Jan. 16, 1968 M. R. ESTABROOK 3,363,366

ABRADING MACHINE

Filed June 30, 1965 2 Sheets-Sheet 1

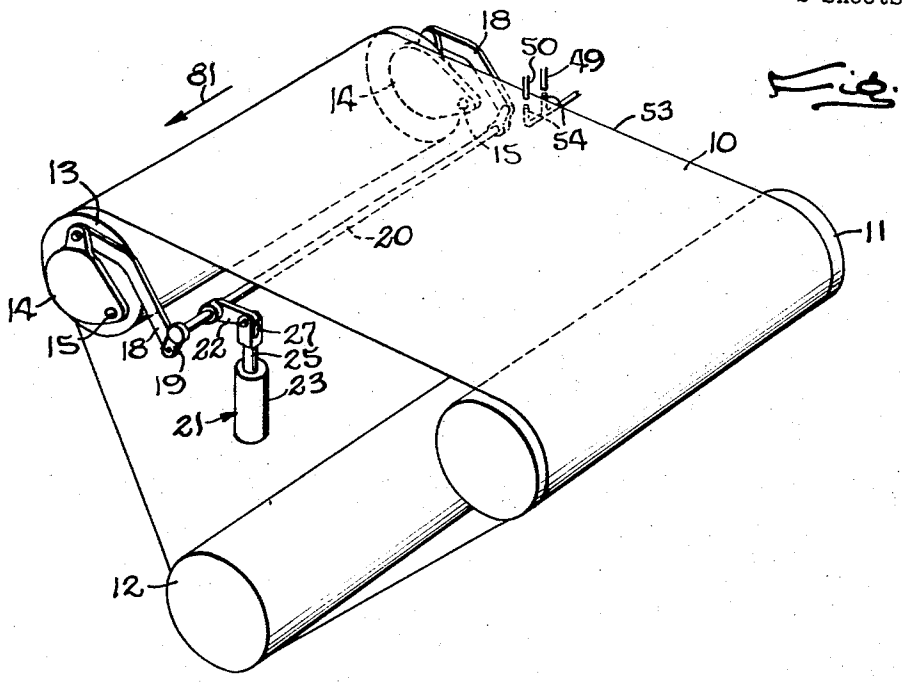


Fig. 1

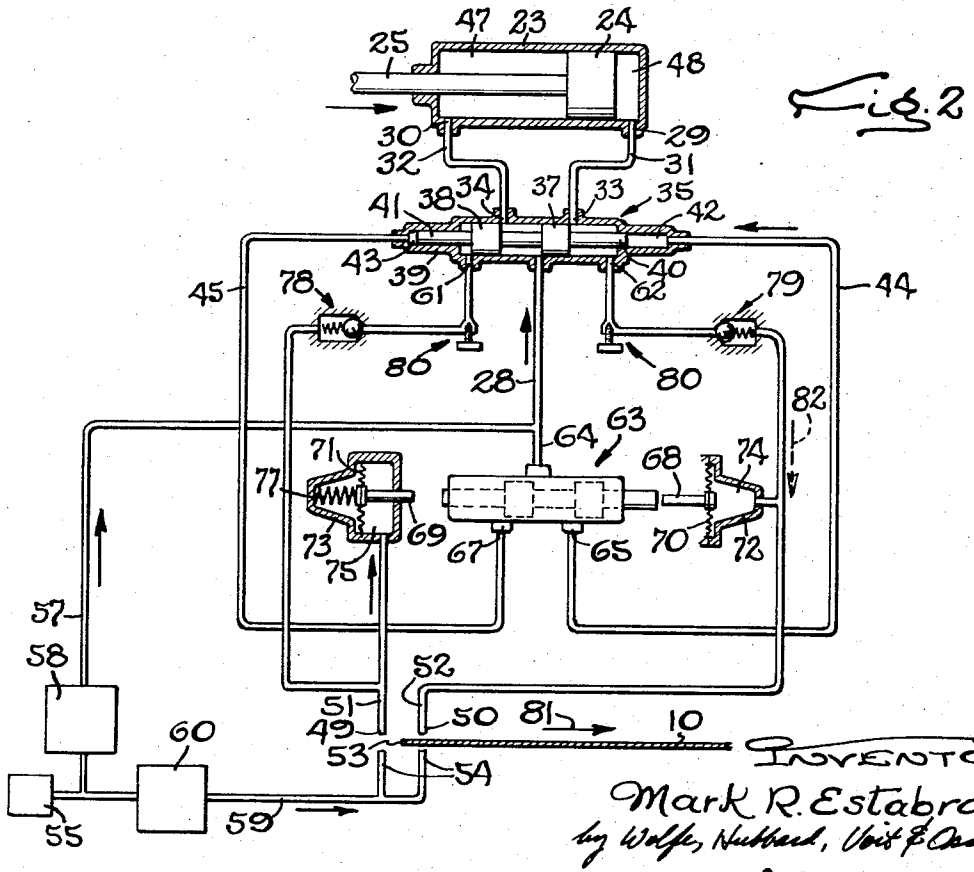


Fig. 2

INVENTOR
Mark R. Estabrook
