May 9, 1939. G. A. VISSER ET AL 2,157,252

ROLLING-IN MACHINE

Filed March 31, 1937 6 Sheets-Sheet 1

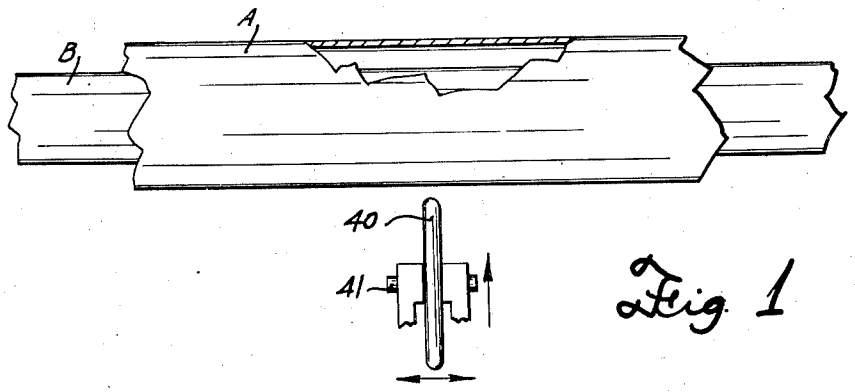


Fig. 1

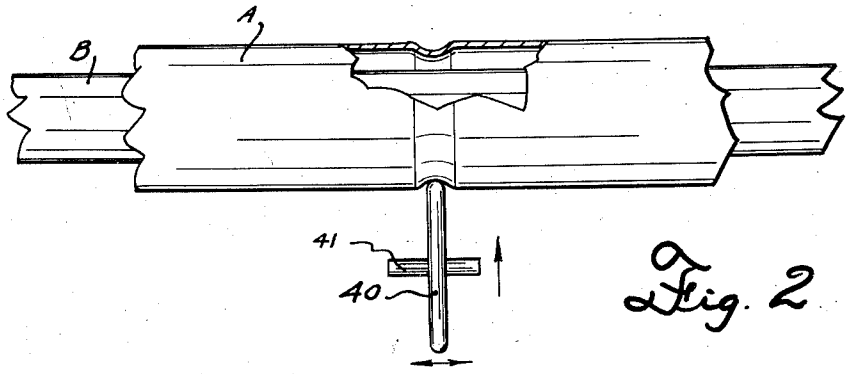


Fig. 2

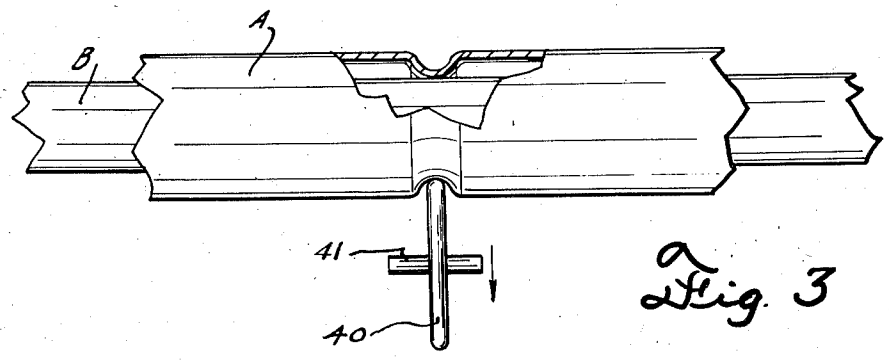


Fig. 3

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ROLLING-IN MACHINE

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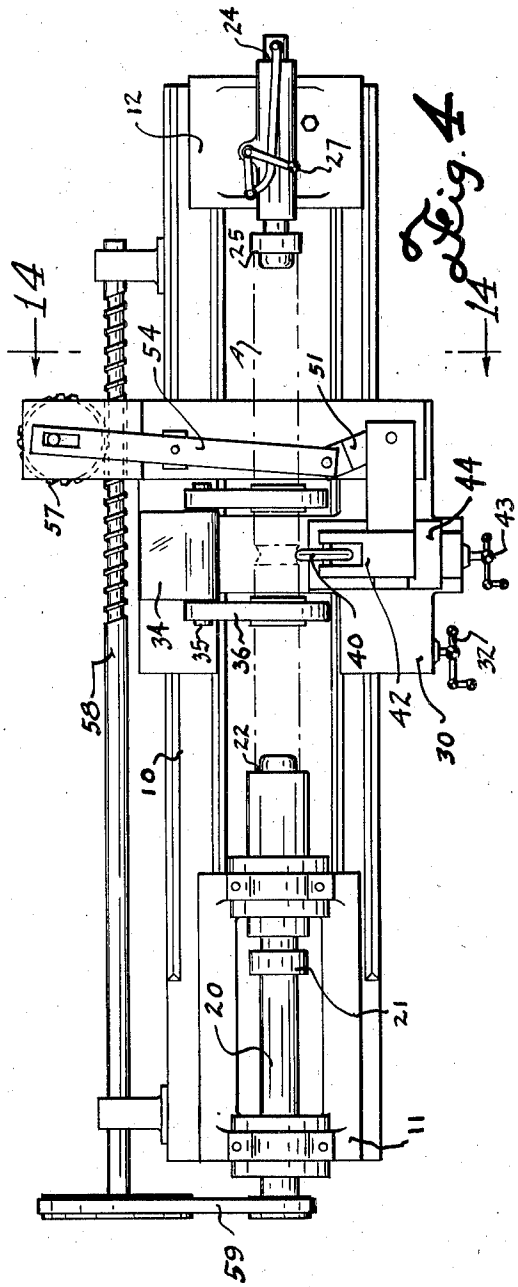


