April 22, 1941. M. L. WOODRUFF ET AL 2,239,409

BRUSH SUPPORTING AND VIBRATING MECHANISM FOR WEB-COATING MACHINES

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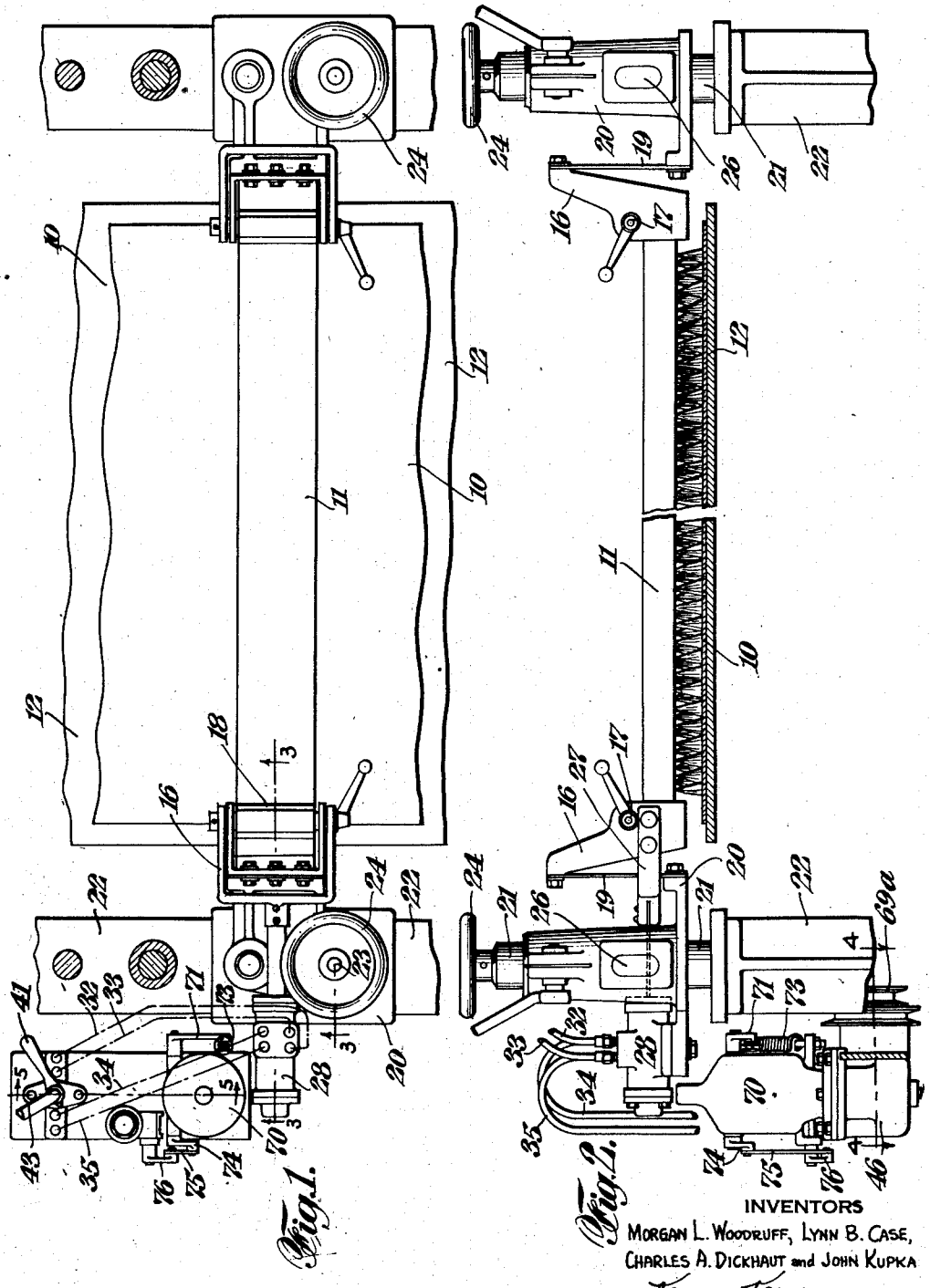


Fig. 1.

Fig. 2.

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Fig. 3.

