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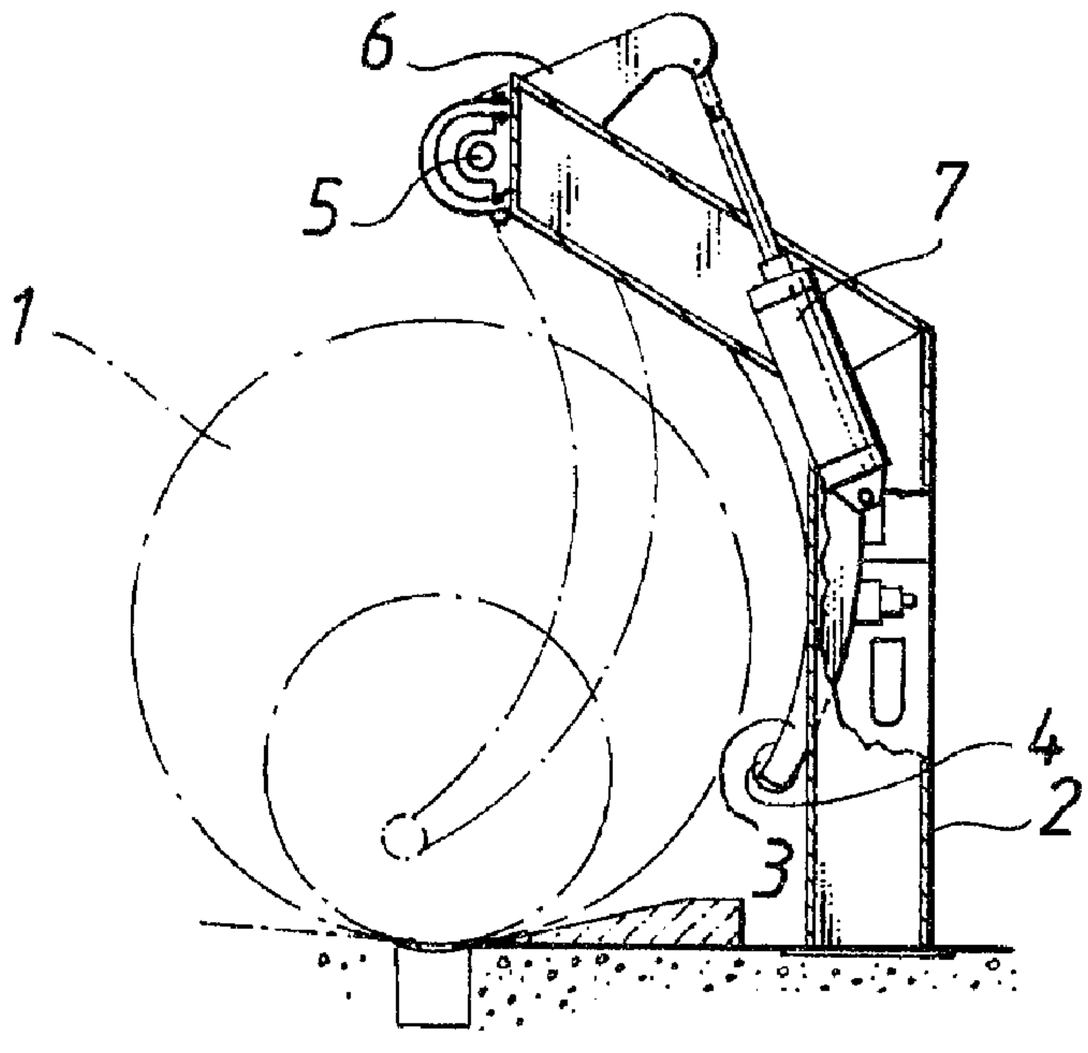