by Wolfe, Hubbard, Voit & Osann
ATTORNEY

Jan. 16, 1968 M. R. ESTABROOK 3,363,366

ABRADING MACHINE

Filed June 30, 1965 2 Sheets-Sheet 2

Fig. 3

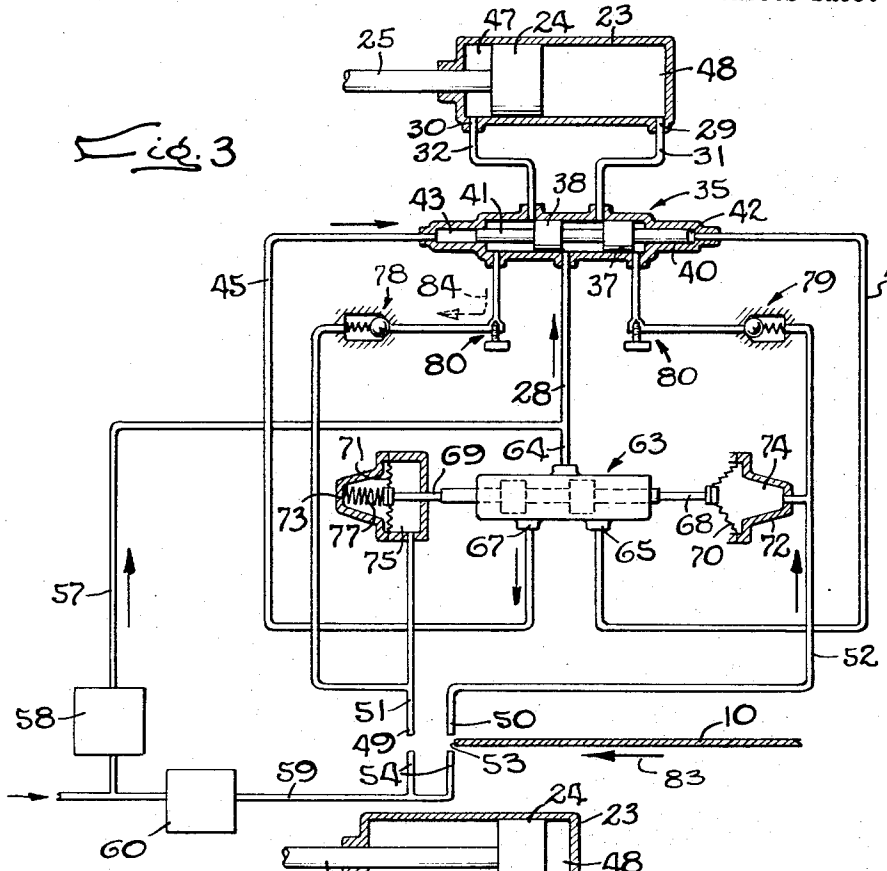
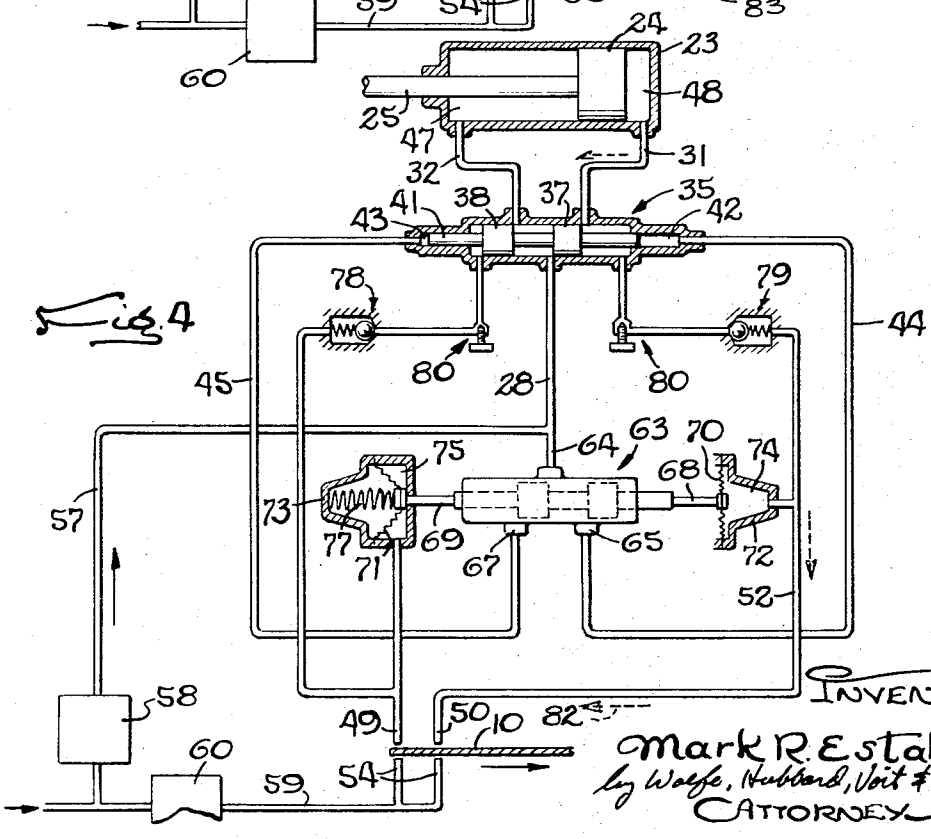


