Feb. 3, 1942. J. MERCIER 2,271,826

PLANT FOR PNEUMATIC, HYDRAULIC, OR LIKE FLUID CONTROL

Filed Nov. 17, 1936 2 Sheets-Sheet 1

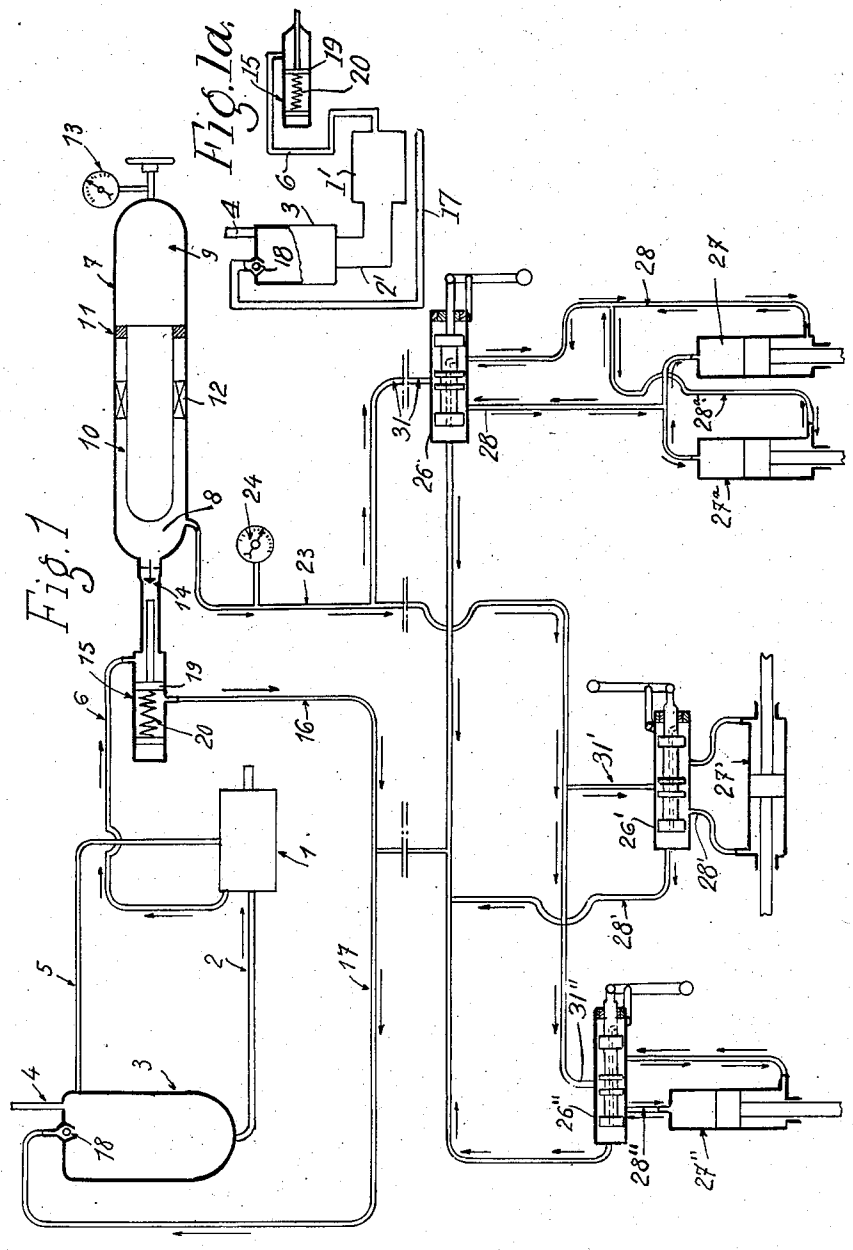


Fig. 1a.