(57) Abrégé/Abstract:
This patent publication discloses a pneumatically operated roll stop particularly for paper rolls and a method for controlling said roll stop. The invention is based on the concept of providing the outlet line from the work chamber (8) of a pneumatic cylinder (17), which is connected to the stop arm of the roll stop, at that side of the cylinder actuated during the braking of the roll motion with a pulse-controlled valve (13) suitable for controlling the outlet flow rate from said work chamber (8) of the cylinder. Such a roll stop comprises a frame, at least one stop arm adapted to said frame with the help of a pivotal joint, said stop arm having a member adapted to its distal end, capable of making contact with said roll to be stopped, further two pneumatic cylinders (7a, 7b) connected by their one ends to said frame and by the other ends to said stop arm, and at least one control valve (12), connected by air lines (9, 11) to said cylinder (7), for the control of the function of the cylinder (7). The air line exiting from the work chamber (8) of the pneumatic cylinder (7) is provided with a valve (13) between the cylinder (7) and the air discharge point, said valve being capable of controlling air outflow from the line by way of pulsed open and closed operation of the valve (13). The invention offers smoother operation of the roll stop and prevents damage to the roll.

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[57] Abstract

This patent publication discloses a pneumatically operated roll stop particularly for paper rolls and a method for controlling said roll stop. The invention is based on the concept of providing the outlet line from the work chamber (8) of a pneumatic cylinder (17), which is connected to the stop arm of the roll stop, at that side of the cylinder actuated during the braking of the roll motion with a pulse-controlled valve (13) suitable for controlling the outlet flow rate from said work chamber (8) of the cylinder. Such a roll stop comprises a frame, at least one stop arm adapted to said frame with the help of a pivotal joint, said stop arm having a member adapted to its distal end, capable of making contact with said roll to be stopped, further two pneumatic cylinders (7a, 7b) connected by their one ends to said frame and by the other ends to said stop arm, and at least one control valve (12), connected by air lines (9, 11) to said cylinder (7), for the control of the function of the cylinder (7). The air line exiting from the work chamber (8) of the pneumatic cylinder (7) is provided with a valve (13) between the cylinder (7) and the air discharge point, said valve being capable of controlling air outflow from the line by way of pulsed open and closed operation of the valve (13). The invention offers smoother operation of the roll stop and prevents damage to the roll.

Roll Stop And Operating Method Of The Same

The present invention relates to a pneumatically operated roll stop particularly suited for paper rolls, and a method for operating said roll stop.

Paper mills utilize large conveyor systems for transferring rolls, for example, from the slitter to the packaging line, and further to the storage area. The transport system comprises, inter alia, lamellar conveyors, car conveyors, ramps and a variety of equipment suited to the transfer of the rolls from one conveyor to the next and to packaging lines. Such transport equipment incorporate different types of pushers and stops employed for pushing the roll into rolling motion and then stopping the same in a controlled manner at a desired location. The most common type of a roll stop is an arm pivotally mounted at its one end and adapted for motion control by means of a pneumatic cylinder. Such a roll stop operates so that along with its rolling motion, the roll hits a contact roll mounted to the distal end of the stop arm and begins to swing the arm toward the direction of the roll motion. Simultaneously, the arm actuates a pneumatic cylinder equipped with an outlet throttle valve at that side of the cylinder actuated during the braking of the roll motion. The throttling action slows down the cylinder stroke rate, as well as thereby also the roll motion, whereby the roll motion is brought to a halt. The cylinder is returned to its home position by applying compressed air pressure to the other side of the cylinder. Such return stroke can be utilized for pushing the roll into a new motion, e.g., away from a wrapping station.

Conventional roll stops are operated at an almost constant rate of speed deceleration throughout the entire roll stopping distance. Currently, the size difference between the minimum size and maximum size paper rolls produced in paper mills is very large; in modern mills ranges typically are as great as 200 to 8000 kg. A pneumatic stop performs satisfactorly only over a restricted range of roll sizes. When several different roll speeds have to be managed, a separate valve with an individual throttling characteristic has been

required for each preset stopping speed. During operation, the roll size is identified, after which a suitable valve/throttling combination is selected for use by a automation system. Obviously, the number of valves is limited in order to avoid an excessively complicated and expensive construction of the equipment. Typically, three different valve/throttling combinations have been employed, whereby three speed ranges are selectable.