Fig. 4



INVENTOR
Mark R. Estabrook
by Wolfe, Hubbard, Voit & Osann
ATTORNEY

United States Patent Office 3,363,366
Patented Jan. 16, 1968

3,363,366

ABRADING MACHINE

Mark R. Estabrook, Rockford, Ill., assignor to Barnes Drill Co., Rockford, Ill., a corporation of Illinois

Filed June 30, 1965, Ser. No. 468,370
17 Claims. (Cl. 51—135)

This invention relates to a belt-type abrading or grinding machine in which an endless abrasive belt is trained around a plurality of rotary rolls which drive and guide the belt along a continuous path into contact with a work surface to be abraded, one of the rolls being rocked or tilted between two oppositely inclined positions to induce controlled back and forth edgewise travel of the belt longitudinally of the rolls. This edgewise motion controls the drift of the belt to maintain the belt generally centered on the rolls while eliminating repetitive and overlying abrasive cuts for an improved surface finish.

More particularly, the invention pertains to a system or apparatus for sensing the edgewise travel of the abrasive belt in each direction and controlling the back and forth tilting of the so-called steering roll which is operated by an air cylinder actuated in response to pressure signals produced by a device for sensing edgewise travel of the belt. Such a machine and sensing apparatus are disclosed in Patent No. 3,132,451 in which two receivers are spaced apart laterally of the belt adjacent one edge of the latter opposite two nozzles directing air jets toward the receivers. The pressure signals produced by covering and uncovering of the receivers upon movement of the belt toward each of the limits of the selected range of movement are used to initiate reversal of the tilt of the steering roll before the belt moves beyond such limits.

The general object of the present invention is to clean the receivers of the sensing apparatus during the abrading operation much more frequently and effectively than has been practical heretofore by reverse flows of air through the receivers produced automatically and repeatedly as an incident to normal operation of the machine thereby keeping the receivers free of dust and grit throughout the abrading process.

Another object is to use the exhaust air from the steering cylinder to flush out each receiver during each cycle of the cylinder.

A further object is to sense and control the belt movement and clean the receivers entirely pneumatically thereby eliminating all electrical components from the system.

Another object is to take advantage of the inherent correlation of the exhausting of the steering cylinder with the covering and uncovering of the receivers to clean each receiver when it is inactive.

A further object is to avoid actuation of the steering cylinder in response to the false pressure signals produced by the exhaust air used to clean the receivers.

Still another object is to prevent high pressure exhaust impulses in the pressure system and, at the same time, adjustably control the rate of tilting of the cylinder.

The invention also resides in the novel apparatus operated by the pressure signals and controlling the actuation of the steering cylinder.

Other objects and advantages of the invention will become apparent from the following detailed description taken in connection with the accompanying drawings, in which

FIGURE 1 is a schematic perspective view showing the relationship of the belt, the supporting rolls, the sensing apparatus and the steering cylinder in an abrading machine of one type in which the present invention may be used.

FIG. 2 is a diagrammatic view of the pneumatic control system for the machine with parts broken away and

shown in section for clarity of illustration, the condition illustrated corresponding to that in FIG. 1.

FIGS. 3 and 4 are views similar to FIG. 2 showing the system in different phases of the operation.

As shown in the drawings for purposes of illustration, the invention is incorporated in a belt sander in which an endless abrasive belt 10 is supported and guided around three generally parallel rotary rolls 11, 12 and 13 arranged to guide the belt along a generally triangular path with one area of the belt contacting the surface of a work piece (not shown) to be abraded. The work piece normally is supported on a suitable conveyor and advanced thereby beneath the belt. One of the rolls in such machines, herein the roll 11, is power rotated to drive the belt at high speed. To induce controlled edgewise travel of the belt relative to the supporting rolls and also relative to the work surface being finished, the roll 13 is rocked back and forth during the abrading operation between two oppositely inclined positions.

