ABSTRACT: A machine for polishing inside walls of a ring-shaped workpiece, such as handles of scissors and the like, in which the workpiece is automatically selected, set up in position and burnished by an endless belt, after which the workpiece is dropped and another workpiece selected. The machine includes a pair of spaced supports for the endless belt with the workpiece therebetween and performs the polishing operation automatically by pushing a loop of the belt through the workpiece opening, expanding the passed-through loop, placing this expanded loop upon a pulley, and then rotating the belt, the spaced supports also being simultaneously rotated around its longitudinal axis and the workpiece position altered so as to enable all interior surfaces of the ring to be polished.
FIG. 1a.
AUTOMATIC BAND POLISHING MACHINE

SUMMARY OF THE INVENTION

This invention relates to an automatic band polishing machine for burnishing the inside parts of ring shaped elements, of toroidal, bow and long ring shapes, for example the rings of scissor handles.

Until now, this burnishing operation has been effected manually by specialized workmen with considerable loss of time. This type of operation is uneconomical and also injurious to the health of the workmen who may inhale the abrasive dust generated during this operation.

It is accordingly an object of the invention to provide a machine which enables automatic threading up of the polishing band so that the above-mentioned operation can be carried out automatically with a considerable production per unit of time whilst reducing the number of workmen who are required only to control the machine and to load and unload the rough finished workpieces. The workmen need no longer be subject to the unhealthy inhalation of dust, since the requirement for manual access to the polishing band is avoided and the machine can be enclosed within a housing which is incorporated therein a dust exhausting installation function of which is to stop the spreading of dust into the plant.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 shows a perspective diagrammatic view of a machine according to the invention.

FIG. 2a is a perspective view of part of the machine of FIG. 1 in the direction of the arrow A.

FIGS. 2a, 2b, 2c show three diagrammatic longitudinal views of the polishing band in three positions before beginning of work.

FIGS. 2d, 2e, 2f show three diagrammatic longitudinal views of the polishing band on the idler pulley and during two following working steps.

FIG. 3 shows a diagrammatic perspective view of a control device comprising a cam shaft and associated microswitches, and pneumatic circuit.

DETAILED DESCRIPTION

Referring to the drawings, FIG. 1 shows a framework with a polishing band 1, having abrasive material such as emery on one surface, in the idle position or during the exchange of workpieces W resting upon the driving pulley 2 which is fixed to an electric motor 3 mounted on a slide 4 which runs on appropriate guides 5 and which is spring loaded by a compression spring 6 in a direction away from the workpiece W, i.e. to the left as viewed in the drawing. The guides 5 are fixed on a frame 7 in turn secured to a plate 15. On plate 15 are fastened by means of an appropriate support a pair of pins 8, forming fixed stops for positioning the band during the displacement caused by a pair of tensioning arms 9, as described below. Each arm 9 is fastened at one end upon a fulcrum 11 and is loaded by a tension spring 12 (FIG. 2a). At the other extremity of each arm 9 is mounted a tensioning pulley 10 for carrying the polishing band in constant tension.

The band 1, whilst stationary at the left side of FIG. 1 passes around the driving pulley 2 and thence via the pins 8 and the pair of tension pulleys 10 passes around the right side of a pusher 13. The pusher 13 is positioned coaxially with the band, so that the band will be retained thereon, and is reciprocated as required by a pneumatic cylinder 14 rigidly secured to the frame 7.

All of the items mentioned, i.e., motor 3 with slide 4 and compression spring 6, pins 8, tensioning arms 9 and the pusher 13 with its driving cylinder 14 are mounted upon the frame 7 which can rotate together with a plate 15 supported by four idler wheels 16 and connected to a ring gear 17 in mesh with a pinion 18 mounted upon a countershaft 19 driven by a motor 20. As a consequence of the above arrangement, the whole frame 7 is able to rotate together with the associated parts about the longitudinal axis of the machine simultaneously with the items mounted on the opposite side of the machine in relation to the workpiece W and described hereinafter.

