July 1, 1958 O. BIGINELLI 2,840,884

APPARATUS FOR SHAPING TUBULAR PARTS

Filed Nov. 15, 1951 4 Sheets-Sheet 1

Fig. 1.

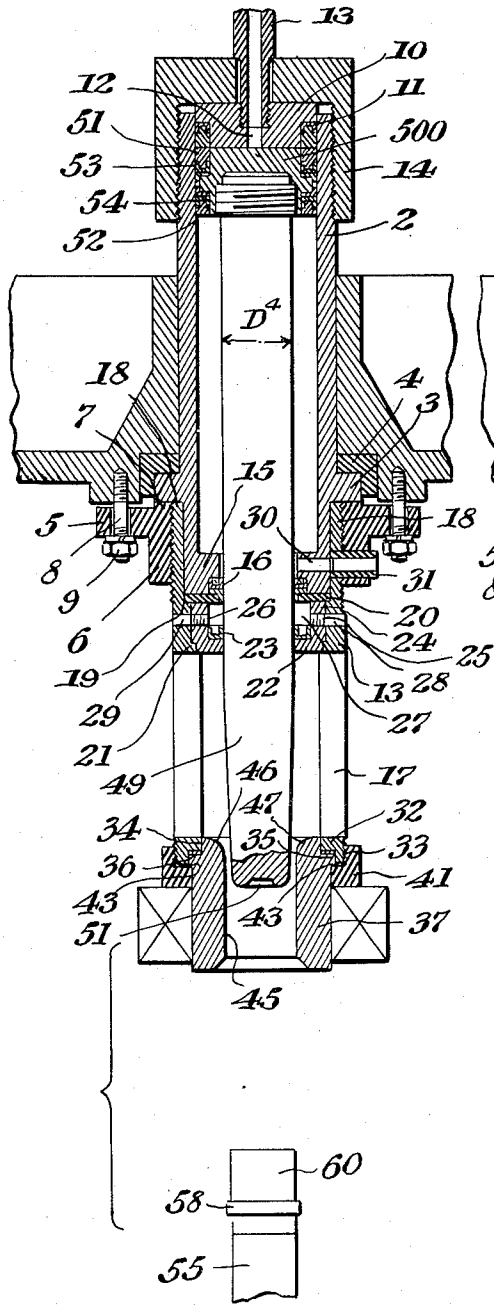
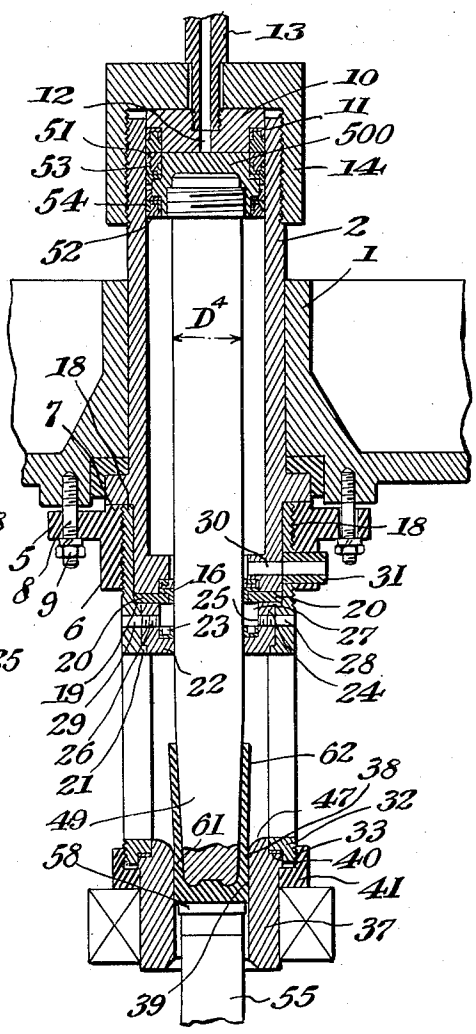


Fig. 2.



INVENTOR.
Oreste Biginelli
BY
Wenderoth, Lind & Ponack
ATTYS.

July 1, 1958 O. BIGINELLI 2,840,884

APPARATUS FOR SHAPING TUBULAR PARTS

Filed Nov. 15, 1951 4 Sheets-Sheet 2

Fig. 3.