While the roll may be mounted in various ways for such rocking, herein it is mounted on a coaxial shaft (not shown) which projects beyond the opposite ends of the roll and is journaled in bearing mounts 14 each pivoted on one side at 15 on the machine frame to swing about inwardly spaced axes parallel to the roll axis 17. The bearing mounts, in turn, are pivotally connected to arms 18 extending inwardly from the mounts and eccentrically connected at 19 to the opposite ends of a shaft 20 generally parallel to the roll and journaled on the machine frame for rotation about its longitudinal axis. In this instance, the eccentric connections 19 are shown as radial crank arms on the ends of the shaft 20 angularly spaced approximately 180 degrees apart. A similar mounting is shown in more detail in the aforesaid patent.

The shaft 20 is oscillated about its longitudinal axis by an actuator 21 connected to a crank arm 22 fast on the shaft and operable to oscillate the shaft about its axis. The actuator comprises a cylinder 23 with a piston 24 fitted therein and connected to the crank arm by a piston rod 25 and a pivoted connection 27 between the rod and the crank. Thus, reciprocation of the piston within the cylinder oscillates the crank 22 and the shaft 20 about the longitudinal axis of the shaft to oscillate the eccentrics 19 and alternately tilt the steering roll a few degrees in opposite directions to steer the belt 10 edgewise back and forth along the roll.

Reciprocation of the piston 24 is produced by air under pressure admitted alternately into the opposite ends of the cylinder 23 from a supply line 28 through two inlet ports 29 and 30 communicating through lines 31 and 32 with the outlet ports 33 and 34 of a pressure operated four-way control valve 35. The latter is of a well known type comprising a spool having two spaced heads 37 and 38 fitted in a hollow generally cylindrical body 39 with the opposite end portions 40 and 41 of the spool stem projecting beyond the heads into pressure chambers 42 and 43 formed by bores in the ends of the body. Thus, the end portions of the stem constitute power pistons for operating the control valve by sliding the spool back and forth within the valve body.

Pilot pressure fluid is admitted alternately into the pressure chambers 42 and 43 through lines 44 and 45 opening into the chambers through the ends of the body. When fluid is admitted into the right-hand chamber 42, the spool is shifted to the left to the position shown in FIG. 2 in which the supply line 28 communicates with line 32 and the inlet port 30 into the rod end 47 of the steering cylinder 23 to shift the piston 24 to the right. When pressure fluid is admitted into the left-hand chamber 43, the spool moves to the right (see FIG. 3) to admit air from the supply line into the head end 48 of the steering cylinder through the

line 31 and the port 33 thereby returning the piston to the left.

As in the patented machine, the control valve 35 is operated by pressure signals produced by a sensing device including two receivers 49 and 50 formed by the open ends of pipes or tubes 51, 52 spaced apart laterally of the belt 10 on one side of the plane of the belt adjacent one edge 53 of the latter to be alternately covered and uncovered by the belt as it moves laterally back and forth. On the opposite side of the plane of the belt and alined with the respective receivers are two nozzles 54 for directing jets of air into the receivers when the latter are uncovered. Thus, the changes in pressure within the receiver pipes produced by such covering and uncovering constitute pressure signals indicating when the belt is approaching the opposite limits of the selected range of movement, and these pressure signals are used to operate the control valve and reverse the tilt of the steering roll 13 before the belt moves beyond such limits.

The pressurized air for operating both the control valve 35 and the steering cylinder 21 is supplied by a suitable high-pressure source 55 (FIG. 2) communicating with the supply line 28 through a line 57 and a pressure reducer 58 which maintains the pressure to the supply line at a selected value such as 35 p.s.i. The source communicates with both jets 54 through a line 59 and a second pressure reducer 60 which delivers air to the jets at a relatively low pressure such as 10 p.s.i.

Since the receivers 49 and 50 are positioned near the belt 10 and in close proximity to the abrading operation, dust and grit thrown off by the belt are carried into the receivers by the air jets and tend to collect in the receiver pipes 51 and 52. If allowed to build up on the walls of the pipes, this dust can interfere with the detection and control of the belt position, the receivers customarily being openings on the order of .060 of an inch in diameter. While attempts have been made to deal with this problem by occasional flushing of the receiver pipes, for example, with exhaust air from the tensioning cylinder shown in the aforesaid patent whenever the tension is released and reapplied to the belt, this relatively infrequent cleaning has not been completely satisfactory.

In accordance with the present invention, the air exhausted from the steering cylinder 23 each time the tilt of the steering roll 13 is reversed is utilized in a novel manner to flush out the receiver pipes 51 and 52 repeatedly during the abrading operation thereby maintaining the pipes clean throughout the operation. Moreover, each receiver is deactivated after it signals the need for reversal of the tilt of the steering roll and is flushed out while inactive in a manner that takes advantage of the inherent correlation of the exhausting of the cylinder and the covering and uncovering of the receivers.

