

May 15, 1951

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2,553,534

MACHINE FOR STRAIGHTENING COLLAPSIBLE TUBES

Filed Sept 18, 1947

3 Sheets-Sheet 1

Fig. 1

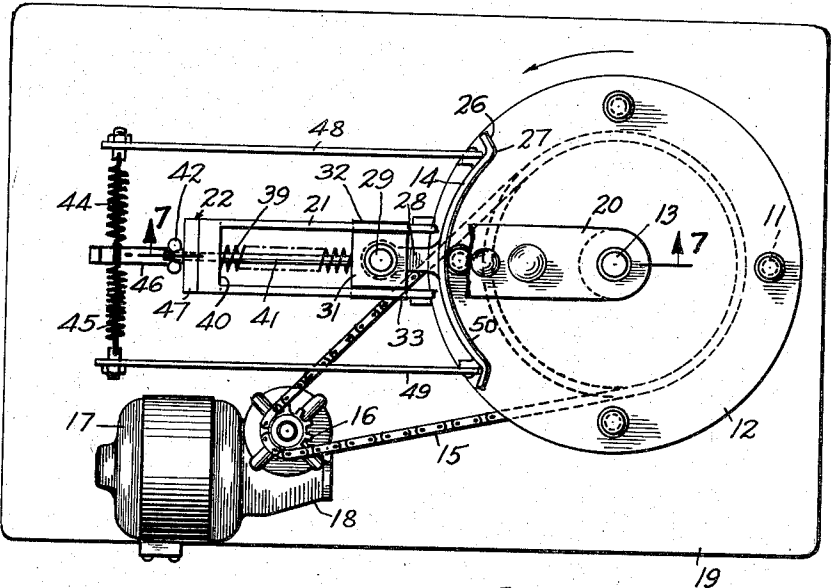
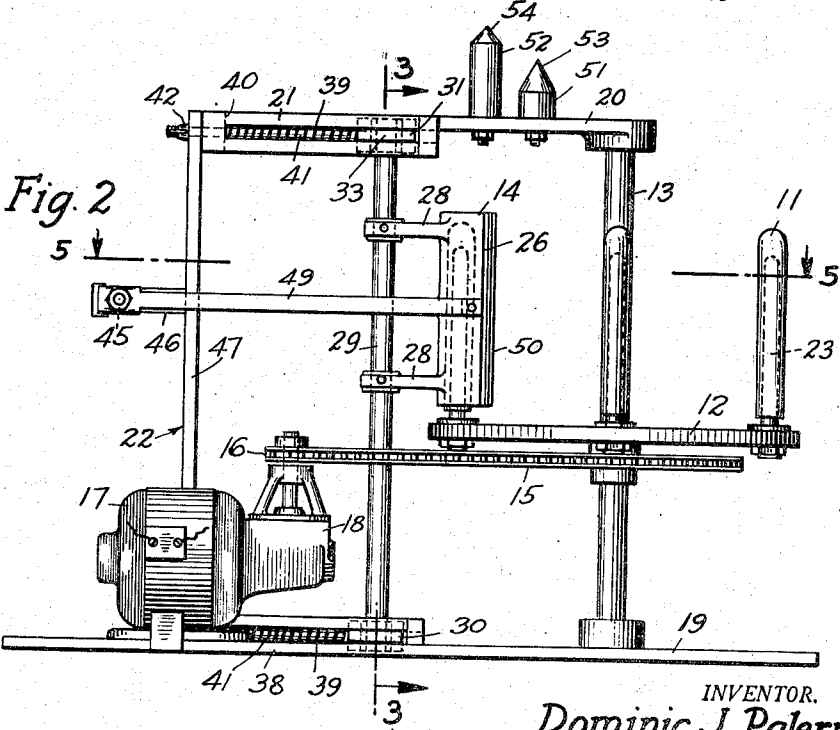