The operating principle of a constant rate-of-speed deceleration over the entire stopping distance as employed in prior-art roll strops, causes several disadvantages. The paper roll hits the contact roll of the stop arm extremely violently at the instant of first encounter, and the outer layers of the roll may become damaged to a scrap condition. The hitting instant imposes a high impact energy on the roll that causes deformations and possibly even web tear. Moreover, such a conventional roll stop is slow in operation, because it operates with a constant rate of speed deceleration over the entire stopping distance. During the transfer of the rolls, the speed of the rolls must be kept low, since the braking power of the roll stops must be designed sufficiently weak to avoid damage to the roll. On the other hand, this results in a long transfer time of the rolls and reduces the speed of the transfer lines substantially. Furthermore, a great number of intermediate stops and roll retarders are necessary to control the speed of the rolling paper rolls.

It is an object of the present invention to achieve a pneumatically operated roll stop offering a controllable rate of stopping deceleration which is related to the required roll braking power as a function of, e.g., the roll weight.

The invention is based on providing the outlet line of a pneumatic cylinder at that side of the cylinder actuated during the braking of the roll motion with a pulse-controlled valve suitable for controlling the air outlet flow rate from the cylinder chamber.

In accordance with the present invention a pneumatically operated roll stop of controllable speed adapted for handling rolls, said roll stop comprising:

a frame;

at least one stop arm adapted to said frame with the help of a pivotal joint, said stop arm having a member adjacent its distal end, for making contact with said roll to be stopped;

at least one pneumatic cylinder connected by one end to said frame and by the other end to said stop arm;

at least one control valve, connected by a first air line and a second air line at least one cylinder, for the control of the function of the cylinder; and

wherein a valve is located in the air line exiting from at least one of the work chambers of the pneumatic cylinder between the cylinder and a air discharge point, said valve controlling air outflow from said line by way of pulsed open and closed operation of the valve.

In a further aspect of the invention, there is provided a method for stopping a roll with the help of a roll using a pneumatically operated roll stop, said roll stop comprising at least one stop arm which is subjected to the braking force whereby the movement of the stop arm is governed by at least one pneumatic cylinder, in which method

- a variable affecting the required braking force, is determined,

-the approach of the roll to the roll stop is sensed,

- the roll is retarded by a stop arm whose movement is governed with a pneumatic cylinder by way of throttling outlet air flow from the cylinder, and wherein

- the throttling of outlet air flow from the cylinder is modulated by controlling between open and closed positions a pulse-controllable valve connected to a cylinder outlet air flow line.

The invention offers significant benefits.

The apparatus according the present invention offers an easy control method of the braking force during the reception of the roll at the roll stop. The braking force of the

receiving roll stop can be set separately by roll, thus permitting an individually optimal control of the braking force of each roll. The rate of the stopping speed at the receiving stop can be adjusted even during the braking motion, thus offering the benefit of low braking power at the instant of first encounter so reducing roll damages substantially. Correspondingly, the braking power can be increased at the end of the stopping motion. This higher braking power imposed on the roll can be utilized to reduce the need for intermediate retarders and increase the roll transfer speed. The stopping motion itself will be quicker by virtue of the shorter total time required for stopping the roll. For such reasons, the capacity of roll handling lines can be increased and the throughput times of the rolls shortened. The apparatus will be simplified over the construction of multiple-valve stops and permit improved control of the stopping operation. The stopping system according to the invention can be easily retrofitted in conventional pneumatically operated roll stops during plant revamping.

The invention is next examined in greater detail with the help of the attached drawing, in which

Fig. 1 shows the side view of a pneumatically operated roll stop.

Fig. 2 shows the block diagram of one embodiment of a pneumatic circuit suited to implement the apparatus according to the invention.

Fig. 1 shows a roll stop adapted above the floor level of a plant. In fact, the construction of the roll stop is not essential to the spirit of the invention, so the roll stop illustrated in Fig. 1 is here described only as an exemplifying embodiment. Such a roll stop comprises a rigid frame 2, whose upper part is inclined so as to approximately coincide with the center line of the stopped roll. Mounted to the outer edge of the frame 2 is a bearing 5, which provides a pivotal joint of a stop arm 3 with the frame 2. The curved stop arm 3 extends downward from the pivotal joint carrying a contact roll 4 at the lower end of the arm. The stop arm 3 extends over the pivot point as a lever arm 6 with the piston rod of a pneumatic cylinder 7 attached to its distal end. This type of roll stop is conventionally

equipped with two parallel stop arms 3 and two pneumatic cylinders 7. Then, the contact roll 4 has the shape of an elongated cylinder and is rotatingly mounted in bearings adapted to the distal ends of the stop arms 3. The roll stop illustrated in Fig. 1 is placed in conjunction with a conveyor. The maximum and minimum sizes of the rolls 1 to be managed are shown in dashed lines. Also the receiving position of the roll stop is drawn in dashed line.

