

1,318,962.

4 SHEETS—SHEET 1.

Technical drawing of a mechanical device, likely a pump or engine component, showing various parts labeled with numbers 1 through 28. The drawing includes a side view of the main assembly and a detailed view of a gear mechanism at the top right.

The main assembly consists of a base (1) supporting a vertical shaft (2) with a piston (3) and a connecting rod (4). The piston is connected to a crankshaft (5) which is mounted on a frame (6). The crankshaft is connected to a flywheel (7) and a gear (8). The gear is connected to a belt (9) which is driven by a motor (10). The motor is connected to a pump (11) which is mounted on a frame (12). The pump is connected to a pipe (13) which leads to a tank (14). The tank is connected to a valve (15) which is controlled by a lever (16). The lever is connected to a spring (17) which is mounted on a frame (18). The spring is connected to a piston (19) which is mounted on a frame (20). The piston is connected to a connecting rod (21) which is mounted on a frame (22). The connecting rod is connected to a crankshaft (23) which is mounted on a frame (24). The crankshaft is connected to a flywheel (25) and a gear (26). The gear is connected to a belt (27) which is driven by a motor (28).

The detailed view of the gear mechanism at the top right shows a large gear (20) with a smaller gear (21) mounted on its shaft. The gears are connected to a belt (22) which is driven by a motor (23). The motor is connected to a pump (24) which is mounted on a frame (25). The pump is connected to a pipe (26) which leads to a tank (27). The tank is connected to a valve (28) which is controlled by a lever (29). The lever is connected to a spring (30) which is mounted on a frame (31). The spring is connected to a piston (32) which is mounted on a frame (33). The piston is connected to a connecting rod (34) which is mounted on a frame (35). The connecting rod is connected to a crankshaft (36) which is mounted on a frame (37). The crankshaft is connected to a flywheel (38) and a gear (39). The gear is connected to a belt (40) which is driven by a motor (41).

Fig. 1 is a cross-sectional view of a circular device, likely a lamp or container. It features a central opening (8) surrounded by concentric rings. The outermost ring is labeled 65, and the inner ring is labeled 29. The device has a flange or rim on the right side.