Fig. 2



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Fig. 3

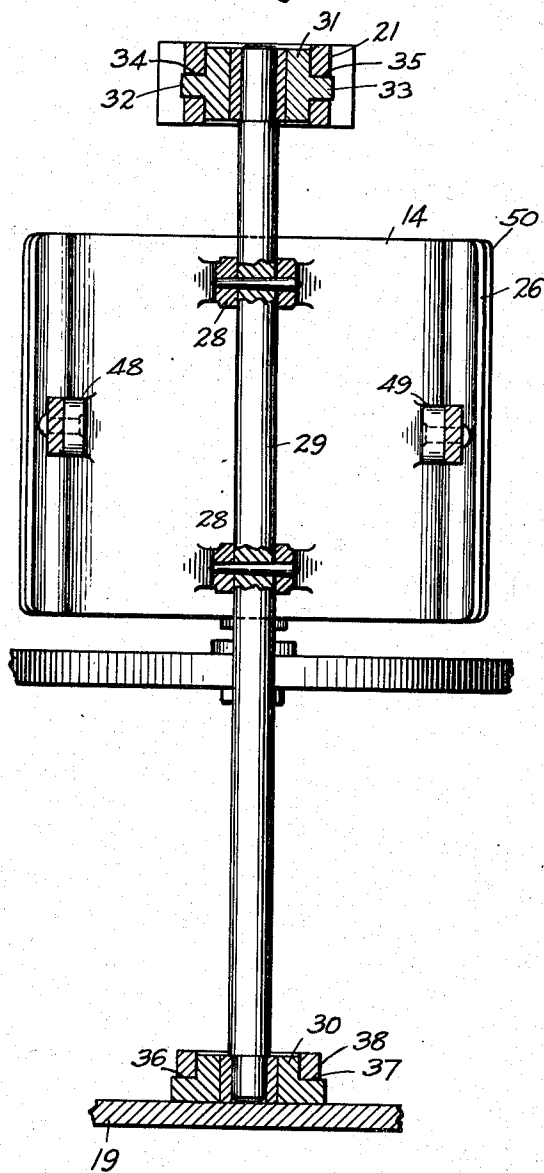
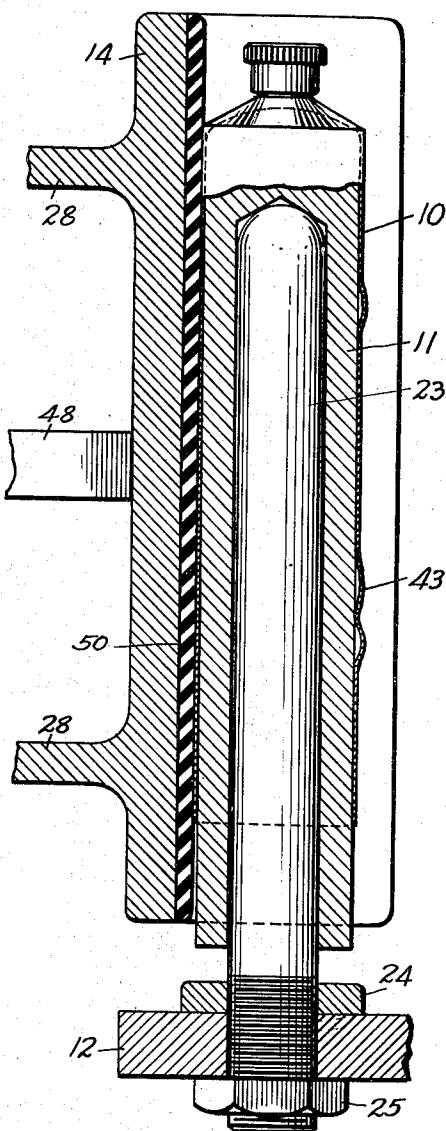


Fig. 4



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2,553,534

MACHINE FOR STRAIGHTENING
COLLAPSIBLE TUBES

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Application September 18, 1947, Serial No. 774,723

10 Claims. (Cl. 153—32)

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This invention relates to machines for straightening and smoothing thin fragile metallic collapsible tubes which may have been damaged or deformed after they have been made and before they have been filled and sealed.

