June 27, 1961 R. O. PETERSON 2,989,764

CLEANING AND FINISHING MACHINE EMPLOYING BELT BRUSHES

Filed Sept. 22, 1958 5 Sheets-Sheet 1

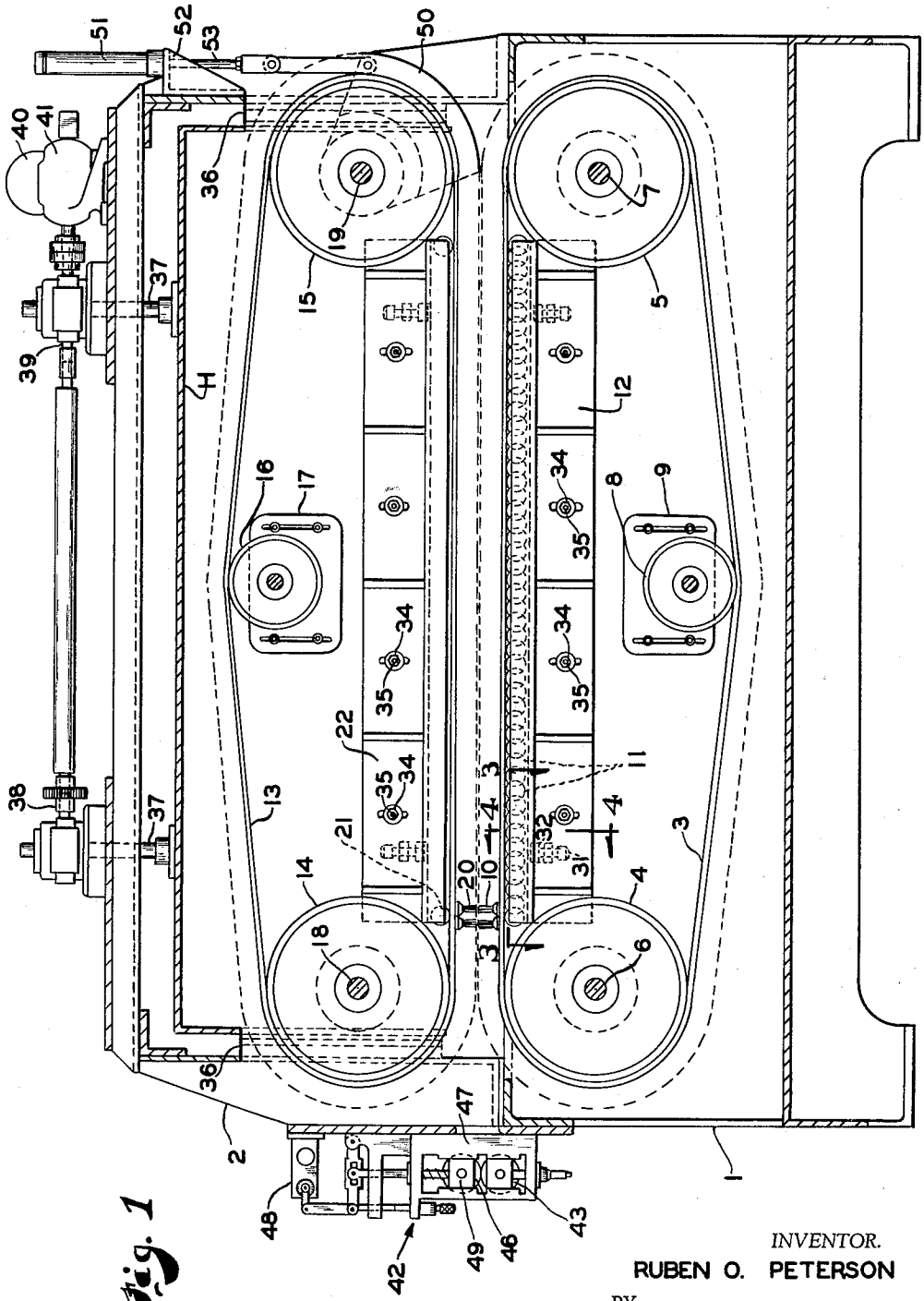

Fig. 1

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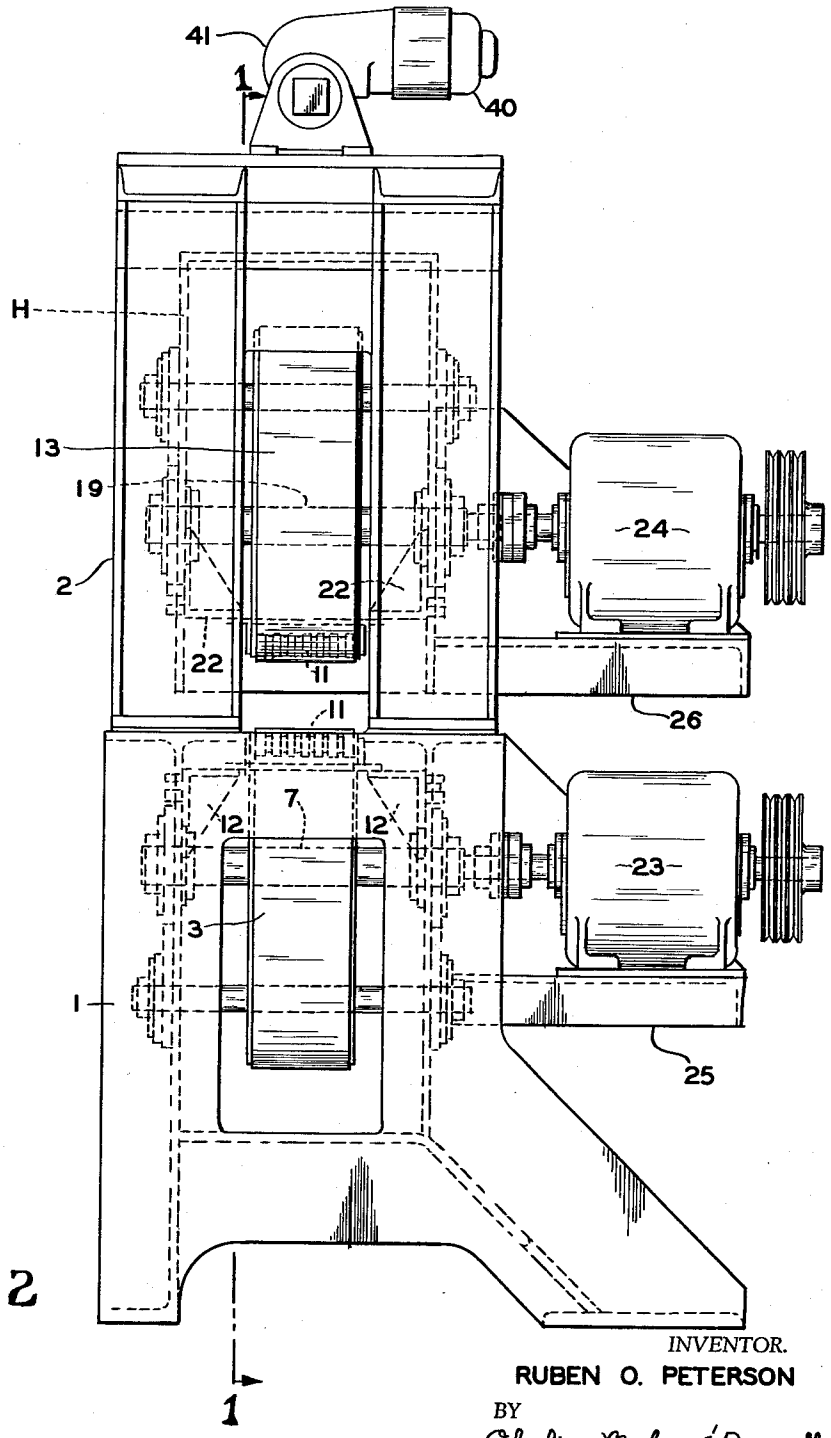

Fig. 2

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CLEANING AND FINISHING MACHINE EMPLOYING BELT BRUSHES

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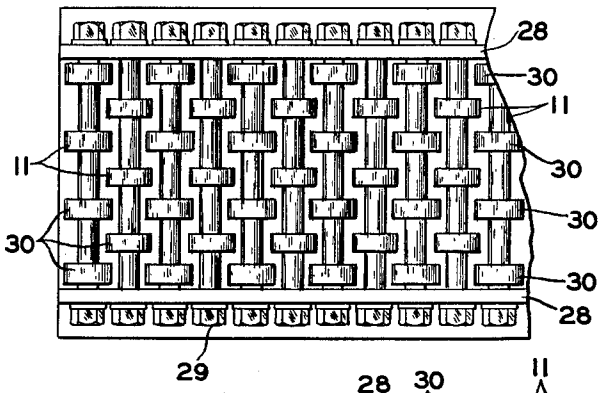

