(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 404 271 A1**

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **90201632.8**

(22) Date of filing: **20.06.90**

(51) Int. Cl.5: **E02F 9/20, E02F 9/22, E02F 9/24**

(30) Priority: **22.06.89 NL 8901572**

(43) Date of publication of application:
27.12.90 Bulletin 90/52

(84) Designated Contracting States:
AT BE CH DE DK ES FR GB GR IT LI LU NL SE

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(54) Hose breakage safety system.

(57) Hose breakage safety system, which serves to prevent an accidental movement from occurring when there is a sudden loss of pressure in a hydraulic system of a lifting device or lifting apparatus. The safety system comprises an electric non-return valve and a pressure sensor which is placed near the other end of a hose or part susceptible to breaking through which the oil of the lifting arm (2) or lever is decharged. The pressure sensor (9) emits an electrical signal which is proportional to the measured pressure and the signal emitted by the pressure sensor (9) is compared with signal emitted in the earlier instance through the electrical non-return valve (4) by means of an electronic circuit. Also a method for checking a breakage which has occurred or a breakage which going to occur in a hose is claimed.

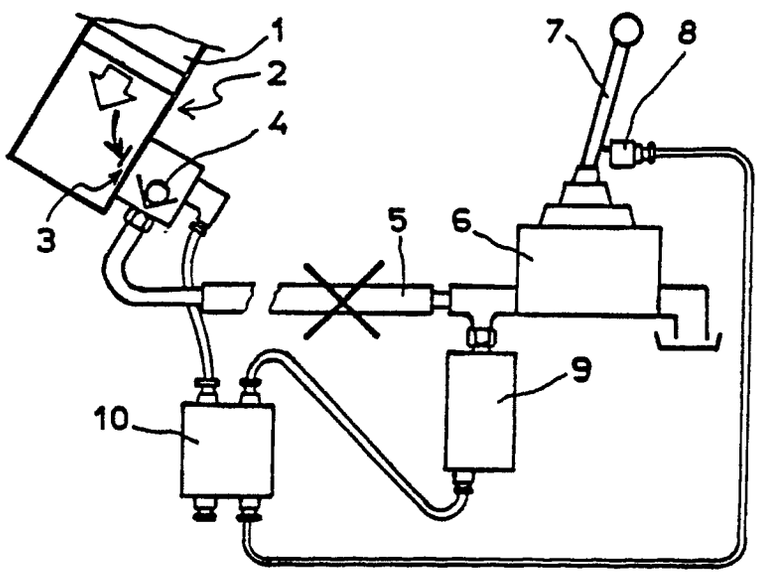

FIG.4

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Hose breakage safety system

The invention relates to a hose breakage safety system, which serves to prevent an accidental movement from occurring when there is a sudden loss of pressure in a hydraulic system of a lifting device or lifting apparatus, which safety system comprises an electrical non-return valve, and to a process for checking a breakage which has occurred or a breakage which is going to occur in a hose or a part of a lifting device or lifting apparatus which is susceptible to breakage.

The use of a hose breakage safety system is generally known in the case of earthmoving machines. These known systems comprise, for example, a valve in which a ball is placed against the pressure of a slack spring; as soon as the pressure becomes too high, through the fact that the hose has broken, the oil will be able to flow out freely, and the valve bangs shut. A number of other systems also operate by means of the flow velocity of the oil out of the cylinder becoming greater after a hose breakage has occurred. A disadvantage of these known systems is that such a valve can never work very fast, because the flow velocity of the oil through the non-return valve can never be the maximum. Another disadvantage is that if operation is at too high speed the valve can go into action spontaneously and will thereby block the operation of the machine, which brings the work to a standstill.

The object of the invention is a hose breakage safety system in which, if a breakage occurs in a hose, it will automatically and almost immediately block the lifting arm, so that the latter remains in the position which deviates only slightly from the position at which the breakage occurred, and where the lowering of the lifting arm can be achieved at maximum speed if the hydraulic system is in order.

This is achieved with a hose breakage safety system through the fact that a pressure sensor is placed near the other end of a hose or part susceptible to breaking through which the oil of the lifting arm or lever is discharged, which sensor emits an electrical signal which is proportional to the measured pressure, and the electrical signal emitted by the sensor is compared with the signal emitted in the earlier instance to the electrical non-return valve or another desired signal, by means of an electronic circuit. A pressure sensor which has a working range of 10 - 50 bar and which can be loaded to a pressure of at least 400 bar is preferably used, so that the pressure surges can be properly absorbed.

