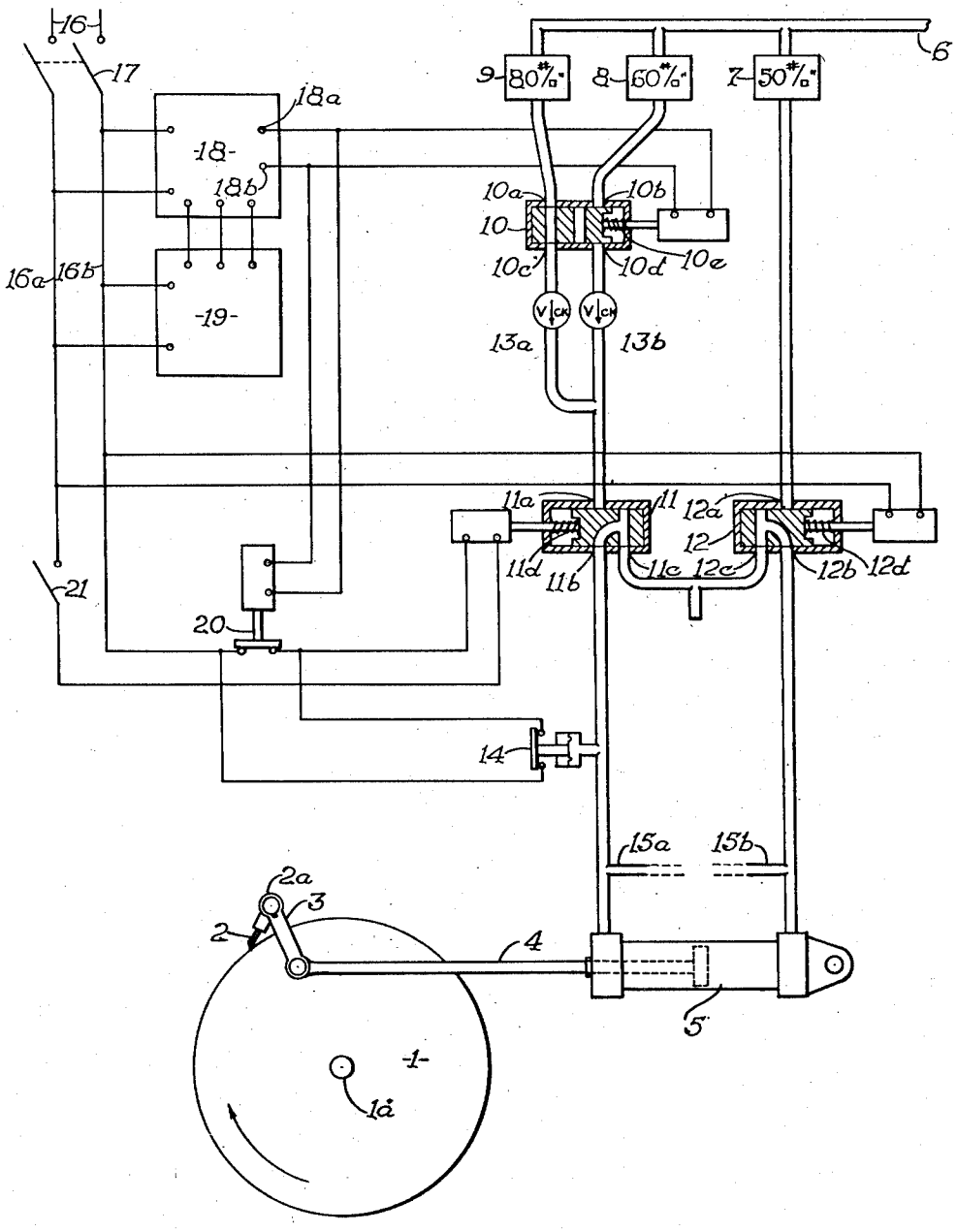
Sept. 4, 1951 G. STEVENSON 2,566,811

DOCTOR BLADE PRESSURE CONTROL SYSTEM AND METHOD

Filed May 17, 1949



INVENTOR.

Gustie Stevenson

BY

Ralph B. Stewart

attorney

Patented Sept. 4, 1951 2,566,811

UNITED STATES PATENT OFFICE

2,566,811

DOCTOR BLADE PRESSURE CONTROL SYSTEM AND METHOD

Gustie Stevenson, Philadelphia, Pa., assignor to F. J. Stokes Machine Company, a corporation of Pennsylvania

Application May 17, 1949, Serial No. 93,809

9 Claims. (Cl. 134—6)

1

This invention relates to a method of and apparatus for controlling the pressure applied to doctor knives for removing material from the surface of rotating drums, such as used in drum driers. Specifically the invention relates to a method and control apparatus for applying a predetermined pressure to a doctor knife and cyclically and periodically relieving this pressure by a predetermined amount.