Fig. 4

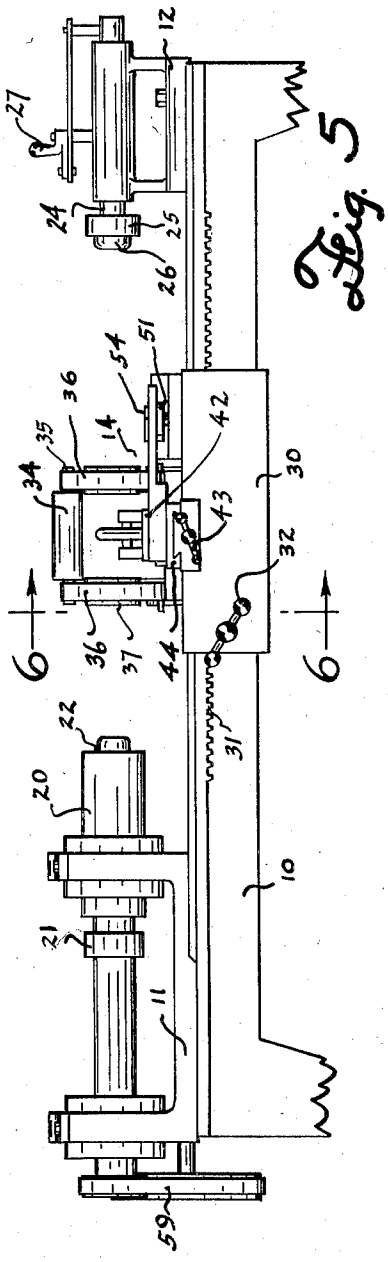


Fig. 5

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ROLLING-IN MACHINE

Filed March 31, 1937 6 Sheets-Sheet 3

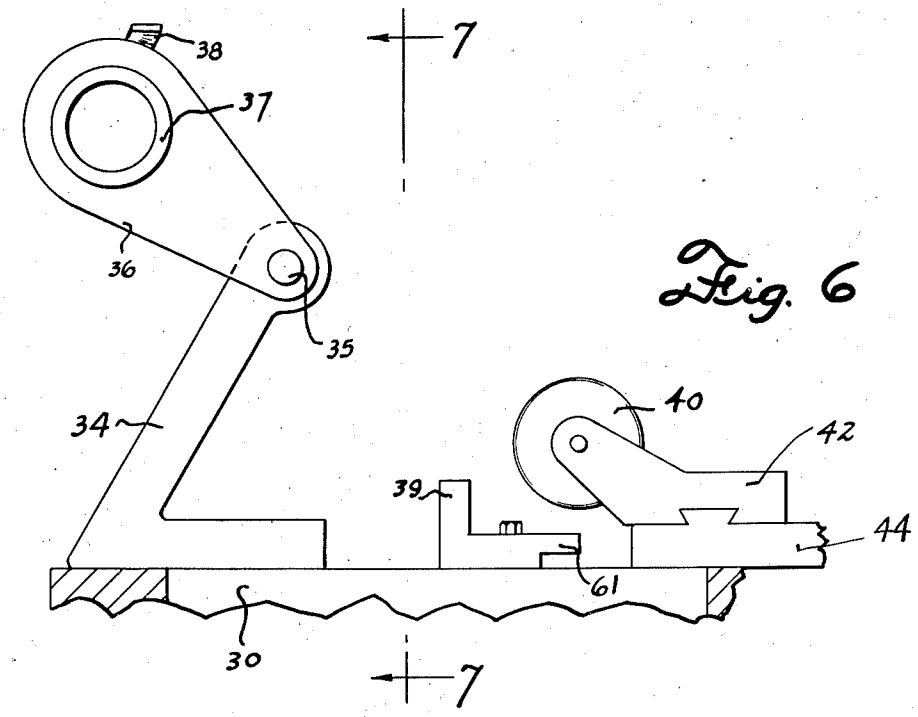


Fig. 6

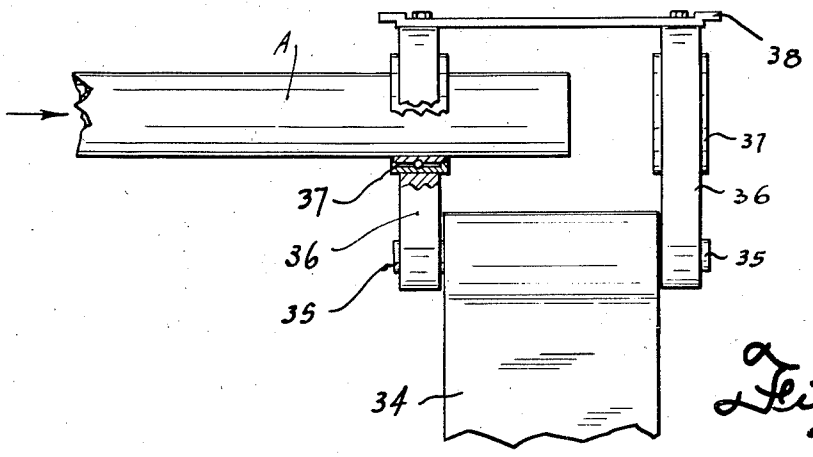


Fig. 7

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ROLLING-IN MACHINE

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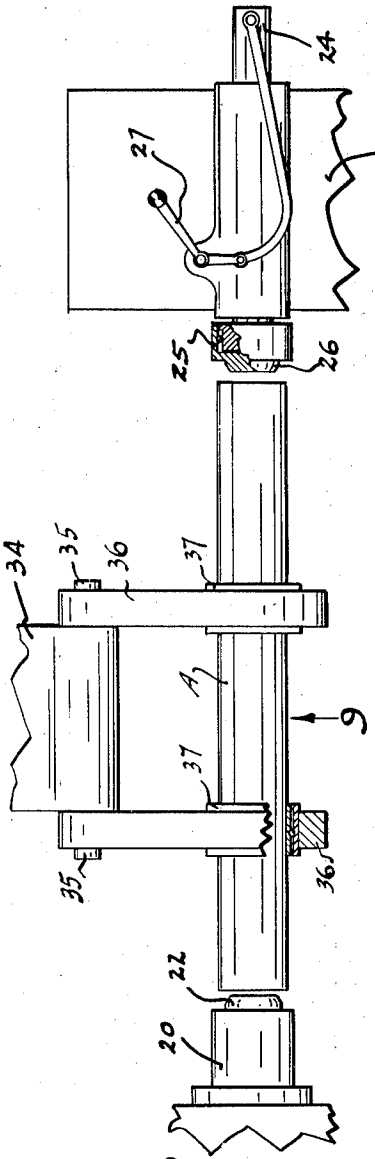