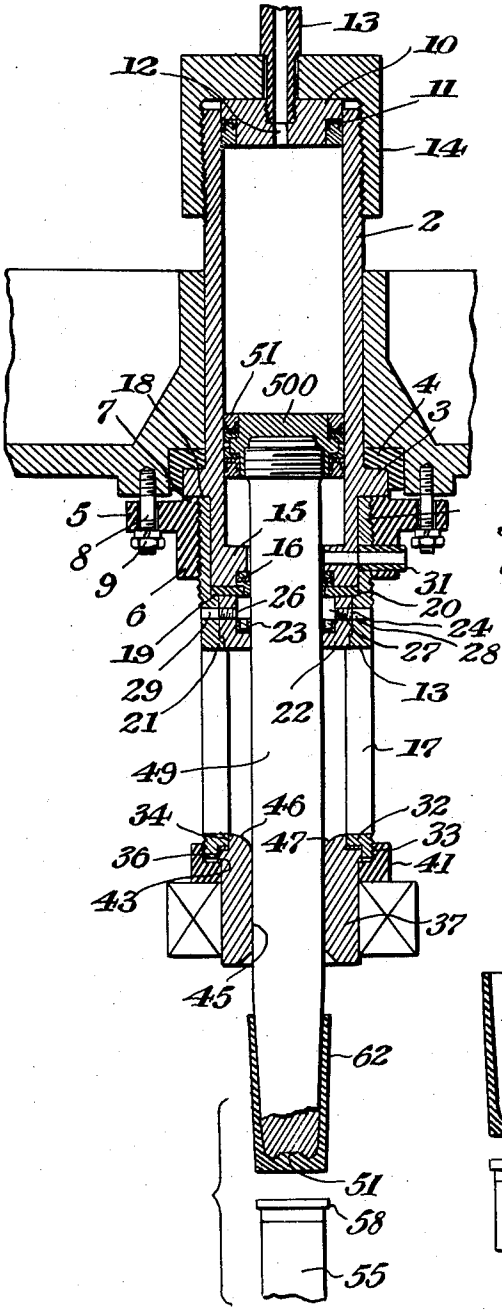
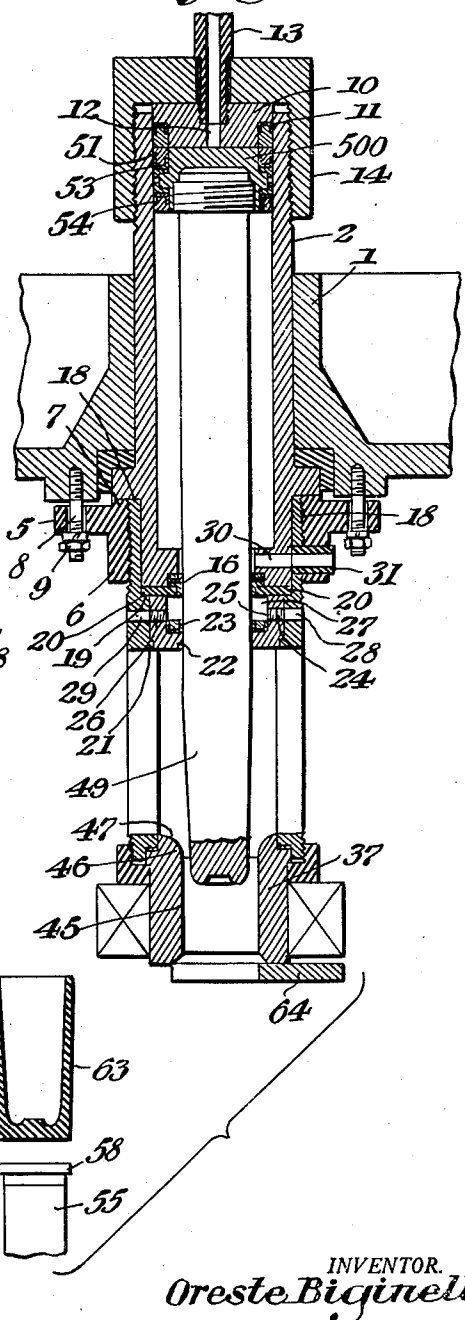


Fig. 4.