Louis H. Brinkman Inventor

By his Attorney

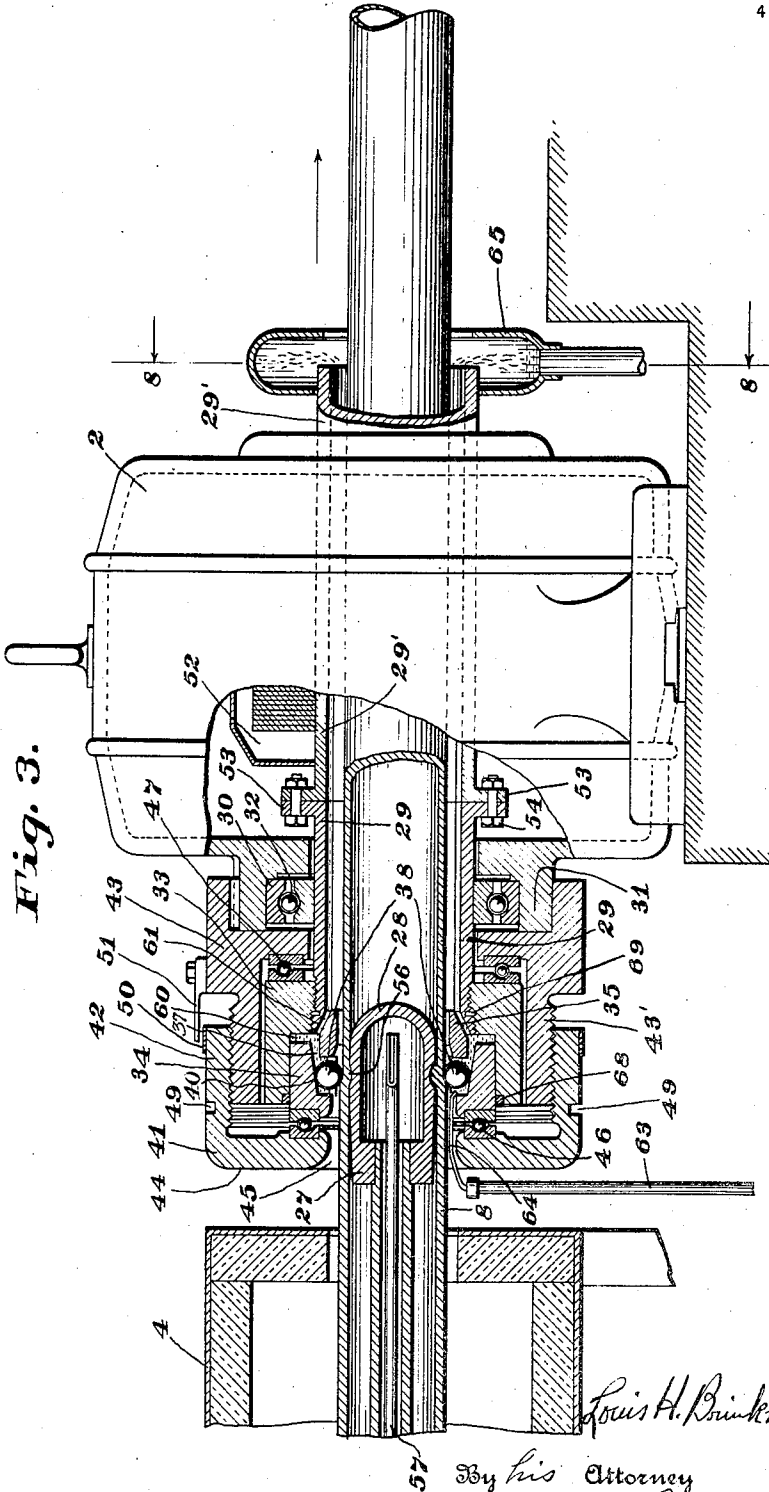
Thomas Howe

L. H. BRINKMAN,
 APPARATUS FOR DRAWING METAL.
 APPLICATION FILED SEPT. 5, 1916.

1,318,962.

Patented Oct. 14, 1919.

4 SHEETS—SHEET 2.



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4 SHEETS—SHEET 3.

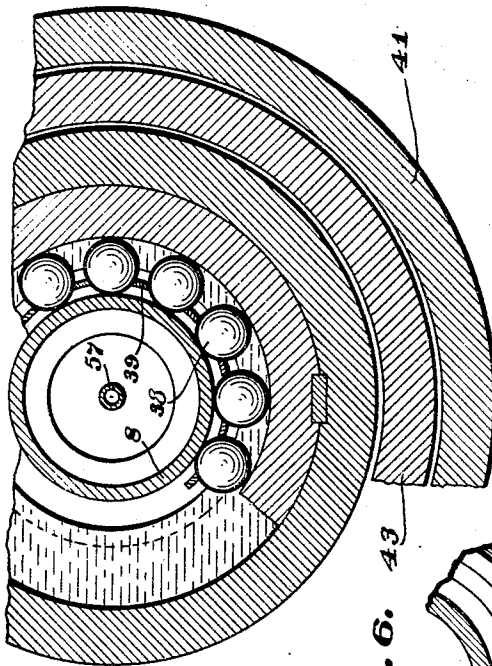


Fig. 5.

Fig. 6.

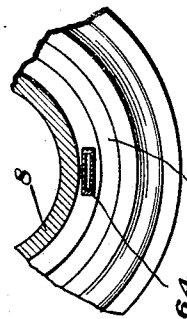


Fig. 7.