Such tubes are frequently dented or partly closed or wrinkled after they have been inspected and packed for shipment to the place where the contents are to be inserted and the open end of the filled tube is to be closed. The damage may occur in various ways, but is frequently due to careless handling which the walls of the tube are too thin to withstand. Consequently, it has been necessary heretofore, to straighten or smooth the tubes by hand before filling, or if they were badly dented, it has been necessary to discard the tubes. Such practice has been expensive and wasteful.

The present invention therefore contemplates the provision of an efficient automatic tube straightening machine provided with suitable replaceable mandrels to adapt the machine to operate on tubes of various diameters, the damaged tubes, with or without a preliminary operation to spread the open ends thereof, being mounted on the mandrels, and the machine rolling the deformed tubes against a yieldable plate while rotating the tubes, thereby to press out all irregularities and to restore the tubes to their original smooth cylindrical shapes.

The invention further contemplates the provision of means for effectively supporting a pressing plate in such a manner that the plate adjusts itself automatically to variations in the irregular surface of the damaged tube and to various positions of the tube, thereby to exert just the proper pressure on the tube to smooth it to its proper original shape.

The invention further contemplates the provision of adjusting means for the plate to enable the machine to operate upon tubes of different diameters.

The various objects of the invention will be clear from the description which follows and from the drawings, in which:

Fig. 1 is a top plan view of the machine with part of the frame broken away to show the underlying structure.

Fig. 2 is a front elevational view of the machine.

Fig. 3 is a fragmentary vertical sectional view of the machine taken on the line 3—3 of Fig. 2, and showing particularly the means for yieldingly supporting the pressure plate.

Fig. 4 is a fragmentary vertical cross sectional

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view of the pressure plate and of the removable tube-supporting mandrel taken on the line 7—7 of Fig. 1 and showing a tube in the course of its rolling movement along the plate and partly straightened and smoothed.

Fig. 5 is a fragmentary horizontal sectional view of the machine taken on the line 5—5 of Fig. 2 and showing the position of the pressure plate and of the parts connected thereto just after the mounted tube has initially engaged the plate.

Fig. 6 is a similar view of the same showing another position of the parts wherein the rolling operation has been completed and the mounted tube is about to leave the pressure plate while the next tube is about to engage the plate.

Fig. 7 is a vertical sectional view of the upper part of the plate-supporting frame of the machine taken on the line 7—7 of Fig. 1 and showing the means for adjusting the plate as well as the tools which perform the preliminary operations upon the tube.

In the practical embodiment of the invention shown by way of example, the damaged tube 10 is manually mounted on one of the mandrels 11 (Fig. 4) carried by the turntable 12 on the shaft 13, which shaft is continuously rotated, the tube being carried by the turntable into and out of rolling contact with the pressure plate 14. As shown, for rotating the turntable, a sprocket wheel on the turntable shaft is rotated by the chain 15 through the sprocket wheel 16 driven by the motor 17 through suitable reduction gearing 18. The lower end of the turntable shaft 13 is journaled in a suitable bearing on the base 19, while its upper end is similarly journaled in the arm 20 extending from the upper slideway 21 forming part of the plate-supporting frame 22. To permit the mandrel 11 to rotate, preferably through a number of revolutions about its own axis when the tube thereon rolls along the plate 14, said mandrel receives and may rest by its own weight on the pin 23 which is fixed to the turntable as by means of the nuts 24 and 25. To replace the mandrel with one of a different diameter, the mandrel is merely lifted off the pin 23 and the mandrel to be substituted is merely dropped on said pin. It will therefore be seen that on rotation of the turntable, the mandrels and the tubes thereon are carried successively against the plate 14 and rolled thereon and therepast, the major plate area being arcuate or cylindrical about the center or axis of the turntable and the plate being normally but yieldingly interposed in the path of the mandrels.