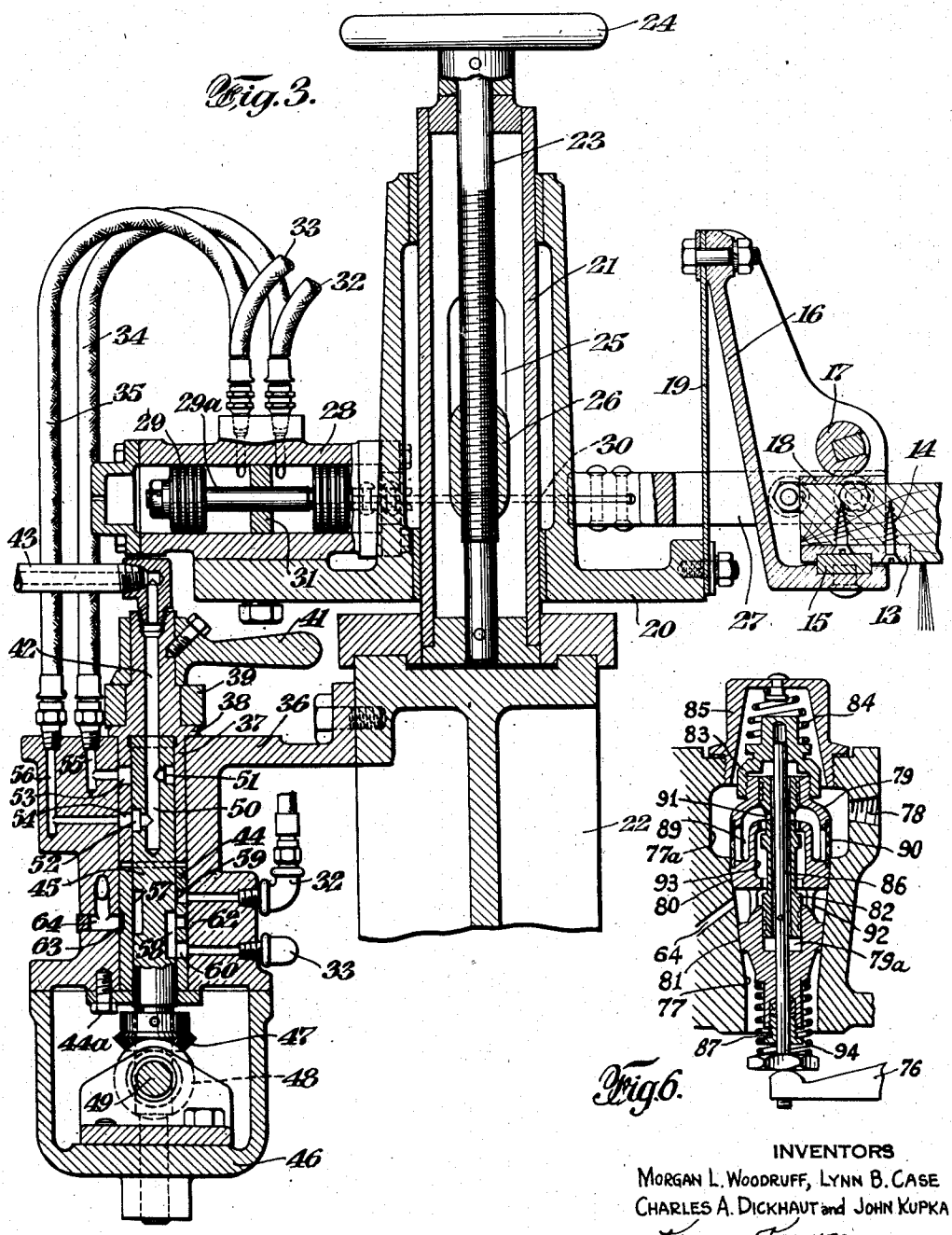


Fig. 6.

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Fig. 4.