To these ends, the control valve 35 is formed with two exhaust ports 61 and 62 alternatively receiving exhaust air through the valve and communicating with the receiver pipes 51 and 52, respectively, to carry the exhaust air reversely through the pipes and out through the receivers 49 and 50. The pressure signal produced in one receiver pipe by the movement of the belt is applied to a pilot valve 63 which actuates the control valve in response to each such signal and then is disabled until a signal is received in the other pipe, thereby deactivating the first receiver during the flushing of its pipe to prevent actuation of the control valve in response to the false pressure signals produced by the exhaust air.

In this instance, the pilot valve 63 is a spool valve having an inlet 64 communicating with the supply line 28 and two outlets 65 and 67 communicating with the chambers 42 and 43 of the control valve 35 through the lines 44 and 45. In one position of the pilot valve spool (FIG. 2), high-pressure air flows through the valve to the outlet 65 and the line 44 to the right chamber 42 and in the other position of the pilot spool (FIG. 3), air flows through the outlet 67 and line 45 to the left chamber 43.

The stem of the pilot spool extends beyond both heads of the spool for engagement with pressure-actuated operators 68 and 69 herein shown as plungers supported adjacent opposite ends of the valve in alinement with openings in the valve body for engagement with the spool. As shown in FIGS. 2–4, each plunger is a rod supported on a diaphragm 70, 71 cooperating with a cup-like housing 72, 73 to define a chamber 74, 75 communicating with one of the receiver pipes 52, 51. The chamber 74 is on the side of the diaphragm 70 remote from the pilot valve 63 so that increases in the pressure in the pipe 52 are transmitted to the chamber to stretch the diaphragm to the left and move the plunger 68 toward the valve. The other chamber 75 is between the valve and the diaphragm 71 so that pressure increases in the pipe 51 and in the chamber shift the plunger 69 to the left against the action of a coiled spring 77 compressed between the diaphragm and the bottom of the cup 73 to urge the plunger to the right. One-way valves 78 and 79 in the form of spring-loaded check valves in the receiver pipes between the chambers 74, 75 and the control valve stop fluid flow toward the control valve and thereby insure that the pressure signals in the receiver pipes act to pressurize the respective diaphragm chambers. A selectively adjustable flow restrictor 80 in each receiver pipe controls the rate of flow of exhaust air into the pipes thereby controlling the rate of movement of the piston 24 and also preventing the application of high exhaust pressure impulses against the diaphragm 70.

Operation

When the machine is in operation and the parts are positioned as shown in FIG. 2 with the piston 24 adjacent the head end 48 of the steering cylinder 23 and the steering roll 13 tilted in a direction to steer the belt 10 in the direction of the arrow 81 in FIG. 2, let it be assumed that the pilot spool has been moved to the right as shown in FIG. 2 and the edge 53 of the belt is midway between the two receivers 49 and 50 and moving to the right toward the receiver 50. Thus, the receiver 50 is covered by the belt and the air jet from one nozzle 54 is flowing into the receiver 49 to raise the pressure in the pipe 51 and the chamber 75 sufficiently to retract the plunger 69 away from the pilot spool against the action of the spring 77. The plunger 68 also is retracted by the action of the diaphragm 70 since the pressures on opposite sides of this diaphragm are substantially equal.

In this condition of the system, high pressure air flows from the pressure reducer 58 through the line 57 to the pilot valve and through the latter to the line 44 communicating with the right pressure chamber 42 of the control valve 35 to shift the spool thereof to the left as shown in FIG. 2 and admit high-pressure air from the supply line 28 into the inlet line 32 and the rod end 47 of the steering cylinder 23. As the piston moves to the right, the air from the head end 48 is exhausted through the line 31 and the control valve into the receiver pipe 52 and then through the flow restrictor 80 and the check valve 79 to flow reversely through the receiver pipe and out through the receiver 50 to flush the latter while it is inactive, the flow of exhaust air being indicated by the arrows 82 in FIG. 2. The flow restrictor limits the rate of flow of air into the receiver pipe not only to control the rate of movement of the piston 24 but also to prevent a high-pressure surge into the chamber 74 during the flushing of the pipe 44. It will be seen that such a surge would extend the diaphragm 70 and plunger 68 and reverse the flow of air to the control valve pressure chambers 42 and 43.

After the piston 24 reaches the end of its stroke, the belt 10 continues to move to the right (FIG. 2) until the belt edge 53 passes the receiver 50 and uncovers the latter to admit the jet from the alined nozzle 54 into the receiver. When this occurs, the jet raises the pressure in the pipe 52 and in the diaphragm chamber 74 to extend the plunger 68 to the left and push the pilot spool to the left

to the position shown in FIG. 3 in which the supply line 28 communicates through the pilot valve 63 with the line 45 leading to the left control valve chamber 43. The other chamber 42 is vented through the line 44 and the pilot valve and its vent port (not shown). Accordingly, the control valve spool moves to the right to establish communication between the supply line 28 and the head end 48 of the steering cylinder to begin moving the piston 24 back to the left to reverse the tilt of the steering roll 13. Now the belt begins to move back to the left as indicated by the arrow 83 in FIG. 3.