As has been indicated, means are provided for automatically compensating for variable irregularities in the damaged tubes, by so supporting the pressure plate that it may yield under excessive pressure put thereon and is spring-pressed to its operative position when the mandrel pressure decreases or ceases. To accomplish these purposes, a series of springs are employed and the plate is mounted for adjustment. The details of the mounting and plate structure will now be described.

The arcuate portion of the plate subtends an angle slightly less than that subtended by an adjacent pair of mandrels 11. There being four mandrels shown, the angle would be slightly less than 90°, but in any case sufficient to cause rotation of the mandrel several times as it rolls. The edge portions 26 of the plate are turned outwardly and are each joined to the arcuate portion by an inwardly convex bend as 27. To support the plate, a pair of vertically spaced apart arms 28 extend from the outer face thereof at about the center line of the plate and are secured to the upright oscillatory shaft 29. The lower end of said shaft is journaled in a suitable bearing in the lower slide 30, while the upper end is similarly journaled in the upper slide 31.

Each of the slides is provided with a pair of opposed outstanding tongues as 32, 33 serving to guide the slide in its movement, the tongues of the upper slide being movable horizontally in the respective horizontal grooves 34, 35 in the upright sides of the slideway 21, while the tongues of the lower slide are similarly movable in the respective grooves 36, 37 of the lower slideway 38. It will therefore be seen that the pressure plate 14 together with the shaft 29 may oscillate as a unit relatively to the slides 30 and 31, and may also move linearly radially of the turntable as a unit with the slides. To urge the slides, the shaft 29 and the plate 14 toward the turntable and into position to engage a tube on the mandrel 11, a compression spring as 39 is interposed between the end wall 40 of the slideway and the outer edge of the slide, the spring being maintained in place in the slideway by the rod 41 passing therethrough and secured at its inner end to the slide. The outer end of the rod 41 passes loosely through the end wall 40 and carries the adjusting nut 42 engaging the outer face of the upright member 47 of the frame 22. Consequently, the limiting innermost positions of the slides in the slideways and the innermost position of the plate 14 relatively to the center of the turntable may readily be adjusted, as when tubes of different diameters are to be operated upon, by the manipulation of the adjusting nuts to lengthen or to shorten the effective lengths of the rods 41 and thereby to permit the springs 39 to move the slides toward the turntable or to draw the slides outwardly away from the turntable and to further compress the springs.

Equalizing springs are also provided to maintain the plate 14 normally concentric with the center of the turntable and to return the plate to such concentric position when permitted to do so after it has been moved therefrom, said springs also aiding in absorbing excess pressure upon the tubes, which pressure may result from the eccentric action of the mandrels on the edge portions of the plate, by permitting a limited yielding or oscillatory movement of the plate at such times. The total effect of the springs is therefore automatically to adjust the straightening pressure on the tube, or the pressure exerted

on the tube as it is squeezed between the mandrel and the plate. That is, the larger the outstanding projections or bumps 43 are on the damaged tube, the greater the straightening pressure, and the smaller the bumps the less pressure on the tube, less pressure being required to smooth out the smaller bumps. It will be seen that with a certain adjustment of the nuts 42 and with a perfect tube on the mandrel, the rotation of the turntable may theoretically cause no movement whatever of the plate 14.

The equalizing springs 44, 45 are arranged respectively on opposite sides of the fixed arm 43 projecting outwardly from the upright member 41 of the plate-supporting frame 22. One end of the spring 44 is secured to the arm 48 fixed to and extending from the plate 14, the other end of the spring being secured to the fixed arm 46. Similarly, one end of the spring 45 is secured to the plate arm 49 which is similar to the arm 48, and the other end of the spring is secured to the fixed arm 46. As best seen in Figs. 5 and 6, the spring 39 projects the pressure plate 14 into the path of the mandrels 11. As a mandrel reaches the plate, it may strike the outstanding edge part 26 of the plate thereby forcing the plate and its arms 28, 48 and 49 to swing slightly in a counter clockwise direction as viewed in Fig. 5, about the center of the shaft 29, and also moving said shaft together with the slides in which it is mounted, to the left or away from the turntable against the action of the spring 39.

