Aug. 21, 1962 J. D. BROWN 3,050,023

TUBE SPINNING MACHINE

Filed May 29, 1959 7 Sheets-Sheet 1

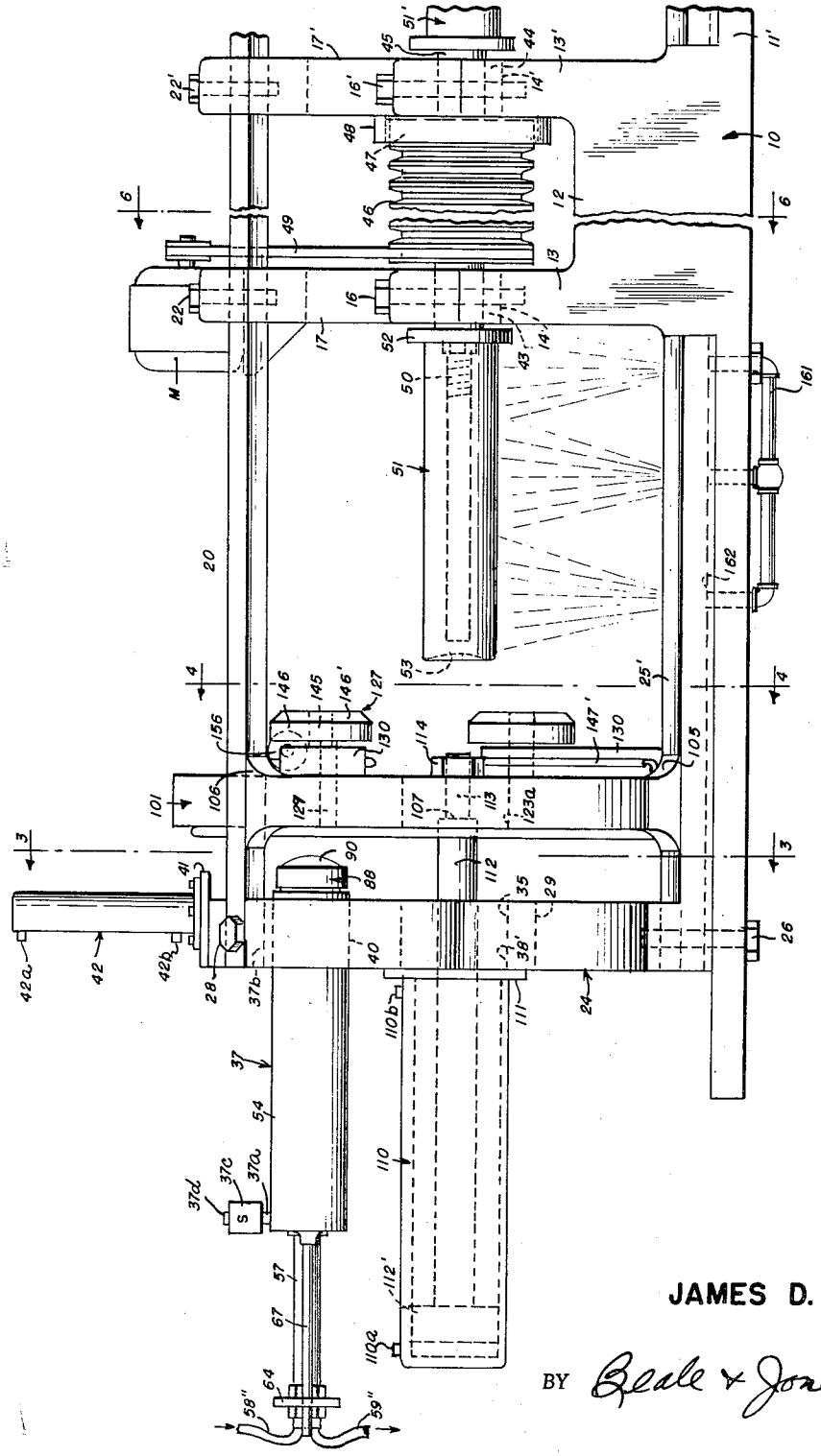


FIG. 1

INVENTOR
JAMES D. BROWN

BY Beale & Jones

ATTORNEYS

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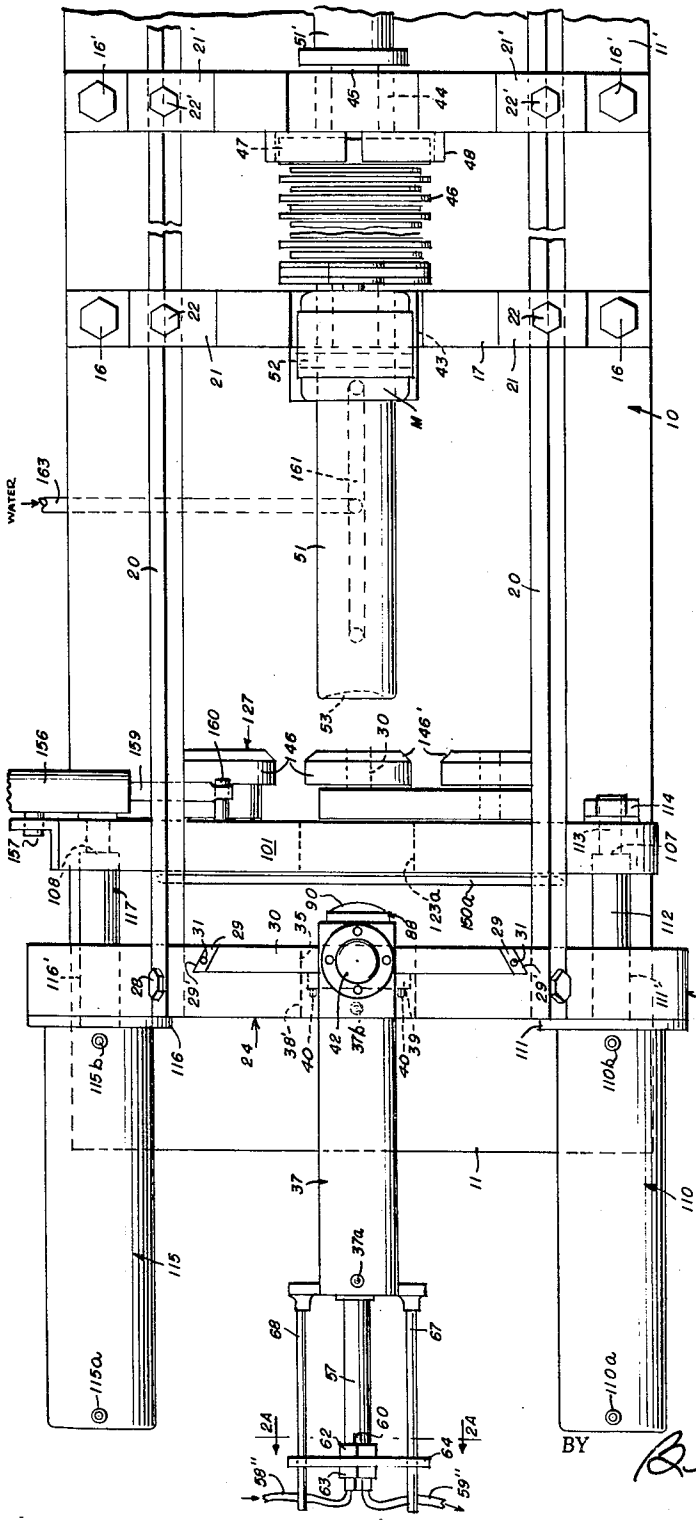