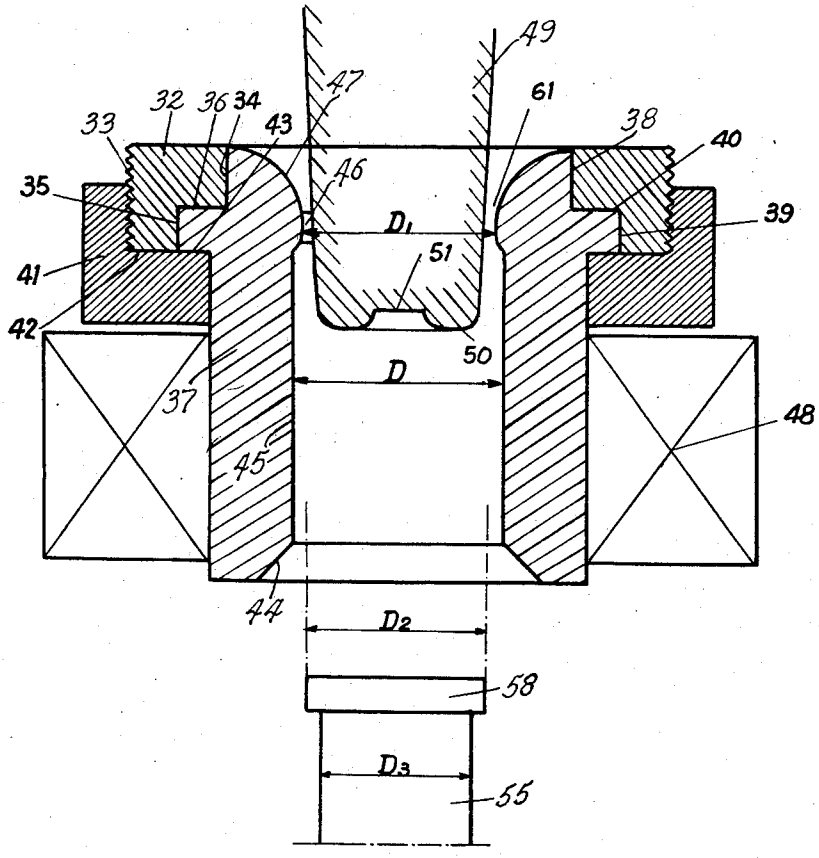
INVENTOR.
Oreste Biginelli,
BY
Wenderoth, Lind & Ponack
ATTYS.

July 1, 1958 O. BIGINELLI 2,840,884

APPARATUS FOR SHAPING TUBULAR PARTS

Filed Nov. 15, 1951 4 Sheets-Sheet 3

FIG. 5



Inventor
Oreste Biginelli
By
Shenderoth, Lind & Ponack
Attorneys.

July 1, 1958 O. BIGINELLI 2,840,884

APPARATUS FOR SHAPING TUBULAR PARTS

Filed Nov. 15, 1951 4 Sheets-Sheet 4

FIG. 6

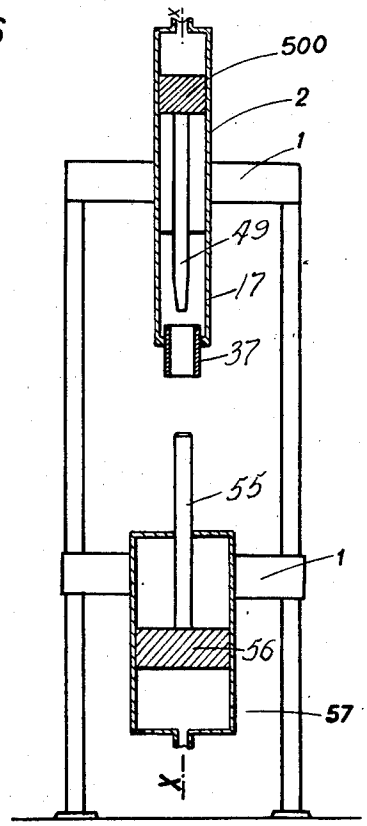
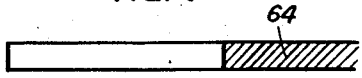


FIG. 7



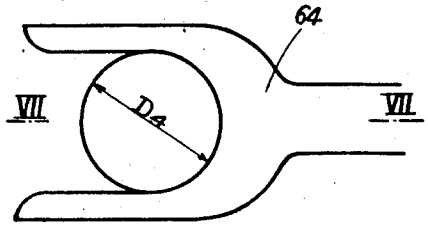


FIG. 8

Inventor
Oreste Biginelli
By
Shenderoth, Lind & Brock
Attorneys.