Fig. 2 shows a pneumatic circuit with two double-acting pneumatic cylinders 7a, 7b suited to implement a roll stop according to the present invention. In such a circuit, the work chambers 8, 10 of the cylinders 7a, 7b are connected by air lines 9 and 11 to ports L2 and L4 of 5/3-way solenoid-driven air valve 12. Both outlet air lines L3, L5 from the cylinder work chambers 8, 10, which are correspondingly connected to the outlet controlling ports of the 5/3-way air valve 12, are provided with a throttle 15. Compressed air required for the operation of the cylinders 7a, 7b is routed to port L1 of the air valve 12 from a compressed-air line 18 via a check valve 17 and a water separator 16.

The stopping of the roll 1 in the above-described system takes places as follows. The roll 1 with a weight identified from, e.g., the automation system of the packaging line, arrives to the roll stop either by rolling down an inclined plane or possessing rotational inertial energy imparted by a pusher. The approach of the roll 1 at the roll stop is sensed by a proximity limit detector, after which the roll 1 hits the contact roll 4 of the roll stop. At the instant of contact, the stop arm 3 is already actuated to a movement in the rolling direction of the roll 1. Pressure in the work chambers 8, later called the retarder chambers, on that side of the pistons of the cylinders 7a and 7b toward which the roll movement forces the pistons is slightly elevated by movement of the stop arm 3 and, because the drive voltage to the solenoid 'a' of the 5/3-way air valve 12 and the 2/2 way pulsing valve 13 is switched on by a signal from the proximity limit detector, the port L3 connected from the 5/3-way air valve 12 to the retarder chambers 8 is driven open toward the throttle 15 and the pulsing valve 12 is also driven open. The stop arm 3, which was waiting for a roll 1 in its forward position, is retracted before the approaching roll 1

imposing a minimum braking force as the outlet air exiting the retarder chambers 8 can freely flow via the pulsing valve 13. After the lapse of the initial phase of the stop arm acceleration, the fully open control of the pulsing valve 13 is changed, pulsed at a rate of approx. 10 Hz, thus causing a reduction in the speed of the stop arm 3 and the pistons of the cylinders 7a, 7b. During this phase the speed is controlled by air outflow rate limited by the fixed throttle 15 and the pulsing valve 13.

After a certain period of pulsed operation, the pulsed control signal to the pulsing valve 13 is switched off, causing the valve to cut off, and the roll 1 is brought with the minimum speed to e.g., a lamellar conveyor. During this phase, the braking power is controlled by the fixed throttle 15 alone. To receive the next roll, the stop arm 3 is driven to its forward position by the control voltage activating the solenoid 'b' of the 5/3-way air valve 12, whereby air is admitted from the compressed-air line 18 to the retarder chambers 8 of the cylinders 7a, 7b so returning the pistons to their home positions.

The above-described system is suited to the control of the stroke speed of an air cylinder for applications requiring several different stroke speeds. Speed control in pneumatic systems is characteristically implemented by throttling the outlet air flow from the cylinder. In the present system the cylinder 7 is controlled by a 5/3-type solenoid-driven air valve 12 and outlet port throttles 15. The air line 9 from the air cylinder retarder chamber 8 is connected to the valve port L2, and the 2/2-way solenoid valve 13 is placed between the port L3 and the throttle 15. When the cylinder 7 makes a positive (+) stroke (piston rod moving outward), solenoid 'a' of the air valve 12 is activated by the control voltage, whereby the outlet air from the retarder chamber 8 can escape via the port L3. The outlet throttle 15 is connected to the air line between L3 and the exit flow throttle is adjusted to give the positive (+) stroke a proper minimum speed for the piston of the cylinder 7. When more speed is desired for the positive (+) stroke, also the pulsing valve 13 is driven open by the control voltage. The 2/2-way pulsing valve 13 is controlled in pulsed manner by alternatingly driving the valve open and closed by the control voltage. Desired stroke speed of the cylinder piston is attained through modulation of the valve pulsing rate. During the return stroke, that is, the negative (-) stroke, the pulsing valve

13 is not activated by the control voltage, so the valve stays closed. In the case the negative (-) stroke also requires speed control, a pulsing valve is also connected in the line between L5 and the exit flow throttle in a similar manner.