FIG. 2

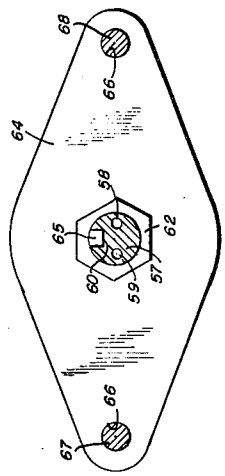


FIG. 2A

INVENTOR
JAMES D. BROWN

BY Beale & Jones
ATTORNEYS

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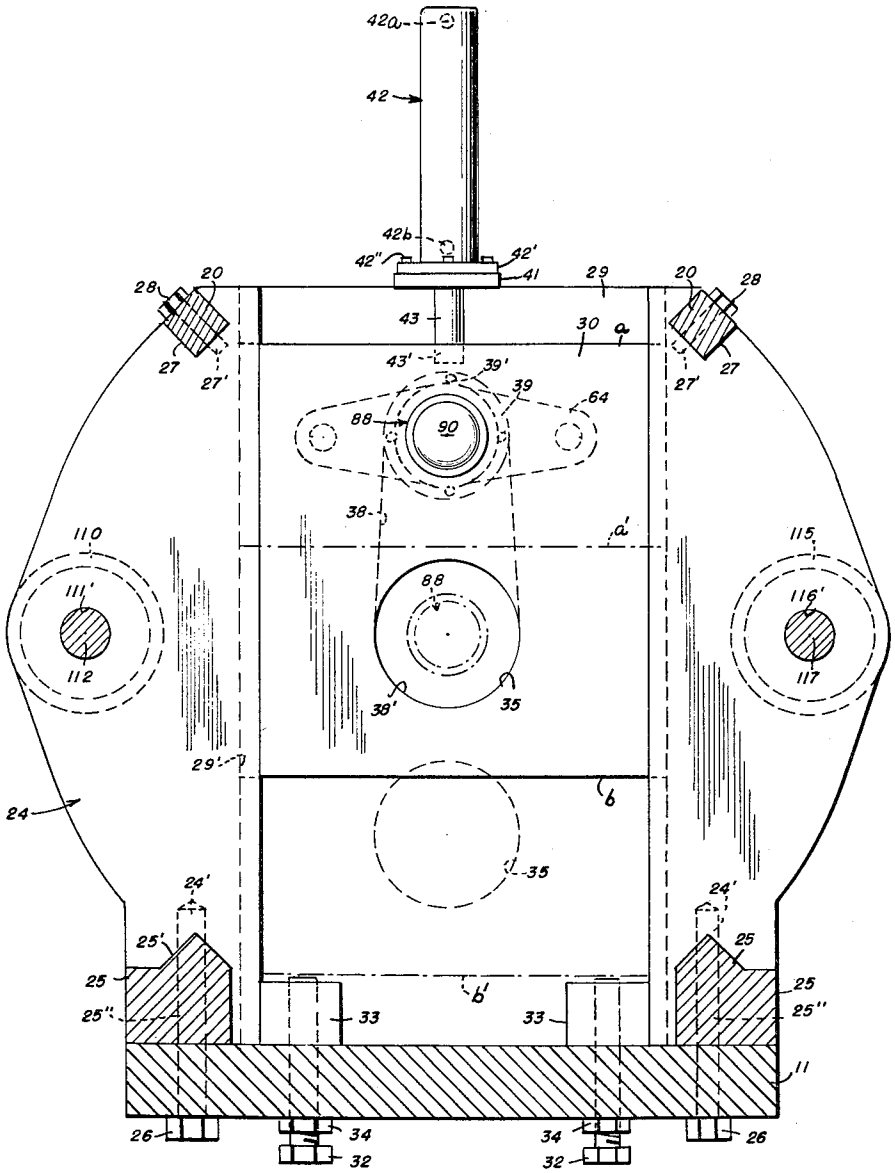


FIG. 3

INVENTOR

JAMES D. BROWN

BY Beale & Jones

ATTORNEYS

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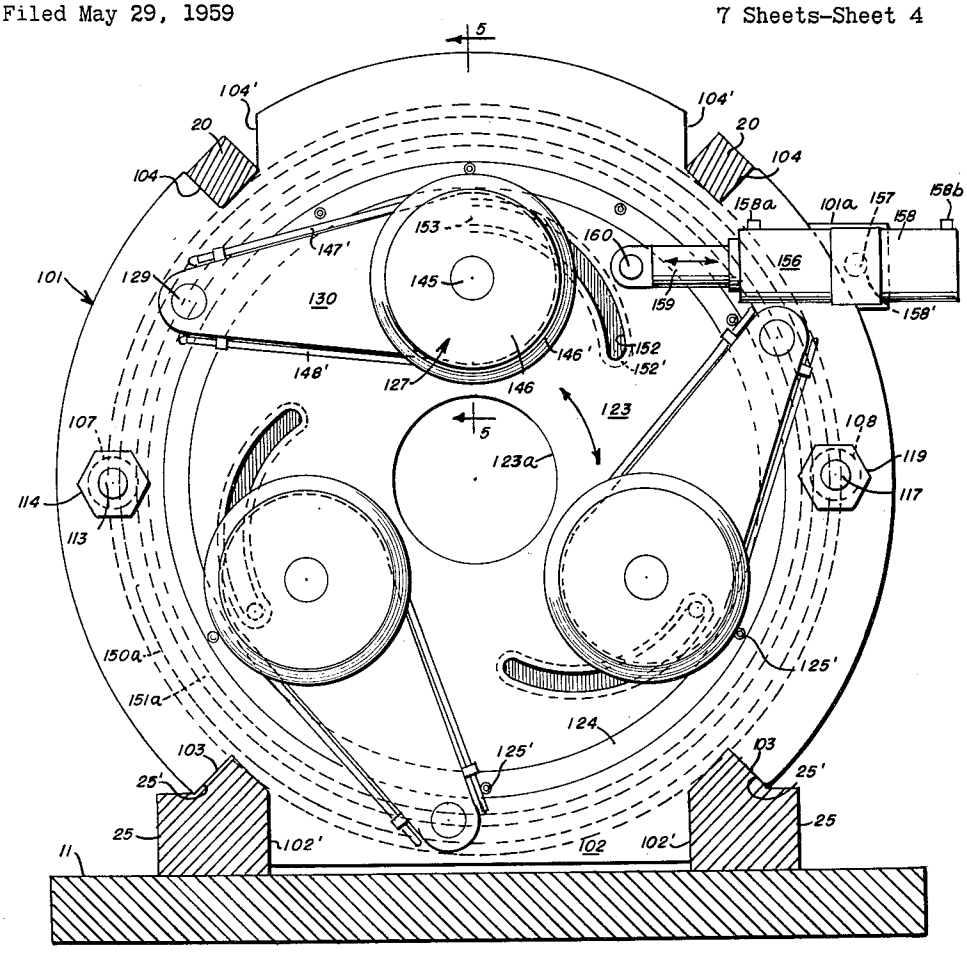