It has been found that a hose breakage safety system according to the invention is extremely suitable for use in earthmoving machines, and in particular in machines operating with a single cylinder. This means that with such a machine provided with the safety system according to the invention the lifting arm or boom can be lowered very slowly because during the downward movement of the boom the electrical non-return valve is fully open and the downward movement is determined by the main valve, which can be very important where the machine is being used for the very accurate placing of parts in, for example, building.

This was hitherto not possible with machines provided with a hitherto known hose breakage safety system, since in the case of such a system the flow through the non-return valve is always limited, both by a minimum and a maximum throughflow, and thus the speed of fall of the boom is determined by the rate of throughflow through the non-return valve. It was also found that such a hose breakage safety system is very suitable for all devices which are designed with a single cylinder, such as fire ladders, tipping lorries etc.

The process for checking a breakage which has occurred or a breakage which is going to occur in a hose or a part susceptible to breakage in a lifting device or lifting apparatus is characterized in that as soon as the lifting device is put into operation an electrical pulse which will open the valve for a specific short period of time is sent to the electrical valve, and in that more or less simultaneously the pressure sensor will carry out a pressure measurement for a predetermined period of time, which pressure measurement is converted by the pressure sensor into an electrical pulse, the size of which is a measure of the measured pressure, following which the electrical valve is opened if the electrical pulse coming from the pressure sensor corresponds within preset limits to the signal emitted in the first instance to the electrical non-return valve or a predetermined electrical pulse, and in that after opening of the electrical valve the signal coming from the pressure sensor is compared continuously with a desired signal and the valve is closed as soon as the signal from the pressure sensor deviates from the desired signal by more than the preset limits.

It has been found in practice that in earthmoving equipment provided with a hose breakage safety system according to the invention, if there is a sudden breakage of a hose during the downward movement of the lifting arm, the latter will make only a slight further fall after the hose breaks. This fall is much smaller than in the case of machines provided with hose breakage safety systems known hitherto.

The invention will be explained in further detail

with reference to the drawing. In the drawing:

Figure 1 shows schematically a part of the hydraulic system provided with a hose breakage safety system according to the invention during lifting;

Figure 2 shows the same schematic part from Figure 1, now with the lever in the neutral position;

Figure 3 shows the same part from Figure 1 during the lowering of the lever arm;

Figure 4 shows the same part as that in Figures 1, 2 and 3, now if a breakage has occurred in the hose;

Figure 5 shows schematically a view of a multi-functional machine, provided with various hose breakage safety systems.

Figures 1, 2, 3 and 4 show schematically a part of the hydraulic system of a multifunctional machine, which could be, for example, a hydraulic excavator or a shovel loader, which in addition to excavation operations could also carry out lifting work and then has to be provided with a hose breakage safety system. In the case of such machines which can carry out several types of operations it is particularly important for them to be provided with a good and quick-acting hose breakage safety system.

Figures 1, 2, 3 and 4 show a cylinder 1 of a lifting arm 2 of, for example, an excavator. An electrical non-return valve 4 is provided near the inflow aperture 3 of the cylinder 1.

The oil runs through a hose 5 via the non-return valve 4 to the cylinder 1. The oil supply and discharge is regulated by a control valve 6 by means of an operating lever 7. Said operating lever 7 switches a mechanical switch 8 on and off depending on the position of the lever. An electrical pressure sensor 9 is placed near the inflow aperture of the hose 5 on the control valve 6.

A control unit 10, provided with the desired electronics, ensures the correct operation of the hose breakage safety system.

Figure 1 shows how the system works when the arm or boom is lifted. During the lifting the switch 8 is not activated, so the hose breakage safety system monitor is not in operation. The machine is, however, automatically safeguarded against breakage of the hose, due to the fact that when pressure no longer comes through at the ingoing port or inflow aperture of the cylinder 1 the non-return valve 4 automatically falls shut and no further oil can flow out, and it can thus no longer flow back. The lifting arm, boom or mast 2 will thus automatically stop.

Figure 2 shows the neutral position. In this position also the hose breakage safety system is not in operation. The non-return valve 4 is closed in this position and nothing can happen if the hose breaks.