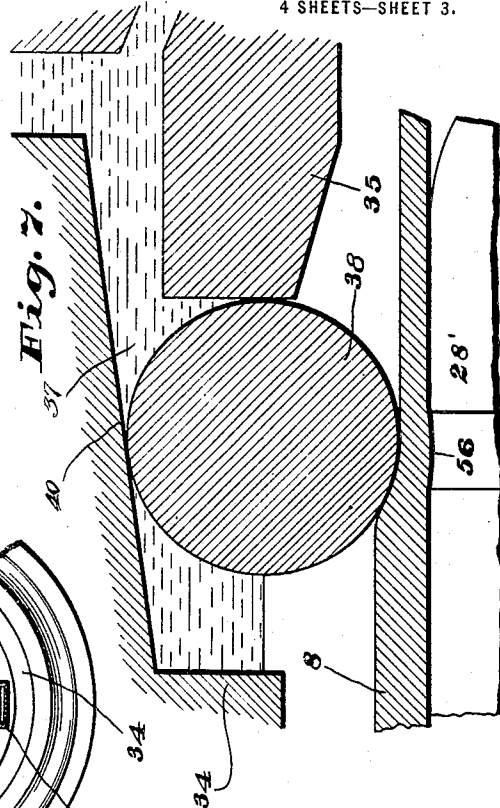
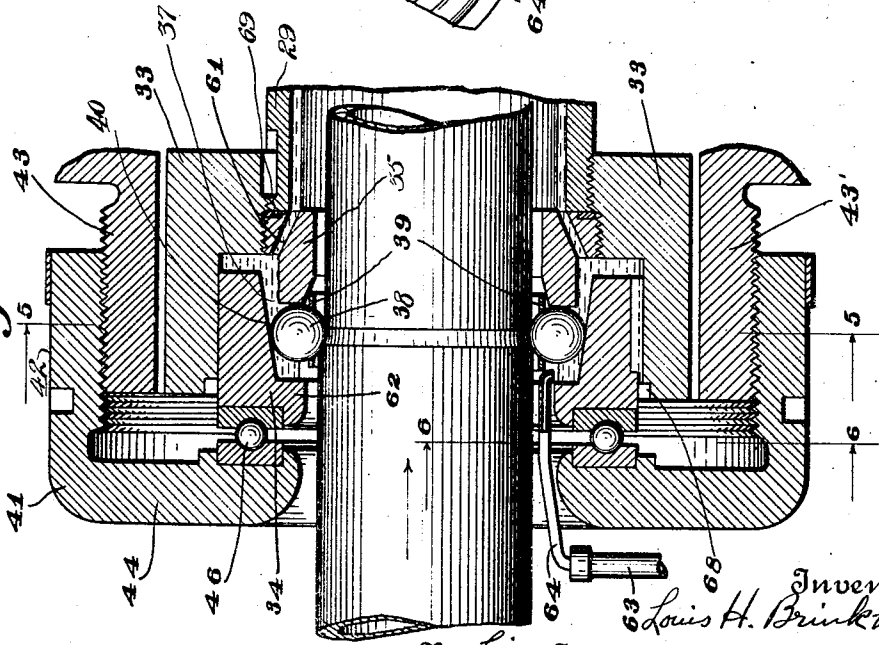


Fig. 4.