FIG. 4

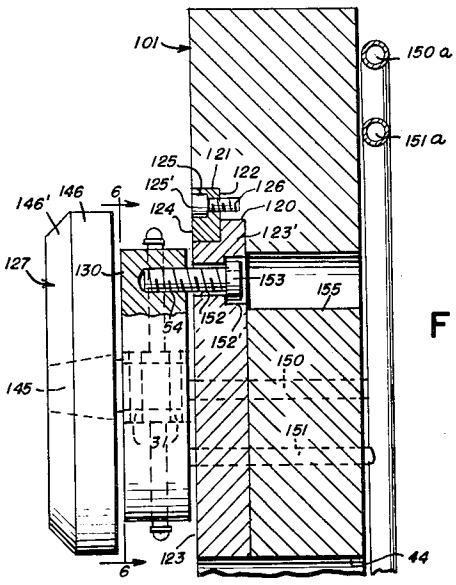


FIG. 5

INVENTOR
JAMES D. BROWN

BY Beale & Jones

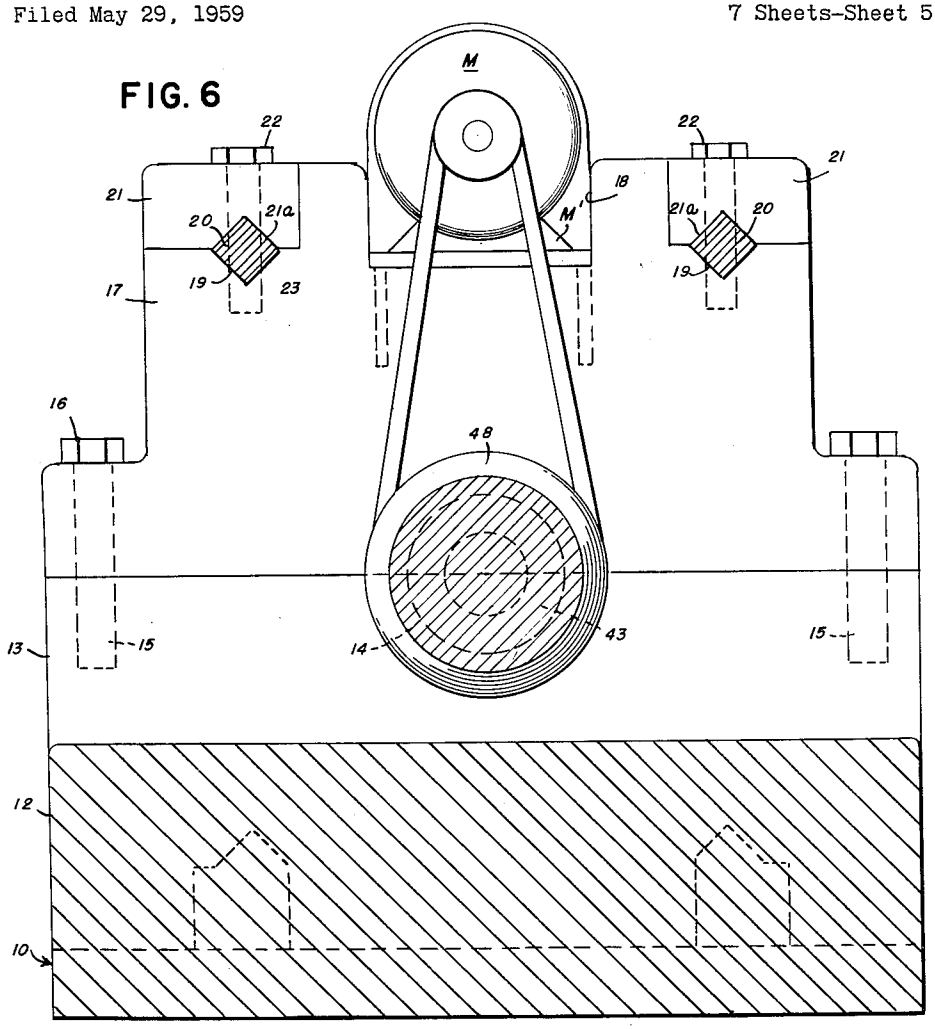
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FIG. 6



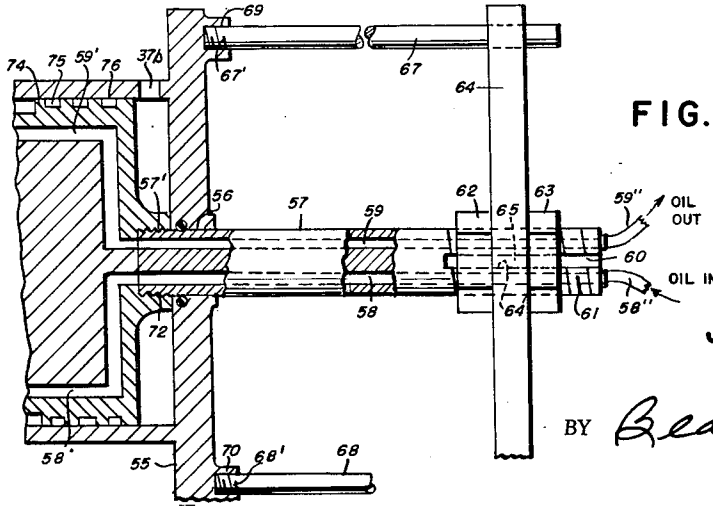


FIG. 9A

INVENTOR
JAMES D. BROWN

BY Beale & Jones

ATTORNEYS

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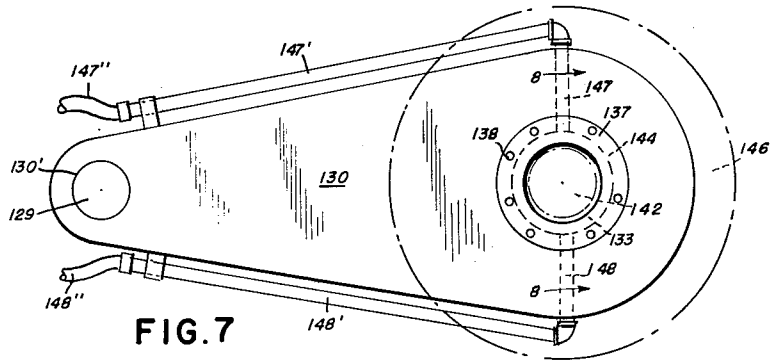