The invention is especially applicable to drum driers wherein a heated drum receives a thin film coating of a liquid slurry which is dried (the water content is reduced by evaporation) in less than one revolution of the drum. It is also applicable to flaking drums, which are cooled by water or other refrigerant and which, by several available methods of feed, receive a thin film coating of a very hot compound (for instance pitch compounds at 550° F.) which is dried to brittleness by extracting heat from the compound. The invention is useful in any situation where a doctor blade is used to remove material from the surface of a rotating drum.

Generally, knife pressure against the drum is obtained by a combination of levers and weights and/or springs or by pressure screws. When the proper knife pressure has been determined the pressure setting is not changed so long as the film of material is cleanly "doctored" from the drum surface. This may last for an indefinite or extended period. However, experience has shown that some materials will cling so tenaciously to the surface of a drum that when a constant unvarying knife pressure is maintained, the hard film will slip under the knife and will not be scraped or "doctored" off of the surface. Worse yet, the drum will receive another coating of material on top of the previous one and the pernicious cycle repeated until eventual complete failure of the process.

The present invention is based on the discovery that by relieving the knife pressure momentarily or for a short period of time and then reapplying the original higher pressure, the knife will continue to doctor the drum cleanly. The amount of original pressure, the degree to which it is relieved, and the durations of application and relief will depend upon the characteristics of the material, the speed of rotation of the drum, and other variables which must be determined for each individual case.

A primary object of the invention is to provide a novel method of doctoring materials from a drum which may be maintained at a high degree of efficiency, even with materials that have

2

heretofore been very difficult to doctor satisfactorily.

Another object of the invention is to provide a control apparatus which will periodically relieve the knife pressure by a predetermined amount.

Still another object is to provide a control apparatus wherein the original pressure, the degree of relief, and the duration of the periods of application and relief may be varied to provide the most efficient combination for the material being doctored.

A further object is to provide a control apparatus having provision for raising the knife from the surface of the drum.

The accompanying drawing diagrammatically represents a preferred embodiment of the invention utilizing fluid-pressure operated cylinders, controlled by two timers, for varying the pressure on the knife.

Referring to the drawing, 1 is a rotating drum such as is used in drum driers, and is mounted on shaft 1*a* which is journaled in suitable bearings not shown. The doctor blade or knife 2 is carried by shaft 2*a* arranged in parallel relation with shaft 1*a* and journaled at each end in suitable bearings not shown. The blade or knife 2 may be raised from or lowered to the surface of drum 1 by rotation of shaft 2*a*. This is accomplished by means of double-acting air cylinder 5 connected through piston rod 4 to actuating arm 3 which is keyed to the shaft 2*a*.

Compressed air for operating cylinder 5 is supplied through line 6 to three pressure reduction valves 7, 8 and 9. These reduction valves are set to supply air at three different pressures for reasons that will soon be apparent and each value is adjustable to provide any desired pressure within certain limits. For purposes of illustration it will be assumed that valve 7 reduces the air pressure to 50 lbs./sq. in. (low pressure); valve 8 to 60 lbs./sq. in. (intermediate pressure); valve 9 to 80 lbs./sq. in. (high pressure).

Pressure regulating valves 8 and 9 are selectively connected to the front end of cylinder 5 through a two-position valve 10 and a cut-off valve 11 connected in series, and regulating valve 7 is connected to the rear end of cylinder 5 through a solenoid operated valve 12. These solenoid operated valves are of known construction and the diagrammatic showing in the drawing is for the purpose of illustration only. The inlet port 12*a* of valve 12 is connected to regulating valve 7, and the outlet port 12*b* is connected to the rear end of cylinder 5. Reduction valve 8

is connected to inlet port 10b of solenoid valve 10 and reduction valve 9 is connected to inlet port 10a of the same valve. Outlet ports 10c and 10d of solenoid valve 10 are connected to inlet port 11a of solenoid valve 11. Check valves 13a and 13b are inserted in the lines from outlet ports 10c and 10d to prevent any air from flowing from solenoid valve 11 back to solenoid valve 10 or between ports 10c and 10d. Exhaust ports 11c and 12c of solenoid valves 11 and 12, respectively, are connected to an atmospheric exhaust; outlet port 11b of valve 11 is connected to the front end of cylinder 5.

