixed interaction, not shown in Figure 4, between the part 3e and the axis 32d, to, on rotation or tilting of the control lever 3 in the direction P4, allow the piston 32a, within the second piston/cylinder arrangement 32, to lift and in this way to reduce the cylinder volume 32b, which means that hydraulic fluid passes through the line 33 and increases the cylinder volume 31b in an equivalent or corresponding manner, whereby a control valve 21, that belongs to and co-operate with the piston 31a and its axis is lifted upwards and a second influence or movement of the control valve 21 takes place, with the use of the same control lever 3 and with a process that is equivalent to that described above. The valve 35a is in this case to be closed and the valve 36a is to be open.

In practice, both valves 35a and 36a may be allowed to be closed during the control sequences.

Figure 4 illustrates the possibility of, when control lever 3 is turned or tilted in the direction P3, only influencing the valve 21 from a neutral position towards and successively onwards to a fully open position.

A rotation or tilting of the control lever 3 in a direction P4 will be able to influence a second piston/cylinder arrangement 32', drawn with dashed lines, and in this way influence via lines 33' and 34' a first piston/cylinder arrangement 31', for an influence of a control valve 21' in the same way as that described with reference to the connections drawn with solid lines.
In addition to the adaptation of the said means such that it can create an excess pressure within the hydraulic auxiliary system "H" with the aid of an oil container 37, where a very small excess pressure is created, the possibility of allowing the line 35 and the line 36, and the control circuits 301, 302, to be placed under pressure with the aid of a pump, naturally lies within the framework of the invention.

With reference to Figure 5, a perspective view of the external form of a slave unit, in the form of a first piston/cylinder arrangement, is shown.

It is therefore to be assumed that Figure 5 illustrates the first piston/cylinder arrangement 31 and there displays an axis 31d intended for an interaction (a fixed interaction) with the axis 21a of the valve 21 and means 21b for pressing and transporting and displacing the piston 31a to a predetermined and intermediate position.

Figure 6 shows a cross-section of the piston/cylinder arrangement 31, according to Figure 5, and shows there that the piston 31a adopts an intermediate position with the cylinder volumes 31b and 31c of equal size, and positioned on each side of the piston 31a.

With reference to Figure 7, an embodiment is shown there, at a somewhat larger scale that in Figure 6, including the piston 31a and where a flange 31g interacts with the cylinder wall, via a seal or sealing means 31g', that makes contact with a centrally positioned cylinder surface 31h, positioned between the volumes 31b and 31c. The cylinder surface 31h is in this case cylindrical and has not been worked in any way.

Two different means are demonstrated in Figures 8 and 9 that are to be adapted to allow, when the master unit 32 and its piston 32a, within the second piston/cylinder arrangement 32, adopts a central position, the creation of the same excess pressure in the two hydraulic systems or control circuits 301, 302, with the lines 33, 34 and the cylinder volumes 31b, 32b and 31c, 32c.

In particular, it is shown, in Figure 8, that the cylinder and the cylinder surface 32e, within the second piston/cylinder arrangement 32, are provided with a circular peripheral track or groove 32e', that at a central position of the piston 32a interacts with a peripheral track or groove 32f in the piston 32a and a ring seal 32g, placed in it with wear resistant edges or lips 32g'.
Figure 8 shows that, in this position, the two hydraulic systems or control circuits 301, 302 are interconnected and communicate with each other through a ring-shaped column 32h, that is formed as shown.

It is an advantage if the recess or column 32h interacts with a hole 32k for connection to the container 37.

Such a hole 32k is not required in the case in which bleeding takes place from another position, located above the fluid level.

Figure 9 shows, at a larger scale similar to that of Figure 8, an interaction between the cylinder wall and the piston, in which position the master unit or the second piston/cylinder arrangement 32, shown in Figures 3 and 4, will be able to offer with only one hole in the cylinder wall (without a track or groove) a pressure equalisation between the two hydraulic systems or control circuits 301 and 302.

The hole 32p has a widening 32r at the bottom such that it can be formed to a rounded shape in order to reduce wear against the edges or wear resistant edges or lips 32g' of the seal 32g.

