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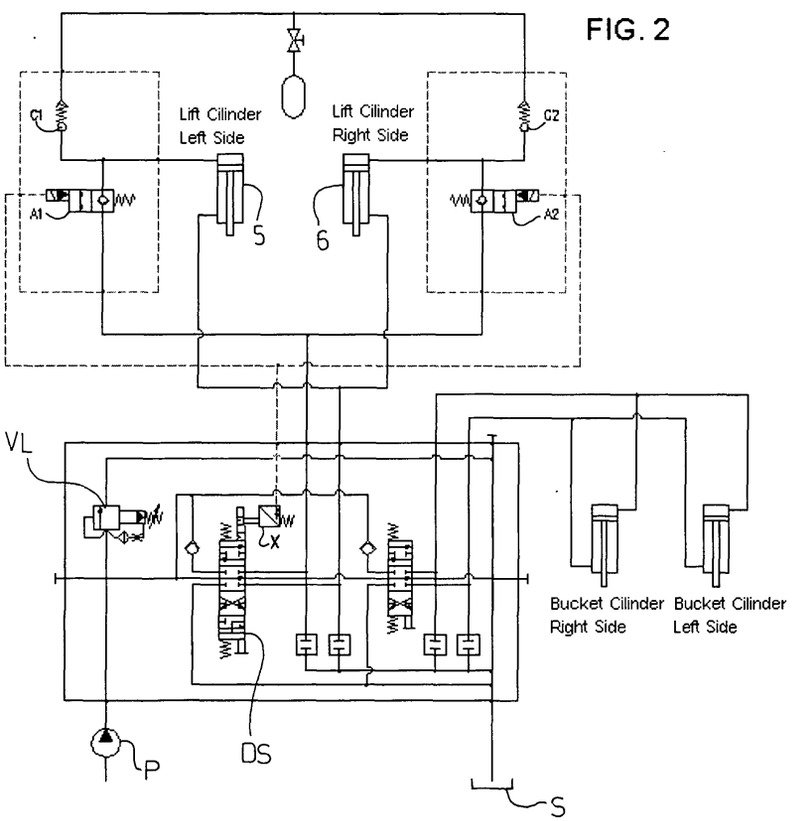
(54) Safety system in a hydraulic apparatus for controlling a front loader of a work machine for use in load lifting and holding operations

(57) The invention relates to the field of control equipment for hydraulic front load raising systems in work machines. Particularly, the invention provides an electrically operated shutoff valve (A1,A2) in the supply circuit for each of the hydraulic lift cylinders (5,6), which valve is actuated by an electric signal from a slide valve (DS) to protect the system during load lifting and holding operations; particularly, the electromechanical system allows the valve to be opened during lowering operations and as the working machine swings to follow the road profile (floating condition of the Front Loader).

FIG. 2



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Description

[0001] The present invention addresses a safety system in a hydraulic apparatus for controlling a front loader of a work machine for use in load lifting and holding operations.

[0002] The term front loader as used herein include buckets, shovels, forks, typically attached at the front of the operating machine or tractor, for moving earth, gravel or else. front loaders are arm linkages, hinged to one another and to the machine which comprise two hydraulic cylinders for load lifting and two hydraulic cylinders for bucket or fork handling.

[0003] The use is known of hydraulically operated safety valves in the hydraulic circuit for controlling lift systems, which valves have the drawback of considerably heating oil due to continuous oil lamination.

[0004] A further drawback of the hydraulic operation of safety valves is that these safety valves tend to open at varying pressures depending on load distribution on the loader, and apply twisting stresses on the loader during lowering operations.

[0005] Current rules require the system to be protected both during the lifting and holding operations of the Front Loader and do not require system protection during the lowering operation of the loader.

[0006] This invention has the object of preventing the load from being abruptly lowered due to the failure of a pipe for conveying oil to the lifting cylinders at the base end, i.e. in the chamber that receives oil during lifting or holding operations, by using a highly simple arrangement to prevent oil heating.

[0007] This object is entirely fulfilled by a safety system for a control apparatus of a front loader of a work machine according to the invention, which comprises a slide valve for supplying fluid to the lift cylinders and is characterized as claimed in the annexed claims and particularly in that it has two shutoff valves on the supply lines of the two lift cylinders respectively, which are electrically actuated by a signal generated by the displacement of the slide valve.

[0008] A further characteristic is that, when an accumulator is provided in the hydraulic circuit, a hose burst valve is fitted in the connection pipe between the accumulator and the cylinder to protect the system in case of failure.