Solenoid valve 10 when de-energized is biased by spring 10e so that ports 10a and 10c are connected by an internal passage to establish a connection from "high" pressure valve 9 to control valve 11. When valve 10 is energized this connection is interrupted and a connection is established between "intermediate" pressure valve 8 to control valve 11 by an internal passage connecting ports 10b and 10d. Solenoid valve 11 when de-enerized is biased by spring 11d so that ports 11b and 11c are connected by an internal passage to provide an exhaust connection for the front end of cylinder 5, and when valve 11 is energized ports 11a and 11b are connected to complete a connection from valve 10 to cylinder 5. Similarly, valve 12 is biased by spring 12d so that ports 12b and 12c are connected to establish an exhaust connection for the rear end of cylinder 5 when the valve is de-energized, and ports 12a and 12b are connected when the valve is energized to establish the connection from the "low" pressure valve 7 to the rear end of cylinder 5. In all cases the "energized" and "de-energized" connections as described above are mutually exclusive, i. e. they cannot exist simultaneously in the same valve at the same time.

Connected to the line between outlet port 11b and the cylinder 5 is a normally-closed pressure switch 14 which is subject to the pressure applied to the front end of cylinder 5; this switch in the present illustration will be set to open at 65 lbs./sq. in. and to close at 60 lbs./sq. in. Air lines 15a and 15b are branch lines that supply a second cylinder similar to cylinder 5 that is mounted at the other end of drum 1.

Electric current for operating the various solenoid valves is supplied from circuit 16 to lines 16a and 16b through main switch 17. The energizing circuit of valve 10 is controlled by two electric timers 18 and 19 connected to lines 16a and 16b and to each other in such a manner that they will operate sequentially, i. e. when timer 19 has timed out the delay period for which it is set it will start timer 18 and when timer 18 has timed out the period for which it is set it will restart timer 19. This alternate operation of timers will continue as long as the timers are supplied with current, and since each timer is minutely adjustable within its range, an infinite number of time-delay combinations is available. These timers are of conventional construction, such as electric timers type 30HLI made by Photoswitch, Inc., and need not be described in detail. It is sufficient to say that timer 18 has a set of contacts which are closed while the timer is in operation, and these contacts supply current to output terminals 18a and 18b to which the solenoid of valve 10 is connected. Thus current will be supplied to valve 10 for intermittent intervals, the duration of these intervals being determined by the setting of timer 18 and the duration of the intervening periods being determined by the setting of timer 19.

The solenoid of valve 11 is connected to lines 16a and 16b through a normally-closed switch 20 and through a manual release switch 21 by which current to solenoid valve 11 may be interrupted without affecting the flow of current to the timers 18 and 19 or to solenoid valve 12. The coil of switch 20 is connected in parallel with the solenoid of valve 10 and is energized during the operation of timer 18.

The solenoid of valve 12 is connected directly across the lines 16a and 16b and will be energized whenever main switch 17 is closed to apply low pressure to the right end of cylinder 5.

When the main switch 17 is open as shown in the drawing the high pressure air is admitted to valve 10 and check valve 13a but is cut off at valve 11; the intermediate pressure air is cut off at valve 10; the low pressure air is cut off at valve 12; and both ends of the cylinder 5 are connected to atmosphere. To place the system in operation main switch 17 and release switch 21 are closed. This will energize valves 11 and 12 and start timer 19. The energization of valves 11 and 12 disconnects the two sides of the cylinder 5 from the atmospheric exhaust and allows high pressure air to flow to the left end and low pressure air to flow to the other; the resultant differential pressure (30 lbs./sq. in.) causes the doctor blade 2 to be pressed against the surface of drum 1. The contacts of pressure witch 14 will be opened at this time since the pressure in the line exceeds 65 lbs./sq. in.

As soon as timer 19 has timed out the delay for which it is set, timer 18 will be started and current supplied through terminals 18a and 18b to valve 10 and the contacts of relay 20. The energization of valve 10 causes the high pressure air to be cut off and allows intermediate pressure air to flow through the valve and check valve 13b to valve 11. Simultaneously with the energization of valve 10 the contacts of relay 20 are opened and since the contacts of switch 14 are also open due to the high pressure in the line, valve 11 is de-energized. When this happens the high pressure side of cylinder 5 is again connected to the atmospheric exhaust, allowing the pressure to drop until it reaches 60 lbs./sq. in. when the contacts of pressure switch 14 will close, shorting out the open contacts of switch 20 and energizing valve 11. At this point a new condition of balance will be attained in which the intermediate pressure air is connected to the cylinder 5 through valves 10 and 11 and the resultant differential pressure acting on the piston of cylinder 5 is reduced to 10 lbs./sq. in. causing a reduction in the force with which the doctor blade 2 is pressed against the surface of the drum 1.

When the timer 18 has timed out the interval for which it is set, the current supply to terminals 18a and 18b will be interrupted and timer 19 will be re-started. Valve 10 will be de-energized and high pressure air will again be admitted to the cylinder 5 through check valve 13a and valve 11. At the same time the contacts of switch 20 will be closed so that when the contacts of switch 14 are opened by the increase in pressure the valve 11 will not be de-energized. Thus the system is returned to its original condition and is ready for repetition of the above described cycle.