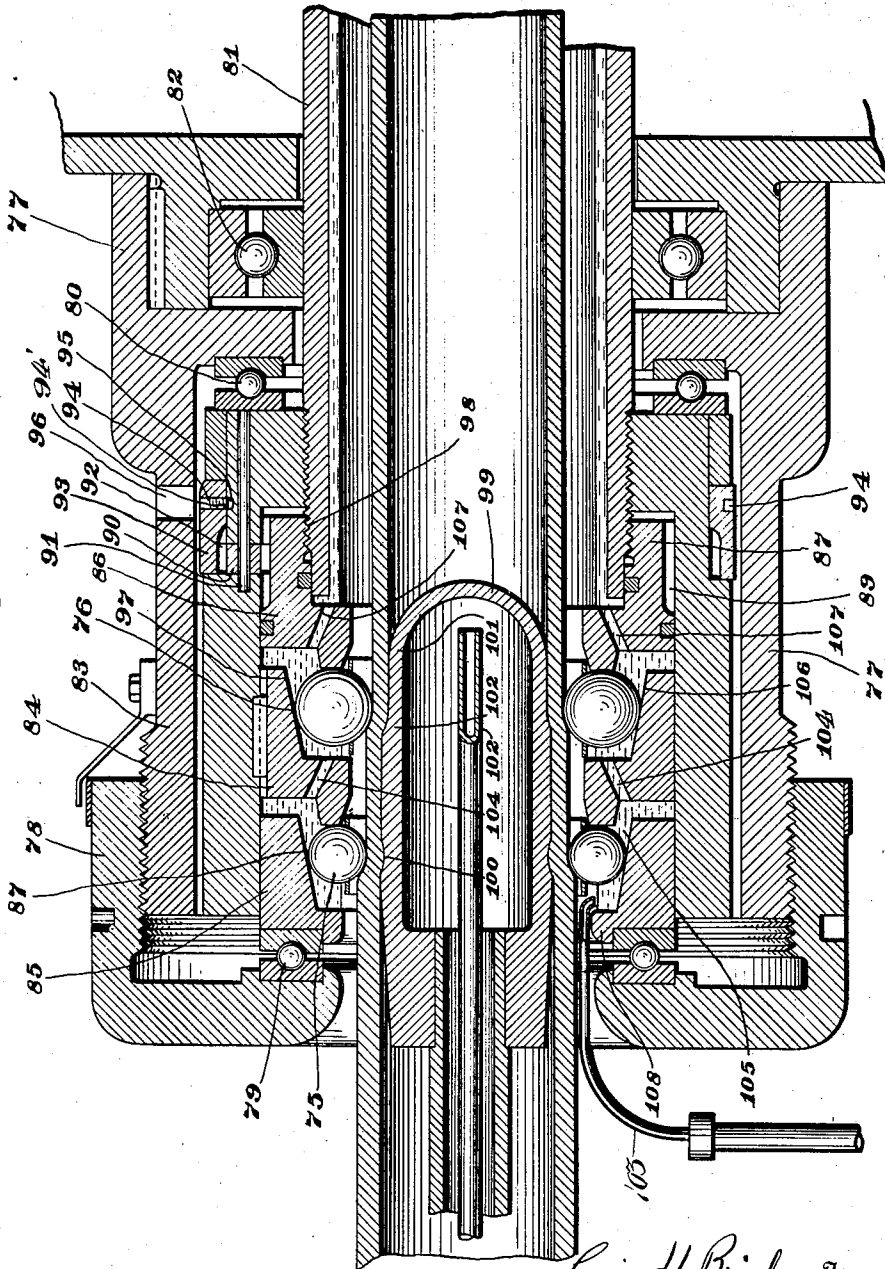
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 4 SHEETS—SHEET 4.

Fig. 9.



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UNITED STATES PATENT OFFICE.

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APPARATUS FOR DRAWING METAL.

1,318,962.

Specification of Letters Patent.

Patented Oct. 14, 1919.

Original application filed October 16, 1914, Serial No. 866,926. Divided and this application filed September 5, 1916. Serial No. 118,475.

To all whom it may concern:

Be it known that I, LOUIS H. BRINKMAN, a citizen of the United States, residing at Glen Ridge, county of Essex, and State of New Jersey, have invented new and useful Improvements in Apparatus for Drawing Metal, of which the following is a specification.

This invention relates to apparatus for drawing metal.

The present application is a division of my application Serial Number 866,926, filed October 16, 1914.

One object of the invention is to provide means for effacing marks or irregularities in rods or tubes produced by the balls of the die or otherwise in drawing down the metal body.

Other and ancillary objects of the invention will appear hereinafter.