United States Patent Office 2,840,884 Patented July 1, 1958

2,840,884

APPARATUS FOR SHAPING TUBULAR PARTS

Oreste Biginelli, Clermont-Ferrand, France

Application November 15, 1951, Serial No. 256,582

Claims priority, application France April 17, 1951

2 Claims. (Cl. 29—1.3)

Processes are already known which enable a hollow cylindrical object in the shape of a case to be obtained, starting from a cylindrical metal part.

These known processes consist of compressing this cylindrical metal part between a male part formed by a cylindrical punch having the internal diameter of the case and a female part formed of a die, also cylindrical, whose internal diameter is equal to the external diameter of the case to be produced.

The compressed metal is forced in the opposite direction to the movement of the punch in the annular space comprised between the punch and the die to form the cylindrical wall of this case.

This known process only enables cases to be obtained with the same thickness over the entire length of the cylindrical wall.

The cylindrical metal part can also be compressed against a fixed punch by means of a rammer sliding in the die and forming the bottom of this die.

This known process also only enables cases to be obtained whose cylindrical wall is the same thickness throughout.

In these two known processes, the longer the case, the more difficult it is to maintain correct centering of the punch.

Other known compression processes comprise two stages.

A first stage in which a thick walled rough part is shaped between a punch and a first die, and a second stage where the cylindrical walls of this rough part are elongated in an open die with a recess between two bores of different diameters.

In this known process which enables long and correctly centered cases to be obtained, particles of metal which must be removed after each operation generally remain in the shoulder of the die connecting the two different bores, so that the case shall not be scratched which is formed in the next operation; owing to this, the output of the machine is greatly diminished.

Furthermore, this process requires the first cylindrical parts to be always of the same volume.

Any difference in volume of this first part is actually revealed by a difference in the thickness of the end of the rough part and a difference in the position of the punch with regard to the die at the beginning of the second stage of the work.

These differences are shown by irregularities in the thickness of the cylindrical wall of the case in the vicinity of the bottom of this case.

The purpose of this invention is to obviate these disadvantages.

It relates to a process for shaping tubular parts with a bottom like cases or sockets, starting from a solid part like a billet or drawn bar, comprising a stage for shaping a hollow rough part and a stage for elongating this rough part, a process characterized in that this rought part is formed, in the first stage, by drawing the metal of the billet through the annular space made between the female part and the fixed axial part; the second stage being achieved by drawing the cylindrical walls of this rough part through the same female part by moving the axial part with regard to this female part pressing on the bottom of the rough part.

According to one feature of the invention, the drawing stage of the rough part is achieved by pressing the axial part on the bottom of this rough part, the relating movement of this axial part with regard to the female part, and in this female part the edges of the rough part being pinched between this female part and the axial part.

The invention also relates to a machine for operating the aforementioned processes characterized in that it comprises, on a common frame, two opposed coaxial press cylinders in which two press pistons move, the upper piston being integral with the axial part. The lower piston being integral with the rammer and a coaxial annular female part coaxial to the axial part and the rammer being fixed to the frame of the press.

According to one feature of the invention, the annular female part is fixed to the upper cylinder, which enables this female part to be more easily centered with regard to the axial part, i. e., the regularity of the annular space arranged between the annular female part and the axial part.

According to one embodiment of the invention, the annular female part is formed by an open draw-plate supplied internally on the rammer side with a cylindrical bore of a certain length and forming a cylinder for this rammer, a contracted annular part, with regard to the cylindrical bore continuing this bore on the axial part side.

According to one feature of the invention, the upper cylinder has an upper end engaged in this cylinder in a sliding manner, this end being integral, through the intermediary of an inlet nozzle of motor fluid, with a cap screwed externally on the cylinder, which enables the stop to be regulated which is formed by this movable end.