On the other side of the workpiece W that is, to the right of the workpiece, as viewed in FIG. 1 there is shown a gear wheel 21 fixed upon appropriate bearings (not shown) and in mesh with a pinion 22 keyed on the same countershaft 19 driven by the motor 20. A slide 23 is mounted to run radially upon guides 24 fixed on the gear wheel 21. The radial displacement of the slide 23 is controlled by a pneumatic cylinder 25 fixed on the gear 21. The slide 23 carries two parallel brackets 26 and 27 on which two holding plates 28 and 29 are displaceably mounted respectively. These holding plates can be moved in a direction perpendicular to the rotary axis of the machine along two pairs of guides 28 and 28' controlled by two pneumatic cylinders 29 and 29' fixed on the brackets 26 and 26'. On the holding plate 27 is mounted an idler pulley 30 on the axis of which is perpendicular to the rotary axis of the machine. On the holding plate 27 is a pair of fingers 31a and 31b which in the idle position are located in front of the idler pulley 30, parallel to and at a certain distance from it. These fingers 31a, 31b are provided on a pair of levers 32a and 32b, respectively, pivoted on the holding plate 27 and controlled by a pneumatic cylinder 33 by means of a suitable linkage (see FIGS. 2a-c). The movements and dimensions of the levers 32a and 32b are such that fingers 31a and 31b can be introduced within the band 1 at both sides of the end of the pusher 13 and therefore apart to open out and extend the band 1 so that the idler pulley 30 can be introduced within the band 1 as described below.

Between the pusher 13 and the fingers 31a and 31b there is a magazine 34 for the workpieces W. This magazine 34 can be of any type and may comprise a frame within which a plurality of workpiece holders 35 can be advanced stepwise by a pneumatic cylinder 36 and a pawl and ratchet mechanism, not shown, in order to locate the workpieces in a delivery position from which they can be received by a mechanism 41. The mechanism 41 is arranged on the opposite side of the rotary axis of the machine with respect to the magazine 34 and in alignment with the latter.

The clamping mechanism 41 is of a conventional type used for mechanical handling and will not therefore be described in detail herein. In this particular case it comprises jaws 37 one of which is fixed to an arm 38 and the other of which is movable to grip the workpiece W.

The arm 38 is the piston rod of a pneumatic cylinder 38' and moves to advance the clamping jaws 37 for gripping the workpiece W as carried forward by the magazine 34, and then to retract them to bring the work pieces into the working position. A pneumatic cylinder 39 with an axis perpendicular to the arm 38 tilts the workpiece during a particular working step (FIG. 2f). If desired further similar means may be provided to impart any additional motions to the workpieces, for example to swing them about an axis perpendicular to the rotary axis of the machine.

As shown in FIG. 3, the machine is provided with a control device comprising a cam shaft 42 carrying cam discs 42a and 42b. The cam shaft 42 is driven by a motor 43 provided with a reduction gear (not shown) and connected to a power supply 44 by way of a timer 45. The cam discs 42a-42b are arranged to actuate microswitches 64a-64b, which in turn actuate electrically operable air valves 47a-47b connected to an air supply 48 and respectively actuating the corresponding cylinders 14, 29a, 33, 29, 38, 36, 25 and 39.

The operation of the described machine is as follows: referring to FIGS. 1 and 2a it can be seen that the polishing band 1, in the idle position or when the workpiece W is being exchanged, rests upon the pulley 2, on the stops 8, on the tensioning pulleys 10 and the tip of the pusher 13. The polishing band 1 is tensioned by a pair of springs 12 which load the two lever arms 9 carrying the tensioning pulleys 10 when advanced by the pusher 13 during its forward stroke under con-
Of the cylinder 14. When the timer 45 is set in operation to activate motor 43, can shaft 42 is rotated and cam discs 42a-h which in turn energize the electromagnetic valves 47a-h to power the cylinders 14, 29, 33, 29, 38, 36, 28 and 39. The first step of the cycle commences when the cam 42c actuates microswitch 46c to power the cylinder 36 so that a new workpiece W is advanced into the path of the piston rod 38 from the magazine 34, and the cam 42d actuates microswitch 46d to actuate power cylinder 38' and thus extend piston rod 38.

Simultaneously, the mechanism 41 actuates the jaws 37 to clasp the next workpiece W in the magazine 34. The cam 42d then releases the microswitch 46d in turn cylinder 36', and the piston rod 38 then moves back opening the new workpiece W in the necessary working position. The cam 42c also releases microswitch 46c so that cylinder 36 returns to the idle position, the pawl and ratchet mechanism leaving the magazine 34 in the advanced position. The cam 42a now actuates microswitch 46a to power the cylinder 14 and extend the pusher 13 in the forward direction. During this forward stroke of the pusher 13, a narrow loop of the band 1 is passed through a ring 40 of the workpiece W, which is located in the working position by the clamping mechanism 41. After the displacement of the pusher 13, the cam 42g actuates microswitch 46g to power the pneumatic cylinder 29 so that the fingers 31a, 31b are raised into the position shown in FIG. 2b, i.e. one on each side of the pusher and inside the loop of the band 1 which is already inside the workpiece. As soon as the loop of the band 1 is engaged by the fingers 31a, 31b, the cam 42f actuates microswitch 46f to power the cylinder 33 which pivots the two levers 32a and 32b about their fulcrums, so that the fingers 31a, 31b spread apart to open out the loop of the band 1. The cam 42e then actuates microswitch 46e to power the cylinder 29 so that the idler pulley 30 is then moved downwardly as viewed in FIG. 1 and lies within the widened loop of the band 1. Then, cam 42f releases microswitch 46f and cylinder 33 is returned to its idle position so that the fingers 31a and 31b close the loop of the band 1, tensioned by the pair of spring loaded arms 9, can conform to the idler pulley 30. The band can be drawn into the positions shown in FIGS. 2c and 2d not only because of the taking up of the loops of the band provided by arms 9 but also because of the displacement of motor 3 and of slide 4 on the guides 5 against the compressive force of the spring 6.