In order that my invention may be more readily understood and further objects of the invention more fully appear, I will first describe an apparatus for drawing hot metal tubes embodying the present preferred form of my invention, and I will thereafter particularly point out the features of my invention in the appended claims. In the accompanying drawings of said apparatus,

Figure 1 is a side elevation of a metal-drawing machine or apparatus embodying the preferred form of my invention;

Fig. 2 is a top plan view of the same;

Fig. 3 is an enlarged elevation of a part of the machine showing the die apparatus proper and other parts in section;

Fig. 4 is a further enlarged sectional view of the die mechanism proper;

Fig. 5 is a fragmentary sectional view taken on line 5—5 of Fig. 4;

Fig. 6 is a fragmentary sectional view taken on line 6—6 of Fig. 4;

Fig. 7 is a greatly enlarged longitudinal sectional view of the device shown in Fig. 4;

Fig. 8 is a cross-sectional view taken on line 8—8 of Fig. 3; and

Fig. 9 shows a die mechanism with a plurality of raceways.

Referring to the drawings, Figs. 1 and 2, 1 is a platform or table on one end of which is mounted a rotary motor 2, on the frame of which the ball die mechanism 3 is journaled, as hereinafter referred to. To the left of this mechanism I provide a furnace such as a gas furnace 4, mounted on legs 5 and having a series of gas pipes 6. This heater is hollow so as to permit the insertion of a mandrel 7 therethrough when tubes are being drawn, and so as to receive the tube 8 to be heated and drawn.

At the rear of the motor a trackway 9 extends along the table in alinement with the die. A draw head 10 and a following block 11 are mounted on the trackway, and the following block is provided with a pair of tongs 12 having their gripping jaws 13 adapted to grip onto a plug or other suitable means 14 secured in the end of the tube 8 to be drawn, while the other extremity of the tongs is provided with toggle links and a connecting hook 15 connecting the tongs to the draw head 10, which is in turn provided with a pivoted hook 16 having a handle 17 by means of which it is lifted into and out of engagement with an endless chain 18 passing over sprocket wheels 19 and 20 mounted near the opposite ends of the table. The chain is driven by means of a suitable motor 21 geared to the sprocket wheel 20 through the gear wheels 22, 23, 24, 25.

When the machine is used for drawing tubes instead of rods, I provide a mandrel 7 above referred to, which is supported at one end in the head of a pillow block 27. The mandrel is preferably of considerably less diameter than the tube to be drawn, and extends through the furnace 4 to the ball die mechanism proper and is provided with an enlarged head 28 lying within the ball die mechanism and of the desired inner diameter of the finished tube.

Referring to Figs. 3—5, a hollow spindle 29 is journaled in a ring 30 fitting in an annular recess of a projection 31 formed on the left-hand frame of the motor 2, the

ring being provided with ball bearings 32. A rotating supporting frame or die block 33 is threaded and keyed onto the extremity of the spindle and is provided with an opening in which suitable die ball-supporting parts, such as relatively adjustable die cheek plates 34 and 35, are secured, the cheek plate 35 being preferably threaded into the die block 33, the cheek plate 34 being keyed to said die block so as to slide in and out therein. The adjacent surfaces of the two cheek plates form a raceway 37 for the die balls 38, and the balls are retained in this raceway by means of a retaining ring 39, (Figs. 3 and 4). The cheek plates being secured to the die block 33, rotate therewith, but the cheek plate 34 is so keyed to the block that it may slide longitudinally therein for the purpose of varying the diameter of the die, which is accomplished by the inclined surface 40 of the cheek plate 34 forcing the balls inward or permitting them to move outward, according as the cheek plate is moved toward or away from the cheek plate 35. The adjustment of the cheek plate 34 is accomplished in the present form of my invention, by means of an adjusting device 41 having an annular flange portion 42 threaded onto an annular frame 43 which is keyed to the projection 31 from the motor frame. The adjusting device, which is in the form of a cap, has an end portion 44 surrounding the end of the die block 34 and is provided with an opening 45 in alinement with the hollow spindle 29.