As soon as the piston 24 begins its leftward stroke, air is exhausted from the rod end 47 through the line 32 and the control valve ports 34 and 61 to the receiver pipe 51, as indicated by the arrow 84 in FIG. 3, to flow through the flow restrictor 80 and the check valve 78 toward the receiver 49 to flush out the latter. It is readily apparent that the flow restrictor 80 in the receiver pipe 51 may be adjusted to allow the exhaust air to flow reversely through the pipe with sufficient pressure to overcome the jet directed from the left nozzle 54 and thereby clean the receiver 49 with the reverse flow. As the belt moves to the left from the position in FIG. 3, it first covers the receiver 50, thereby reducing the pressure in the chamber 74 so that the plunger 68 is retracted idly, leaving the pilot spool in the position in FIG. 3. Continuing to the left, the belt edge 53 gradually crosses the space between the receivers and then passes the receiver 49 to cover the latter and deflect the jet from its nozzle 54 away from the receiver. The resulting pressure drop in the chamber 75 permits the spring 77 to extend the plunger 69 to the right and shift the pilot spool to the right into the position shown in FIG. 4. In this condition of the system, high-pressure air again is admitted through the pilot valve 63 and the line 44 to the right-hand chamber 42 of the control valve 35 to move the spool thereof to the left and admit air from the supply line 28 into the rod end 47 of the steering cylinder 23 to reverse the tilt of the steering roll 13 while flushing the receiver 50 and its pipe 52 with the exhaust from the steering cylinder as indicated at 82.

It will be seen that the back and forth movement of the abrading belt 10 will continue under the control of the foregoing system which not only reverses the tilt of the steering roll 13 to maintain the belt within the limits of a selected range of travel but also uses the exhaust air from the steering cylinder 23 to flush out the receivers 49 and 50 and their pipes 51 and 52 repeatedly and automatically as an incident to actuation of the steering cylinder throughout the abrading operation. As a result, the dust and grit accompanying the operation are effectively removed and prevented from accumulating in the system. Moreover, the system may be controlled completely pneumatically without any electrical components.

I claim as my invention:

1. In an abrading machine, the combination of, an endless abrading belt; means supporting said belt for movement along a continuous path, said supporting means including a tiltable steering roll for inducing inward and outward edgewise travel of said belt upon back and forth tilting of said roll between two oppositely inclined positions; a reciprocating pneumatic actuator for tilting said roll between said positions; a device for sensing edgewise travel of said belt to the two extremes of a preselected range of lateral travel comprising inner and outer receivers spaced apart laterally of said belt alongside the plane thereof and opening toward said plane, inner and outer nozzles respectively alined with said receivers to direct jets of air across said plane into the receivers, said receivers being supported adjacent one edge of said belt for back and forth movement of said edge between an outer position in which both receivers are covered and an inner position in which both receivers are uncovered, first means operable in response to the pressure rise in said inner receiver produced by uncovering thereof by said belt during inward movement of the belt to operate said actuator to tilt said roll in a direction to induce outward travel of said belt, second means operable in response to the pressure drop in said outer receiver produced by covering thereof by said belt to operate said actuator and tilt said roll in a direction to induce inward travel of said belt, and means receiving exhaust air from said actuator in both directions of operation thereof and directing said exhaust air out through said inner receiver when the latter is covered and out through said outer receiver when the latter is uncovered thereby to clean each receiver once during each cycle of said actuator while the receiver is inactive.

2. The combination defined in claim 1 including a control valve for directing air under pressure alternately to opposite ends of said actuator, and a pilot valve for operating said control valve, said first and second pressure responsive means comprising first and second operators for said pilot valve actuated by the pressure changes in said receivers.

3. The combination defined in claim 2 in which said first operator includes a plunger for shifting said pilot valve into one condition in response to pressure rises in said inner receiver.

4. The combination defined in claim 3 in which said second operator includes a plunger for shifting said pilot valve into its other condition in response to pressure drops in said outer receiver.

5. The combination defined in claim 3 further including selectively adjustable means for restricting the rate of flow of exhaust air through said inner receiver to prevent the application of high pressure exhaust impulses to said first operator.

6. The combination defined in claim 2 in which said control valve is formed with said means for receiving exhaust air and directing the same into the respective receivers.