The tension on the spring 44 is thereby decreased and that on the spring 45 increased, but the spring 39 continues to urge the plate toward the mandrel to squeeze the tube therebetween and to initiate the smoothing action desired. As the turntable continues its rotation, the tube and mandrel roll against the inner surface of the plate, which is preferably surfaced with a layer of suitable yieldable material such as the rubber sheet 50, the outstanding deformations being thereby ironed out. When the mandrel reaches the position shown in Fig. 1 at the center of the plate, said plate is again concentric with the turntable, equal tension being exerted on the equalizing springs 44 and 45. As the mandrel passes the center line of the plate and approaches the position thereof shown in Fig. 6, the plate is swung in a clockwise direction about the shaft 29 and the spring 44 is more greatly tensioned than its companion spring 45, the slides 30 and 31 also moving in their respective slideways more or less, depending on the extent to which the irregularities in the surface of the tube still project beyond the mandrel. By the time the mandrel has left the plate, it has rolled and rotated the tube thereon several times against the plate and has so squeezed the tube that all deformations have been removed therefrom and the tube is substantially as straight and smooth as when it was made. When the mandrel leaves the plate, said plate swings back to its normal position concentric with the turntable, and the operation is repeated with the succeeding mandrel.

It will be understood that some tubes are so greatly damaged that they cannot be placed on the mandrel without some preliminary straightening. Certain fixed straightening tools are therefore provided for such preliminary operations. As best seen in Fig. 7, the tools 51 and 52 are secured to the arm 20 of the plate-supporting frame 22 or at any other convenient point. The tool 51 is pointed and terminates in a cone 53, the

greatest diameter of which is larger than that of the largest tube, that is, the tube of the greatest diameter to be operated upon. If the tube is almost closed at the originally open end thereof, said end is forced downwardly upon the cone 53 which enters the tube and enlarges and rounds the opening to approximately its proper shape and diameter. The tube is then removed from the tool 51 and forced down on the tool 52, which also terminates at its upper end in a cone as 54 of lesser altitude than that of the cone 53, and having a cylindrical body part of the same diameter as that of the mandrel 11. Most of the inwardly projecting indentations are thereby removed from the tube, after which the tube is mounted on the mandrel and the remaining inwardly projecting indentations thus removed. The rolling of the tube against the plate as above described constitutes the final operation completing the straightening and smoothing of the tube without detriment to any cap which the tube may carry or to any printing or other surface decoration thereon, the straightened tube being removed and replaced by another damaged one.

It will be seen that I have provided a simple and efficient machine for straightening and smoothing fragile collapsible tubes, which effectively perform their functions and produce the desired result at comparatively little cost. While a certain specific embodiment of the invention has herein been shown and described, various changes may be made therein without departing from the spirit of the invention defined in the appended claims.

I claim:

1. In a tube straightening machine, a freely rotatable upright tube supporting mandrel of a diameter to fit tightly into the tube to be straightened, the axes of the tube and the mandrel being coincident when the tube is on the mandrel, means for rotating the mandrel in an orbit about a vertical axis spaced from the axis of the mandrel including a non-rotating pin supporting the mandrel solely by gravity, and a spring pressed pressure plate in the path of the mandrel curved about the vertical axis and arranged to engage a tube mounted on the mandrel to roll and to squeeze the tube between the plate and the mandrel to rotate the mandrel and the tube as a unit about the coincident axes thereof by the rolling action of the tube on the plate, a spring urging the plate toward said spaced vertical axis, screw-threaded means fixed to the slide hereinafter mentioned for adjusting the innermost position of the plate, means for pivotally and slidably supporting the plate including a slide, a pivot for the plate carried by the slide, and opposed equalizing springs urging said plate toward a predetermined position.