[0009] These and other characteristics will be more apparent from the following description of a few embodiments, which are shown by way of example and without limitation in the accompanying drawings, in which:

- Figure 1 shows a tractor with a Front Loader attached thereto.
- Figure 2 shows the diagram of the hydraulic circuit annexed to the system.
- Figure 3 shows the diagram of the hydraulic circuit annexed to the system, according to a possible variant.

[0010] Referring to Figure 1, a tractor is shown, which is equipped with a front bucket 2 driven by cylinders 3 and a lifter system composed of arms 4 connected to lift cylinders 5 and 6.

[0011] Referring to Figure 2, a hydraulic circuit is shown which includes an oil pump P, a relief or pressure limiting valve VL, an oil tank S, a slide valve DS for driving the lift cylinders 5 and 6.

[0012] Two shutoff valves A1 and A2 are provided in the supply circuit for the two lift cylinders, at the base end, to prevent pressure losses in the cylinders and any undesired descent of the front-end assembly.

[0013] In the embodiment as shown in Figure 2, an accumulator SA is also provided, on whose supply pipe two hose burst valves C1 and C2 are fitted, one for each cylinder, and namely located at the connection between the accumulator and the cylinder, to protect the system in case of failure of the connection between the accumulator and the cylinder.

[0014] Such hose burst valve is only provided in combination with an accumulator.

[0015] The shutoff valve is electrically actuated by a microswitch X, which is mechanically operated by the slide valve DS through a cam system.

[0016] The shutoff system is operated by a single electric control on both lift cylinders.

[0017] When the slide valve is in the holding position (as shown in the Figure), the oil contained in the pump is directly discharged in the tank.

[0018] If the slide valve is set in the lifting position, oil is pumped to the inlet of the lift cylinder at the base end and, by acting on the piston, causes the assembly to be raised, thanks to the fact that, at the same time, the oil contained at the rod end is discharged to the storage tank.

[0019] In both the above conditions, i.e. the holding and lifting conditions, the shutoff valves A1 and A2, are in the position as shown in Figure 2, i.e. in a one-way oil passage position.

[0020] This position is forced by the spring that is always provided in the safety valve.

[0021] If the slide valve is set in the lowering position, the microswitch X excites the shutoff valves by an electric signal so that they can be opened before discharge is controlled by the slide valve (to equalize pressure in both cylinders even with an unbalanced load and prevent the structure from being subjected to twisting stresses).

[0022] Electrically operated shutoff valves must remain in the open position during lowering operations and even as the operating machine swings to follow the road profile (floating condition of the loader).

[0023] Referring to Figure 3, a variant will be now described, which includes a pressure switch PS, which receives oil by the slide valve when the latter is set in the loader lowering position.

[0024] This pressure switch provides an electric signal which supplies the shutoff valves A1 and A2 and

namely, during load lowering operations, the shutoff valves are controlled by the electric signal from the pressure switch PS connected with the rod end of the lift cylinders; this actuates the solenoid valves to equalize the pressure in the two cylinders, before discharge is controlled by the slide valve.

[0025] Even though this is not visible from Figure 2, this protection system may be also advantageously implemented on the cylinders for handling the bucket 3.

[0026] While specific reference has been made herein to front loaders, the above safety systems may be obviously advantageously used for excavators, attached to the front or the rear part of a tractor or for other work machines which encounter the same safety problems.

Claims

1. A safety system in a hydraulic apparatus for controlling a front loader, for use in load lifting and holding operations, comprising a slide valve (DS) for supplying fluid to the lift cylinders (5) and (6), **characterized in that** it has shutoff valves (A1) and (A2) on the supply lines of the two lift cylinders, which are electrically actuated by a signal generated by the displacement of the slide valve (DS).

2. A safety system as claimed in claim 1, wherein the signal is provided by means of a microswitch (X), which is mechanically operated by the slide valve.

3. A safety system as claimed in claim 1, wherein the signal is provided by means of a pressure switch (PS), which is hydraulically operated by the slide valve.

4. A safety system for a front hydraulic apparatus of a work machine, for use in load lifting and holding operations, comprising a slide valve (DS) for supplying fluid to the lift cylinders (5) and (6), and an accumulator (SA), **characterized in that** it has two hose burst valves (C1) and (C2), which are located at the connection between the accumulator and their respective cylinder at the base end thereof.