Fig. 1

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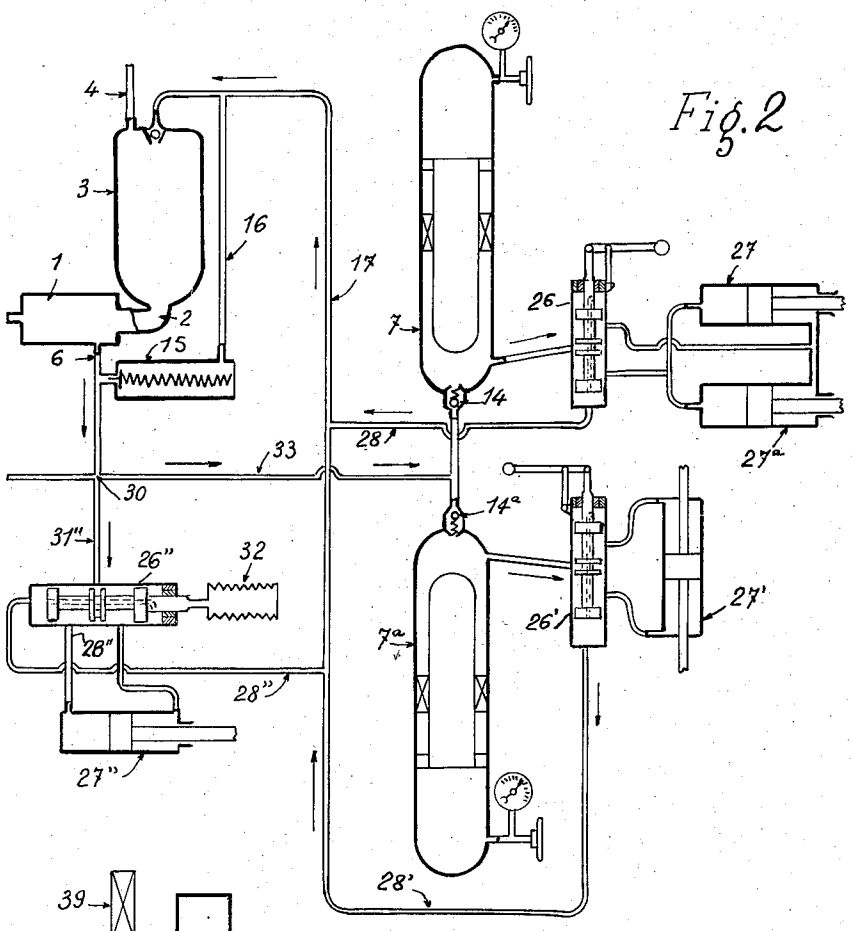


Fig. 2

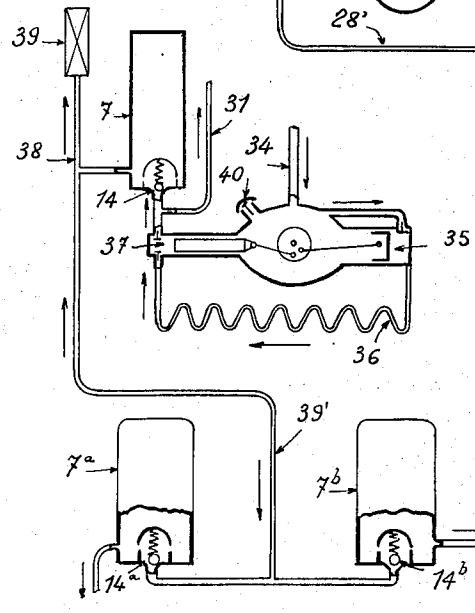


Fig. 3

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PLANT FOR PNEUMATIC, HYDRAULIC, OR LIKE FLUID CONTROL

Jean Mercier, Neuilly-sur-Seine, France

Application November 17, 1936, Serial No. 111,223
In France November 27, 1935

5 Claims. (Cl. 103—42)

The present invention has for its object a plant for hydraulic or pneumatic control utilizing a fluid (oil, air or the like) at a very high pressure and chiefly adapted for operating the controls of aircraft.

The said plant is principally characterized by the fact that it comprises in combination:

A pump (or a compressor) for small output, which may if necessary be combined with a feeding tank situated at a higher level than the said pump or compressor;

A device for limiting the delivery pressure to a given maximum value;

One or more tanks for the storage of the delivered fluid, said tank or tanks being provided with a check-valve;

Distributers for the fluid under pressure supplied by the said storage tanks, and jacks or like devices supplied with fluid under pressure by the distributers.