In certain applications the pulsing valve 13 is controlled constantly open in the beginning of the piston movement. Next, the operation is controlled by pulsing the valve. At the end of the movement the pulsing valve 13 receives no control voltage. This arrangement provides different piston speeds for the different phases of the stroke.

The above-described system facilitates an extremely flexible speed control. The variables that can be controlled to meet the different roll sizes are typically the open-state duty cycle, pulsing rate and duration of pulsed control for the pulsing valve. Proper modulation of these variables achieves stopping of rolls of any size in a controlled manner without damage to the rolls. Selection of suitable control schemes for each roll size permits extremely smooth stopping of rolls with different sizes by means of a relatively simple stopping system. Moreover, such a system operates faster than a roll stop controlled with a preset throttle. As the outlet air flow from the cylinder can be easily controlled by the pulsing valve, the preset throttle can be adjusted for a high flow resistance, whereby the final phase of the stopping motion can achieve very efficient deceleration.

Besides that described above, the present invention can have alternative embodiments. For example, the number of cylinders and types of valves incorporated in the system can be varied to achieve an optimal arrangement for specific application. The only essential requirement in the system is the pulse-controlled valve which is located between the outlet flow port of the retarder chamber of the cylinder, and the discharge point of the outlet air. The pulsing valve can be placed, for example, between the cylinder control valve and the cylinder. The preset throttle can be omitted if desired, whereby the speed control of the braking movement is implemented by controlling the pulsing variables alone. When the system is provided with a fixed throttle, the pulsing valve must be placed in the air line between the throttling point and the cylinder. Besides for stopping

rolls, the present apparatus is also applicable to deceleration of rolling rolls in an arrangement permitting sway-away of the stop arm, sorting of rolls and other roll handling application requiring a movement of controllable speed.

Claims

1. A pneumatically operated roll stop of controllable speed adapted for handling rolls (1), said roll stop comprising:

- a frame (2);

- at least one stop arm (3) adapted to said frame (2) with the help of a pivotal joint (5), said stop arm having a member (4) adjacent its distal end, for making contact with said roll (1) to be stopped;

- at least one pneumatic cylinder (7) connected by one end to said frame (2) and by the other end to said stop arm (3);

- at least one control valve (12), connected by a first air line (9) and a second air line (11) said at least one cylinder (7), for the control of the function of the cylinder (7), and; wherein

-a valve (13) is located in the air line exiting from at least one of the work chambers (8) of the pneumatic cylinder (7) between the cylinder (7) and a air discharge point, said valve controlling air outflow from said line by way of pulsed open and closed operation of the valve (13).

2. A roll stop as defined in claim 1 where the rolls are of paper or metallic materials.

3. A roll stop as defined in claim 1 or claim 2 having a throttle (15) located in a cylinder air outlet line from the work chamber (8) of the cylinder (7), prior to the discharge point of the air, wherein the connection of the pulse-controlled valve (13) is located between the control valve (12) and the throttle (15).

4. A roll stop as defined in claim 1 or claim 2 wherein the connection of the pulse-controlled valve (13) is located between the cylinder (7) and the control valve (12).

5. A roll stop as defined in any of claims 1 to 4 wherein the pulse-controlled valve (13) is connected in the air outlet lines from both work chambers (8, 10).

6. A roll stop as defined in any one of claims 1 to 5 wherein the pulse-controlled valve (13) is a 2/2-way solenoid valve.