Thus, with a renewed reference to Figure 4, it is shown there that at least two parallel second piston/cylinder arrangements 32, 32' can be influenced by a single control lever 3, by allowing the control lever 3 to be moved in a first direction P3 or in an opposing second direction P4.

Naturally three or four parallel second piston/cylinder arrangements (32) can be influenced by a single control lever in a manner that is previously known.

The invention also exploits a second means 21b, arranged within or in the vicinity of the control valve 21, in order to be able to displace and position the piston 31a within the first piston/cylinder arrangement 31 in a central position, and in this way the same pressure will be present within each cylinder volume 31b, 31c, via the volumes 32b, 32c, provided that the control lever 3 does not make contact with and press against the axis 32d, that belongs to the second piston/cylinder arrangement 32.

Naturally, the invention is not limited to the embodiments given as examples above. It can undergo modifications within the framework of the innovative concept illustrated in the accompanying claims.
Particular attention should be paid to the fact that each displayed or shown unit can be combined with every other displayed or shown unit within this framework in order to achieve the desired technical function.
CLAIMS

1. An hydraulic-operated regulating arrangement, adapted such that it can offer a remote control of a control device (21), in the form of a control valve for a working flow, where it should be possible to bring one part (21a), that belongs to the control device, from a first position towards and onwards to at least one second position and vice versa, where the said regulator displays a first piston/cylinder arrangement (31) that can interact with said part (21a) and that functions as a slave unit, and a second piston/cylinder arrangement (32) that can be influenced or activated (3) manually or in a similar manner and that functions as a master unit, and lines or conduits (33, 34) are adapted to allow an hydraulic connection of the first piston/cylinder arrangement (31) with the second piston/cylinder arrangement (32), such that an influence or activation (P3), caused manually or in an equivalent manner, and an equivalent or corresponding displacement of the piston (32a) within the second piston/cylinder arrangement causes, via said lines (33, 34), an equivalent or corresponding influence and an equivalent or corresponding displacement of the piston (31a) within the first piston/cylinder arrangement, whereby not only the first piston/cylinder arrangement but also the second piston/cylinder arrangement are selected to be double-acting arrangements, that a first control circuit (301) comprises a first line (33), adapted to interconnect a first cylinder volume, within the first piston/cylinder arrangement, with a first cylinder volume, within the second piston/cylinder arrangement, that a second control circuit (302) comprises a second line (34), adapted to interconnect a second cylinder volume, within the first piston/cylinder arrangement, with a second cylinder volume, within the second piston/cylinder arrangement, that a first means (37) is arranged to prevent the entry of air to the said piston/cylinder arrangements and to the said two lines, characterised in that means (32h) are adapted to cause or create the same excess pressure within the two interacting hydraulic control circuits (301, 302), when the piston (32a), within the second piston/cylinder arrangement (32), adopts a predetermined position, such as a central position.
2. An arrangement according to claim 1, characterised in that the said means (37) is adapted to create an excess pressure within a complete hydraulic auxiliary system.

3. An arrangement according to claim 1 or 2, characterised in that the cylinder, within the second piston/cylinder arrangement, is provided with a peripheral track or groove (32e') that, at the said position for the piston (32a), interacts freely with a peripheral track or groove (32f) in the piston.

4. An arrangement according to claim 1, characterised in that at least two parallel oriented or related second piston/cylinder arrangements (21, 21') can be influenced by a single control lever (3).

5. An arrangement according to claim 1, characterised in that a second means (21b) is arranged such that it can locate the piston, within the first piston/cylinder arrangement (31), in a central position.

6. An arrangement according to claim 1 or 5, characterised in that the said piston, in the second piston/cylinder arrangement (32), is adapted to be displaced by the pressure difference to a predetermined position, such as a central position.

7. An arrangement according to claim 1 or 6, characterised in that the cylinder within the said central position is assigned to a passage.

8. An arrangement according to claim 1 or 7, characterised in that the passage has been assigned the form of a hole, adapted as a bleed hole.
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: F15B 7/10
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: F15B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE, DK, FI, NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-INTERNAL, WPI DATA, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Date of the actual completion of the international search: 24 April 2003
Date of mailing of the international search report: 25-04-2003

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