FIG. 7

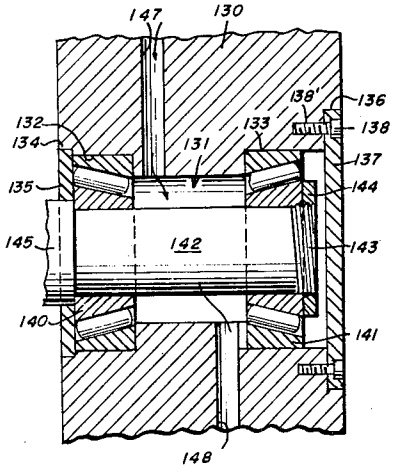


FIG. 8

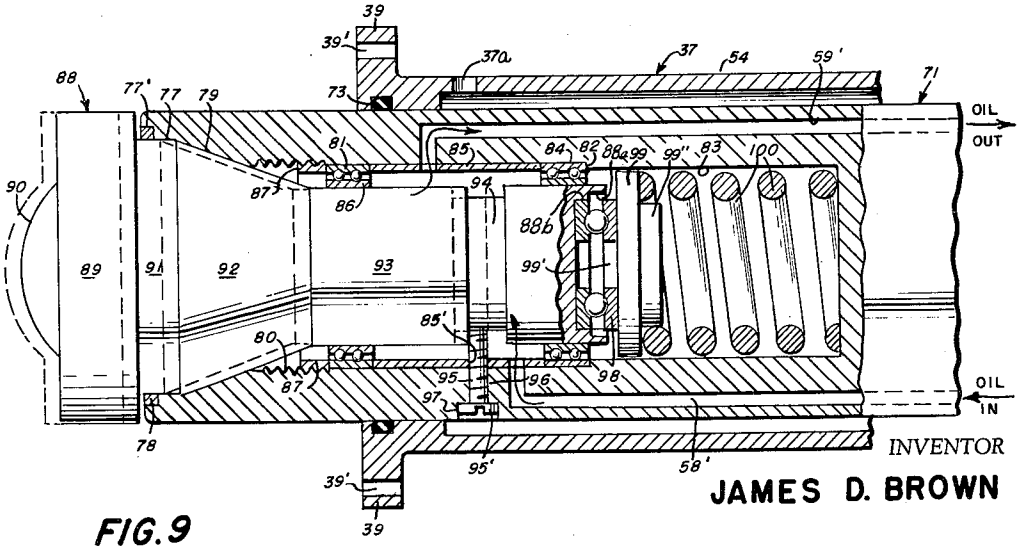


FIG. 9

INVENTOR
JAMES D. BROWN

BY Beale & Jones

ATTORNEYS

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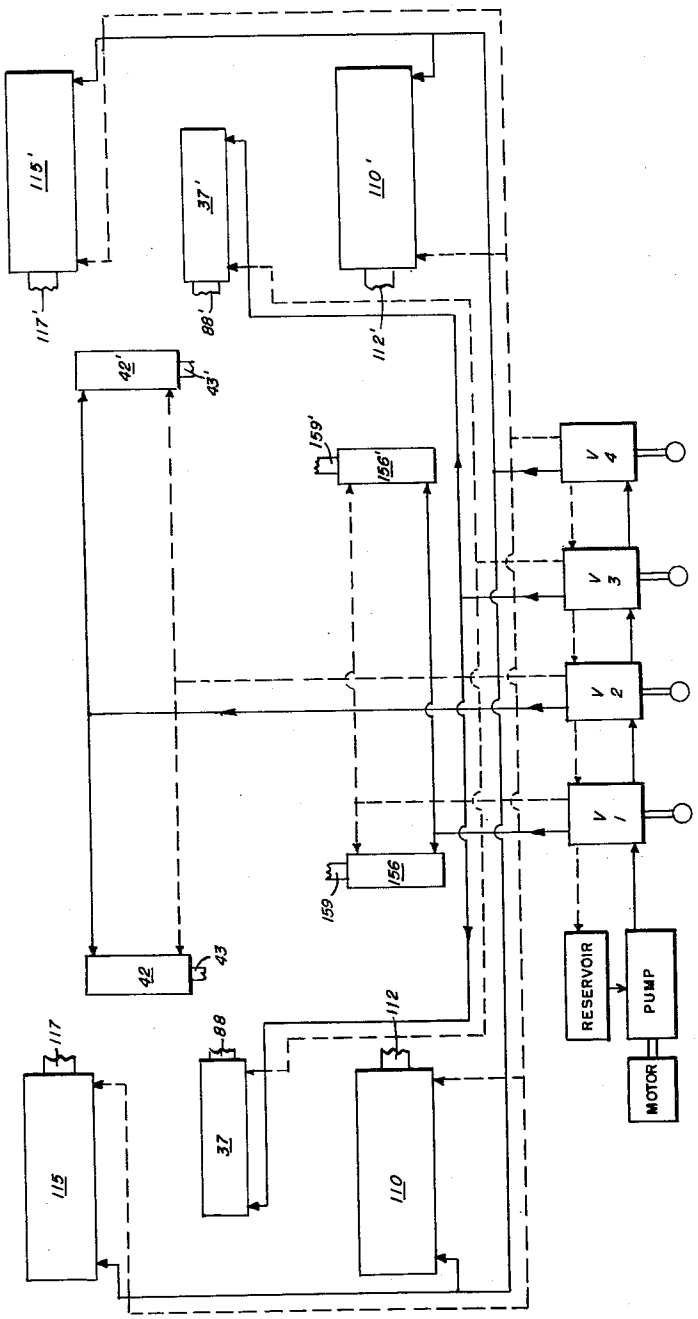


FIG. 10

INVENTOR

JAMES D. BROWN

BY Beale & Jones

ATTORNEYS

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3,050,023

TUBE SPINNING MACHINE

James D. Brown, R.D. 2, Box 300A, Halifax, Pa.

Filed May 29, 1959, Ser. No. 816,927
3 Claims. (Cl. 113—52)

This invention relates to improvements in tube spinning machines and particularly to the formation of closed end tubes from preformed cups, pierced billets or plate stock.

The apparatus according to this invention is for the forming of closed end cylinders of the heavy duty type as are used for storage of oxygen, acetylene, etc. The initial closed end cylinder is formed on this apparatus and is worked down further and has a neck formed thereon by other suitable machines. The closed end rough cylinder has heretofore been punched out of a billet and the walls have been very nonuniform. By the hereinafter described apparatus blank closed end cylinders are formed having very uniform wall thickness throughout and thus a much better product that is finally finished as a high pressure gas container is ultimately able to be formed.

It is an object of the invention to form on a single machine a closed end tube from preformed cups, pierced billets or a piece of plate stock.

Another object of the invention is to provide spinning apparatus for readily forming a closed end tube wherein the wall thickness is maintained uniform throughout its circumference and length.