Fig. 8

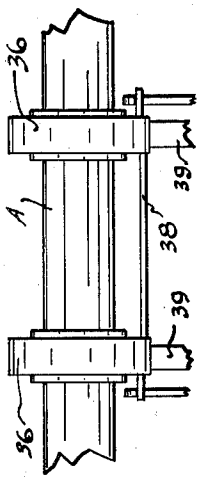


Fig. 9

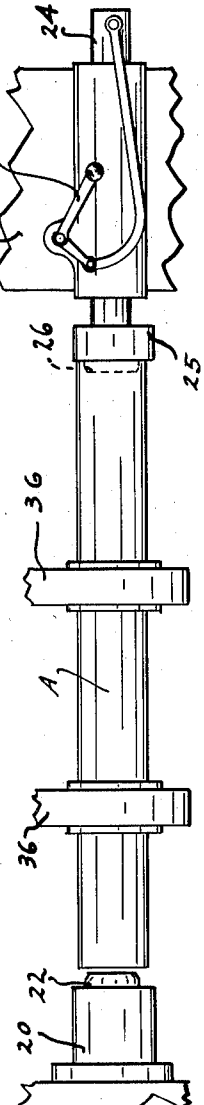


Fig. 10

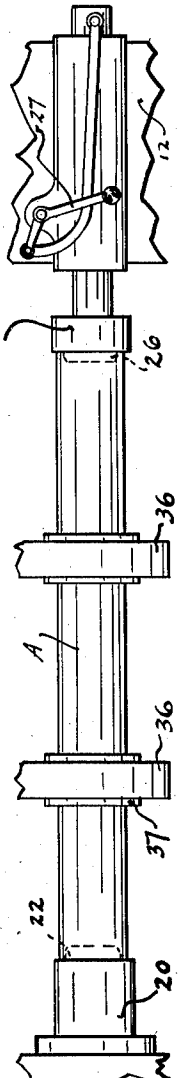


Fig. 11

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May 9, 1939. G. A. VISSER ET AL 2,157,252

ROLLING-IN MACHINE

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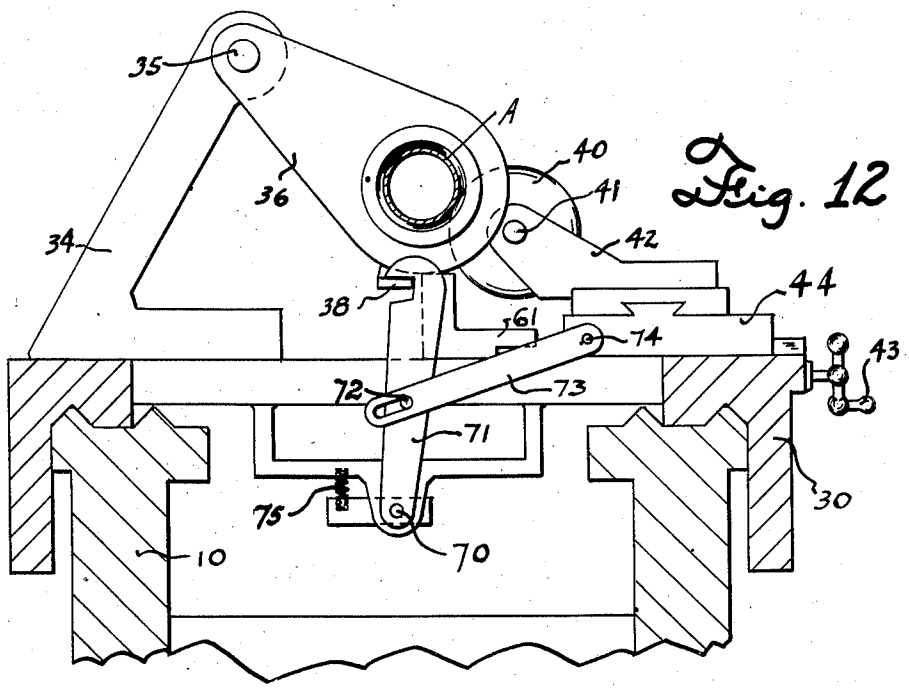