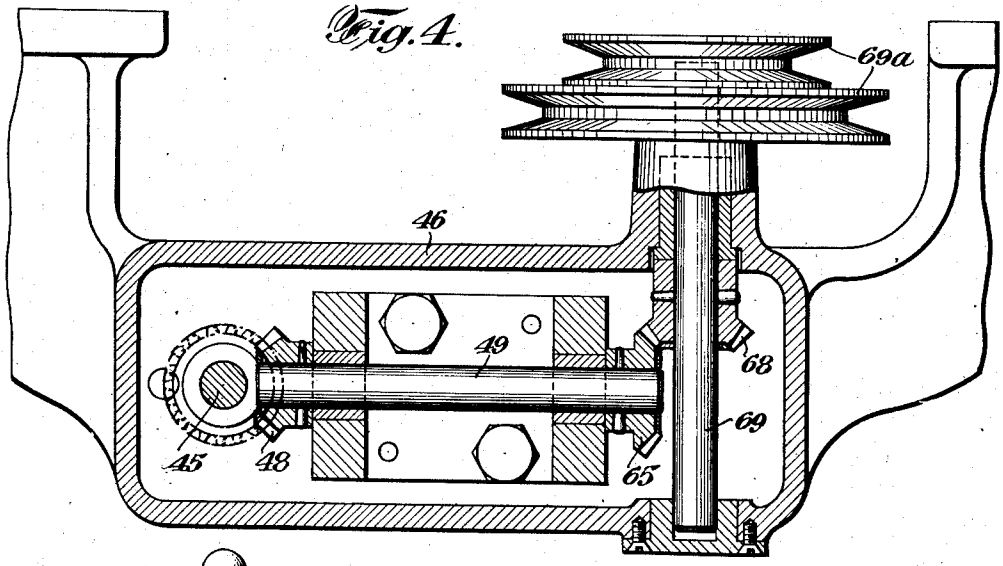
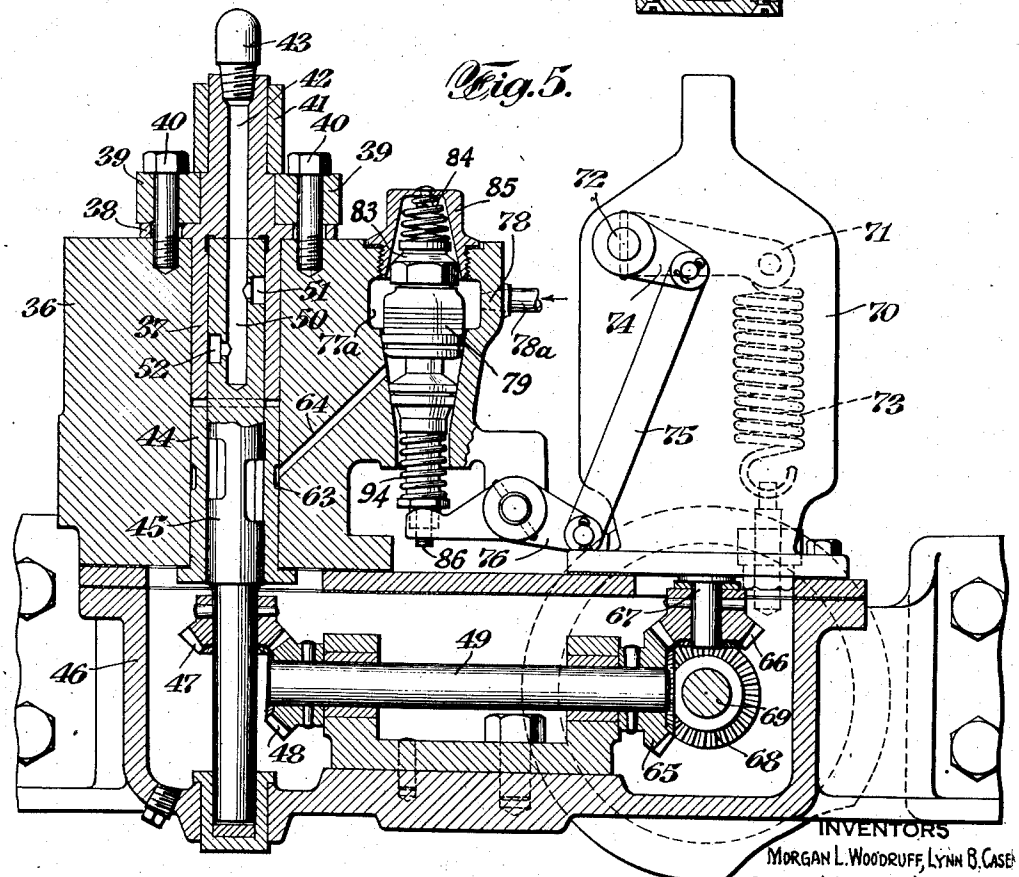


Fig. 5.