7. In an abrading machine, the combination of, an endless abrading belt, means supporting said belt for movement along a continuous path, said supporting means including a tiltable steering roll for inducing back and forth edgewise travel of said belt upon back and forth tilting of said roll between two oppositely inclined positions, a pneumatic actuator including a cylinder and a piston reciprocable therein, said actuator being connected to said steering roll to tilt the latter between said positions in response to the admission of pressure fluid into the opposite ends of said cylinder, a device for sensing edgewise movement of said belt including two laterally spaced receiver pipes disposed alongside and opening toward the plane of said belt and positioned adjacent one edge thereof to be alternately covered and uncovered by the belt during said back and forth edgewise movement, means for producing pressure signals in said receiver pipes as a result of such covering and uncovering, a control valve for alternately directing pressure fluid to the opposite ends of said cylinder to shift said steering roll back and forth between said positions, a pilot valve for operating said control valve, and pressure actuated operators for said pilot valve each having an actuating chamber communicating with one of said receiver pipes, said control valve having means thereon for receiving the exhaust fluid from said cylinder in each direction of operation of said actuator and alternating said exhaust fluid between said receiver pipes to clean the latter once during each cycle of said actuator.

8. In an abrading machine, the combination of, an endless abrading belt, means supporting said belt for movement along a continuous path, said supporting means including a tiltable steering roll for inducing back and forth edgewise travel of said belt upon back and forth tilting of said roll between two oppositely inclined positions, a pneumatic actuator including a cylinder and a piston reciprocable therein, said actuator being connected to said steering roll to tilt the latter between said posi-

tions in response to the admission of pressure fluid into the opposite ends of said cylinder, a device for sensing edgewise movement of said belt including two laterally spaced receiver pipes disposed alongside and opening toward the plane of said belt and positioned adjacent one edge thereof to be alternately covered and uncovered by the belt during said back and forth edgewise movement, means for producing pressure signals in said receiver pipes as a result of such covering and uncovering, a control valve for alternately directing pressure fluid to the opposite ends of said cylinder to shift said steering roll back and forth between said positions, a pilot valve for operating said control valve, and selectively adjustable flow restrictors in said receiver pipes for restricting the rate of flow of exhaust air from said cylinders.

9. In an abrading machine, the combination of, an endless abrading belt, means supporting said belt for movement along a continuous path, said supporting means including a tiltable steering roll for inducing back and forth edgewise travel of said belt upon back and forth tilting of said roll between two oppositely inclined positions, a pneumatic actuator including a cylinder and a piston reciprocable therein, said actuator being connected to said steering roll to tilt the latter between said positions in response to the admission of pressure fluid into the opposite ends of said cylinder, a device for sensing edgewise movement of said belt including two laterally spaced receiver pipes disposed alongside and opening toward the plane of said belt and positioned to be alternately covered and uncovered by the belt during said back and forth edgewise movement, means for producing pressure signals in said receiver pipes as a result of such covering and uncovering, means responsive to said pressure signals and operating said actuator to maintain said belt within a preselected range of edgewise movement determined by the spacing of said receiver pipes, and means for alternating the exhaust fluid from said cylinder between said receiver pipes and directing the exhaust fluid reversely through the receiver pipes to clean the latter repeatedly during the abrading operation.

10. In an abrading machine, the combination of, an endless abrading belt, means mounting said belt for movement along a continuous path and including a tiltable steering roller for inducing back and forth edgewise travel of the belt between two laterally spaced positions upon back and forth tilting of the roller, a double-acting cylinder for tilting said roller back and forth in response to the introduction of pressure fluid alternately into the opposite ends of said cylinder, a nozzle positioned on one side of said belt to direct a jet of fluid under pressure toward one edge portion of the belt when the latter is in one of said positions, a receiver positioned on the other side of said belt to receive said jet when the belt is spaced laterally from said one position whereby said belt covers said receiver when in said one position and uncovers the receiver in moving toward the other position, means for detecting the pressure changes resulting from the covering and uncovering of said receiver and for operating said cylinder to reverse the direction of movement of said belt in response to said pressure changes, and means for carrying exhaust fluid from said cylinder reversely through said receiver thereby to clean the receiver once during each cycle of said actuator.

11. In an abrading machine, the combination of, an endless abrading belt, means supporting said belt for movement along a continuous path, said supporting means including a tiltable steering roll for inducing back and forth edgewise travel of the belt upon back and forth tilting of said steering roll in opposite directions, a pneumatic actuator comprising a cylinder and a piston reciprocable therein, said piston being connected to said steering roll to tilt the latter alternately in opposite directions upon back and forth motion of said piston, a device for sensing edgewise motion of said belt including first and second receivers disposed alongside and opening toward the plane of said belt and first and second nozzles alined with the respective receivers to direct jets of air across said plane and into said receiver, said receivers and the alined nozzles being spaced apart laterally of the belt and supported adjacent one edge of the latter for back and forth movement of said edge between them with said first receiver spaced inwardly from said second receiver and normally covered by said belt, means operable in response to pressure increases in said first receiver as a result of uncovering thereof to operate said actuator in one direction and induce travel of said belt edge toward said second receiver, means operable in response to pressure drops in said second receiver as a result of covering thereof to operate said actuator in the other direction and induce travel of said edge back toward said first receiver, and means receiving exhaust air from said actuator in both directions of operation thereof and directing said exhaust air out through said first receiver while the latter is covered and through said second receiver while the latter is uncovered thereby to clean each of said receivers once during each cycle of said actuator while the receivers are inactive.