A further object of the invention is to provide a closed end tube spinning machine which is double-ended having oppositely positioned rotated mandrels over each of which is formed a closed end tube by means of axially and radially movable rollers.

A still further object of the invention is to provide a double-ended rotating mandrel type of tube spinning machine in which a blank of sheet stock is utilized and clamped over the end of each rotating mandrel by an axially and transversely movable pressure member whose transverse movement after axial movement to release the cylinder on the mandrel permits removal of the formed closed end cylinder after spinning.

Other objects of this invention will in part, be obvious and in part appear hereinafter. This invention is disclosed in the embodiment thereof shown in the accompanying drawings and it comprises the features of construction combination of elements and arrangement of parts that will be exemplified in the construction hereinafter set forth and the scope of the application of which will be indicated in the appended claims.

For a more complete understanding of the nature and scope of this invention, reference may be had to the following detailed description, taken together with the accompanying drawings in which:

FIG. 1 is a front elevation of the center and left-hand end of the duplicate-ended spinning machine;

FIG. 2 is a top plan view of the machine shown in FIG. 1;

FIG. 2*a* is a section of the tailstock mounting along line 2A—2A of FIG. 2 on an enlarged scale;

FIG. 3 is a vertical section along line 3—3 of FIG. 1 on an enlarged scale showing the mounting of the tailstock and its operator for transverse movement to permit removal of a formed-up closed end tube;

FIG. 4 is a vertical section along line 4—4 of FIG. 1 on an enlarged scale and showing the mounting and movement of tri-rollers;

FIG. 5 is a vertical cross section on an enlarged scale along line 5—5 of FIG. 4 showing a roller mounting and lubrication of same;

FIG. 6 is an enlarged scale view along line 6—6 of FIG. 1 showing the upper top rails and idler motor mounting and drive of mandrel shaft;

FIG. 7 shows a roller arm mounting of one of the arms in FIG. 4 on an enlarged scale and the combined lubrication and cooling lines leading to the bearing thereof;

FIG. 8 is a sectional view on line 8—8 of FIG. 7 showing the bearings of the roller mounting on a further enlarged scale;

FIG. 9 is the forward end on an enlarged scale of the tailstock structure;

FIG. 9A is the other end, the rear end, of the tailstock shown in FIG. 9; and

FIG. 10 is a diagrammatic layout of the power cylinders for the various components and the supply of fluid controlled thereto.

Throughout the description like reference numerals refer to similar parts.

A base generally indicated at **10** forms the main frame of the machine. This base or main frame had bed plates **11** extending to either side as at **11** and **11'**, shown in FIG. 1, an integrally formed and extending upward from the center portion is a center section **12** having bifurcations **13** and **13'** which extend up as mounting members. Each of these members **13** and **13'** has a central bearing recess generally indicated at **14** in FIG. 6 to receive the tapered bearings that mount the mandrels, as will be explained.

At each of the ends of the upstanding bifurcated member **13**, see FIG. 6, there is a threaded aperture **15—15** to receive cap screws **16** which secure respectively on each upstanding bifurcation a vertical support **17** which has a notched-out center portion **18** to receive a motor mounting M' and V-shaped slots **19** on either side to receive longitudinally extending top rails **20—20**. These top rails are secured on the member **17** by means of cap blocks **21** which have a vertical aperture therethrough to receive cap screws **22** that are threadedly received in apertures **23** formed in the vertical members **17**. These vertical members or top rail supports **17** are positioned on each of the upstanding bifurcations **13** and **13'**, as shown in FIG. 1. It will be noted that the lower face of the cap blocks **21** has a V-shaped recess **21***a* therein opposite the recess **19** in the rail support member **17** so as to receive the rails which, in this instance, are substantially square shape in cross section.

A tailstock support generally indicated at **24** that supports the outer ends of the rails **20—20** and certain power apparatus will now be described. Reference to FIG. 3 shows the left base end **11** having mounted on either side lower rails **25—25** having upwardly extending V-shape bearing surfaces **25'** and apertured with vertical apertures **25''** to receive securing screws **26** which extend up into the threaded apertures **24'** in the base of tailstock support **24**. The tailstock support **24** and its mounting best shown in FIG. 3 is formed with square recesses at its upper corners as indicated at **27** which have threaded aperture **27'** at their base and receive the outer ends of the top rails **20** which are secured by cap screws **28**. The tailstock support **24** is formed with a slideway **29** from top to bottom in the right-hand face as shown in FIG. 2. Each side of the slideway **29** is formed with tapered shoulders **29'** within which is slidably received the mounting plate **30** for the tailstock. This mounting plate **30** has dovetail edges and is held within the slide receiving recess **29** by gibs **31** as shown in FIG. 2 which take up the slack and provide a proper slide fit for the plate **30**. In the partly raised position of the plate **30** as shown in FIG. 3, the upper edge is at position *a* and its lowered position would be shown from the top edge *a'* as in broken line while the two respective positions for the bot-

tom edge are at *b* and *b'*. Adjustable positioning of the plate on downward movement is afforded by the screws **32** extending up through bed **11** into threaded apertured blocks **33** positioned on the top surface of the bed **11**. Locknuts **34** serve to lock the screws **32** in adjusted position. In FIG. 3, the tailstock support **24** has an aperture **35** formed therein extending from front to back and in line with the central apertures **14** and **14'**, see FIG. 1, in which lies the axis of the mandrel to be described. Thus, a cylinder formed on the mandrel as will be described may be removed through the aperture **35** when the tailstock slide **30** is elevated to extreme top position. The description of the tailstock will continue. In the tailstock support **24** there is an elongated aperture **38** having the bottom **38'** in line with the aperture **35** in the plate **30** when the plate **30** is in down position. Extending through an aperture **39** in the upper portion of plate **30** is the tailstock or fluid pressure actuated jack generally indicated at **37** in FIGS. 1 and 2. In order to accommodate the sliding movement of the tailstock **37** with its mounting plate **30** an elongated cutout indicated by the broken lines **38** in FIG. 3 in tailstock support **24** extends upward from the bottom **38'** in line with aperture **35** in the plate **30**. This cutout portion **38—38'** permits the tailstock to be moved up and down in member **24**. Thus, the tailstock **37** is lowered to place the axis thereof on the axis of the mandrel, as will be explained.

The tailstock **37** is shown in FIGS. 9 and 9A on an enlarged scale and is provided with a transversely extending apertured flange **39** having apertures **39'** therein in its outer main body to provide for mounting of the same on plate **30**. This flange **39** is shown mounted in FIG. 2 and FIG. 3 by means of cap screws **40**, see FIG. 2, which extend into threaded apertures in the plate **30**. Attached to the top of tailstock support **24** for the tailstock is the horizontal plate **41**, see FIG. 3, on which is mounted a tailstock actuating power cylinder generally indicated at **42** having a lower flange **42'** that is secured by screws **42''** to the mounting plate **41**. This power cylinder **42** has a piston rod **43** which is secured to the plate **30** as at **43'**. Thus, when fluid pressure is applied at **42***a*, see FIG. 1, the power piston is moved down and plate **30** is moved down to position the tailstock **37** in position in axial alignment with a mandrel **51** to be described. The other power lead to the power cylinder **42** for the tailstock is indicated at **42***b* at the lower end of the cylinder. The details of the structure and operation of the tailstock **37** as shown in FIGS. 9 and 9A will be explained hereinafter.