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BRUSH SUPPORTING AND VIBRATING MECHANISM FOR WEB-COATING MACHINES

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18 Claims. (Cl. 91—37)

This invention relates to brush-supporting and vibrating mechanism for web-coating machines.

It has heretofore been suggested to use one or more brushes vibrating transversely of a coated web for the purpose of finishing the coating operation. In a high speed coating machine, the brush must vibrate at a very high frequency in order satisfactorily to finish the coating operation. The vibrating brush acquires considerable momentum and provision must be made to prevent the creation of shocks at the end of the strokes by reason of such momentum as otherwise vibrational effects will be set up in the machine as well as in the vibrating parts.

An object of this invention is the provision of brush-supporting and vibrating means capable of high speed vibration without setting up objectionable vibrations in the coating machine and which is effective and economical in operation as well as being of simple construction and light weight.

In one embodiment of the invention, the brush is supported at each end by a resilient strip and vibration is effected of the brush by means of a duplex piston arranged in a cylinder open at both ends to atmosphere and divided by an apertured partition into two chambers, each of which contains a piston head connected by a rod passing through the aperture in the cylinder partition. The piston is attached to the brush and means operated in synchronism with the web are provided for supplying motivating fluid under pressure alternately to the two chambers between the partition and the piston heads and alternately venting said chambers. Means also are supplied for controlling the pressure of the motivating fluid responsive to the frequency of piston vibration so that the pressure is increased with increase of brush vibration frequency and vice versa.

Other objects, novel features and advantages of this invention will become apparent from the following specification and accompanying drawings, wherein:

Fig. 1 is a fragmentary plan view of a machine embodying the invention;

Fig. 2 is a front elevation of Fig. 1;

Fig. 3 is an enlarged section on the line 3—3 of Fig. 1;

Fig. 4 is a section on the line 4—4 of Fig. 2;

Fig. 5 is an enlarged section on the line 5—5 of Fig. 1, and

Fig. 6 is an enlarged section of the pressure controlling valve illustrated in Fig. 5 in elevation.

As shown in Figs. 1, 2 and 3, a web 10 of freshly coated material is fed beneath a vibrating brush 11 over suitable supporting means 12. Each end of the brush bar is provided with a metal insert 13 attached to the bar by screws 14 and having a transverse groove. Within the groove is seated a plate 15 carried by a bracket 16. In each bracket is provided a rotatable eccentric 17 adapted to engage a plate 18 interposed between the eccentric and the top of the brush bar. The eccentric serves to hold the brush bar firmly against the bracket with the plate 15 acting to anchor the brush bar to the bracket.

To the upper end of each bracket 16 is attached the upper end of a resilient member 19, preferably a strip of spring steel or the like and the lower end of each member 19 is attached to a carriage 20 slidably mounted on a hollow post 21 supported by a frame 22. In each post is provided a rotatable screw-threaded stem 23 equipped with a hand wheel 24. Each post 21 is provided with longitudinal diametrically opposed slots 25 through which extends a bar 26 attached at either end to the associated carriage 20, the bar being provided with an interior threaded bore co-operating with the screw-threaded stem 23. Vertical adjustment of either carriage 20 is effected by rotation of the corresponding hand wheel 24.

A yoke 27 straddles the left hand resilient member 19 and has its ends attached to the left hand bracket 16. In alinement with the yoke 27 is a cylinder 28 open at each end to atmosphere and in which is slidably mounted a duplex piston 29 having a rod 29a connecting the two pistons. The right hand end of the piston is connected by a resilient strip 30 with the yoke 27. Reciprocation of the piston is effected by means later to be described and by virtue of the interconnection of the piston to the brush 11, the latter is caused to vibrate transversely of the strip 10.