Figure 3 shows what happens if the lifting arm 2 is being lowered. During lowering the non-return valve 4 must be kept open. However, in order to be able to open the non-return valve and keep it open, a number of conditions must be met. The operating lever 7 must be placed in the position for lowering of the mast 2. As a result of this the switch 8 will be depressed and the control unit 10 will consequently receive current and immediately afterwards emit a brief measured pulse, as a result of which the non-return valve 4 is opened during the brief pulse period; the hose will thereby come to pressure and at the other side of the hose 5 the pressure sensor 9 will observe a pressure wave. This pressure sensor 9 will convert the measured pressure into an electrical signal which is sent to the control unit 10. The latter compares the received electrical pulse with the outgoing pulse and, if it corresponds thereto within a predetermined limit, this will indicate that the hose is in good condition. The control unit 10 will now open the valve 4, and said valve 4 remains open so long as pressure is measured by the pressure sensor 9.

Figure 4 shows the situation in which the hose 5 is broken. No pressure will now be measured by the pressure sensor 9, and so no electrical pulse will be emitted to the control unit 10. The valve 4 will now remain closed, and it will not be possible to lower the lifting arm.

Figure 5 shows a number of experiments which were carried out with a machine always provided with a number of generally known hose breakage safety systems. It was found that as soon as breakage was simulated without the operating person being aware of it the lifting arm always made a considerable fall. The machine provided with the present hose breakage safety system was, however, found to give the best result. The lifting arm did actually make a slight fall from the position where the breakage occurred (from position A, the initial position for all experiments, to position B), but this was only a small part of the full potential fall length. An additional advantage of the present hose breakage safety system is that during normal use, i.e. when no breakage has occurred in the hose, the lifting arm or lever 2 can be moved at virtually the maximum possible speed from the top position to the bottom.

Machines which are equipped with a hose breakage safety system according to the invention are also provided with a switch by means of which the safety system can be switched off. This is important in particular for, for example, being able to use an earthmoving machine as an excavator, in which case the boom does not, of course, need to make any downgoing movement.

Claims

1. Hose breakage safety system, which serves to prevent an accidental movement from occurring when there is a sudden loss of pressure in a hydraulic system of a lifting device or lifting apparatus, which safety system comprises an electrical non-return valve, characterized in that a pressure sensor is placed near the other end of a hose or part susceptible to breaking through which the oil of the lifting arm (2) or lever is discharged, which pressure sensor (9) emits an electrical signal which is proportional to the measured pressure, and the signal emitted by the pressure sensor (9) is compared with the signal emitted in the earlier instance to the electrical non-return valve (4) or another desired signal, by means of an electronic circuit.

2. Hose breakage safety system according to Claim 1, characterized in that the pressure sensor has a working range of 10 - 50 bar and can be loaded to a pressure of at least 400 bar.

3. Process for checking a breakage which has occurred or a breakage which is going to occur in a hose or a part of a lifting device or lifting apparatus which is susceptible to breakage, characterized in that as soon as the lifting device is put into operation an electrical pulse which will open the valve for a specific short time is sent to the electrical valve, and in that more or less simultaneously the pressure sensor will carry out a pressure measurement for a predetermined period of time, which pressure measurement is converted by the pressure sensor into an electrical pulse, the size of which is a measure of the measured pressure, following which the electrical valve is opened if the electrical pulse coming from the pressure sensor corresponds within preset limits to a predetermined electrical pulse level, and in that after opening of the electrical valve the signal coming from the pressure sensor is compared continuously with a desired signal and the valve is closed as soon as the signal from the pressure sensor deviates from the desired signal by more than the preset limits.