According to one feature of the invention, the axial part is formed by a cylindrical rod needle fixed to the upper piston, the end part of this needle being slightly cone-shaped, and having, at the end, in a hollow, the relief to be made on the bottom of the case.

According to another feature of the invention, the rammer is formed by a cylindrical rod terminating at its upper end in a larger diameter flange and capable of sliding like a piston in the cylindrical bore of the draw-plate.

This invention also relates to methods of lubrication adapted to the drawing operations described above and enabling this process to be carried out.

The invention also relates to a process for shaping tubular parts in accordance with those described and characterized in that one part by weight of crystalline graphite and two parts by weight of oil are used for lubricating purposes.

According to one feature of the invention, linseed oil is used for work on hot metal operated at more than 500° centigrade.

According to another feature of the invention, a mineral quenching oil is used for work on hot metal operated at less than 500° centigrade.

A machine in accordance with the invention is shown by way of example in the accompanying drawing, in which:

Figure 1 is an axial section view of the machine in its starting position:

Figure 2 is an axial section view of this machine after the first working stage:

Figure 3 is an axial section view of this machine after the second working stage.

Figure 4 is an axial section view of the machine when the finished case reaches the ejection stage.

Figure 5 is a section view, on a larger scale, of the female part.

Figure 6 is a diagrammatic view of the machine assembly.

Figures 7 and 8 are section and plane views of the extracting device.

The machine illustrated in Figures 1 to 4 comprises the following essential parts:

(*a*) An upper press cylinder fixed in the frame **1** of a press.

This upper cylinder **2** is fitted with a collar **3** which presses on a bearer **4** in the shape of a ring inserted in the frame **1**.

A flange **5** with a tapped collar **6** and shoulder **7** presses by this shoulder against the collar **3** of the upper cylinder **2**. The flange **5** is fitted with holes through which gudgeons **8** pass which are screwed into the frame **1**. Nuts **9** screwed on to these gudgeons **8** press on the flange **5**, which, through the intermediary of the shoulder **7**, tightens the collar **3** of the cylinder in the bearer **4** and ensures that the cylinder **2** is securely fixed in the frame **1**.

The upper cylinder **2** is arranged vertically and its axis XX′ is the axis of the machine or the working axis.

At its upper part, the cylinder **2** is formed by a movable end **10** engaged in a sliding manner in the bore of this cylinder **2**. This end **10** comprises, on the internal side, a peripheric seating in which watertight packing **11** is placed in U-shaped section. This end **10** is pierced by an axial hole **12** and is integral, through the intermediary of a fluid inlet nozzle **13**, with a cap **14** screwed on the external thread of the cylinder **2**.

By screwing down or unscrewing this cap **14** the position of the end is regulated in the cylinder **2**.

At its lower part, the cylinder **2** comprises an internal shoulder **15** forming an end in which the rod of the piston which will be described further on, can slide freely.

This shoulder is pierced by a radial channel **30** prolonged by a fluid inlet nozzle **31**.

The tightness between this rod and this end is ensured by a washer **16** of U-shaped section placed in a shoulder seating **15** on the external side.

(*b*) A draw-plate holder case **17** of a general tubular shape comprising an upper part in the form of a sleeve **18** engaged on the lower part of the cylinder **2**, and screwed by external threading in a tapping in the collar **6** of the flange **5**.

The bearing **18** in the form of a sleeve comprises internal shoulders **19**—**21**. The shoulder **19** presses on a washer **20** maintaining the washer **16** in its seating.

The shoulder **21** presses on an annular part **22** with a seating on the internal side for a U-shaped washer **23** applied against the piston rod. The annular part **22** presses against the washer **20** through the intermediary of a ring **24** pierced by two radially opposed holes **25**—**26**. This ring **24** makes an annular cooling chamber **27** round the piston rod.

The sleeve **18** is pierced with two diametral channels **28**—**29** facing the opposite holes **25**—**26** of the ring **24**.

The case **17** has a ring **32** at its lower part with a square section fitted with an externally threaded bearing **33**.

Internally, the ring **32** has two bores of different diameters **34**—**35** exactly centered on the axis XX′ and a flat shoulder **36** connecting these two bores and exactly perpendicular to this axis XX′.