The cylinder 28 is provided with a central partition 31 through which extends the rod 29a of the duplex piston, the cylinder thus being divided into a left hand and a right-hand chamber, each of which is provided with a pair of ports, one of which is an inlet port and the other of which is an outlet port. Compressed air is supplied to the left-hand chamber through the flexible conduit 33 and air is supplied to the right-hand chamber through the flexible conduit 32. Air is discharged from the left-hand chamber through the flexible conduit 35 and air is discharged from the right-hand chamber through the flexible conduit 34.

A bracket 36 is supported by the frame 22 and is provided with a vertical bore in the upper end of which is arranged the lower end of a valve housing 37, said housing having a flange 38 resting on the top surface of the bracket 36. A collar 39 rests upon the top surface of the flange 38 and is attached to the bracket 36 by bolts 40 passing through arcuate slots in the flange 38 (Fig. 5). A handle 41 is attached to an extension of the housing 37 for effecting arcuate adjustment of the housing. In the upper end of the extension is provided a passageway 42 communicating with a vent pipe 43 leading to atmosphere. Below the housing 37 is provided a second cylindrical valve housing 44 which is slightly spaced from the housing 37 and is fixed against rotation by the attachment bolts 44a. A cylindrical valve body 45 extends through the two valve housings and has its lower end journalled in a casing 46 attached to the bracket 36. A spur gear 47 keyed to the valve body 45 meshes with a spur gear 48 carried by the shaft 49.

In the upper end of the valve body 45 is provided a passageway 50 which is continuously in communication with the passageway 42. Arcuately spaced branch passageways 51 and 52 extend radially from the passageway 50 to the periphery of the valve body at different elevations and terminate in arcuate grooves. In the valve casing are provided ports 53 and 54 communicating respectively with passageways 55 and 56 in the bracket 36 which in turn communicate respectively with the conduits 34 and 35. Rotation of the valve body successively connects the conduits 34 and 35 to atmosphere through the passageway 43, thus alternately venting the two chambers of the cylinder 28. In the lower part of the valve body are provided two arcuately spaced longitudinal grooves or cut-outs 57 and 58 at different elevations. Also, in the valve casing 44 are provided longitudinally alined and spaced ports 59 and 60 respectively in communication with the conduits 32 and 33 and adapted to have the grooves 57 and 58 register respectively therewith. Between the ports 59 and 60, the housing 44 is provided with a port 62 adapted to have the grooves 57 and 58 register alternately therewith and which communicates with a peripheral groove 63 which in turn communicates with a passageway 64 in the bracket 36. Rotation of the valve body thus brings the left and right hand chambers of the cylinder 28 alternately into communication with the passageway 64 through the intermediary of the conduits 32 and 33. The passageway 64 communicates with a source of compressed air as will later be described and the arrangement of the various ports and passageways above referred to is such that when the left hand chamber of the cylinder 28 is in communication with the passageway 64 the right hand chamber is in communication with the vent pipe 43 and vice versa. Thus, rotation of the valve body is effective to cause reciprocation of the double-headed piston with consequent vibration of the brush 11, the frequency of vibration of the brush being dependent upon the rotational speed of the valve body 45.

The shaft 49 is provided with a spur gear 65 which meshes with a spur gear 66 on a governor shaft 67 and a spur gear 68 on a drive shaft 69, the latter of which is provided with pulleys 69a by means of which power may be furnished through the medium of a belt. A governor 70 is provided with an arm 71 carried by a shaft 72, counter-clockwise rotation of which is opposed by the spring 73. A second arm 74 carried by the shaft 72 has its outer end connected by a link 75 with one end of a rocker arm 76. The interior mechanism of the governor, not shown here, is actuated by the shaft 67 and is of such structure that increase and decrease in speed of the shaft 67 rotates the shaft 72 counter-clockwise and clockwise respectively. The shaft 69 is driven from the same drive shaft as the feed means (not shown) for the web 10 so that the feed rate of the web is synchronized with the governor.

The passageway 64 communicates with a generally conical chamber 77 having an annular portion 77a of enlarged diameter and also having an inlet 78 which communicates through a pipe 78a with a source of compressed air (not shown). In the chamber 77, means are provided for controlling the pressure of air supplied through the passageway 64 to the cylinder 28 in response to variation in the speed of the web 10 so that the pressure of the air supplied to the cylinder 28 as well as the rate of flow of such air varies with a change of frequency of vibration of the bar 11 resulting from a change of the feed rate of the web 10. The pressure regulating device herein illustrated and described is a commercial one obtainable in the open market and it is to be understood that other similar devices may be used for the purpose of regulating the pressure of the air supplied to the chamber 28.