7. A method for stopping a roll using a pneumatically operated roll stop, said roll stop comprising at least one stop arm (3) which is subjected to the braking force whereby the movement of the stop arm is governed by at least one pneumatic cylinder (7), in which method

- a variable affecting the required braking force, is determined,

-the approach of the roll (1) to the roll stop is sensed,

- the roll (1) is retarded by a stop arm (3) whose movement is governed with a pneumatic cylinder (7) by way of throttling outlet air flow from the cylinder (7), and wherein

- the throttling of outlet air flow from the cylinder (7) is modulated by controlling between open and closed positions a pulse-controllable valve (13) connected to a cylinder outlet air flow line.

8. The method as defined in claim 8 wherein the variable affecting the required braking force is the weight of the roll (1) to be received.

9. A method as defined in claim 7, in which method the cylinder outlet air flow is throttled by a preset throttle (15) wherein

- during a first phase of the cylinder stroke, the cylinder outlet air flow is routed via the preset throttle (15) and the open-positioned pulse-controllable valve (13),

- during a second phase of the stroke of the cylinder (7), the cylinder outlet air flow through the pulse-controllable valve (13) is reduced by way of the pulsed control, and

- during a third phase of the cylinder stroke, the pulse-controllable valve (13) is in the closed position, whereby the outlet air flow rate is determined by the preset throttle (15) alone.

10. A method as defined in claim 9, characterized in that the cylinder outlet air flow is kept unrestricted for a short period after the roll (1) has contacted the stop arm (3).

11. A method as defined in claim 10, characterized in that at the roll contact instant, an open-state duty cycle, pulsing rate and fully-closed duration of the pulsed control for the pulse-controlled valve (13) is determined separately for each roll (1) to be received.