By means of the check-valve, which is located between the outlet of the pump and each of the said storage tanks the pressure prevailing in the tank may be conserved. This pressure may serve to control several times in succession the jacks or like parts which are to be displaced, notwithstanding a breakage of the pipes on the upstream side of the check-valve or a breakdown of the pump or a breakdown of the motor which drives the pump.

If necessary, one or more distributers can be connected directly with the delivery end of the pump, without being fed by said storage tank or tanks.

According to another feature of the invention, the pump comprises a pipe for the evacuation of air and for re-priming, said pipe connecting the intake end of the pump to the top of the feeding tank, which latter is in free connection with the atmosphere.

Instead of using a pipe for evacuation of air, use can be made of a submerged pump, i. e., a pump located in immediate proximity to the aforesaid tank to which it is connected in this case by a very short and large pipe which insures the automatic evacuation of the air-bubbles.

The device for limiting the delivery pressure may be of any known type.

In the case in which the fluid employed is a liquid, such as oil, the storage tank (or each storage tank) consists of a cylinder containing a piston, provided with a tight packing, which serves to provide two separate chambers, whereof one is adapted to contain the liquid under pressure and the other air.

In the case in which the fluid employed is air, the jacks may discharge into the atmosphere.

It is also feasible, in the case of air or any other gas, to use an arrangement in closed circuit, and herein the distributing valves are preferably situated at the lowest points of the circuits. A small amount of oil or other liquid is provided in these circuits and collects at these lowest points, thus insuring absolutely non-leaking conditions for the said valves; the oil which is drawn along with the air or other gas will again enter the intake pipe of the compressor.

In the accompanying drawings, which are given solely by way of example,

Fig. 1 is a diagrammatic general view of the improved hydraulic or pneumatic control in accordance with the invention;

Fig. 1*a* shows a modification;

Fig. 2 is a like view of a modification;

Fig. 3 is a like view, showing a preferred modification of a pneumatic plant.

In the embodiment shown in Fig. 1, the plant comprises a pump 1, which may be of any type. This pump withdraws the liquid, such as oil or the like, through a pipe 2, from a feeding tank 3, which is at a higher level than the pump. The top of tank 3 is connected with the atmosphere by a pipe 4. This pipe, if necessary, may be provided with any usual check-valve which will prevent all loss of liquid, for instance when the entire plant stands upside down or when the aircraft upon which the said plant is mounted oscillates or is inclined.

The inlet end of the pump is connected by a pipe 5 to the top of the said tank thus insuring the automatic priming of the pump after the whole system has been turned upside down, since any amount of air that has been trapped in the pump escapes through pipe 5 and is replaced by a corresponding amount of liquid present in the lower portion of said pipe 5, connected to the inlet side of the pump.

Instead of using the aforesaid arrangement, the pump may be placed at 1' (Fig. 1*a*) in immediate proximity to the said tank, to which it would then be connected by a very short pipe 2' of large diameter, which alone will provide for the repriming action.

The delivery end of the pump is connected by a pipe 6 to a storage device consisting of a tight cylinder adapted to withstand very high pressures (such as 200 kgs. per sq. cm.). The said cylinder is separated into two chambers 8 and 9 by a piston 10, which is guided, for instance, by a guide 11. Between the piston 10 and the cylinder

7 are provided one or more packing pieces 12, for instance of the elastic type, and thus there will be no risk of any communication between the chambers 8 and 9, in spite of the very high pressures in use.

The chamber 9 is filled with air, whose pressure is indicated by a pressure-gauge 13. The chamber 8 is connected with the discharge pipe 6 through a check-valve 14 which only permits the compressed liquid to flow from the pump to the said storage device.

On the discharge pipe 6 connecting the pump 1 to the chamber 8 of the storage device 7, is mounted a by-pass 15 which short circuits the pump when the delivery pressure attains a given maximum value, by directly connecting the pipe 6, by means of a pipe 16, to the pipe 17 serving for the general return of the liquid to the top of the feeding tank 3 (a check-valve may be provided at 18 at the point where the pipe 17 opens into the tank). The by-pass may be of any known type, and in the construction represented in the figure, it comprises a piston 19 which is urged to the right by a spring 20.