Fig. 3

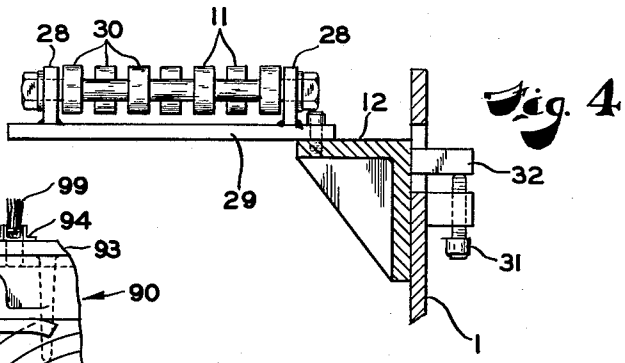

Fig. 4

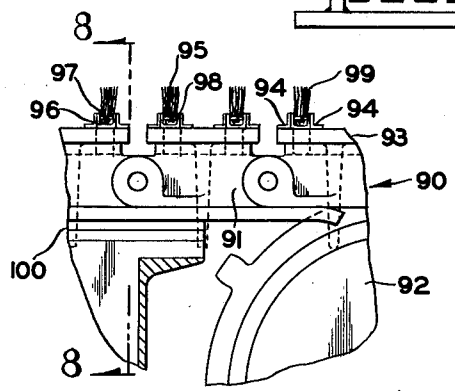

Fig. 7

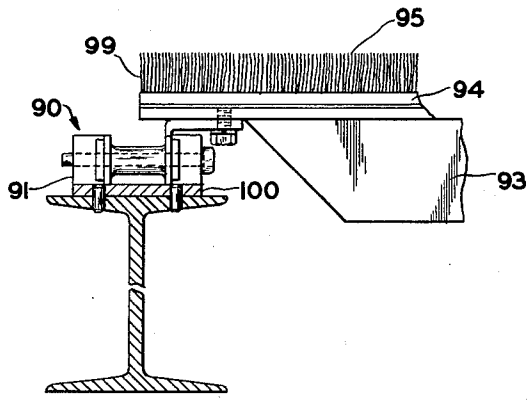

Fig. 8

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CLEANING AND FINISHING MACHINE EMPLOYING BELT BRUSHES

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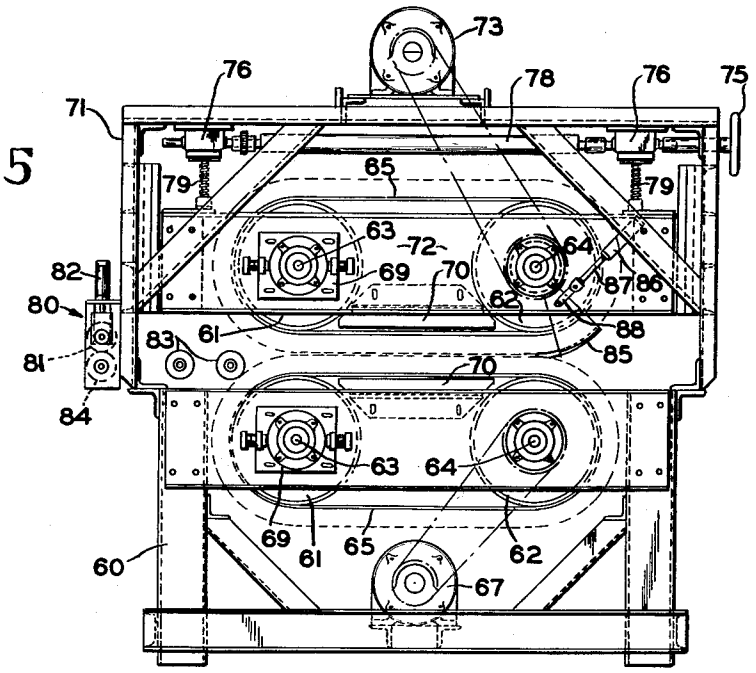
Fig. 5