The end portion 44 of the adjusting device is intended to thrust inwardly against the cheek plate 34, and in order to avoid friction between said device and the adjacent cheek plate 34 in adjusting the die while the machine is in operation, and to take up any thrust from the die balls, I provide ball bearings 46 between the cheek plate 34 and the said surrounding portion 44 of the adjusting device; and I also provide ball bearings 47 between the inner end of the die block 33 and the adjacent wall of the annular frame 43 for taking up the thrust of the die balls, which will be exerted through the die block and said bearings against the frame of the motor.

The adjusting device 41 is operated by a handle or pin not shown which is adapted to fit into holes 49 around the circumference of the flange 42 of the adjusting device by means of which the adjusting device may be screwed in and out along the annular threaded extension 43' of the frame 43.

If it is desired to reduce the diameter of the die, the operator inserts the handle in one of the sockets 49 on the adjusting cap 41, and rotates it in a direction to move it toward the motor, whereupon the inward thrust of the cap upon the cheek plate 34

causes the same to be moved inwardly forcing its tapering surface against the die balls to move them inwardly, to reduce the diameter of the die. Conversely if it is desired to enlarge the diameter, the operator rotates the adjustable cap 41 in the opposite direction, relieving the plate 34 of the thrust, so that when the tube is pulled over the mandrel against the die balls, it forces the balls outwardly, thereby shifting the die plate 34 outward against the adjusting cap, thereupon permitting the balls to move out radially by reason of the upwardly flaring surface of the said cheek plate 34, resulting in an enlargement of the diameter of the die.

In the present form of my invention, the annular flange 42 of the adjusting device and an adjacent part of the stationary frame 43 are provided one with a graduated scale 50 and the other with a pointer 51 whereby the adjusting device may be set within proper limits for any desired diameter to which the tube or rod is to be drawn down. By this arrangement, each time after the tube has been drawn through the machine the ball die may be adjusted for the succeeding draw without having to shut down the machine.

In order to efficiently draw tubes or rods with a rotary ball die, it is important that the die should rotate at a high speed, and in order to accomplish this purpose and to simplify the machine, the motor 2 is mounted on the table in alinement with the ball die and the rotor 52 of the motor is directly connected to the hollow spindle 29. In the present form of my invention I use an electric motor to drive the hollow spindle, and mount the armature of the motor on an extension 29' of the hollow spindle 29, the two parts of the spindle being provided with flanges 53 secured together by bolts 54, although it will be understood that any suitable drive may be adopted for rotating the rotary die parts.

With the exception of the furnace 4, so much of the apparatus as has already been described is in general somewhat similar to the apparatus forming the subject matter of my above mentioned co-pending application, and in so far as it is similar it is covered by said application.

I have found in practice that in the operation of ball dies for drawing metal, and particularly in the drawing of metal tubes, the surface of the finished tube is marked or slightly corrugated by the action of the rotating die balls, and in order to overcome this difficulty and render the product smooth, I provide the head 28 of the mandrel with a groove 56 lying substantially in the plane of the raceway, and preferably of a radius larger than the radius of the die balls operating in connection therewith, the forward edge of the groove being preferably slightly

higher than the rear edge. The object of providing this groove is to permit the die balls to crowd the metal down into the groove as it is drawn between the balls and the mandrel, and cause it to be stretched as it is drawn out over the rear edge of the groove, this operation overcoming the corrugations or marks that would otherwise appear on the tube due to the action of the die balls thereon. Where hot tubes are to be drawn with the apparatus, I provide the mandrel 7 in the form of a hollow tube having the enlarged head 28 hollow, and through the hollow mandrel I pass a small tube 57 preferably extending from the tail end of the mandrel and through the same to the enlarged head. I connect this tube up with a suitable source of cooling fluid 58, from which water will be discharged into the tube from whence it will flow to the hollow head and out again through the hollow mandrel 7. This flow of water will prevent the mandrel from becoming overheated by the furnace and the hot tube. In the preferred embodiment of the invention the enlarged head of the mandrel is made of hard steel to prevent wearing.