The case **17** is supplied with longitudinal ports between the upper sleeve **18** and the lower ring **32**, these ports enabling the work to be inspected from the exterior, which is being executed by the machine, and limit the heat transmission by conductivity between the draw-plate and the press cylinder.

(*c*) A draw-plate or die **37** (Figure 5) fixed on the lower ring **32** of the draw-plate holder case.

This draw-plate **37** of general tubular shape has two smooth bearings **38**—**39** of different diameters at its upper part, and a flat shoulder **40** (Fig. 2) corresponding to the bores **34**—**35** and the shoulder **36** of the ring **32**.

This draw-plate thus engages by its bearings and shoulders in the corresponding part of the ring **32**. It is fixed on this ring **32** by a washer engaged around this draw-plate **37**, screwed on the externally threaded bearing **33** of this ring, and pressing by the internal shoulder on a corresponding external shoulder **43** of the draw-plate **37**.

Internally, the draw-plate **37** has a working surface comprising from bottom to top: a widely open conical surface **44**, a cylindrical bore **45** of a certain length and diameter D, a cylindrical bore **46** of shorter length and diameter D_1 slightly less than the diameter D, a large radius clearance **47**.

The bearing **40** of the draw-plate must be absolutely perpendicular to the axis of this draw-plate, so that the bores **45** and **46** are accurately centered on the working axis XX′.

Around the draw-plate **37** is a heat generator formed, for example, by an electric resistance **48** of annular shape.

(*d*) A drawing needle **49** whose lower end is slightly cone-shaped and presents the shape to be given to the interior of the case.

In the case of the example illustrated, this needle has rounded edges **500** and an axial depression **51** at its lower part.

The needle **49** is screwed by its upper part to the rod in a press piston **50** sliding in the upper press cylinder **2**.

The rod of the needle **49** is of cylindrical shape and slides tightly in the watertight packing **16**—**23** of the cylinder **2** and the case **17**. The diameter D_4 of this rod is slightly less than the diameter D_1 of the bore **46** of the draw-plate.

The press piston **500** has annular seatings **51**—**52** on both its surfaces in which U-shaped watertight packing **53**—**54** is placed.

(*e*) A rammer **55** centered on the working axis XX′, and integral with a press piston **56** similar to the upper piston **500**. This lower piston **56** moves in a lower press cylinder **57** similar to the upper press cylinder **2**, this lower cylinder being fixed to the common frame **1** of the press (Fig. 6).

The rammer **55** has a cylindrical rod **55** terminating at its upper part in a flange **58** of D_2 diameter slightly greater than the D_3 diameter and slightly less than the D diameter of the bore **45** of the draw-plate, so as to be able to slide with slight friction in this bore **45**. (Fig. 5).

The machine described above operates in the following manner:

(*1*) *Placing in the working position*—(*Fig. 1*).—The needle **49** is in its high position, the piston **500** pushing against the movable end of the cylinder **2**, adjusted in a suitable position by screwing down or unscrewing the cap **14**.

In this position, the point of the needle is engaged in the bore **45** of the draw-plate.

The rammer **55** is in its low position. The starting part is placed on this rammer **55**, this part being a cylindrical piece of bar or billet **60**, whose diameter is approximately that of the case to be produced.

The billet **60** is previously heated and coated with graphited oil.

(*2*) *Drawing the case*—(*Fig. 2*).—The driving fluid is injected into the lower part of the lower cylinder **57**, the lower piston **56** rises at the same time as the rammer **55** holding the billett **60**.

This billet is pushed into the draw-plate **37** by the rammer **55** which engages in this draw-plate behind this billet.

The billet **60** is crushed on the point of the needle whose shape it adopts in relief.

The movement of the rammer **55** continues upwards, the flange **58** of this rammer forms a piston in the bore **45** of the draw-plate which forms the cylinder, and the metal of the billet **60** is drawn upwards by the annular space **61** existing between the needle **49** and the bore **46** of the draw-plate.

At the end of the upward stroke of the rammer **55**, the rough form **62** of a case is obtained, covering the point of the needle **49** and taking on the shape of the latter.