2. In a machine for straightening deformed collapsible tubes, a turntable, means for continuously rotating the turntable, a series of spaced rotatable mandrels upstanding from the turntable, an arcuate plate above the turntable and in the path of the mandrels, an upright pivot for the plate permitting oscillation of the plate, a pair of vertically spaced slides supporting the pivot for oscillation therein, means for adjusting the innermost positions of the slides, pivot and plate as a unit, a slideway for each of the slides, a spring urging the slides toward the innermost adjusted positions thereof, and opposed springs urging said plate toward a central position when said plate is oscillated out of said position.

3. In a machine for straightening deformed

collapsible tubes, a loosely rotatable upright mandrel of an outer diameter to fit tightly into the tube to be straightened around substantially the entire inner surface of the tube, an oscillatory and slidable plate yieldably supported in a position substantially concentric with the path of movement of the mandrel, a pivot supporting the plate and movable as a unit therewith toward and from the mandrel, means for moving the mandrel in a circular path toward and from the plate thereby to roll the mandrel and a tube mounted thereon along the surface of the plate and means for resisting both outward movement of the pivot away from the plate and rotary movement of the plate about the pivot.

4. A tube straightening machine according to claim 3 in which the means for moving the mandrel comprises a turntable an upright pin fixed to the turntable and supporting the mandrel solely by gravity, and means for continuously rotating the turntable, and in which the surface of the plate is arcuate and concentric with the axis of rotation of the turntable and means for adjusting the innermost position of the pivot at a selected distance from the axis.

5. A tube straightening machine according to claim 4 the means for resisting outward movement of the pivot and rotary movement of the plate including a spring urging the pivot radially of and toward the axis of the turntable and a pair of springs opposed to each other and one resisting oscillation of the plate in one direction and the other resisting oscillation of the plate in the opposite direction.

6. In a machine for straightening deformed collapsible tubes, a plate, a pivot for the plate slidable in a direction substantially perpendicular to the surface of the plate, the plate oscillating about the pivot and sliding linearly with the pivot, a tube-holding freely rotatable mandrel, a pin supporting the mandrel, means for rolling the mandrel along the inner surface of the plate thereby to rotate the mandrel and the pin and to impart the oscillatory and sliding movements to the plate and an orbital movement to the mandrel, and springs to resist said oscillatory and sliding movements, the mandrel rotating on the pin only when the tube thereon rolls on the surface of the plate.

7. In a tube straightening machine, a plate, a slidable pivot for the plate, the plate oscillating about the pivot and sliding linearly with the pivot, a tube-holding rotatable mandrel, means for rolling the mandrel along the inner surface of the plate thereby to impart the oscillatory and sliding movements to the plate, and springs to resist said movements, one of the springs being a compression spring urging the plate toward the mandrel to squeeze a tube on the mandrel between the plate and the mandrel during the rolling movement of the mandrel along the plate, and the remaining springs consisting of a pair of opposed equalizing springs on opposite sides of the pivot respectively, one of said equalizing springs being tensioned on oscillation of the plate in one direction and the other being tensioned on oscillation of the plate in the opposite direction.

8. In a tube straightening machine, a turntable, a series of freely rotatable mandrels upstanding from the turntable, a plate concave inwardly and in the path of the mandrels, an upright pivot for and in outward spaced relation to the plate and permitting oscillation of the plate, means yieldable outwardly away from the

turntable for adjusting the innermost positions of the pivot and plate as a unit relatively to the axis of the turntable and means for resisting rotary movement of the plate about the pivot.

9. The tube straightening machine of claim 8 5 the means for resisting rotary movement of the plate being yieldable and urging said plate toward a central position when the plate is oscillated out of said position under the pressure of a mandrel.

10. The tube straightening machine of claim 9, the last mentioned yieldable means comprising opposed springs, one arranged on one side of the

pivot and the other on the other side of the pivot.

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