I have found in the operation of apparatus of this character for drawing hot metal, that it is exceedingly important, if not necessary, to cool the die parts, and in the case of ball die apparatus, to preferably bring the cooling fluid directly in contact with the die balls to more readily cool them. I have also found it extremely important, if not necessary, particularly with ball die apparatus for drawing metal, to remove the scale which accumulates from the tube being drawn. Such scale interferes with the die balls, and in the case of apparatus using die balls in a raceway, it clogs the raceway so as to seriously interfere with, if not prohibit, the proper operation of the apparatus; and one feature of my present invention contemplates the cooling of the die parts and the removal of the scale. It is important, if not necessary, in doing this, to prevent the cooling fluid from coming in contact with the hot metal being drawn, or otherwise chilling the same, since this would seriously interfere with, if not prevent, the hot drawing of the metal.

In order to attain the above objects without chilling the hot metal, where hot metal is being drawn, I deliver fluid to the rotating die parts in such manner that it is caused by centrifugal force to flow against the die parts and out through passages arranged for its outlet. In the present embodiment of the invention the die cheek plates 35 and 34 which form the raceway between them for the die balls, are so arranged as to provide an annular passage 60 (Figs. 4 and 7) leading therefrom and communicating with a se-

ries of openings or passages 61 leading to the inner surface of the rotary spindle 29.

The outer end of the cheek plate 34 is provided with an annular flange 62 projecting inward radially, so that the opening through said cheek plate is of less diameter than the inner diameter of the hollow spindle 29; and I provide means, such as a suitable pipe 63, having a flattened extension 64 projecting through the opening of cheek plate 34 and curved at its extremity so as to discharge the cooling fluid, preferably water, into the raceway, just within the annular flange of said cheek plate. The object of this is to have the water so contained at the end of the die apparatus where delivered, that a slight "head" will be maintained between the delivery and discharge ends. When the fluid is to flow through the spindle it is thus delivered into the rotating parts adjacent the portion of less radius from the center of the "pass" than the inner radius of the spindle, so as to provide this slight "head" to cause the water to flow from said point of delivery across the raceway and through the passages or openings 60, 61, into the hollow spindle and along the inner surface of the same, to a hood 65 (Figs. 3 and 8). Only a slight "head" is necessary to cause the water to take this course through the spindle, since the action of the centrifugal force is so great that a large amount of water will be caused to flow through the parts with an extremely slight "head" between the delivery point and the inner surface of the spindle. For example, I have found that with the apparatus stationary, only an extremely small stream of water will trickle through the apparatus, while with the apparatus running, a considerable amount of water will be caused to flow through the apparatus, due to the centrifugal force acting upon the water delivered to the rotating parts of said apparatus. The centrifugal force tends to throw the water outward radially, so that in order to have it flow through the spindle rather than leak over the annular flange of the cheek plate 34, it is necessary that said flange should be extended inwardly nearer to the axis of the "pass" than is the inner surface of the spindle. While in drawing hot metal it is desirable to convey the cooling fluid off through the spindle in this manner so as not to have it leaking over the apparatus and possibly getting in contact with the hot metal being drawn.

In the machine shown and described die balls are used and the fluid is brought in direct contact with the balls to more readily cool them and to wash away scale. The passages 61 for fluid, above referred to, may be arranged in any suitable way, such as by drilling a series of holes through the cheek

plate 35, as shown. In order that the water may not be forced by the relatively great centrifugal force through the different parts of the die apparatus and come in contact with the hot tube, I provide a packing ring 68 between the die block 33 and the cheek plate 34, to prevent the flow of the cooling fluid between these two parts; and I provide a second packing ring 69 to prevent the flow of liquid between the die block and cheek plate 35.