Fig. 12

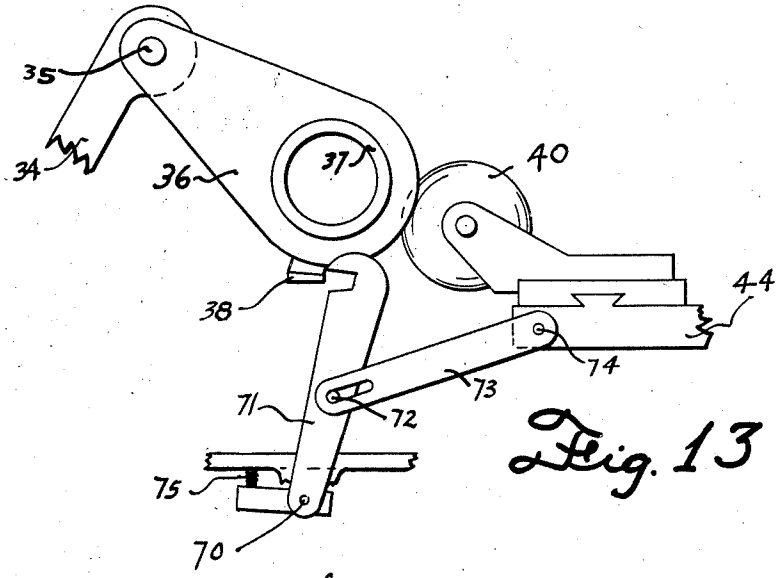


Fig. 13

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ROLLING-IN MACHINE

Filed March 31, 1937 6 Sheets-Sheet 6

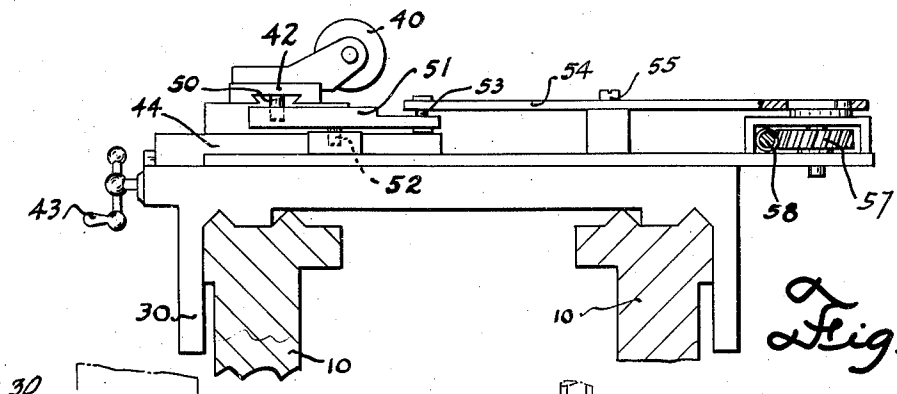


Fig. 14

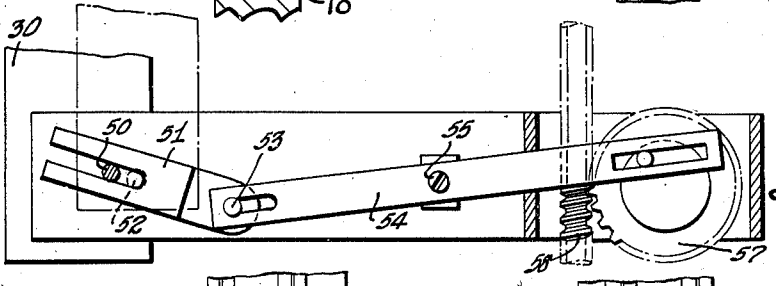


Fig. 16.