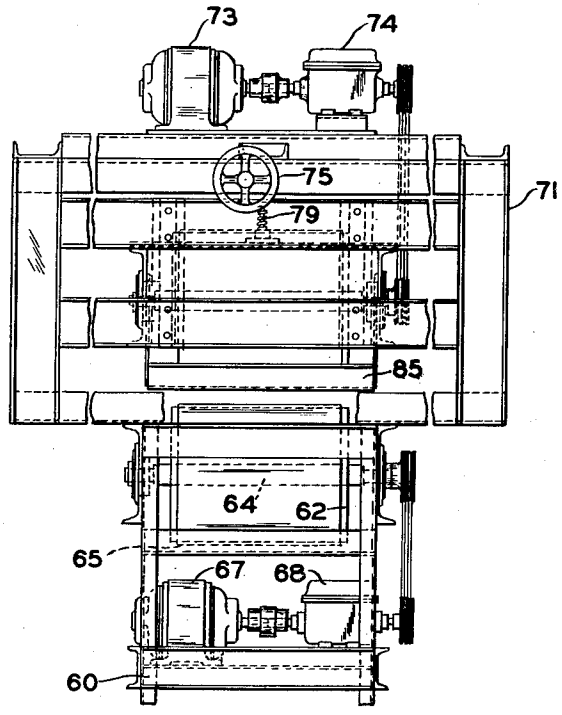


Fig. 6

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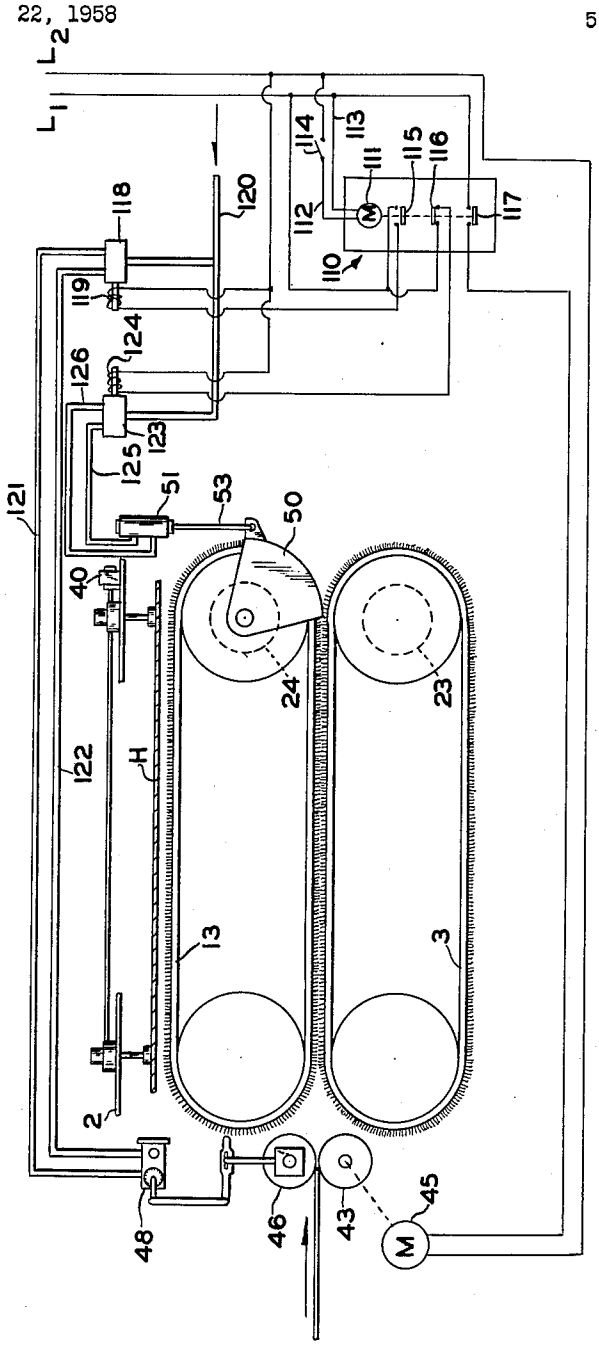

Fig. 9

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CLEANING AND FINISHING MACHINE EMPLOYING BELT BRUSHES

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Filed Sept. 22, 1958, Ser. No. 762,428
11 Claims. (Cl. 15—77)

This invention relates as indicated to a cleaning and finishing machine employing belt brushes, and more particularly to a machine adapted to process articles such as metal sheets and the like.

Belt brushes are known in the art and have certain advantages for various purposes. Thus, a belt type brush permits the use of a long circumference which is the equivalent of a very large diameter cylindrical rotary brush and permits a large area of contact with a flat workpiece at any given moment. This larger area of contact permits a great deal of work to be accomplished at relatively low brush speeds, and it also makes it possible for the brush to transport dislodged material from the workpiece surface and to remove such material therefrom. This latter action is often particularly desirable when a brush is employed in either dry or wet scrubbing a sheet or strip. It is often important to convey loosened material from the workpiece surface rather than merely to agitate such material by means of the brush and to rely on suction or flow of a liquid to carry such material away.

A further advantage of belt brushes is their suitability as workpiece conveying or transporting means since the belt brush is capable of supporting a large flat workpiece such as a steel sheet, for example, without scratching or damaging the surface of the same, and the brush material can be selected to yield to the extent necessary to accommodate certain irregularities of the workpiece. Furthermore, the same brush which thus transports the workpiece may be utilized to perform a brushing operation thereon. Because of the large area of brush contact, it is usually possible to accomplish such brushing with the belt moving at the same speed as when it is employed to convey the article to the brushing station.

In my co-pending application Serial No. 640,652, filed February 18, 1957, for "Brush Element and Belt Brush Construction," I disclose certain improved forms of belt brushes which are particularly adapted to be employed in the machines of the present invention. Such belt brushes are of relatively inexpensive construction but mount the brush elements in a manner both firmly securing them to the endless belt and also laterally bracing them for more efficient engagement with the work. A wide variety of belt brushes may, however, be utilized in the machines of my invention.

It is accordingly an important object of my invention to provide a cleaning and finishing machine employing a belt brush arranged to support and transport a workpiece.

Another object is to provide a machine in which the belt brush or brushes serve both thus to transport the workpiece and also to brush the surface of the latter.

Still another object is to provide a brushing machine of the type indicated which may be substantially automatic in operation.

A further object is to provide a belt brushing machine employing belt brushes disposed simultaneously to engage and brush opposite sides of the work.

Other objects of the invention will appear as the description proceeds.

To the accomplishment of the foregoing and related ends, said invention then comprises the features hereinafter fully described and particularly pointed out in the claims, the following description and the annexed drawing setting forth in detail certain illustrative embodiments of the invention, these being indicative, however, of but a few of the various ways in which the principle of the invention may be employed.

In said annexed drawing:

FIG. 1 is a vertical cross-section view of one form of machine embodying the principles of my invention, such section having been taken substantially along line 1—1, FIG. 2;

FIG. 2 is an end elevation on an enlarged scale of the machine of FIG. 1;

FIG. 3 is a fragmentary top plan view as viewed from line 3—3, FIG. 1 of one of the bed of belt backup rolls;

FIG. 4 is a vertical cross-section view taken along line 4—4, FIG. 1 showing the details of construction of the backup rolls;

FIG. 5 is a side elevational view of another form of machine embodying the principles of this invention;

FIG. 6 is an end elevation of the machine of FIG. 5;

FIG. 7 is a fragmentary front elevation view of a machine employing a chain belt bushing;

FIG. 8 is a cross-section view along line 8—8, FIG 7; and

FIG. 9 is a control diagram for automatic operation of such machines.