FIG. 1

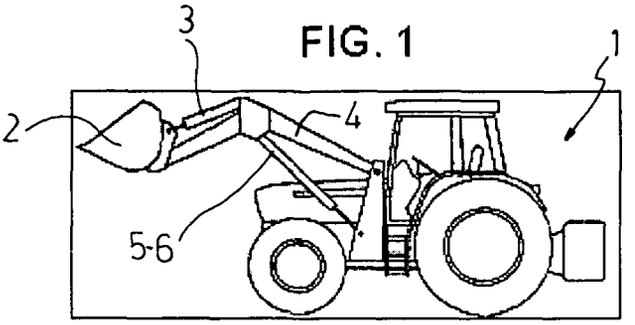

3
1
2
4
5-6

FIG. 2

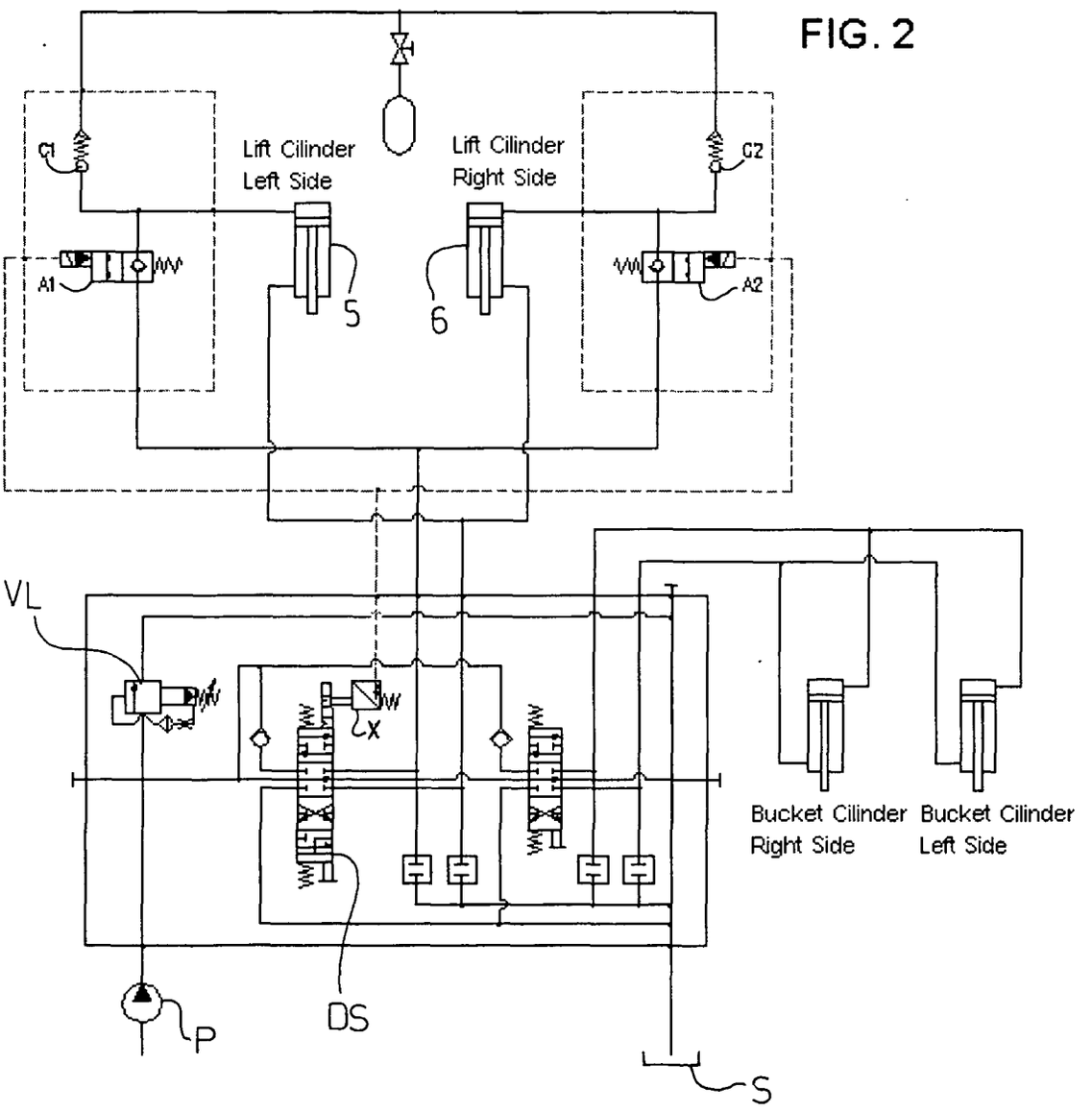
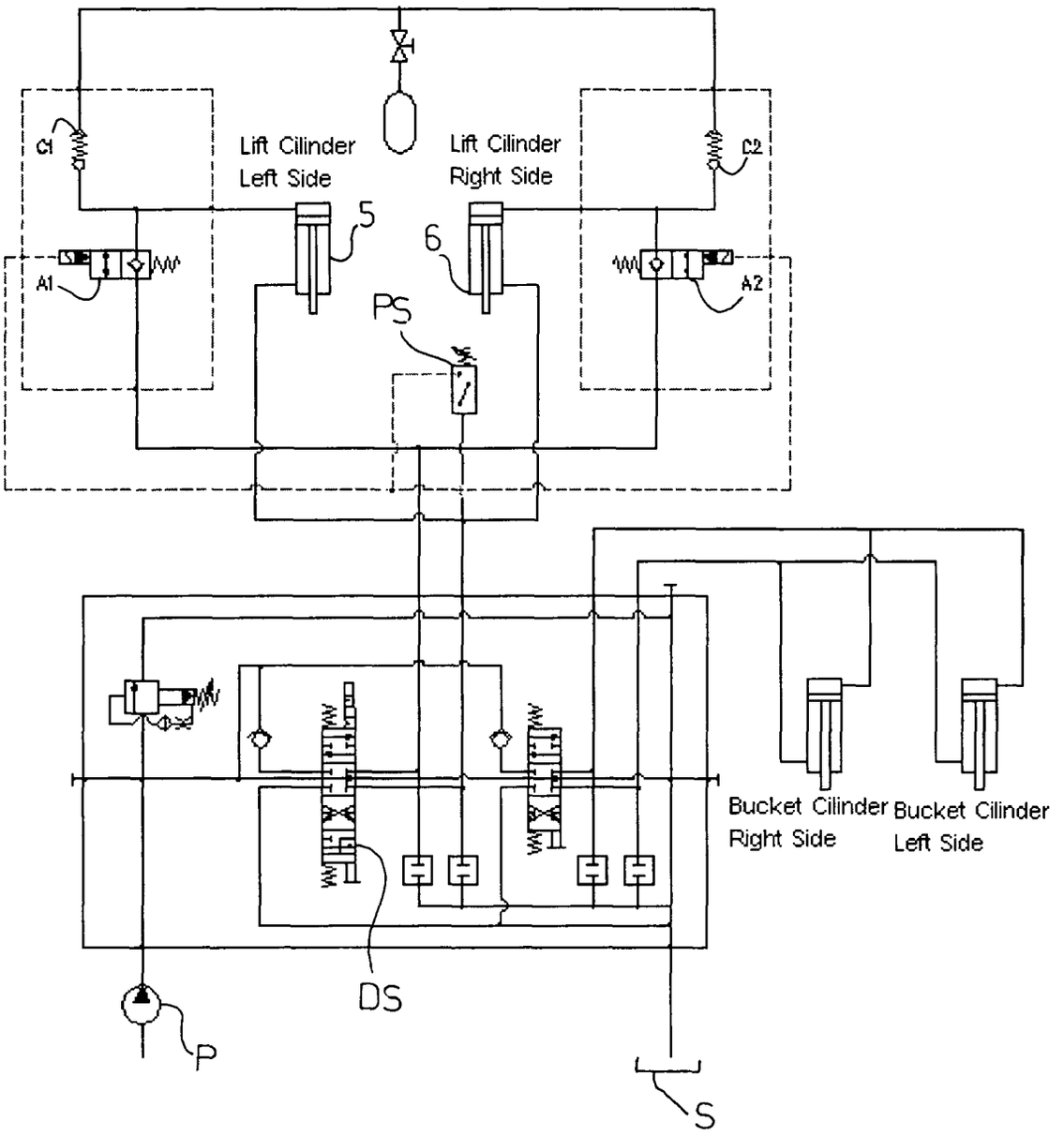

C1
Lift Cilinder
Left Side
Lift Cilinder
Right Side
C2
A1
5
6
A2
VL
X
Bucket Cilinder
Right Side
Bucket Cilinder
Left Side
P
DS
S

FIG. 3


C1
Lift Cilinder
Left Side
Lift Cilinder
Right Side
C2
5
6
A1
A2
PS
Bucket Cilinder
Right Side
Bucket Cilinder
Left Side
DS
P
S