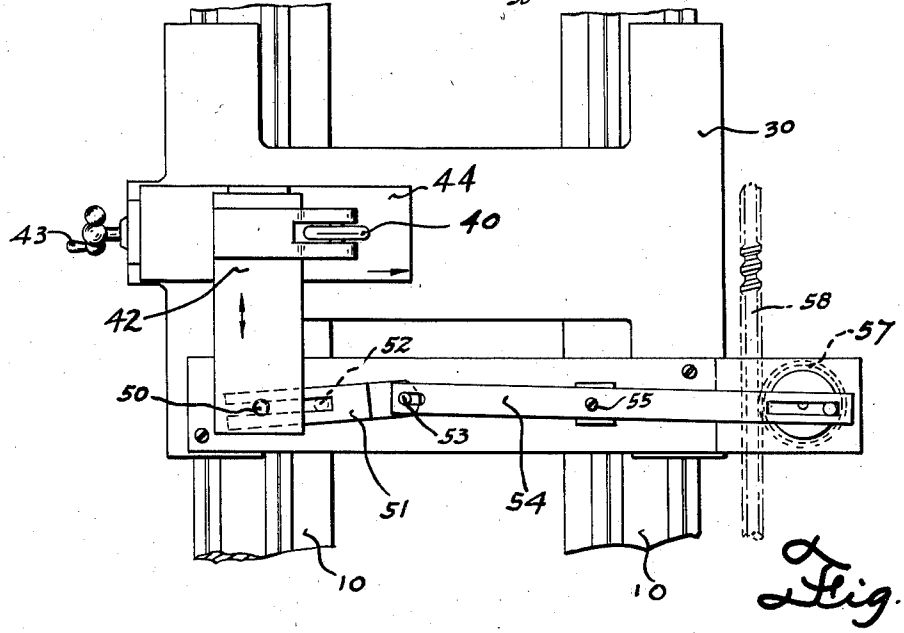


Fig. 15

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Patented May 9, 1939

2,157,252

UNITED STATES PATENT OFFICE

2,157,252

ROLLING-IN MACHINE

George A. Visser, Floyd E. Deremer, and James T. Sprott, Detroit, Mich., assignors to Oldberg Mfg. Co., Detroit, Mich.

Application March 31, 1937, Serial No. 133,940

12 Claims. (Cl. 153—73)

This application relates to a machine for rolling in an inwardly projecting rib in a tube of sheet metal. If the sheet metal tube receives within it a second tube, the ribs may be relied upon to frictionally engage the inner tube and thus hold it in place in the outer tube.

Fundamentally the method is as follows: The tube in which the rib is to be rolled in is rigidly supported and spun or rotated very rapidly about its axis by suitable driving means. A roller tool is reciprocated longitudinally of the axis of the tube while in engagement with the tube, and at the same time is caused to advance towards the axis of the tube.

The longitudinal travel of the roller tool is cut down in amount as the tool advances towards the axis of the tube; by the time the tool has been advanced or fed to its limit and the rib completely rolled in, its longitudinal travel has been cut down to approximately zero.

In the preferred embodiment the tube is positively rotated or spun, whereas the roller tool is mounted to rotate freely on its axis and rotates only because its periphery is in frictional engagement with the rapidly rotating tube.

Also, in the preferred embodiment, the tube or work is supported in the machine, not only at its ends, but also at points as close together as practicable, and between which is the zone in which the rib is to be rolled in, in a work holder; and means are provided for locking the work holder in place during the rolling in operation.

The operation here described amounts to nothing more than a displacement of the metal of the tube in each zone wherein a bead is rolled-in, as will be developed more fully by reference to the appended drawings and specification.

In these drawings,

Figs. 1–3 show a tube in progressive stages of the rolling-in operation, with a rolling-in tool shown nearby;

Fig. 4 is a top plan view of a machine of the invention;

Fig. 5 is a fragmentary front elevation thereof;

Fig. 6 is a fragmentary side section thereof on line 6—6 of Fig. 5, but showing the work holder swung back;

Fig. 7 is a fragmentary front view on line 7—7 of Fig. 6, showing a work piece being inserted in the holder;

Figs. 8, 10, and 11 show the arrangement for supporting the tube in the machine with the parts shown in three different positions;

Fig. 9 is a fragmentary front view on arrow 9 of Fig. 8;

Figs. 12 and 13 are side sections showing the arrangement for locking the work holder in place during the operation of the machine;

Fig. 14 is a fragmentary view in side section showing the means for causing longitudinal reciprocation of the roller tool;

Fig. 15 is a plan view of Fig. 14;

Fig. 16 is a fragmentary plan view of the same means in further detail.

As shown in Figs. 1–3 the operation and machine hereof is intended to form one or more ribs or beads in a sheet metal tube. The tube when brought to the machine is of uniform diameter as shown at A in Fig. 1 and may have within it a second tube B which is to be assembled with respect to the first tube A by the engagement between the second tube B and the inner surfaces of the ribs formed in the outer tube A by the machine and method hereof.

After the rolling-in operation hereof has been carried on for a little while, the zones thereof which are being rolled in have assumed the shape of Fig. 2 which shows a tube A having ribs of slight depth formed therein. At the completion of the rolling-in operation the tube A has deep ribs formed therein as shown in Fig. 3. If the ribs extend to the inner tube B and frictionally engage the latter they aid in maintaining the latter in assembly in the outer tube.

The operation hereof in no way changes the length of the tube A and in no way deforms the tube wall other than to displace the metal in the zones defined by the ribs from the condition of Fig. 1 to that of Fig. 3. It will be observed that the surface area of each such zone remains uniform throughout the operation. The operation of rolling-in by the method and machine herein shown increases the axial length of each zone but at the same time decreases the diameter of each zone. Since the surface area of each zone is a multiple of its axial length and its diameter it will be seen that displacement without deformation takes place because the increase in axial length is compensated for by the decrease in diameter with the result that the

area of each zone remains constant during the operation of the machine herein shown.

The operation is performed as follows: The tube A is spun rapidly on its axis. The roller tool is reciprocated longitudinally and while so reciprocating is advanced towards the axis of the tube until the rib is rolled in, after which it is withdrawn. During the advance of the tool, its longitudinal travel is cut down in amount, until, at the end of the advance or feed, when the rib is completed, the longitudinal travel of the roller tool is zero or nearly so. The roller tool rolls on its bearing because of its frictional peripheral engagement with the tube.

The machine for performing the operation will now be described. It may generally be described as a lathe, since it comprises a bed 10 on which is mounted a head stock 11, a tail stock 12, and a carriage.