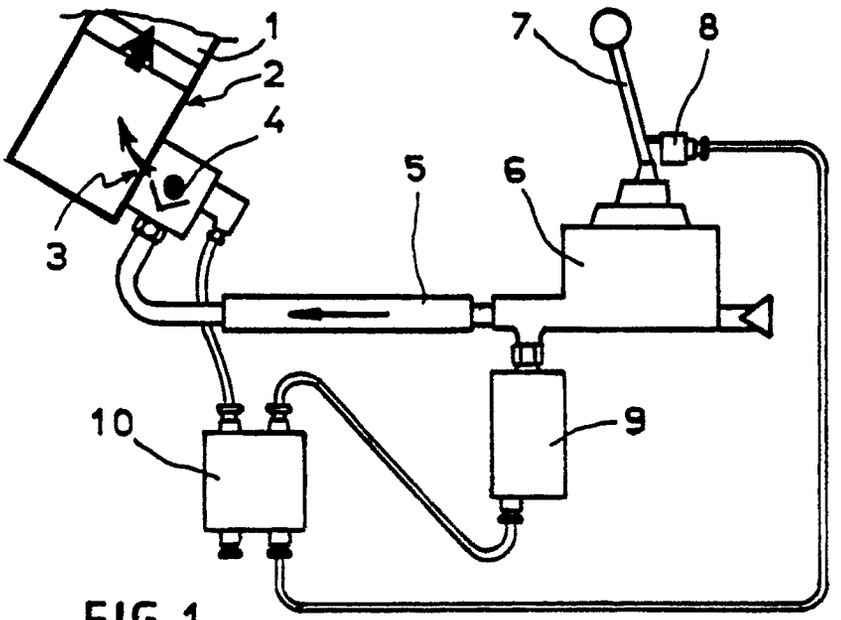

FIG.1

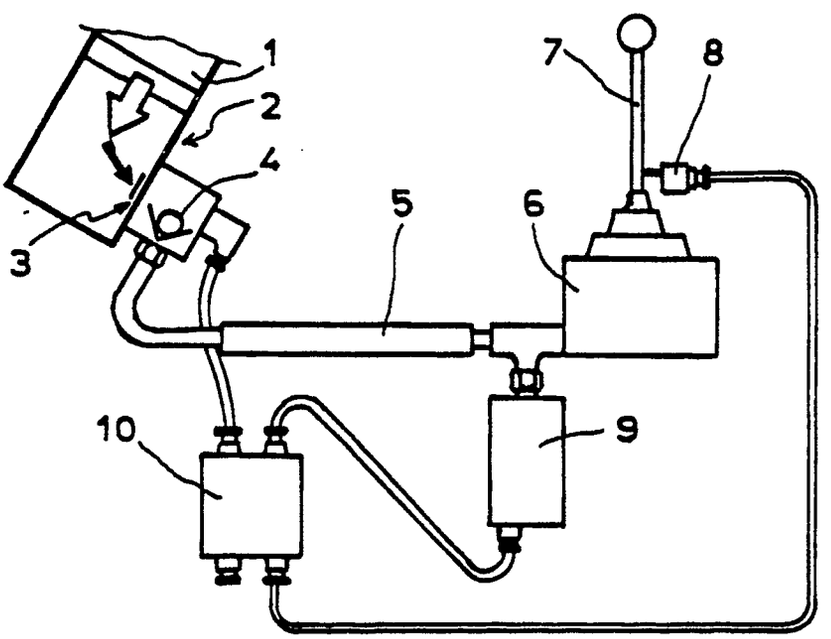

FIG.2

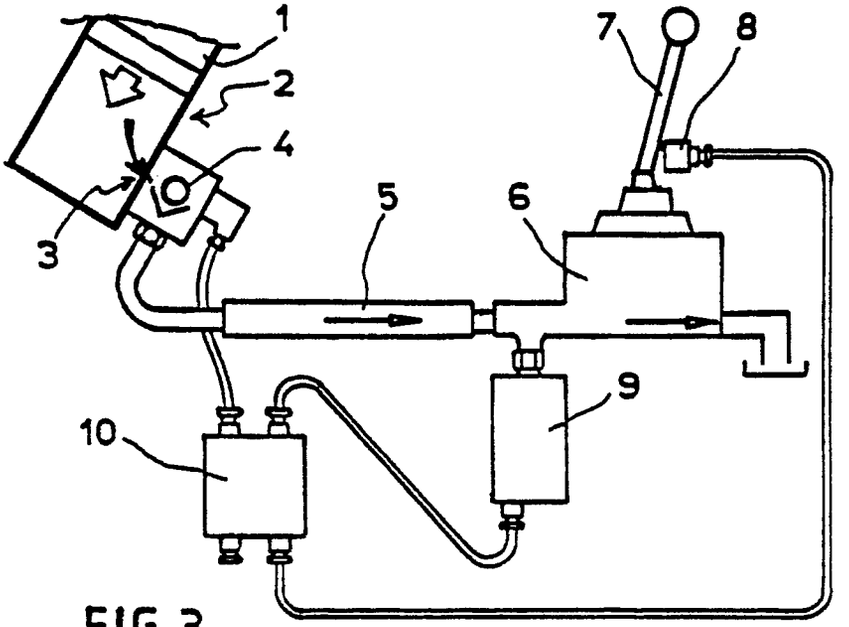

FIG.3

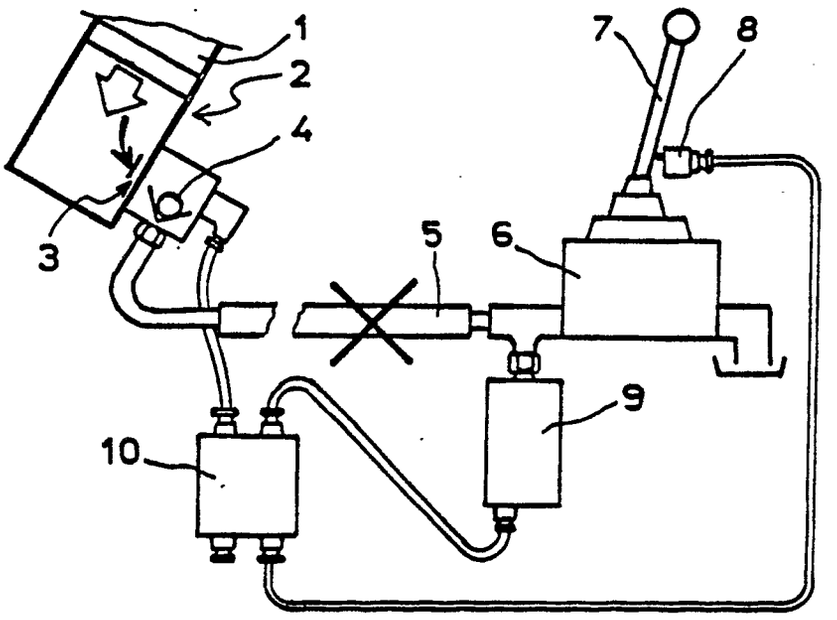

FIG.4

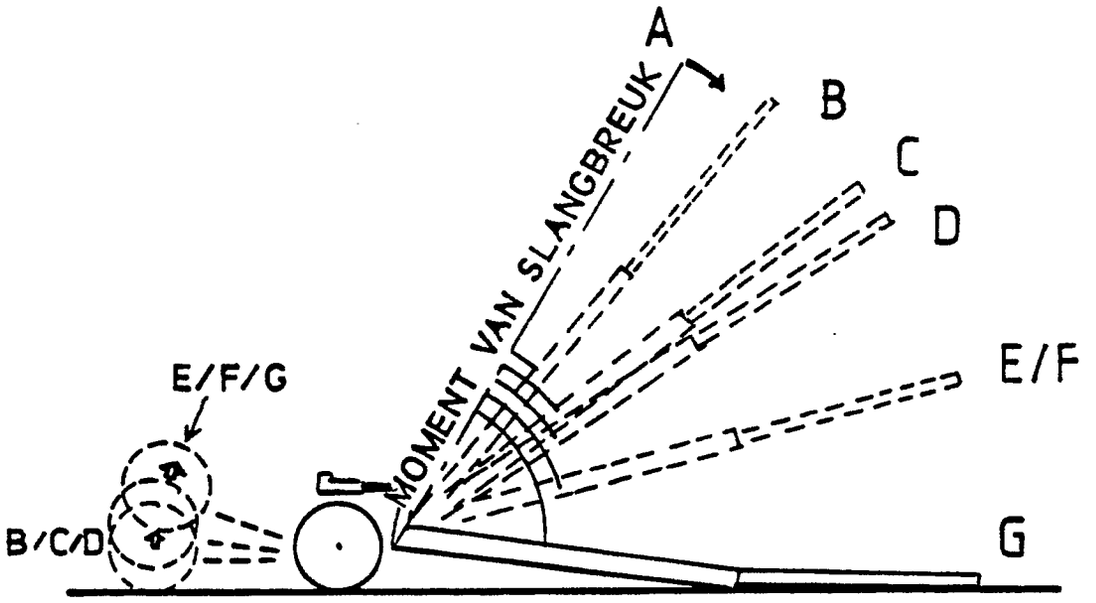

FIG.5

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EUROPEAN SEARCH REPORT

Application Number

EP 90 20 1632

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X	FR-A-2 497 851 (R. MASCHA et al.) * Claims 1-8; figures 1-6 *	1	E 02 F 9/20 E 02 F 9/22 E 02 F 9/24
A	---	2,3	
A	FR-A-2 363 512 (A.S. LINDBLOM) * Claims 1-4; figures 1,2 *	1-3	
A	---	1	
	FR-A-2 397 578 (BAUDET) * Page 1, lines 1-32; fig. *		

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

E 02 F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	12-09-1990	ANGIUS P.

CATEGORY OF CITED DOCUMENTS

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