As already explained, the frequency of applying and relieving the pressure on the doctor blade will depend upon the nature of the material being

doctored. The usual speed of rotation of a drum drier is from 2 to 8 revolutions per minute, and when using timers which are adjustable from zero to 4 minute intervals, it is possible to adjust the frequency of the control cycle to any value between many times per revolution of the drum to only once every 32 revolutions of the drum.

A satisfactory explanation of why the periodic release of the blade pressure causes improved doctoring has not been developed, but actual experience has demonstrated that when the blades cease to clean the drum surface, relieving the pressure and then reapplying it causes them to bite into the "baked on" material and to cut through it. It seems possible that the blade is somewhat flexed when under normal pressure, and when this pressure is released, the blade straightens out somewhat to increase the angle of attack and this causes it to dig into the hard coating.

The release switch 21 is for the purpose of raising the doctor blade 2 clear of the drum 1 when desired. When the switch 21 is opened the valve 11 will be de-energized and the left or high pressure side of the cylinder 5 will be connected to the atmospheric exhaust; valve 12, however, will not be affected and the low pressure air will continue to be supplied to the other side of cylinder 5, with the result that air under pressure of 50 lbs./sq. in. will be applied to the right end of cylinder 5 and the doctor blade 2 will be raised clear of the drum 1.

It will be apparent to those skilled in the art that other connections than those described in this illustrative example are possible without departing from the spirit of my invention. In the arrangement shown, if the electric power should fail, all valves will be moved to a position to cut off the compressed air and to conduct each end of cylinder 5 to exhaust. While I prefer to use two cylinders, one connected to each end of the doctor blade, only one may be used with operating means to apply equalized pressures to the two ends of the blade.

What I claim is:

1. A pressure control system for a doctor blade associated with a rotary drum comprising a double-acting fluid-pressure actuated cylinder connected to said blade to move the blade towards and away from said drum, a source of fluid under pressure, means energizing said cylinder from said source to press said blade against said drum with a predetermined pressure, and means acting periodically at regular intervals for reducing said pressure to a lower value while maintaining said blade in contact with said drum.

2. A pressure control system according to claim 1 and including manually operable means for energizing said cylinder from said source of fluid to move said blade away from said drum.

3. A pressure control system for a doctor blade associated with a rotary drum comprising a double-acting fluid-pressure actuated cylinder connected to said blade to move the blade towards and away from said drum, a source of fluid at high, intermediate and low pressures, a connection from the low pressure source to one end of said cylinder for moving said blade away from said drum, a connection from the high pressure source to the other end of said cylinder whereby said blade is pressed against said drum by a pressure determined by the difference between the high and low pressures, aid means acting periodically at regular intervals for switching said last named connection from said high pressure source to said intermediate pressure source and back to said high pressure source.

4. A pressure control system according to claim 3 and including manually operable means for cutting off the second named connection whereby said low pressure source moves said blade away from said drum.

5. A pressure control system for the doctor blade of a rotary drum comprising a fluid pressure actuated cylinder connected to said blade to press the blade against said drum, a source of fluid at high pressure and a source at intermediate pressure, means including a two-position valve for connecting one or the other of said sources to said cylinder, and means for periodically operating said valve from one position to the other.

6. A pressure control system according to claim 5 wherein said valve is normally biased to a position connecting the high pressure source to the cylinder and is provided with a magnet for operation to the other position, and including a timing device for energizing said magnet for an adjustable time, and a second timing device controlled by the timing-out of said first timing device and being operable after an adjustable time for initiating another timing cycle of the first timing device.

7. A pressure control system according to claim 6 and including a magnetically actuated cut-off valve included in the connection between said two-position valve and said cylinder and being normally biased to cut-off position, a normally closed pressure-actuated switch connected between said cut-off valve and said cylinder and being operable to open position at a pressure between said high and intermediate valves, an energizing circuit for said cut-off valve completed through said pressure switch, and a control relay energized in parallel with the magnet of said two-position valve and having normally closed contacts connected across the contacts of said pressure switch.

8. A pressure control system for a doctor blade on a rotary drum comprising means for pressing said blade against said drum at a predetermined pressure and means acting periodically at regular intervals for reducing said pressure by a predetermined amount while maintaining the blade in contact with said drum.

9. The method of doctoring materials from a drum provided with a doctor blade which consist in pressing the blade against the drum with a predetermined pressure and periodically and at regular intervals relieving the pressure by a predetermined amount while maintaining the blade in contact with said drum.

GUSTIE STEVENSON.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,704,853	Berry	Mar. 12, 1929
2,330,889	Holcomb	Oct. 5, 1943
2,474,052	Johnson	June 21, 1949