The head stock may be of any suitable design. It is shown as provided with a head stock shaft 20 suitably mounted in bearings and caused to rotate at a very high speed by means of a suitable driving mechanism, as for example a motor (not shown) which may be supported below and from the bed of the machine and which may be connected by a belt drive (not shown) to a pulley 21 on the head stock shaft so that the latter rotates rapidly. On the working face of the head stock shaft is an abutment shoulder 22 dimensioned to fit within and form a support for an end of the work which is in the form of a sheet metal tube of uniform diameter.

The tail stock of the machine is mounted on the bed so that it may be moved longitudinally of such bed in a manner that is common to lathe tail stocks. Journalled within the tail stock is the tail stock shaft 24 on whose working end is a head 25 provided with an abutment 26 complementing the abutment 22 on the head stock shaft so as to receive the tail stock end of the tube which is to be operated on by the machine here disclosed. Suitable means herein shown but not herein specifically described, and arranged to be operated by a handle 27, is provided to reciprocate longitudinally the tail stock shaft 24 and with it the abutment 26, towards and away from the head stock 20 for obvious purposes.

Slidably supported on the rails of the lathe is the carriage 14. This generally comprises a carriage base 30 provided with a small pinion (not shown) meshing with the rack 31 on the bed of the machine so that when the pinion is rotated by the carriage travel handle 32 the carriage may be moved to any desired position along the bed of the lathe, as is common with carriages of lathes in general.

Supported on the carriage base is an upwardly extending arm 34 whose upper end is provided with pivotal supports 35 for two parallel work holder arms 36 having holes therethrough in which are free running roller bearings 37 so dimensioned as to be capable of closely receiving within them the tube or work intended to be operated on by the machine, the relative dimensions of the tube and the interior of the roller bearings being such that the tube may be slid into such roller bearings freely and easily without, however, there being an excessive disparity between such dimensions to cause an excessive play between the tube and these bearings. Connecting the arms 36 so that these and the connecting part comprise a unitary work holder is a connecting bar 38.

When the machine is about to receive a tube to be worked on, the tail stock is drawn back to the position shown in Fig. 8 by means of the handle 27 and at the same time the work holder is swung on its pivotal mounting 35 to the work-receiving position of Fig. 6. The tube is then slid endwise into the roller bearings 37 of the work holder arms 36 until the ends of the tube are within the span between the head and tail stock abutments 22 and 26. Then the work holder is swung forwardly, the termination of such forward swing of the work holder being determined by the engagement of the work holder arms with suitable stop portions 39, Fig. 6, secured to the carriage base 30.

Thereafter the tail stock handle 27 is moved first to cause the tail stock abutment 26 to dispose itself within the tail end of the tube and then to cause the tail stock to advance further towards the head stock and move the work so that its head end receives the head stock abutment 22. When this has been done it will be found that the work is supported at its ends on the head and tail stock ends in coupled relation with the head stock shaft so as to be driven thereby and at the same time is supported by the work holder arms 36 at points between which is the zone in which is to be rolled in the rib. The stress imparted on the tube by the operation of rolling-in the rib is absorbed by the work holder arms which are close to the rib being rolled in and in this way undue beam deflection of the tube as a whole due to the load imparted thereon by the operation being performed thereon is prevented.

After the work is suitably supported on the head and tail stocks and coupled to the head stock for driving, the tube is then worked on by the roller tool which is now to be described. The roller tool comprises a roller 40 journalled freely at 41 on an arm 42 arranged to be advanced towards or away from the axis of the tube, moving relatively to the carriage base 30, by a suitable feeding means not herein shown but intended to be operated by the feed handle 43 which operates on the arm 42 through the medium of a feed block 44 arranged to slide towards the work on the carriage base 30. The roller tool is generally of large diameter compared to its axial length, as illustrated, and its edge is formed of the contour desired for the rib to be rolled in the tube or work. It is journalled freely but steadily in the arm 42 so that it can be rotated by the frictional engagement between the edge of the roller tool 40 and the surface of the tube which it engages.

The roller tool is not only moved axially towards the work or tube by the feed handle 43, but in addition is caused to reciprocate longitudinally with respect to the carriage base 30 by a reciprocator means about to be described. Such means includes a pin 50 formed on the arm 42 and projecting downwardly into a yoke 51 pivotally mounted at 52 on the carriage base 30 and pivotally connected at 53 to an oscillating arm 54 which is also pivotally connected to the carriage base so as to be mounted thereby at 55. The rear or free end of the oscillating arm 54 is operatively connected to a worm wheel 57 in mesh with a worm 58 arranged to extend longitudinally of the machine at the rear thereof and arranged to be rotated constantly from the head stock shaft through the medium of a belt drive referenced generally 59.

It will be observed that during the operation of the machine the roller tool 40 is constantly reciprocated longitudinally of the machine by virtue of the reciprocator means just described. With-

out interfering with such reciprocating movement of the roller tool, the latter may be caused to advance axially towards the work by the feed handle 43.