Referring now more particularly to FIGS. 1 and 2 of the drawing, the machine there illustrated comprises a lower elongated base frame 1 on which is mounted an upper frame 2. Such frames may desirably be of welded construction, and each is adapted to have an endless belt brush mounted therein. Thus, endless belt 3 passes around pulleys 4 and 5 mounted on shafts 6 and 7 respectively journalled for rotation in base frame 1, with a smaller intermediate pulley 8 carried by vertically adjustable plate 9 engaging the lower course of the belt to tension the latter. Lengths of brush strip 10 are mounted on the outer surface of belt 3 and extend transversely of the latter in the manner generally described and illustrated in my prior application Serial No. 640,652.

While the upper course of belt 3 is tensioned between pulleys or rolls 4 and 5, it is nevertheless often desirable to provide auxiliary support for such upper course, and this may consist of a bed of rolls 11 underlying such course and journalled in vertically adjustable brackets such as 12.

The upper belt 13 similarly passes about pulleys 14 and 15, and its lower course is adapted to be tensioned through vertical adjustment of tensioning roll 16 carried by vertically adjustable bracket 17. Pulley 14 is mounted on shaft 18 journalled in inner housing H within upper frame 2 for rotation about a horizontal axis, and pulley 15 is similarly mounted on shaft 19. Lengths of brush strip 20 are secured to the outer surface of belt 13 as indicated, and the lower course of this belt is backed up by a bed of rolls 21 journaled in vertically adjustable brackets such as 22. It will accordingly be seen that the belt brush assembly mounted in the upper frame 2 is an inverted duplicate of that mounted in base frame 1 with the upper horizontal course of belt brush 3 directly opposed to the lower horizontal course of belt brush 13 (in FIG. 2 the belts 3 and 13 are shown without the brush elements thereon).

Pulley 5 is, of course, keyed to shaft 7 which is driven by electric motor 23, pulley 15 being similarly keyed to shaft 19 which is driven by electric motor 24. Motor 23 is carried by outer bracket 25 mounted on the side of base frame 1 whereas motor 24 is carried by bracket 26 which is mounted on inner vertically reciprocable frame H.

The belt backup rolls 11 as best shown in FIGS. 3 and 4 have their ends journalled in the upstanding flanges

28 of a channel-like member 29 and each roll 11 is formed with several axially spaced apart belt-engaging portions 30 which are axially staggered and nested with respect to the portions 30 of laterally adjacent rolls 11 to provide a plurality of closely and uniformly spaced areas lying in a plane to accurately and uniformly support the upper course of the belt 3 whereby the tips of the brush strips 10 will likewise, uniformly support and work upon the sheet or strip metal in a manner presently to be described. The channel-like roll support member 29 is bolted, or otherwise secured, to the vertically adjustable brackets 12, and as shown in FIG. 4, vertical adjustment is made as by means of the adjusting screws 31 which bear upon lugs 32 projecting laterally from brackets 12 through openings in the side of the base frame 1.

The bed of rolls 21 which serves as a backup for the bottom course of the upper belt 13 is of the same construction as just described, except inverted whereby further description and illustration is unnecessary.

In both cases, the vertically adjustable brackets 12 and 22 are securely locked in desired adjusted positions as by means of the nuts 34 that are threaded onto screws 35 projecting through vertically disposed slots in the respective brackets 12 and 22.

Accordingly, when flat sheet stock is to be operated upon by the brush strips 10 and 20, the brush bristles will engage the surfaces of such sheet with uniform pressure as it and the brush strips 10 and 20 are moved with respect to each other.

In order that this machine may accommodate workpieces of various thicknesses, the inner housing H is vertically adjustably supported by the guideways 36 in the upper frame 2, vertical adjustment being effected as by the upwardly extending screws 37 thereon that have threaded engagement with worm wheels (not shown) or the like, engaged with motor driven worm shafts 38 and 39. The worm shafts 38 and 39 may be driven as by the electric motor 40 and gear reducer unit 41 mounted on the top of the upper frame 2.

It is to be understood that the electric power line leading to the brush drive motors 23 and 24 may be equipped with an ammeter by which the degree of brushing pressure can be determined. Suitable means (not shown) may be provided to energize the drive motor 40 in opposite directions to maintain such uniform pressure engagement of the brush strips with the work-piece according to the ampere draw of the brush drive motors.

At the left-hand end of the upper frame 2 is a pneumatically actuated pinch roll assembly 42 to assist in feeding of strip or sheet stock in the bight formed by the brush strips 10 and 20 of the belts 3 and 13 as they pass around the pulleys 4 and 14. With the drive motors 23 and 24 energized to drive the pulleys 5 and 15, the brush belts 3 and 13 will transport the workpiece in flat condition from left to right as viewed in FIG. 1. Moreover, because the brush strips 10 and 20 are then preferably travelling at the same speed, the brushing action will commence only after the entire sheet is disposed between the belts 3 and 13. In this way, the opposite faces of the sheet will be uniformly brushed.