As illustrated in Fig. 6, a generally conical plug 79 is arranged in the chamber 77 and is provided with two surfaces 80 and 81 forming air-tight seals above and below the end of the passageway 64. The plug 79 is provided with an axial bore 79a and a piston 82 is slidably contained therein. The upper end of the bore is closed by a cap 83 threaded on to the upper end of the plug 79 and a spring 84 is interposed between the cap 83 and a cover 85 screwed into the upper end of the chamber 77, the spring 84 tending to maintain the plug 79 with the surfaces 80 and 81 in sealing contact with the inner surface of the chamber. The piston 82 is connected to a rod 86 with a slight clearance between the outer surface of the rod and the inner surface of the piston and the upper end of the rod is supported by the cap 83 while the lower end of the rod extends through the lower portion of the plug 79. A stuffing box 87 is provided at the lower end of the rod 86 to form an air tight seal therewith.

The plug 79 is provided with passageways 89 leading from the exterior of the plug to the bore 79a, these passageways being provided with screens 90 at their outer ends. The piston 82 is provided with ports 91 providing communication between the passageways 90 and the opposite ends of the bore 79a by way of the passageway provided along the rod 86 due to the clearance between it and the interior surface of the piston. Also, the plug 79 is provided with ports 92 leading to an annular cut-out in the plug 79, such cut-out forming a chamber communicating with the passageway 64.

The bore 79a is provided with an enlarged portion 93 arranged between the inner ends of the passageways 89 and the ports 92 and adjacent the ends of this enlarged portion the piston 82 is of reduced diameter thereby affording communication between the passages 89 and the

ports 92 with the piston in the position shown in Fig. 6. The position of the piston is dependent upon the position of the rocker arm 76 and a spring 94 tends to hold the bottom end of the rod 86 in contact with the end of the rocker arm 76.

Air from the pipe 78a enters the chamber 77 and then flows through the passageways 89 and the enlarged portion 93 of the plug bore and out through the ports 92 to the passageway 64, by means of which it is supplied to the distributing valve. Some air passes through the ports 91 to the opposite ends of the piston 82 thereby producing a balanced effect in the piston. A change of speed in the web 16 produces movement of the rocker arm 76 under the influence of the governor with consequent movement of the rod 86 and piston 82, thereby varying the extent of communication between the passageways 89 and the ports 92 with consequent variation in the pressure of the air supplied to the cylinder 28. The pressure of the air supplied to the cylinder 28 as well as the rate of flow of such air varies with a change of frequency of the vibration of the bar 11 resulting from change of the feed rate of the web 10 and the arrangement is such that air is supplied to the cylinder at proper pressure to vibrate the brush at a large frequency with the least amount of undesirable vibrational effect in the remainder of the machine.

By rotary adjustment of the housing 37, the timing of the expansion period for each piston stroke may be varied. The cut-off of the supply of compressed air to the cylinder chambers is fixed by reason of the fact that the valve housing 44 is held against rotation while the venting of the cylinder chambers may be varied relative to the cut-off by rotation of the valve housing 37. Variation of the compression and expansion cycle may thus be effected to meet conditions as desired.

In the foregoing description, reference has been made to only one vibrating brush and vibrator therefor. It is, however, contemplated that there may be a plurality of brushes arranged adjacent each other with a like number of vibrators all supplied with motivating fluid by a single valve. Such valve will differ from the valve shown only by having the necessary additional passageways and ports to supply air to a plurality of cylinders instead of a single cylinder, the arrangement of such ports and passageways being such that each brush vibrates out of phase with each remaining brush. In Fig. 1 are illustrated additional posts for mounting a second pair of carriages 20 and brush-supporting attachments. While specific reference has been made to air as the motivating fluid, it is to be understood that the invention contemplates the use of other forms of motivating fluid such, for example, as oil.

We claim:

1. A device of the character described comprising a pair of parallel resilient members fixed at corresponding ends, a bracket attached to the free end of each member and extending obliquely therefrom toward the other bracket, a brush having its ends connected to said brackets, and means attached to one end of said brush to effect vibration thereof.