The means herein described has been so designed that automatically and without attention on the part of the operator the amount of longitudinal travel of the roller tool is reduced in correspondence to the degree of feed. This relation is established, as shown best in Fig. 16, by the variation in the distance between the pin 50 and the pivot 52 of the oscillating yoke 51. At the beginning of feed the distance between pin 50 and pivot 52 is at its maximum and consequently the longitudinal travel of pin 50, and roller tool 40, is at its maximum. As feed progresses, the distance between pin 50 and pivot 52 automatically lessens, and such lessening of this distance is reflected in a lessening of the longitudinal travel of the roller tool 40, until the roller tool 40 has been fed towards the work to its limit, at which time the distance between said pin 50 and pivot 52 is at its minimum, reflecting in the minimum of longitudinal travel for the roller tool 40.

In the operation of the machine the feed or advance of the roller tool 40 towards the work is terminated by the engagement of the feed block 44 with a feed stop 61 supported on the carriage base 30 of the machine and suitably located. In the event the machine is used to roll beads in tubes at a time when such tubes contain within them other tubes, and it is desired that the depth of the ribs be sufficient to cause the inner surfaces thereof to engage the inner tubes, the termination of feed may be determined not only by or not even by a stop, such as the stop 61, but by the resistance offered to further feed of the tool 40 by the engagement of the rolled-in ribs with the inner tube, such resistance being felt by the operator at the feed handle 43.

In order to insure the work holder being locked securely in work holding position during the rolling-in operation, an automatic lock therefor has been provided and the same will now be described. Pivotally mounted on the carriage base 30 at the pivot 70 is a locking arm 71 having a hooked end adapted to be hooked over the cross bar 38 which connects the work holder arms 36 and with them forms a unitary work holder. The locking arm is connected by a pin 72 to a slotted locking link 73 which in turn is pivotally connected at 74 to the feed block 44. The locking arm 71 is, furthermore, spring urged at 75 to remain normally in a locking position.

When the operation of rolling-in a bead is about to commence, the work holder arms 36 and their connecting and locking bar 38 are swung down onto the stops 39. At this time the feed block 44 is most remote from the work and consequently the locking arm 71 is restrained by link 73 and is in the position where its hooked end is not locked over the cross bar 38 of the work holder. The relation of the locking arm 71 and the roller tool 40 is such that though both are advanced in the same direction, and simultaneously, the locking arm 71 hooks over the work holder connecting bar 38 before the roller tool 40 reaches the work. Therefore advance of the feed block 44 towards the work first permits the locking arm 71 to hook over the work holder connecting bar 38 and lock the work holder unit onto the stop 39 and thus form a rigidly held firm support for the work. Further advance of the feed block 44 in no way disturbs the previously established locking of the work holder but merely causes the roller tool 40 to advance towards and engage the tube, this further advance being permitted by the slot in link 73. On completion of the rolling-in operation the feed block 44 is caused to retreat and such action first pulls the tool 40 out of the rib and away from the work and then releases the work holder unit. It will be observed that an interval elapses between the time that the tool 40 is pulled away from the work and the time that the work holder unit is released. This interval, coupled with the interval that elapses between the time that the work holder unit is locked in place and the time that the tool engages the work, is important in insuring the work holder unit being securely locked at all times that the work is in engagement with the roller tool; in other words, these intervals guard against the tool operating on the work except when the work is securely held in place.

The machine and method hereof have been found useful with particular reference to tubes made of thin sheet metal which are not heavy enough to offer the necessary resistance to the loads imparted to the tubes by the rolling-in tools. Where beads are formed in tubes of very heavy stock, it is entirely possible that other methods than the one herein disclosed might be employed, inasmuch as the weight of the stock provides the tubes with suitable resistance to the loads imparted by the rolling-in rollers, which resistance, incidentally, might be obtained, even in the case of thin sheet metal stock, by the provision of an arbor for the tube being worked upon. In the instance herein disclosed, the resistance is created not by the weight of the stock and not by the use of a center arbor, but solely by the centrifugal forces created by the extremely rapid rotation of the tubes.

Now having described the method and the machine hereof, reference will be had to the claims which follow for a determination of the scope of this invention.

We claim:

1. A machine for forming an inwardly projecting bead in a sheet metal tube comprising means for holding the tube at its ends, with no mandrel therein, and rapidly rotating it axially while it is so held, a rounded edge roller tool, means rotatably mounting said tool on an axis parallel to and adjacent the tube axis, means for moving said tool transversely towards the tube axis.

2. A machine for forming an inwardly projecting bead in a sheet metal tube comprising means for holding the tube and rapidly rotating it axially, a rounded edge roller tool, means rotatably mounting said tool on an axis parallel to and adjacent the tube axis, means for moving said tool transversely towards the tube axis, the tube holding means including elements through which the tube passes and which form abutments against the thrust produced on the tube by the advance of the tool, and means actuated by the advance of the tool towards the tube for locking the elements stationarily and firmly while the tool engages the tube.

3. A machine for forming an inwardly projecting bead in a sheet metal tube comprising means for holding the tube and rapidly rotating it axially, a rounded edge roller tool, means rotatably mounting said tool on an axis parallel to and adjacent the tube axis, means for moving said tool transversely towards the tube axis and means for reciprocating the tool longitudinally

along the tube while the tool moves transversely, and means for reducing the reciprocating travel of the tool in accordance with the advance of the tool towards the tube axis, the last mentioned means being synchronized to the advance of the tool so that the tool reciprocatory travel reduction is automatically correlated to the tool advance.