The bottom pinch roll 43 is adapted to be driven by an electric motor 45 (see FIG. 9) and suitable means as shown may be employed to adjust the pinch roll 43 vertically to bring its top surface so as to lie in the plane defined by the tips of the bristles of the brush strips 10. The top pinch roll 46 is vertically movably supported in the block 47 mounted at the left-hand end of the top frame 2 through a pneumatically actuated motor 48 which is linked as shown to the bearing blocks 49 of the top pinch roll. Thus, when the top pinch roll 46 is forced downwardly by actuation of motor 48 toward the bottom motor driven pinch roll 43, a workpiece between said rolls will be fed into the bight formed by the top and bottom belt assemblies 13 and 3 and, of course, when the belts are driven, the workpiece will continue to be lineally fed thereby from left to right as viewed in FIG. 1. If it be desired to feed the workpiece under tension, the lineal speed of the belts 3 and 13 may be increased so as to be greater than the peripheral speeds of the pinch rolls 43 and 46.

At the right-hand end of the upper frame 2 and swingably mounted on the shaft 19 is a stop member 50 with which the leading end of the workpiece is engaged, thereby to arrest lineal travel of the workpiece. When that occurs the brush strips 10 and 20 will uniformly work upon the top and bottom surfaces of the workpiece to condition the surfaces thereof. It is to be noted that the brush strips 10 and 20 have a large area contact with the surfaces of the workpiece and that any foreign matter removed from the surfaces of the workpiece will be carried away therefrom.

The stop member 50 is arranged to be moved away from the end of the workpiece at the proper time, as by means of the pneumatic piston-cylinder assembly 51 that is mounted on the bracket 52 of the upper frame 2 and which has its piston rod 53 connected by link 54 to the stop member. When the stop member 50 is swung in a counterclockwise direction as viewed in FIG. 1, the belts 3 and 13 again will be operative to advance the workpiece toward the right out of the machine, whereupon return of the stop member 50 to the position shown in FIG. 1 will render it effective to stop the conveying of the next workpiece for performance of the brushing operations simultaneously on both faces thereof.

The machine illustrated in FIGS. 5 and 6 is basically the same as that shown in FIGS. 1 to 4, in that it comprises a base frame 60 which mounts pulleys 61 and 62 on shafts 63 and 64, respectively, over which pulleys is trained an endless brush belt 65 comprising, for example, a flexible belt having transverse brush strips secured thereto. The shaft 64 is driven as by an electric motor 67 and speed reducer 68 through belts and pulleys as shown clearly in FIG. 6. Tensioning of the brush belt 65 is accomplished by mounting the bearings of the shaft 63 in horizontally adjustable plates 69. Between the pulleys 61 and 62 and underneath the top course of the brush belt 65 is a bed of rolls 70 which, as the bed of rolls 11 in the machine of FIGS. 1 to 4, provide a plane support for workpieces transported into the machine.

This machine also includes a top frame 71 in which an inner housing 72 is vertically adjustably supported, the inner housing 72 mounting pulleys 61 and 62 and shafts 63 and 64 over which the top brush belt 65 is trained. Essentially the top belt and pulley assembly is the same as the bottom one, except inverted. In this case, the top shaft 64 is driven through another electric motor 73, speed reducer 74 and V-belt drive. Again, the top shaft 63 is provided with bearings that are parts of horizontally adjustable plates 69 whereby the top brush belt 65 may be suitably tensioned. Backing up the bottom course of the top brush belt 65 is another bed of rolls 70.

The inner housing 72 is arranged to be vertically adjusted by means of the hand wheel 75 which, through suitable gearing 76 and coupling shafts 78 raises or lowers both ends of the inner housing simultaneously through the upstanding screws 79 that either have threaded engagement with nuts in the gear boxes 76 or, if desired, with nuts formed in the bosses mounted adjacent the ends of the inner housing.

At the left side of the frame assembly is a pinch roll assembly 80, the upper roll 81 of which is actuated downwardly by a pneumatic cylinder 82 and, if desired, idler rolls 83 may be provided in advance of the bight formed by the brush belts 65. The bottom pinch roll 84 may be power driven as is the bottom pinch roll of the FIG. 1–4 machine.

Again the drive shaft 64 of the top brush belt assembly has a swingable stop member 85 actuated by a pneumatic

cylinder **86** having its piston rod **87** connected by link **88** to the stop member.

The upper frame **71** may be of much greater width than the widths of the brush belts **65** so that sheet stock may be brushed over its entire width even though wider than the brush belts. In shifting such wide sheets sideways it is preferred that the hand wheel **75** be operated to raise the inner housing **72** and the top brush belt assembly carried thereby. When the sheet has been thus shifted for brushing of the next adjacent area, the hand wheel **75** is turned to bring the inner housing **72** down so that the brush strips of both brush belts **65** will exert the desired brushing pressure against the faces of the sheet therebetween. Thereupon, with the stop member **85** in the position shown in FIG. 5 and with the motors **67** and **73** energized, the brush belts **65** will be driven with respect to the sheet to perform the brushing operation thereon. Then, when the pneumatic cylinder **86** is actuated to swing the stop member **85** in a counterclockwise direction with its inner end clear of the leading edge of the sheet, the latter will be conveyed toward the right out of the machine.