(3) *Drawing the rough form of the case—(Figure 3).*—By introducing the driving fluid into the upper part of the lower cylinder **57** and opening the exhaust of the lower part of this cylinder, the piston is moved downwards **56** and the rammer **55** also, which then disengages the rough form **62** of the case.

The driving fluid is then injected through the nozzle **13** into the upper part of the upper cylinder **2**, which causes the piston **500** and the needle **49** to move downwards. This needle **49** lowers as far as the position shown in Figure 3, its rod sliding in the bore **46** of the draw-plate **37**.

In this movement, the cylindrical part of the rough part **62** of the case is drawn between the cone-shaped point of the needle **49**, which acts as a chuck, and the bore **46** of small diameter, which acts as a drawing collar-plate.

At the end of the down stroke of the needle **49**, the case **63** has an external cylindrical form of D_1 diameter and an internal form corresponding to the shape of the point of the needle **49**.

This case covers the point of this needle **49** which projects downwards through the draw-plate **38** (Fig. 3).

(4) *Extraction of the case—(Fig. 4).*—A U-shaped extractor **64** (Figs. 7 and 8) and whose internal diameter is slightly greater than the D_4 diameter of the rod of the needle **49** is engaged on this rod between the draw-plate **37** and the case **63**.

The driving fluid is then admitted to the lower part of the cylinder **2** to move the piston **500** and the needle **49** upwards. The edge of the case **63** pushes against the extractor **64** and the case is held thus while the needle continues its upward movement.

The machine thus returns to its starting position and is ready for a new operation.

The driving fluid admitted or discharged by the nozzles **13—31** of the cylinder **2** can be a liquid such as oil or a gas such as compressed air.

The inlet and exhaust control is effected by means of distributors of known types.

The inlet and discharge control of the driving fluid in each cylinder can be effected so as to obtain: a rapid stroke when the effort made is weak; a slower stroke when the working effort is made.

Thus, the rammer **55—58** will bring the billet **60** rapidly against the point of the needle **49** then move slowly and according to a reduced stroke to draw the metal of the billet **60**.

The disengaging stroke of the rammer **55—58** outside the draw-plate will take place in a rapid manner.

The up-stroke of the needle through the draw-plate **37** and during which the extraction of the finished case takes place, does not require force and occurs rapidly.

Finally, the down-stroke of the needle through the die for producing drawing of the rough part, requires much less work than the drawing of the rough part by the rammer. The upper cylinder **2** can have a much smaller section than that of the lower cylinder **57** and the down stroke of the needle **49** can be made much more rapidly than the up-stroke of the rammer **55**.

In the annular space **27** surrounding the rod of the needle **49** cooling water is circulated arriving by one of the channels **28—29** and leaving by the other. The rod of this needle is thus cooled, which reduces the heat transmitted by conductivity from the point of this needle

49 to the piston **500**, the cylinder **2** and the watertight packing.

In the machine described above, the needle **49** is advantageously made of one piece, which enables very accurate centering of this needle **49** in the draw-plate.

The cases obtained also have cylindrical walls of very even thickness.

The process claimed can also be used for certain metals, such as aluminum, without external heating of the draw-plate **37**. The water circulation in the annular space **27** can nevertheless be maintained to prevent the heat given off by the metal worked being transmitted to the watertight packing.

In this case, spray lubrication is provided for over the draw-plate **37**.

The process applies to all metals or alloys capable of being manipulated hot or cold, such as brass, copper, aluminium bronze, mild or semi-hard steel, aluminium, light alloys, magnesium alloys, etc.

According to the present invention, a mixture is used in connection with the above-mentioned processes and for hot work on brass, steel and in a general manner on all metals worked at more than 500° centigrade, this well-stirred mixture being composed of:

	Parts by weight
Linseed oil	2
Crystalline graphite	1

For hot working on aluminium, light alloys and in a general manner on all metals working at less than 500° centigrade, a well-stirred mixture is used consisting of:

	Parts by weight
Mineral quenching oil	2
Crystalline graphite	1

The mineral quenching oil should preferably contain 10 to 20% of colza oil.

Shaping work can be facilitated by an addition of 10% by weight of linseed oil to mineral oil mixed with crystalline graphite.

In the case of the cold working of a metal such as aluminium, the starting billet is coated with a viscous mineral oil such as that normally used for greasing the gears of the back axle of automobiles.