At the same time, cam 42c releases microswitch 46c so that cylinder 14 moves pusher 13 back into its idle position and cam 42g releases microswitch 46g and the cylinder 29 lowers fingers 31a and 31b, as viewed in FIG. 1, away from the rotary axis of the machine (FIG. 2d) so that they do not obstruct movement of the band 1. Then the cam 42b actuates microswitch 46b so that the pneumatic cylinder 25 acts on the slide 23 and the pulley 30 moves away from the rotary axis of the machine and provides the band 2 with the cutting angle α which is necessary to process the ring shaped part 40. (Drawing 2c). At the same time the cam 42a actuates microswitch 46a to power cylinder 39 so that the arm 38 is tilted about its axis to incline the workpiece at an angle β during finishing, see FIG. 2f. Now the timer 45 is set to initiate the polishing operation by means of a cam 49 of the cam shaft and a microswitch 50. First the motor 3 is activated by timer 45 to drive the band 1 by means of the driving pulley 2 and the polishing operation begins, whereas the motor 43 is stopped by the timer 45 and the cam shaft 42 also stops. At the same time the motor 20 is also activated by timer 45, and the countershaft 19 and the two pinions 18 and 22, the ring gear 17 and gear wheel 21 are driven so that the two units on both sides of the workpiece W rotate in synchronism and the band 1 rotates inside the ring shaped opening 40. Consequently the plane defined by the band 1 as driven by the driving pulley 2 and by the idler pulley 30 rotates about the axis of the machine.

When the polishing operation is completed, after the time set by the timer 45, the latter stops the motors 3 and 20 and starts the motor 43 so that further steps of the cycle can be provided by the cam shaft 42. Thus the cam 42 releases the microswitch 46b so that the cylinder 25 moves the pulley 30 back towards the rotary axis of the machine. The cam 42a releases microswitch 46a so that cylinder 39 is returned to the idle position (FIG. 1), the cam 42g actuates microswitch 46g to power cylinder 29 so that the fingers 31a, 31b are raised, as viewed in FIG. 1, to the rotary axis of the machine and the cam 42f actuates microswitch 46f to power cylinder 33 so that it reopens the fingers 31a and 31b as shown in FIG. 2c, hooking the two arms of the loop of the band 1 in order to remove it from the idler pulley 30. The cam 42e then releases microswitch 46e so that cylinder 29 returns to the position shown in FIG. 1 and the idler pulley 30 is removed from the path of the band 1. The cam 42d then actuates microswitch 46d to power cylinder 14 so that the pusher 13 is again advanced through the workpiece opening 40.

The cam 42f then releases microswitch 46f to return the cylinder 33 and the fingers 31a, 31b to the position shown in FIG. 2b, so that the band 1 is laid upon the tip of the pusher 13 by fingers 31a and 31b. During this movement, the band 1 will be constantly kept in tension by the spring 12 and the tensioning arms, and the spring 6 which tends to urge the motor 3 to the left as viewed in the drawings. Immediately afterward, the cam 42g releases microswitch 46g and the cylinder 29 returns to the position of FIG. 1 to remove the fingers 31a, 31b from the path of the band 1. The cam 42h now releases microswitch 46h so that the cylinder 14 returns to the idle position thus withdrawing the pusher 13 and the band 1 back again through the workpiece opening 40 to the initial idle position. The working cycle is now complete and the next cycle can be commenced on a new workpiece. Upon extension of the piston rod 38 to engage a new workpiece as described above, the mechanism 41 releases the finished workpiece W so that it falls onto a delivery chute not shown.

It should be understood that the machine described above illustrates one example only of the invention and alterations and modifications can be made thereto without departing from the scope of the invention as defined in the claims. For example, the cylinder 39 for inclining the workpiece during working (Drawing 2f), for the working of scissors with inclined finger holes, may be replaced by any other suitable locating means for the working of pieces with peculiar shapes, and devices for example for the axial movement of the workpiece can be added, so that all surfaces of the workpiece are conveniently positioned against the band 1 in turn.