As will be explained later in detail, the machines herein may have associated therewith suitable timing devices to enable brushing of the surfaces of the workpiece for the desired length of time to properly condition the surfaces.

Referring now to FIGS. 7 and 8, there is shown therein a brush belt **90** which is in the form of a link chain **91** adapted to be driven by a sprocket wheel **92** and having transversely extending web-reinforced members **93** provided with paired angles **94** to replaceably receive brush strips **95** therebetween. The brush strips **95** here are shown as comprising brush backs or channel members **96** having opposed teeth **97** which engage over the retaining wire **98** for the doubled-up bristles **99**. In lieu of a bed of rolls to support the top course of the brush belt **90** in a plane, guides **100** may be provided as shown. In any event, the tips of the bristles **99** of the brush strips **95** will lie in a plane to effect brushing of the surfaces of the workpiece engaged thereby in the same general manner as described in connection with the machines of FIGS. 1 to 4 and FIGS. 5 and 6.

Referring now to automatic operation of the machines disclosed herein, there is shown in FIG. 9 a schematic wiring and piping diagram for the FIGS. 1–4 machine. It is to be understood that the FIGS. 5 and 6 machine may be similarly wired up for automatic operation. At the outset, it should be stated that the belt drive motors **23** and **24** may be controlled by conventional switches and in the power line to each there may be provided an ammeter by which the machine operator may determine the intensity of the brushing of the workpiece disposed between the brush belts **3** and **13**; and that the reversible motor **40** for raising and lowering the inner housing H, and consequently the top brush belt **13**, may be controlled by a suitable normally open reversing switch whereby the machine operator by watching the ammeters in the belt drive motor circuits may raise or lower the housing H to achieve desired brushing pressure between the brush belts **3** and **13** and the top and bottom faces of the workpiece. Accordingly, for sake of simplifying the diagram of FIG. 9, these conventional motor controls have been omitted and, if desired, a load responsive device may be utilized to automatically actuate motor **40**.

In FIG. 9 the reference numeral **110** denotes an automatic timer, the motor **111** of which is connected to the power lines L_1 and L_2 by leads **112** and **113** and is energized by switch **114**. Operated by timer motor **111** are three contactors **115**, **116**, and **117** of which contactors **115** and **117** are normally open, and of which contactor **116** is normally closed.

Associated with the air motor **48** for operating pinch roll **46** is a solenoid valve **118** which, when the solenoid **119** thereof is deenergized (contactor **115** in normally open position), allows air under pressure from line **120** to be conducted through line **121** to actuate the air motor **48** in a direction to raise the pinch roll **46**. On the other hand, when contactor **115** is closed the energization of solenoid **119** will actuate valve **118** so that air under pressure will flow through line **122** to the air motor **48** to actuate the latter in the opposite direction to lower the top pinch roll **46**.

The drive motor **45** for the bottom pinch roll **43** is controlled by the normally open timer contactor **117**, the motor **45** being deenergized and energized when the contactor **117** is open and closed respectively.

Associated with the air motor **51** for operating the stop member **50** is a solenoid valve **123** which, when the solenoid **124** thereof is energized (contactor **116** in normally closed position), allows air under pressure from line **120** to be conducted through line **125** to actuate the air motor **51** in a direction to swing the stop member **50** clockwise to arrest the conveying motion of the workpiece between the belt brushes **3** and **13**. When the solenoid **124** is deenergized by opening of contactor **116** the valve **123** shifts to a position to conduct air pressure through line **126** to the air motor **51** to actuate the latter in the opposite direction whereby the stop member **50** is swung counterclockwise clear of the end of the brushed workpiece, the brushed workpiece then being conveyed by the belt brushes **3** and **13** toward the right out of the machine.

Assuming now that the belt brush drive motors **23** and **24** have been started, the operator will close the timer switch **114** to start the automatic reset timer **110**. Such energization of the timer will close contactors **115** and **117** so that air motor **48** will press the top pinch roll **46** against the workpiece and motor **45** will drive the bottom pinch roll **43**. Thus the workpiece will be fed into the machine between the top and bottom courses of the respective brush belts **3** and **13**. The timer **110** will then be effective to open contactors **115** and **117** whereby the workpiece will continue to be fed into the machine to brushing position by the brush belts **3** and **13**. Since contactor **116** is yet closed the workpiece will continue its movement until its leading end engages the stop member **50**. When that occurs the brush belts **3** and **13** in moving with respect to the stopped workpiece will effect brushing of the opposite faces of the workpiece until such time that the timer **110** has run its cycle and has opened the contactor **116**. When contactor **116** is open, the air motor **51** in the manner already described will swing the stop member **50** to allow the belt brushes **3** and **13** to transport the brushed workpiece out of the machine.