Also attached to the tailstock mounting plate **24** in horizontal position towards opposite edges thereof as shown in FIGS. 2 and 3 are power cylinders **110** and **115** as by means of a conventional mounting collar arrangement **111** for cylinder **110** and **116** for cylinder **115**. The plate **24** is apertured at **111'** and **116'** and extending respectively therethrough is the piston rod **112** for cylinder **110** and **117** for cylinder **115**. Each of the cylinders **110** and **115** have fluid power supply connections **110***a* and **110***b* for cylinder **110** and **115***a* and **115***b* for cylinder **115** in the respective ends. The tailstock power cylinder has fluid pressure connections at **37***a* and **37***b*.

Mandrel Mounting

Mounted in the bifurcated uprights **13** and **13'** in the respective center apertures **14** and **14'**, see FIG. 1, are tapered roller bearing assemblies **43** and **44** respectively which are held in position by the respective pillow blocks or caps **17** and **17'**. Rotatably supported in these bearings is a mandrel shaft **45** having formed thereon a special V-groove pulley arrangement consisting of some 18 V belt grooves as indicated at **46** and especially formed brake drum portion **47** about which is mounted a brake drum **48**. Suitable means are provided for operating the brake drum **48** to slow down the rotation of the mandrel shaft when power on the V belts as shown in FIG. 2 in broken line is removed on the main drive motor (not shown). The motor M shown in FIG. 1 and connected by belt **49** to one of the grooves of the V belt pulley **46** is merely for turning over the mandrel shaft **45** during adjustment, cooling, etc. and not while spinning. The shaft **45** is formed on each end with a properly threaded portion indicated at **50** in FIG. 1 for the left-hand side to receive the internally threaded mandrel generally indicated at **51**. The mandrel **51** has formed thereon a shoulder portion at its inner end, as indicated at **52**, and a dimple or recess in the end at **53** into which plate stock to be formed into a closed end cylinder is pressed by the tailstock plunger, as will be described. The mandrel **51** is here shown as cylindrical and is the member about which the closed-end cylinder is to be formed by the spinning action.

Tailstock Assembly

In FIGS. 9 and 9A the tailstock generally indicated at **37** is shown in detail. The left-hand end as illustrated in FIG. 9 joins on with the right-hand end as shown in FIG. 9A in the illustration, however, the tailstock is mounted on the left-hand side of the apparatus in a reverse manner, as shown in FIGS. 1 and 2. This tailstock is here illustrated as being hydraulically actuated and has a cylinder **54** with a flanged forward end **39** having mounting apertures **39'** therein as previously described. The rear end is formed with a transversely extending flange **55**. This flanged end **55** has a central aperture **56** which receives a rod **57** having longitudinal apertures **58** and **59** extending the length thereof to receive a supply of cooling and lubricating oil in one and to exhaust through the other. The rear end of the rod **57** has a keyway **60** formed therein and is threaded at **61** to receive adjusting nuts **62** and **63** to hold a stop plate **64** in adjusted position thereon. The stop plate **64** has a keyway **64'** therein and receives a key **65** which extends therein and into the keyway **60**. Stop plate **64** as shown in FIG. 2A has apertures **66** and **66** extending therethrough to receive the respective guide rods **67** and **68** which are threadedly secured at their inner ends **67'** and **68'** in threaded sockets **69** and **70** formed in end flange plate **55** of the cylinder member **54**. Thus, the adjusting nuts **62** and **63** may be moved to position the stop plate **64** and in such positioning will determine the length of travel of the rod **57**, which is attached to the piston whose length of travel towards the mandrel determines the thickness of the bottom of the cylinder being formed. The forward or inner end of rod **57** is threaded at **57'**.

A specially formed piston **71** has an internally threaded rear end **72** which receives the threaded end **57'** of rod **57**. Extension of oil passages **58** and **59** are indicated at **58'** and **59'** in the piston **71** so that oil may be sent to and removed from the internal forward end of the piston which mounts the rotary member as will be described. Suitable packing glands generally indicated at **73** are formed in the cylinder **54** at the left-hand end thereof as shown in FIG. 9. Piston **57** has a head portion generally indicated at **74** which has, as indicated, three ring-receiving annular recesses **75** to receive the rings **76**. This head portion **74** is of slightly greater diameter than the main portion of the piston **71** where it passes through the packing glands **73**. The left-hand end as shown in FIG. 9 of the piston **71** has an internal cavity made up of stepped and tapered parts as will be described. Starting at the left-hand end as shown in FIG. 9 is a short cylindrical portion **77** having a packing gland portion **77'** to receive the packing gland **78**. An inwardly tapered portion **79** joins with an internally threaded portion **80** which joins with a slightly smaller diameter bearing receiving recess **81** that extends for over half the length of the internal cavity to a shoulder portion **82** which joins with an extreme inner end cavity **83** of slightly smaller diameter. A ball bearing assem-

bly 84 mounts in cavity 81 against the shoulder 82 and forward of this abutting same is a sleeve or spacer 85 against whose forward end the forward bearing assembly 86 abuts. An externally threaded retainer ring 87 is received in the threaded portion 80 and holds the bearing assembly 86 in place against the sleeve 85.

Mounted within this internal recess portion in the piston 71 is a plate-engaging rotary member generally indicated at 88. This rotary member 88 is formed with a cylindrical outer end or head 89 having a protruding spherical portion 90 whose outer curvature corresponds with the concave shaped end surface or dimple 53 in the end of the mandrel 51. Next in from the head 89 is a cylindrical body 91 received within the packing gland 77' and the recess 77 and this portion 91 joins with a tapered portion 92 of like taper to the tapered portion 79 of the cylinder 71. The rear end of the tapered portion 91 joins with a cylindrical journal portion 93 which is slidably mounted within the bearing races 84 and 86 and has midway its length an annular reduced in diameter portion 94 of relatively short length axially within which is received a stop screw 95 threadedly mounted in an aperture extending radially within the piston 71 at 96 and having a countersunk portion at 97 to receive the head 95' of the stop screw 95. Spacer 85 is apertured at 85' so that screw 95 may pass therethrough. Formed in the inner end of axially movable and rotary member 88 is a rear end recess 88*a* terminating at its bottom in a smaller diameter recess portion 88*b* which receives a thrust bearing 98.