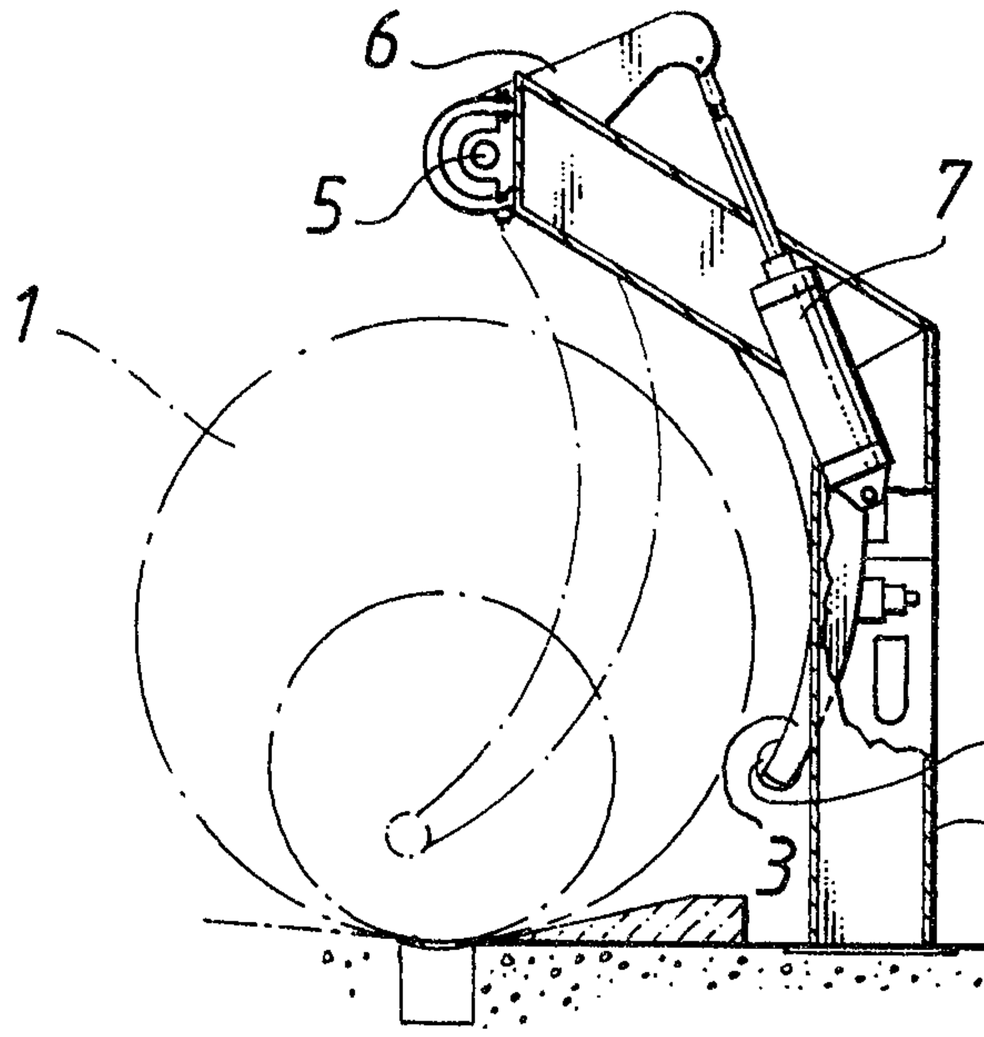

Fig.1

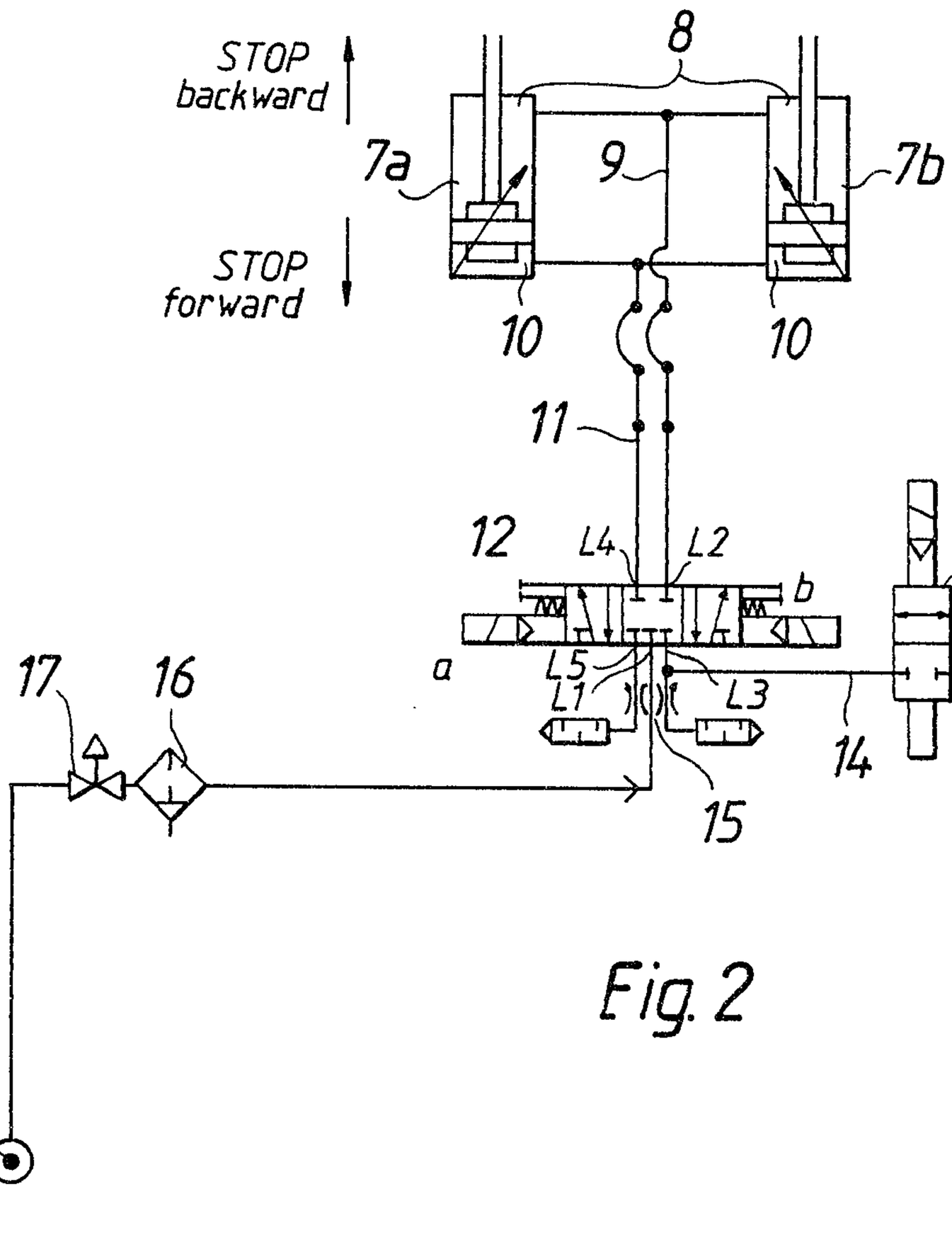

Fig. 2