4. A machine for forming an inwardly projecting bead in a sheet metal tube comprising means for holding the tube at its ends, with no mandrel therein, and rapidly rotating it axially while it is so held, a rounded edge roller tool, means rotatably mounting said tool on an axis parallel to and adjacent the tube axis, means for moving said tool transversely towards the tube axis, the tube holding means including elements between the ends of the tube through which the tube passes and which form abutments against the thrust produced on the tube by the advance of the tool, and means actuated by the advance of the tool towards the tube for locking the elements stationarily and firmly while the tool engages the tube.

5. A machine for forming an inwardly projecting bead in a sheet metal tube comprising means for holding the tube at its ends, with no mandrel therein, and rapidly rotating it axially while it is so held, a rounded edge roller tool, means rotatably mounting said tool on an axis parallel to and adjacent the tube axis, means for moving said tool transversely towards the tube axis, the tube holding means including elements between the ends of the tube through which the tube passes and which form abutments against the thrust produced on the tube by the advance of the tool, the elements being closely spaced and so related to the tool that the bead formed by the tool is between the elements, and means actuated by the advance of the tool towards the tube for locking the elements stationarily and firmly while the tool engages the tube.

6. A machine for forming an inwardly projecting bead in a sheet metal tube comprising means for holding the tube at its ends, with no mandrel therein, and rapidly rotating it axially while it is so held, a rounded edge roller tool, means rotatably mounting said tool on an axis parallel to and adjacent the tube axis, means for moving said tool transversely towards the tube axis and means for reciprocating the tool longitudinally along the tube while the tool moves transversely, and means for reducing the reciprocating travel of the tool in accordance with the advance of the tool towards the tube axis, the last mentioned means being synchronized to the advance of the tool so that the tool reciprocatory travel reduction is automatically correlated to the tool advance.

7. A machine for forming an inwardly projecting bead in a sheet metal tube comprising means for holding the tube and rapidly rotating it axially, a rounded edge roller tool, means rotatably mounting said tool on an axis parallel to and adjacent the tube axis, means for moving said tool transversely towards the tube axis and means for reciprocating the tool longitudinally along the tube while the tool moves transversely, and means for reducing the reciprocating travel of the tool in accordance with the advance of the tool towards the tube axis, the last mentioned means being synchronized to the advance of the tool so that the tool reciprocatory travel reduction is automatically correlated to the tool advance, the tube holding means including elements between the ends of the tube through which the tube passes and which form abutments against the thrust produced on the tube by the advance of the tool.

8. A machine for forming an inwardly projecting bead in a sheet metal tube comprising means for holding the tube and rapidly rotating it axially, a rounded edge roller tool, means rotatably mounting said tool on an axis parallel to and adjacent the tube axis, means for moving said tool transversely towards the tube axis and means for reciprocating the tool longitudinally along the tube while the tool moves transversely, and means for reducing the reciprocating travel of the tool in accordance with the advance of the tool towards the tube axis, the last mentioned means being synchronized to the advance of the tool so that the tool reciprocatory travel reduction is automatically correlated to the tool advance, the tube holding means including elements between the ends of the tube through which the tube passes and which form abutments against the thrust produced on the tube by the advance of the tool, the elements being closely spaced and so related to the tool that the bead formed by the tool is between the elements.

9. A machine for forming an inwardly projecting bead in a sheet metal tube comprising means for holding the tube and rapidly rotating it axially, a rounded edge roller tool, means rotatably mounting said tool on an axis parallel to and adjacent the tube axis, means for moving said tool transversely towards the tube axis and means for reciprocating the tool longitudinally along the tube while the tool moves transversely, and means for reducing the reciprocating travel of the tool in accordance with the advance of the tool towards the tube axis, the last mentioned means being synchronized to the advance of the tool so that the tool reciprocatory travel reduction is automatically correlated to the tool advance, the tube holding means including elements between the ends of the tube through which the tube passes and which form abutments against the thrust produced on the tube by the advance of the tool, the elements being closely spaced and so related to the tool that the bead formed by the tool is between the elements, and means actuated by the advance of the tool towards the tube for locking the elements stationarily and firmly while the tool engages the tube.

10. A machine for forming an inwardly projecting bead in a sheet metal tube comprising means for holding the tube at its ends, with no mandrel therein, and rapidly rotating it axially while it is so held, a rounded edge roller tool, means rotatably mounting said tool on an axis parallel to and adjacent the tube axis, means for moving said tool transversely towards the tube axis, means for reciprocating the tool longitudinally along the tube while the tool moves transversely, and means for reducing the reciprocating travel of the tool in accordance with the advance of the tool towards the tube axis.

11. A machine for forming an inwardly projecting bead in a sheet metal tube comprising means for holding the tube at its ends, with no mandrel therein, and rapidly rotating it axially while it is so held, a rounded edge roller tool, means rotatably mounting said tool on an axis parallel to and adjacent the tube axis, means for moving said tool transversely towards the tube axis, the tube holding means including elements between the ends of the tube through which the tube passes and which form abutments against the thrust

produced on the tube by the advance of the tool.

12. A machine for forming an inwardly projecting bead in a sheet metal tube comprising means for holding the tube at its ends, with no mandrel therein, and rapidly rotating it axially while it is so held, a rounded edge roller tool, means rotatably mounting said tool on an axis parallel to and adjacent the tube axis, means for moving said tool transversely towards the tube axis, the tube holding means including elements between the ends of the tube through which the tube passes and which form abutments against the thrust produced on the tube by the advance of the tool, the elements being closely spaced and so related to the tool that the bead formed by the tool is between the elements.

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