The chamber 8 of the storage device 7 is connected by a pipe 23 (provided with a pressure-gauge 24), and by branch pipes 31—31'—31'' . . . to distributers 26—26'—26'' . . . which control the delivery of compressed liquid to one or more jacks 27—27ª, 27' and 27'', respectively. The distributors also direct fluid to pipes 28ª, 28ᵇ, and 28ᶜ, while return is permitted through 28ᵈ, 28ᵉ, and 28ᶠ respectively to pipes 26, 28', and 28'' leading to return pipe 17, as shown by Fig. 1. Or the fluid may be directed to pipes 28ᵈ, 28ᵉ and 28ᶠ while return is permitted through 28ª, 28ᵇ and 28ᶜ, respectively. The jacks 27—27ª, 27' 27'' serve to actuate any element which is to be moved. For instance, the jacks 27—27ª may be used to lift the landing gear of an aeroplane, the jack 27' may control the body flaps, and the jack 27'' may operate the cooling radiators 70 which can extend more or less out of the fuselage 51.

The operation of the said plant is as follows: The pump withdraws liquid through the pipe 2 from the tank 3 and delivers it through the pipe 6 into the chamber 8 of the storage device 7. This delivery continues up to the moment where the maximum pressure is attained. As soon as this maximum has been reached, the by-pass short-circuits the pump. Thus the pilot has at any time a reserve supply of compressed liquid contained in the said storage device, and hence he may at any time, by operating one of the distributers 26—26'—26'', act in the desired direction upon any of the jacks 27—27ª, 27', 27'', and in this manner upon the parts to be displaced.

As above indicated, owing to the check-valve 14, the storage device 7 will be cut off from the upstream part which is under the pressure of the plant, so that a breakage of one of the pipes 2 or 6 will not deprive the pilot of the reserve supply of compressed liquid, and thus will be sufficient to provide for all desired operations for a safe landing on ground or on water.

Obviously, the by-pass 15 can be replaced by any other suitable device.

Fig. 2 represents a modification in which the delivery pipe 6 of the pump 1, forwardly of the by-pass 15, comprises a branch at 30.

A branch pipe 31'' leads directly to a distributer 26'' adapted to supply a jack 27'' which may perform any desired operation of any pivotally or slidably mounted elements of the aircraft. The control of the said distributer is insured, for instance, by a thermostat 32.

Another branch 33 of the delivery pipe leads to two storage devices 7—7ª which are disposed in parallel, and are provided with check-valves 14—14ª. Each of the said storage devices is connected to one or more distributers 26—26' supplying jacks 27—27ª, 27'. The first two jacks (27—27ª) may serve to operate the disappearing landing gear of an aeroplane, and jack 27' may operate a device of any kind, such as super planing device, an aerodynamic brake, a body flap, etc. The return of fluid to the tank 3 takes place in parallel by the pipes 28—28'—28'', as in the previous construction.

This arrangement of several storage devices permits of reducing the length of the different pipes and of making the various parts of the plant independent. As will be noted, the part 26''—27'' is not provided with storage devices, but this part controls the movement of auxiliary devices, i. e., it performs an operation which is in fact auxiliary and whose stopping will not have any serious consequences, at least for the moment.

The aforesaid arrangements can be actuated quite as well by liquids as by air or gas.

In the case of air, the jacks or other apparatus may discharge into the atmosphere or into the inlet pipe of the compressor, and thus the necessary power can be greatly reduced. This latter method which results in the use of a closed circuit, will be naturally employed whenever use is made of a gas other than air.

Whether air or other gas be used, it will be advantageous to employ preferably an arrangement analogous to the one shown in Fig. 3.

In this embodiment, the plant comprises a compressor 1 in two stages. The air or other gas is for instance withdrawn at 34, compressed in a cylinder 35 and then driven through the cooling worm 36 into a second cylinder 37 in which it is again compressed. From this cylinder 37 the compressed air (or other fluid) is caused to flow into a storage device 7 wherefrom a portion thereof passes through a pipe 38 into a distributer 39; another pipe 39' leads to two storage devices 7ª and 7ᵇ connected in parallel.

Each of the storage devices 7—7ª—7ᵇ is provided at its lowest part, with a corresponding check-valve 14—14ª—14ᵇ.

Preferably the circuit is closed, i. e., the discharge end of the jacks, or like devices, supplied by the storage devices, is connected to the suction pipe 34 of the compressor. Preferably an intermediary tank 34ª is interposed between 26 and 1.