Mounted against the thrust bearing 98 is a circular plate 99 received within the smaller inner end cavity 83 of the piston 71. This plate 99 has a forwardly projecting centrally disposed boss 99' and a rearwardly extending boss 99''. The forwardly extending boss 99' is received within the bearing assembly 98 and the rearwardly projecting boss 99'' receives thereabout the heavy duty compression coil compression spring 100 which extends to the rear of cavity 83 and presses against the plate 99 about the boss 99''. When the piston 71 is forced to the left by pressure applied at 37*b*, see FIG. 9A, the rotary and axially movable member 88 moves from the broken line to the full line position and tends to compress spring 100 while the spherical protrusion 90 on the end of 88 seats against a plate, a preformed cup or a pierced billet to be formed into a cylinder and pushes and forms the bottom end of the cylinder being formed up against the dimple 53 on the end of the mandrel 51 to hold it firmly in place while the spinning rollers as will be described act to spin the plate or the stock into a tube. Movement of the piston 71 to the right or to a retracted position from engagement with the plate or stock is accomplished by means of reversing the flow of hydraulic pressure and applying it at aperture 37*a*, see FIG. 9, at which time the flow through aperture 37*b* is reversed. Flexible pressure carrying conduits (not shown) are attached to the respective apertures 37*a* and 37*b*. Cooling of the rotary and axially movable member 88 is accomplished through the oil supply through the ducts 58—58' which lead to the journal portion 93 and exhaust through the conduits 59'—59. The conduits or passageways 58 and 59 are connected respectively to flexible supply leads 58'' and 59''. The oil passing around the journal 93 also serves to lubricate the bearings 86, 84 and 98. Oil also eases up the taper portion 92 and lubricates the journal portion 91 riding in the cylindrical portion 77 adjacent the packing 77'. A suitable cooling system (not shown) is provided whereby the lubricating and cooling oil is cooled.

In FIG. 1 there is shown attached to aperture 37*a* in the tailstock cylinder 54 a solenoid operated valve generally indicated at 37*c*. A suitable hydraulic connection 37*d* is associated with this valve 37*c*. When bottom forming pressure is applied to piston 71, this solenoid operated valve 37*c* is in a closed position and is bypassed. When the bottom end of the ultimate cylinder is being formed mandrel 51 is stationary. After the bottom is suitably formed and at the time the main drive motor is started and operates to carry out a spinning step on the stock, the solenoid operated valve 37*c* opens and the fluid bypasses to an adjustable pressure relief valve (not shown) whose pressure is set to be overcome by the normal and inherent pressure of spring 100. This action allows the piston 71 to move to the right, as viewed in FIGS. 9 and 9*a*, relative to the rotary member 88. In this latter condition the relative position of rotary member 88 will be as shown in broken line. In this latter condition the rotary member 88 is rotating and thrusting against the thrust bearing 98.

Spinner Rollers and Mounting

Reference to FIGS. 1, 2, 4 and 5 shows the spinner roller mounting plate or cross head 101 having a circular-like shape as shown in FIG. 4 with a bottom portion 102 having vertical sides 102' and on either side a cutout V portion 103 which is received over the tracks 25 and the inverted V-shaped portions 25' thereof mounted on the bedplate 11. In the upper portion of plate 101 are cutouts 104 having vertical faces 104' to receive the upper rails 20 so that the plate 101 may be slid along the bottom and top rails to urge it toward and away from the mandrel 51 as will hereinafter be described. In FIG. 1 the plate 101 is shown formed with flanges 105 extending outwardly from either side adjacent the rail cutouts to act as guides along the rails 25' while integral flanges 106 are likewise provided at the tops adjacent the cutouts 104 to guide the plate 101 along the rails 20.

Along the horizontal diameter of plate 101 and towards the outer sides thereof, there are apertures 107 and 108 to receive piston rods of the power cylinders 110 and 115 used to move the plate 101. Power cylinder 110 has fluid pressure connections 110*a* and 110*b* which supply pressure to the pressure cylinder. A mounting collar generally indicated at 111 serves to mount the pressure cylinder 110 on the tailstock support 24. Piston rod 112 of the power cylinder 110 projects through tailstock support 24 in a suitable aperture formed therein and its end is received in aperture 107. The end of rod 112 is threaded at 113 as indicated in FIG. 2 and receives a securing nut 114.

A cooperating power cylinder 115 is mounted also on tailstock support 24 and has hydraulic connections 115*a* and 115*b*. A suitable collar mounting 116 mounts the cylinder 115 to the tailstock support 24 and its piston rod 117 extends through the tailstock support 24 and through aperture 108 in plate 101 where it receives a nut 119 to hold it in place.

Referring to FIG. 5, the plate 101 has a cylindrical recess 120 in the left-hand or forward face thereof joining with a slightly larger cylindrical recess 121 having a bottom wall 122 joining the two recesses. A circular cam plate 123 is received in the recess 120 and this plate is formed with an annular flange 123' against which is mounted a securing ring 124 having suitable apertures 125 to receive cap screws 125' which are received in threaded recesses 126 in plate 101. A plurality of these cap screws 125' spaced apart are shown in FIG. 4.

In the illustration shown, cam plate 123 has associated therewith three spinning rollers, however, four or more rollers might be utilized. A roller arm is indicated at 130 which is elongated and narrow at one end and larger at the other. At the narrower end there is an aperture 130' which receives a cap screw 129 securing the arm to plate 101. Reference to FIG. 8 shows a general recess 131 extending therethrough having a front bearing recess 132 and a rear bearing recess 133. Associated with the front bearing recess 132 is a retainer recess for the oil seal for the front bearing as indicated at 134 to receive a front bearing oil seal 135. The rear bearing recess 133 has an associated larger rear recess 136 outward thereof, to receive the rear oil retaining cover plate 137 which is se-

cured by cap screws **138** received in apertures **138'** in arm **130**. Received in the front bearing recess **132** is a front bearing assembly **140** and in the rear bearing recess **133** a rear bearing assembly **141**. These bearings receive a roller shaft **142** having a threaded rear end **143** which receives a securing nut **144**. The forward end of shaft **142** is tapered at **145** to receive a spinner roller **146** having a forward tapered spinning surface **146'**. The rollers **146** may be differently shaped. In FIG. 8 there is shown a passageway **147** to supply lubricating and cooling oil and a discharge passageway **148** for the oil. These connect with supply exhaust lines **147'** and **147''** and the exhaust line **148'** and the flexible connection **148''** as shown in FIG. 7. These flexible lines **147''** and **148''** connect with fittings so that oil supply is through a passage **150** in plate **101** that connects with an manifold **150***a* while **148''** connects with passage **151** and manifold **151***a*. The plate **123** has a cam groove **152** therein which is of arcuate shape and receives a guide screw or stud **153** that is threaded into an aperture **154** in arm **130**. The head of screw **153** is received within a slot **152'** on the reverse side of plate **123**. Access to install screw **153** is through the aperture **155** in plate **101** as shown in FIG. 5.