12. The combination defined in claim **11** in which said pressure responsive means include a pilot valve and two pressure-actuated operators therefor communicating with the respective receivers to operate said pilot valve in response to pressure changes in said receivers.

13. The combination defined in claim **12** further including a pilot-operated control valve receiving pilot pressure from said pilot valve and operated thereby to supply pressurized air alternately to opposite ends of said cylinder.

14. In an abrading machine, the combination of, an endless abrading belt, means supporting said belt for movement along a continuous path, said supporting means including a tiltable steering roll for inducing back and forth edgewise travel of said belt in response to tilting of said steering roll between two oppositely inclined positions, a pneumatic actuator including a cylinder and a piston reciprocable therein, said actuator being connected to said steering roll to tilt the latter back and forth in response to the admission of pressure fluid into opposite ends of said cylinder, a device for sensing the edgewise motion of said belt including a receiver disposed on one side of and opening toward the plane of one portion of said belt and a nozzle positioned on the other side of said plane to direct a jet of air across the plane into said receiver, said receiver and said nozzle being supported adjacent one edge of said belt for back and forth movement of said edge between them whereby said belt alternately covers and uncovers said receiver during such movement, control means responsive to pressure changes in said receiver and operating said actuator to steer said belt edgewise back and forth, and means receiving exhaust air from said cylinder in one direction of operation of said actuator and directing said exhaust air reversely through said receiver to clean the latter each time and said actuator operates in said one direction.

15. In an abrading machine, the combination of, an endless abrading belt, means supporting said belt for movement along a continuous path, mechanism for inducing back and forth edgewise motion of said belt relative to said supporting means including a reciprocating pneumatic actuator operable when actuated to reverse the direction of edgewise travel of said belt, a device for sensing the edgewise motion of said belt including first and second receivers disposed alongside and opening toward the plane of said belt and positioned adjacent one edge thereof with said first receiver spaced inwardly from said second receiver and normally covered by said belt, means for creating pressure changes in said first receiver as a result of uncovering thereof by said belt and in said second receiver as a result of covering thereof by said belt, control means responsive to said pressure changes and operating said actuator to steer said belt edgewise back and forth, and means receiving exhaust air from said actuator and di-

recting the air reversely through said first receiver when the latter is covered and through said second receiver when the latter is uncovered thereby to clean the receivers once during each cycle of said actuator and while the receivers are inactive.

16. In an abrading machine, the combination of, an endless abrading belt, means supporting said belt for movement along a continuous path, mechanism for inducing back and forth edgewise motion of said belt relative to said supporting means including a reciprocating pneumatic actuator operable when actuated to reverse the direction of edgewise travel of said belt, a device for sensing the edgewise motion of said belt including a receiver disposed on one side of and opening toward the plane of one portion of said belt and positioned adjacent one edge thereof to be covered and uncovered by the belt as said edge moves back and forth, means for creating pressure changes in said receiver as a result of covering and uncovering thereof, control means responsive to said pressure changes and operating said actuator to steer said belt edgewise back and forth, and means receiving exhaust air from said actuator and directing the air reversely through said receiver to clean the latter each time said actuator operates in one direction.

17. In an abarding machine, the combination of, an endless abrading belt, means supporting said belt for movement along a continuous path, said supporting means including a tiltable steering roll for inducing back and forth edgewise travel of the belt upon back and forth tilting of said steering roll in opposite directions, a pneumatic actuator comprising a cylinder and a piston reciprocable therein, said piston being connected to said steering roll to tilt the latter alternately in opposite directions upon back and forth motion of said piston, a device for sensing edgewise motion of said belt including first and second receivers disposed alongside and opening toward the plane of said belt and first and second nozzles alined with the respective receivers to direct jets of air across said plane and into said receivers, said receivers and the alined nozzles being spaced apart laterally of the belt and positioned for back and forth movement of said belt between them whereby said belt alternately covers and uncovers each receiver during such movement, control means responsive to pressure changes in said receivers and operating said actuator to steer said belt edgewise back and forth, and means receiving exhaust air from said actuator in both directions of operation thereof and alternating said exhaust air between said receivers to clean each of the latter once during each cycle of said actuator.

References Cited

UNITED STATES PATENTS

2,597,256	5/1952	Murray	51—148
2,735,630	2/1956	Ziebolz	242—57.1
2,860,840	11/1958	Jacobsen	242—57.1
3,039,483	6/1962	Deering	137—83
3,132,451	5/1964	Kile	51—138
3,159,170	12/1964	Callan	242—57.1 X

ROBERT C. RIORDON, *Primary Examiner.*

DONALD G. KELLY, *Assistant Examiner.*