In the case of a closed circuit, this circuit will preferably contain a small quantity of oil or other liquid, which will collect at the lower points of the plant, at which points the check-valves 14—14ª—14ᵇ are located, and the said liquid will form tight hydraulic joints in these places. A small quantity of oil or other liquid will of course be drawn into the jacks, but this will proceed from the discharge end of the jacks to the inlet end of the compressor, and will finally arrive at the lowest points, where it can again act in its sealing capacity.

The compressor is preferably provided with a valve 40 (Fig. 3) of any known type for the admission of air, which can be adjusted for any desired pressure, for instance slightly above the discharge pressure of the jack or jacks.

Obviously, as in the preceding case, one or more pipes 31, directly connected with the delivery end of the pump, may lead directly to one or more distributers, without the use of a storage device in this circuit.

It is evident that the said invention is not limited to the embodiments herein described and represented, which are given solely by way of example.

Having now described my invention, what I claim as new and desire to secure by Letters Patent, is:

1. In a system for controlling a hydraulically operated device, the combination of a storage tank for liquid under pressure, resilient means associated with said tank for varying the pressure therein in accordance with the amount of liquid present in said tank, delivery means for supplying liquid under pressure for replenishing said storage tank, including a circuit adapted to communicate with said storage tank for the feed of liquid thereto when the pressure in said tank is lower than the pressure of liquid in said feed circuit, means for limiting the pressure of the liquid supplied by said circuit to a given value, means for cutting off said storage tank from said feed circuit when the pressure in said delivery means drops below the pressure in said storage tank, and means, wholly independent of said feed circuit, for connecting said storage tank with said device to be operated.

2. In a system for controlling a hydraulically operated device, the combination of a storage tank for liquid under pressure, resilient means associated with said tank for varying the pressure therein in accordance with the amount of liquid present in said tank, delivery means for constantly holding liquid under pressure available for replenishing said storage tank, including a circuit adapted to communicate with said storage tank for the feed of liquid thereto when the pressure in said tank is lower than the pressure of liquid in said feed circuit, means for limiting to a given value the pressure of the liquid in said feed circuit, a check valve interposed between said feed circuit and said storage tank adapted to open in the direction of said storage tank, and conduit means, wholly independent of said feed circuit, for connecting said storage tank with said device to be operated.

3. In a system for controlling a hydraulically operated device, the combination of a storage tank for liquid under pressure, resilient means associated with said tank for varying the pressure therein in accordance with the amount of liquid present in said tank, a feeding tank, a pump system connected with said feeding tank, including a delivery chamber, means for limiting the pressure in said chamber to a predetermined value, a communication between said delivery chamber and said storage tank, a check valve mounted in said communication adapted to open only in the direction of said storage tank and conduit means, wholly independent of said feed circuit, for connecting said storage tank with said device to be operated.

4. In a system for controlling a hydraulically operated device, the combination of a storage tank for liquid under pressure, resilient means associated with said tank for varying the pressure therein in accordance with the amount of liquid present in said tank, a feeding tank, a pump system connected to said tank including a delivery chamber, a spring relief valve in said chamber for discharge of liquid therefrom, whereby the pressure in said chamber is limited to a predetermined value, a communication between said delivery chamber and said storage tank, a check valve mounted in said communication adapted to open only in the direction of said storage tank, and conduit means, wholly independent of said feed delivery chamber and said pump system, for connecting said storage tank with the above mentioned device to be operated.

5. In a system for controlling a hydraulically operated device, the combination of a storage tank for liquid under pressure, resilient means associated with said tank for varying the pressure therein in accordance with the amount of liquid present in said tank, a feeding tank, a pump, a main conduit connecting the inlet of said pump with the bottom of said tank, a supplementary conduit connecting the inlet of said pump with the top of said tank, a delivery chamber connected with the outlet of said pump, pressure relief means in said chamber for the discharge of liquid therefrom, whereby the pressure in said chamber is limited to a predetermined value, a communication between said delivery chamber and said storage tank, a check valve mounted in said communication adapted to open only in the direction of said storage tank, and conduit means, wholly independent of said pump chamber and the pump conduits, for connecting said storage tank with said device to be operated.

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