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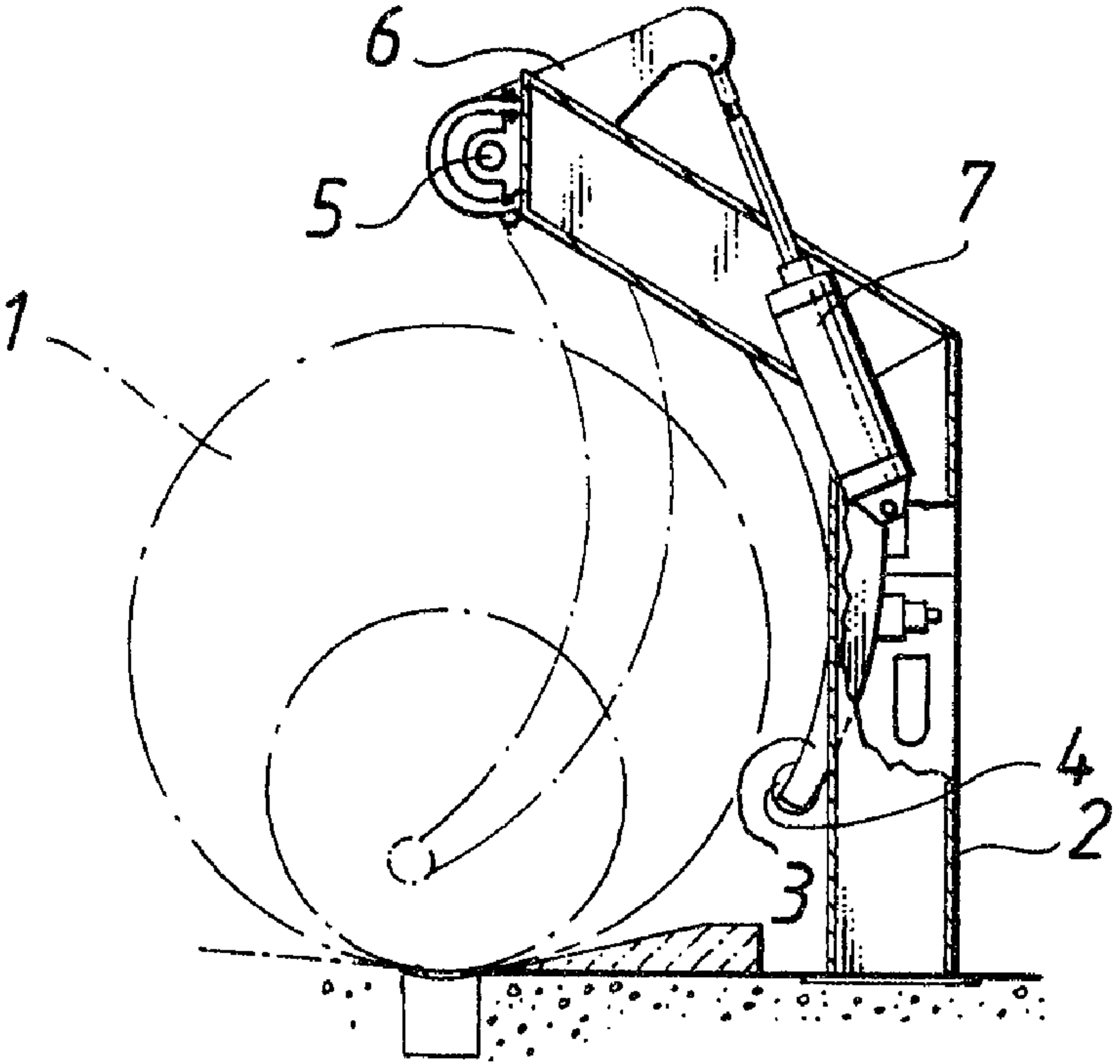
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