2. A device of the character described comprising a pair of parallel resilient members fixed at corresponding ends, a bracket attached to the free end of each member, a brush having its ends connected to said brackets, a pneumatic vibrator attached to one end of said brush, means for supplying compressed air to said vibrator and discharging air therefrom, said means including a rotatable valve controlling the flow of air to and from said vibrator, and means for rotating said valve.

3. A device of the character described comprising a pair of parallel resilient members fixed at corresponding ends, a bracket attached to the free end of each member, a brush having its ends connected to said brackets, a pneumatic vibrator attached to one end of said brush, means for supplying compressed air to said vibrator and discharging air therefrom, said means including a rotatable valve controlling the flow of air to and from said vibrator, means for rotating said valve, and means regulated by the rotational speed of said valve for controlling the pressure of the air supplied to said vibrator.

4. A device of the character described comprising a pair of parallel resilient members fixed at corresponding ends, a bracket attached to the free end of each member and extending obliquely therefrom toward the other bracket, a brush having its ends connected to said brackets, a cylinder having a centrally apertured transverse partition and open to atmosphere at each end, a rod extending through said partition and having a piston connected to each end, connections between one piston and said brush, an inlet and outlet port in said cylinder at either side of said partition, a cylindrical valve housing having a supply port together with a first pair of axially spaced ports communicating with said cylinder inlet ports and a second pair of axially spaced ports communicating with said cylinder outlet ports, a rotatable valve in said housing having a pair of arcuately spaced longitudinal cutouts adapted alternately to connect said supply port to each of said first pair of ports and an axial passageway leading to atmosphere with two arcuately spaced branches adapted alternately to connect said passageway to each of said second pair of ports, a source of motivating fluid under pressure in communication with said supply port, and means for rotating said valve.

5. A device of the character described comprising a pair of parallel resilient members fixed at corresponding ends, a bracket attached to the free end of each member and extending obliquely therefrom toward the other bracket, a brush having its ends connected to said brackets, a cylinder having a centrally apertured transverse partition, a rod extending through said partition and having a piston connected to each end, connections between one piston and said brush, an inlet and an outlet port in said cylinder at either side of said partition, a cylindrical valve housing having a supply port together with a first pair of axially spaced ports communicating with said cylinder inlet ports and a second pair of axially spaced ports communicating with said cylinder outlet ports, a rotatable valve in said housing having a pair of arcuately spaced longitudinal cutouts adapted alternately to connect said supply port to each of said first pair of ports and an axial passageway leading to atmosphere with two arcuately spaced branches adapted alternately to connect said passageway to each of said second pair of ports, a source of motivating fluid under pressure in communication with said supply port, means for rotating said valve, and means responsive to the rotational speed of said valve for controlling the pressure of the air supplied to said passageway.

6. A device of the character described comprising a brush, means supporting said brush for vibratory movement, a fluid actuated vibrator connected to said brush and having inlet and outlet ports, a source of motivating fluid under pressure, means including a valve housing and a rotatable valve therein for supplying fluid to and discharging fluid from said vibrator, said valve housing having ports communicating with said vibrator ports and said valve having passageways adapted for co-operation with said casing ports upon rotation of said valve alternately to connect said vibrator to said fluid source and vent said vibrator, and means to rotate said valve.

7. A device of the character described comprising a brush, means supporting said brush for vibratory movement, a pneumatic vibrator connected to said brush and having inlet and outlet ports, a source of compressed air, means including a valve housing and a rotatable valve therein for supplying air to and discharging air from said vibrator, said valve housing having ports communicating with said vibrator ports and said valve having passageways adapted for cooperation with said casing ports upon rotation of said valve alternately to connect said vibrator to said air source and vent said vibrator, means to rotate said valve and means responsive to the rotational speed of said valve for controlling the pressure of the air supplied to the vibrator.

8. A device of the character described comprising a brush, means supporting said brush for vibratory movement, a cylinder having a centrally apertured transverse partition, a rod extending through said partition and having a piston connected to each end, connections between one piston and said brush, an inlet and outlet port in said cylinder at either side of said partition, a cylindrical housing, a rotatable valve in said housing, a source of compressed air, said housing having ports communicating with said cylinder ports and said valve having passageways connected to said air source and adapted for cooperation with said ports upon rotation of said valve alternately to connect each chamber to said compressed air source and to vent said chamber, and means for rotating said valve.