Rotation of cam plate **123** is under the control of a power cylinder generally indicated at **156** in FIG. 4. A lug **101***a* extending from the mounting plate **101** has a pivot pin **157** mounted therein on which is pivotally mounted the power cylinder **156**. The power cylinder **156** includes a cylinder portion **158** and mounting portion **158'** which may be termed a mounting portion. Power cylinder **156** has fluid pressure connections **158***a* and **158***b*. Suitable flexible fluid pressure conduits are connected to the respective connections **158***a* and **158***b*. A piston rod **159** extends from the power cylinder **156** and is attached to the plate **123** in a pivotal manner by a pivot pin **160**.

By use of the power cylinder **156** and the controls therefor as will be explained hereinafter, accurate control of movement of plate **123** is obtained and thus movement in and out of the roller assemblies **127** against the stock being formed into a closed end cylinder is obtained. The roll carrying plate **101** is under the control of the power cylinders **110** and **115** for axial movement. The central aperture **123***a* in plate **123** allows the mandrel **51** with the plate formed thereover as a closed end tube to extend therethrough in the formation and spinning of the plate about the mandrel **51**.

Aperture **123***a* in the cam plate is in alignment with the aperture **38'** in tailstock mounting plate **24**.

A spray system for conducting cooling fluid to cool the mandrel **51**, as may be necessary, is indicated in FIGS. 1 and 2 at **161**. It includes, for example, three nozzles **162** and a supply conduit **163**. Spraying may be done while machine is waiting conveyance of next plate or preformed billet to be spun and at this time motor (*m*) will be actuated and slowly rotates mandrel **51** for even cooling.

Fluid Pressure System

In FIG. 10 there is shown diagrammatically the hydraulic fluid supply system used with this tube spinning machine. A motor driven pump having connected therewith a reservoir as labeled in FIG. 10, supplies the fluid under pressure to the respective control valves **V1**, **V2**, **V3** and **V4**. In the system shown provision is made for counteracting forces since the mandrels **51** and **51'** are positioned oppositely and axially in alignment. Valve **V1** operates the pressure actuators **156** and **156'** to rotate cam plate **123**. Valve **V2** applies pressure under control to the pressure cylinders **42** and **42'** to move the tailstocks **37** and **37'** up and down while valve **V3** is the control for the pressure actuator **37** and **37'** for the tailstock to move the rotary member **88** against the stock which is held firmly against the end of the mandrel **51** and which forces in the arcuate bottom thereof in the recess **53** as shown in FIG. 2. Valve **V4** controls the pressure to the respective pressure actuators **110** and **115** and **110'** and **115'** to move the respective plates **101** carrying the rollers which work down the respective stock pieces into the respective cylindrical containers.

A highly efficient machine for forming a closed end cylinder from preformed cups, pierced billets or plates is provided. The tailstock pressure applying jack **37** to hold the plate or stock on the mandrel is mounted so that it is removed from axial alignment with mandrel **51** to permit insertion of a preformed cup or pierced billet and ready removal of the formed cylinder. Very accurate and uniform wall thickness closed at one end cylinders of the heavy duty type may be readily made from preformed cups, pierced billets or plate stock. It is intended that the material being worked would be adequately preheated to render it more readily formable. However, cold forming of relatively small thickness material or stock could be handled. While an arrangement of three rollers for carrying out the spinning has been shown, four or more roller arrangements might be utilized.

I claim as my invention:

1. Apparatus for making cylinders closed at one end, comprising, in combination, a frame having a central upstanding portion and integral bed plates projecting generally horizontally in opposite directions at the bottom thereof, said central portion having bifurcated bearing members projecting upward therefrom, upstanding cap blocks received over said bearing members and having longitudinal upper rail receiving means in their top portions, a mandrel member received in said bearing members and having mandrel portions at opposite ends and a drive pulley thereon positioned between said bifurcated bearing members, said bed plates having longitudinally extending spaced apart bottom rails thereon extending parallel to the axis of said mandrel member, a fluid pressure actuated jack for each end of the apparatus for clamping stock to be formed against the end of each mandrel portion, upstanding mounting means for each jack on each projecting bed plate permitting them to be moved transversely into and away from axial alignment with the mandrel and a stock engaging portion thereof axially toward and away from said mandrel to hold stock thereagainst to be formed, said jack mounting means having an aperture therethrough for movement of a formed closed end cylinder therethrough and upper rail mounting means thereon in alignment with the upper rail mounting means on said cap blocks, upper rails mounted in said upper rail mounting means and extending parallel to the axis of said mandrel member, a cross head mounted between said bottom and upper rails for sliding movement along said rails between each jack mounting means and the adjacent mandrel portion, said cross head having a central aperture for movement of the adjacent stock engaging portion of the jack therethrough and removal of a formed closed end cylinder, a circular recess in the face of each of said cross heads nearest the adjacent mandrel portion, a rotary circular plate member mounted in said recess in the cross head, said rotary plate having a central aperture therethrough in axial alignment with said aperture in the cross head and the axis of said mandrel member, roller mounting arms pivoted at their outer ends to the said cross head, spinning rollers rotatably mounted on the inner ends of said arms and projecting toward said adjacent mandrel portion for engagement with the stock to shape it over said adjacent mandrel portion, said rotary plate having arcuate cam means, cam guide means connected with said cam means and to said arms, means for rotating said rotary plate whereby said roller mounting arms carrying the spinning rollers are rotated to move said rollers toward and away from the axis of said mandrel member and means to move the cross head toward and away from said adjacent mandrel portion to bring said spinning rollers into working engagement with the stock.

2. Apparatus for making closed end cylinders accord-

ing to claim 1 wherein said roller mounting arms have anti-friction bearing means mounting said rollers thereon and lubricating supply and exhaust means are provided for said anti-friction bearings to lubricate and cool the same.

3. Apparatus for making cylinders closed at one end, comprising, in combination, a frame having a central upstanding portion and integral bed plates projecting generally horizontally in opposite directions at the bottom thereof, said central portion having bifurcated bearing members projecting upward therefrom, a mandrel member received in said bearing members and having mandrel portions at opposite ends and a drive pulley thereon positioned between said bifurcated bearing members, said bed plates having longitudinally extending spaced apart rail means extending parallel to the axis of said mandrel member, a jack means including a stock engaging portion for each end of the apparatus for clamping stock to be formed against the end of each mandrel portion, upstanding mounting means for each jack on each projecting bed plate permitting them to be moved transversely into and away from axial alignment with the mandrel and the stock engaging portion thereof toward and away from said mandrel to hold stock thereagainst to be formed, said jack mounting means having an aperture therethrough for movement of a closed end cylinder therethrough, a cross head mounted on said bottom rail means for sliding movement between each jack mounting means and the adjacent mandrel portion, said cross head having a central aperture for movement of the adjacent stock engaging portion of the jack therethrough and removal of a formed closed end cylinder, spinning rollers having mounting means mounting them on said cross head in spaced position about the axis of said mandrel member for movement toward and away from said axis

of the mandrel member, power operating means for movement of said mounting means for the spinning rollers and means to move said cross head toward and away from said adjacent mandrel portion to bring said spinning rollers into working engagement with the stock as said rollers are moved by their mounting means.

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