After the brushed workpiece has been transported out from between belt brushes **3** and **13** the timer **110** will again close the contactors **115**, **116**, and **117** so that the pinch rolls **43** and **46** will feed the next workpiece into the machine and so that the stop member **50** is returned to operating position to arrest the movement of such succeeding workpiece.

It is to be understood that instead of employing regular brushes, as herein shown by way of example, the belts may be provided with buff material, grinding or honing elements, or other abrading means (fine or coarse). Furthermore, the cleaning and finishing machine employing belt brushes as disclosed herein may be utilized to brush work such as continuous metal strip traveling between the opposed brush courses in a direction transversely of the latter, in which case the pinch rolls and intermittent stop means may be omitted. The adjustable anti-friction back-up means for such courses and the power means for shifting the brushes bodily relatively toward and away from each other to vary the spacing of such courses and the brushing pressure on the work, as well as to assist in positioning the latter, will still be of advantage.

Other modes of applying the principle of the invention may be employed, change being made as regards the details described, provided the features stated in any of the following claims, or the equivalent of such, be employed.

I therefore particularly point out and distinctly claim as my invention:

1. A machine for surface-conditioning sheets and the like comprising a base provided with an elongated working area defined by a sheet backup means and an opposed lineally travelling course of an endless surface-conditioning element adapted to contact the opposite faces of a sheet to convey the latter in one direction into the working area; movable stop means on said base operative in one position to arrest conveying movement of the sheet through such working area whereby the face of the sheet contacted by said element is surface-conditioned by lineal movement of the latter with respect to the sheet; and actuating means to move said stop means to another position out of engagement with the sheet whereby the surface-conditioned sheet is conveyed in such one direction out of such working area.

2. The machine of claim 1 wherein a movable inner housing is provided on said base to mount said back-up means and said element for relative movement toward and away from each other, and wherein means are provided for movably adjusting said housing thus to vary the distance between said back-up means and such lineally travelling course of said element to accommodate different thicknesses of sheet and to vary the contact pressure of said element against the sheet.

3. The machine of claim 1 wherein such working area is open at one end for insertion of the leading edge of such sheet for conveying toward the other end, wherein said stop means is disposed adjacent to the other end of such working area and is disposed to be engaged by the leading edge of the sheet, and wherein sheet feed means is disposed adjacent to the open end of such working area to initially advance the leading edge of a sheet into the open end of the working area.

4. A machine for surface-conditioning sheets and the like comprising a base providing an elongated working area defined by endless surface-conditioning elements including spaced apart lineally travelling courses of such elements adapted to contact the opposite faces of a sheet to convey the latter in one direction into the working area; movable stop means on said base operative in one position to arrest conveying movement of the sheet through such working area whereby the opposite faces of the sheet contacted by said elements are simultaneously surface-conditioned by lineal movement of said elements with respect to the sheet; and actuating means to move said stop means to another position out of engagement with the sheet whereby the surface-conditioned sheet is conveyed in such one direction out of such working area.

5. The machine of claim 4 wherein such working area is open at one end for insertion of the leading edge of a sheet therein for conveying toward the other end, and wherein said stop means is disposed adjacent to the other end of such working area and is disposed to be engaged by the leading edge of the sheet.

6. The machine of claim 4 wherein one of said elements is carried by an inner housing, and wherein means are provided to mount said inner housing to said base for movement of said one element toward and away from the other to accommodate different thicknesses of sheets and to vary the contact pressures of said elements against the sheet therebetween.

7. A machine for brushing the opposite faces of sheets and the like comprising a base; a first pair of parallel pulleys journalled on said base for rotation about horizontal axes; a first endless belt brush trained over said pulleys; an inner housing disposed above the top course of said belt brush; guide means supporting said housing for vertical adjustment with respect to said base; a second pair of parallel pulleys journalled on said inner housing for rotation about horizontal axes; a second endless belt brush trained over said second pair of pulleys and having a bottom course disposed above and parallel to the top course of said first brush belt; drive means operative to drive one of the pulleys of each pair so that said courses move lineally in the same direction; adjusting means operative to adjust said inner housing so that said courses at one end contact the opposite faces of a sheet inserted therebetween and thus convey the sheet toward the other end to a position therebetween; and movable stop means adjacent such other end of said courses operative, in one position, to interrupt the conveying movement of the sheet by said courses whereby continued lineal travel of said courses effects brushing of the opposite faces of the sheet.

8. The machine of claim 7 wherein an actuator for said stop means is operative to move said stop means to a position clearing the brushed sheet whereby said courses are effective to convey the same out of the machine.

9. The machine of claim 7 wherein a timer controlled actuator for said stop means is operative to move said stop means to a position clearing the brushed sheet whereby said courses are effective to convey the same out of the machine.

10. The machine of claim 7 wherein each belt brush comprises an endless member, and a series of brush strips extending transversely across said endless member.

11. The machine of claim 7 wherein said stop means comprises a swingably mounted member that includes a portion disposed between said belt brushes adjacent such other end of said courses for engagement by the leading edge of the sheet, and wherein actuating means are provided to swing said swingably mounted member so that such portion thereof laterally clears the leading edge of the sheet whereby the brushed sheet is conveyed by said belt brushes out from between said travelling courses.

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