9. A device of the character described comprising a brush, means supporting said brush for vibratory movement, a cylinder having a centrally apertured transverse partition, a rod extending through said partition and having a piston connected to each end, connections between one piston and said brush, an inlet and outlet port in said cylinder at either side of said partition, a cylindrical housing, a rotatable valve in said housing, a source of compressed air, said housing having ports communicating with said cylinder ports and said valve having passageways connected to said air source and adapted for cooperation with said ports upon rotation of said valve alternately to connect each chamber to said compressed air source and to vent said chamber, means for rotating said valve, and means responsive to the rotational speed of said valve for regulating the pressure of the air delivered to said cylinder.

10. A device according to claim 6 in which said brush-supporting means comprises a pair of resilient members fixed at corresponding ends, a bracket attached to the free end of each member and extending obliquely therefrom toward the other bracket and connections between said brackets and the ends of said brush.

11. A device according to claim 7 wherein said brush-supporting means comprises a pair of resilient members fixed at corresponding ends, a bracket attached to the free end of each member and extending obliquely therefrom toward the other bracket and connections between said brackets and the ends of said brush.

12. A device according to claim 8 wherein said brush-supporting means comprises a pair of resilient members fixed at corresponding ends, a bracket attached to the free end of each member and extending obliquely therefrom toward the other bracket and connections between said brackets and the ends of said brush.

13. A device according to claim 9 wherein said brush-supporting means comprises a pair of resilient members fixed at corresponding ends, a bracket attached to the free end of each member and extending obliquely therefrom toward the other bracket and connections between said brackets and the ends of said brush.

14. A device of the character described comprising a brush, means supporting said brush for vibratory movement, a pneumatic vibrator connected to said brush and having inlet and outlet ports, a source of compressed air, a two-part cylindrical valve housing having its first part arranged for arcuate adjustment, said first housing part having a first pair of axially spaced ports communicating with said vibrator outlet ports and said second housing part having a supply port together with a second pair of axially spaced ports communicating with said vibrator inlet ports, a rotatable valve in said housing having a pair of arcuately spaced longitudinal cutouts adapted alternately to connect said supply port to each of said second pair of ports, and an axial passageway leading to atmosphere with two arcuately spaced branches adapted alternately to connect said passageway to each of said first pair of ports, a source of motivating fluid under pressure, in communication with said supply port, and means for rotating said valve.

15. A device according to claim 14 characterized by means responsive to the rotational speed of said valve for controlling the pressure of the motivating fluid supplied to said passageway.

16. A device of the character described comprising a pair of resilient members fixed at corresponding ends, a bracket attached to the free end of each member and extending obliquely therefrom toward the other bracket, a transverse bar on each bracket, a brush having a grooved plate at each end for receiving said bar and an eccentric rotatably supported by said bracket for engagement with said brush to hold the latter with the bar arranged in the plate groove.

17. A device of the character described comprising a brush, means supporting said brush for vibratory movement, a fluid-actuated vibrator connected to said brush and having inlet and outlet ports, a source of motivating fluid under pressure, means including a valve housing and a rotatable valve therein for supplying fluid to and discharging fluid from said vibrator, said valve housing having ports communicating with said vibrator ports and said valve having passageways adapted for co-operation with said casing ports upon rotation of said valve alternately to connect said vibrator to said air source and vent said vibrator, means to rotate said valve, and means responsive to the rotational speed of said valve for controlling the pressure of the motivating fluid supplied to the vibrator.

18. A device of the character described comprising a brush, means supporting said brush

for vibratory movement, a cylinder having a centrally apertured transverse partition and open to atmosphere at both ends, a rod extending through said partition and having a piston connected to each end, connections between one piston and said brush, an inlet and an outlet port in said cylinder at either side of said partition, a cylindrical housing, a rotatable valve in said housing, a source of motivating fluid under pressure, said housing having ports communicating with said cylinder ports and said valve having passageways connected to said fluid source and adapted for co-operation with said ports upon rotation of said valve alternately to connect each chamber to said fluid source and to vent said chamber, and means for rotating said valve.

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