As previously mentioned, the control and programming device can be of any known type provided that it guarantees the necessary synchronism between the operation of the relevant parts of the machine and the motors and permits the regulation of the operating times of the various phases, and may comprise a completely electronic control circuit. In fact, the machine according to this invention can be used successively for different working steps of a polishing process, or for different workpieces requiring a different type of abrasive.

Also, the machine can be constructed with a different workpiece loading and handling mechanism, for instance with a vertical magazine and/or with a different clasp mechanism or magazine adapted to various types of workpieces, for example a plate-rack in which the workpieces are loaded and from which they are then removed by the clasp mechanism. Moreover, the driving cylinders can be hydraulic instead of pneumatic, the electric motors can be equipped with variable speed control, and any modification of structure, outside shape, the control devices and auxiliary mechanisms can be carried out. In particular, instead of rotating the band 1 this can be a whole by means of the ring gear 17 and gear wheel 21, means may be provided for rotating the workpiece itself while the path of the band 1 remains fixed.

1. A machine for the automatic polishing of the inside surface of ring shaped workpieces, said machine comprising two spaced supporting means, an endless polishing band carried by said supporting means, said band being adapted to run thereon and between which the workpiece is intended to be placed,
band tensioning means associated with one of said supporting means to support the endless band in an idle position free of the other supporting means whereby the ring shaped workpiece can be positioned in the free space between the endless band and said other supporting means, means for extending the endless band from its idle position through the ring shaped workpiece so positioned towards said other supporting means, further means for receiving the extended portion of said endless band and placing it around the said other supporting means, and means for driving the endless band extending between the two supporting means to polish the workpiece.

2. A machine as claimed in claim 1, further comprising a support for receiving the workpiece and means for imparting relative rotation to said support and the supporting means for the band, about a longitudinal axis of the machine.

3. A machine as claimed in claim 2, in which the said band supporting means respectively comprise pulleys at least one of which is arranged to be driven by said driving means, the said band extending means comprising a pusher member mounted for rectilinear movement within the periphery of the band in order to engage and extend the band against the resistance of the tensioning means, and the said band receiving means comprising a plurality of fingers for insertion within the extended portion of the band to open out the latter for arrangement over the corresponding pulley.

4. A machine as claimed in claim 3, in which a driven one of said pulleys together with the driving means therefor, the band tensioning means and the pusher member are mounted upon a common rotary member on one side of the workpiece support, and the other pulley, being an idler pulley, and the band receiving means are mounted upon a further rotary member coaxial with the first and arranged on the other side of the workpiece support, means being provided for rotating said two rotary members in synchronism in order to rotate the endless band relatively to the workpiece about said longitudinal axis of the machine.

5. A machine as claimed in claim 4, in which the said plurality of fingers and the pulley associated therewith are each mounted for movement along an axis perpendicular to the medial plane of the endless band, and are so arranged for movement in timed relation that with the band extended by said pusher member, first the fingers are moved along the corresponding axis and inserted within the band, the fingers are then spread apart to open out the band, the pulley is moved along its corresponding axis and inserted within the opened out portion of the band, the fingers are then contracted together to allow the band to conform to the pulley and finally the fingers are withdrawn from the band by movement along the corresponding axis.

6. A machine as claimed in claim 5, in which the pulley associated with said fingers is also mounted for movement along a further axis at right angles to the first in order to vary the cutting angle of the band relatively to a workpiece.

7. A machine as claimed in claim 6, in which the said band tensioning means comprises a pair of arms each pivoted at one end upon a common support together with the associated band supporting means, and each having an idler pulley for engagement with the band and being spring loaded in a direction for tensioning the band.

8. A machine as claimed in claim 7, in which the said driving means comprises a motor with a band driving pulley fixed to the motor shaft, the motor being slidably mounted for movement at right angles to the motor axis and being spring loaded for sliding movement in a direction to tension the polishing band.

9. A machine as claimed in claim 8, including a magazine device for feeding workpieces consecutively to the working position, said device being arranged to operate in timed relation to the said band extending means so that workpieces are advanced to and from the working position when the band is retracted, and the band extending and polishing operations are effected between advancing steps of the feed device.

10. A machine as claimed in claim 9, in which the said magazine feeding device comprises a magazine for workpieces arranged laterally adjacent the path of the polishing band, and said workpiece support includes a gripping device for workpieces arranged for to and fro movement transversely to the path of the band to transfer workpieces from the magazine to the working position.

11. A machine as claimed in claim 10, in which the said gripping device is further arranged for movement to vary the working position of the workpiece during polishing.

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