An oil should be selected which adheres well to the metal so as to stand up to the washing produced by the running of the cooling water required, as described in this principal patent.

The various means of lubrication described above enable the shaping operations to be carried out which are described in the principal patent, without the risk of tearing or folding the metal.

With regard to known processes, this process claims the following technical advantages:

(1) The two stages of shaping the rough part from the billet and drawing this rough part are carried out in the same female part **37**. Owing to this fact, the machine is simpler than known machines.

(2) The female part has no internal shoulder capable of retaining scraps of metal and requiring to be cleaned after each operation.

(3) The billet **60** used as a starting part appreciably has the diameter of the finished case and can be cut from a bar of relatively small section. In this manner, losses of metal by sawing or cutting the bar into lengths are reduced.

(4) The process claimed enables cases to be obtained of cylindrical external shape, but with a tapered internal form.

Furthermore, the end of this case can have any relief required, either outside or inside. It only requires a corresponding hollow to be made on the surface of the end of the needle **49** or the surface of the end of the rammer **55—58**.

(5) The first stage takes place by crushing the billet on

the end of the needle 49, i. e., by compressing and forcing the metal of the billet 60 by the rammer 55—58.

The second stage is obtained by drawing the rough part whose end is pushed by the needle 49 and whose edges are pinched in the drawing port formed between the female part 37 and the tapered surface of this needle.

In both stages the metal is manipulated parallel to the direction of the movement of the movable part and in the same direction as that of this movement, which produces perfectly strong cylindrical walls.

(6) The process claimed combining an operating of shaping and an operation of drawing enables a tubular part to be obtained in a single press operation whose walls are thinner than those of the part which could be obtained by a single drawing operation.

What I claim is:

1. In a machine for the shaping of tubular elements having a bottom, such as cases, from a solid starting billet, a frame, an upper cylinder mounted on said frame, a lower cylinder opposite and coaxial with said upper cylinder, mounted on said frame, an upper piston sliding in said upper cylinder, an axial member integral with said upper press piston and consisting of a needle having a cylindrical stem and an end portion which is slightly conical, a female member of annular shape secured on said frame in the axis of the upper and lower cylinders, said female member having a cylindrical bore and a constricted annular part of smaller diameter than that of the cylindrical bore on the side of the axial member and of greater diameter than the diameter of the axial member to permit the latter to slide past said constricted part, a lower press piston sliding in the lower cylinder, and a ram secured on said lower press piston and coaxial with said female member and with said axial member.

2. In a machine for the shaping of tubular elements having a bottom, such as cases, from a solid starting billet, a frame, an upper cylinder mounted on said frame, a lower cylinder opposite to and coaxial with said upper cylinder, mounted on said frame, an upper press piston sliding in said upper cylinder, an axial member integral with said upper press piston and consisting of a needle with a cylindrical stem, the end portion of which is slightly conical, a female member of annular shape secured on said frame in the axis of said upper and lower cylinders, and said female member having a cylindrical bore and a constricted annular part of smaller diameter than that of said cylindrical bore on the side of the axial member and of greater diameter than the diameter of the axial member to permit the latter to slide past said constricted part, a lower press piston sliding in said lower cylinder, and a ram secured on said lower press piston and coaxial with said female member and with said axial member, said ram consisting of a cylindrical stem terminating at its upper portion in a flange capable of sliding like a piston in the cylindrical bore of said female member.

References Cited in the file of this patent

UNITED STATES PATENTS

560,480	Deming	May 19, 1896
851,262	Tatum	Apr. 23, 1907
1,151,222	Scrimgeour	Aug. 24, 1915
1,474,066	Brown	Nov. 13, 1923
1,684,102	Leustig	Sept. 11, 1928
2,063,562	Sparks	Dec. 8, 1936
2,183,637	Biginelli	Dec. 19, 1939
2,237,993	Korbuly	Apr. 8, 1941
2,339,959	Stadlin	Jan. 25, 1944
2,407,855	Stephens	Sept. 17, 1946
2,596,552	Heimann	May 13, 1952

FOREIGN PATENTS

212,258	Germany	Dec. 24, 1907
443,060	Germany	Dec. 17, 1922
524,146	Great Britain	of 1940
851,629	France	of 1940