The operation of the machine described is as follows:

The mandrel 7 is lifted out of the socket 26 and the tube 8 to be drawn is slipped over the rear end of the mandrel and into the furnace 4 where, after its forward end has been heated, the plug 14 is threaded or otherwise secured into the forward end of the tube and gripped by the tongs 12, which are then connected to the draw head 10. The motor 2 driving the ball die is then started up, the cooling fluid turned on, the adjusting cap 41 moved to the desired setting, as indicated by the scale 50, and the handle 17 of the draw head is then operated to throw the hook 16 into engagement with one of the links of the endless chain 18, whereupon the tube is drawn forward through the ball die, the die balls forcing the tube against the mandrel head to reduce the thickness of the metal, the metal, in the present form of the invention, as previously pointed out, being forced by the die balls into the groove 56 and stretched over the rear edge of the same in leaving the groove, to obviate any ball marks thereon. After the tube has been completely drawn through the die, the handle 17 will be thrown back to release the hook in the well known manner, whereupon the die is adjusted for the next draw and the operation repeated.

The form of the machine shown in Fig. 9 provides for the use of two separate sets of die balls 75, 76, which may be so arranged and constructed as to reduce the thickness of a tube by two steps during one drawing operation without altering its inner diameter; but in the form of the invention shown, the two sets of die balls are used, the rear set to reduce the inner diameter of the tube without reducing its thickness. In this form of the machine the annular supporting frame 77, with the adjusting cap 78 and the thrust ball bearings 79, 80, the spindle 81 and the ball bearings 82, are all substantially as shown and described in the foregoing form. But in order to use the two sets of balls to advantage in the various uses to which the apparatus may be put, it is important to be able to independently adjust the diameter of the die at each set of balls, and to do this it is necessary to independently adjust two of the die cheek plates. To this

end, I provide the die block 83 with an intermediate stationary cheek plate 84, which may be rigidly secured to the die block in any suitable manner. On each side of this cheek plate I provide longitudinally shiftable cheek plates 85, 86. The cheek plate 85 has an upwardly tapering surface 87 forming, with the adjacent surface of the cheek plate 84, a raceway for the set of die balls 75; and this raceway is adjustable to vary the diameter of the die at this set of balls, in the manner already described with reference to the first form of the invention. The second cheek plate 86 is suitably threaded onto the end of the spindle 81 by means of a lateral annular flange 87 which is internally threaded and which on its outer surface is provided with gear teeth 89 meshing with a pinion 90 set on a stub shaft 91 mounted in the die block 83. This pinion in turn meshes with an internal gear 92 cut on an annular flange projecting from an adjusting ring 93 loosely mounted on the die block so as to be shifted thereon. This ring is provided with a series of holes 94 lying in the same plane with a second series of holes 95 drilled in the die block. The outer stationary annular frame 77 is provided with a slot 96 also in the plane of said holes, so that if it is desired to shift the cheek plate 86 to the left so as to force the die balls 76 down the inclined surface 97 of cheek plate 84 to reduce the diameter of the die at this set of balls, it is only necessary to insert a pin through slot 96 into one of the holes 94 and rotate the ring 93 in a direction which will cause cheek plate 86 to rotate through the intermediate gear teeth 92, pinion 90 and gear teeth 89, in a direction to screw it along the threads 98 toward cheek plate 84. To increase the diameter of the die, the ring 93 is operated in the opposite direction. When the machine is operating the cheek plate 86 is held from longitudinal movement by a screw threaded pin 94' in one of the holes 94 of the ring 93, which is adjusted to extend into one of the holes 95 of the die block 83. When so adjusted, the cheek plate and die block are locked against relative rotation by means of the connection through the aforesaid gearing. By withdrawing the pin from the hole 95 the ring 93 may be turned on the block 83 and again locked by causing the pin to enter a hole 95 after the cheek plate 86 has been longitudinally adjusted to the desired position. The tool for screwing and unscrewing the pin may be inserted through the slot 96 in the frame 77 from whence it may enter the hole 94 to engage with the pin.

Where the device is used as herein shown, to reduce the thickness of the metal by the action of the first set of die balls, and to

reduce the inner diameter of the tube by the action of the second set of die balls without reducing its thickness at that point, I provide a mandrel preferably having an enlarged head 99 and preferably having a groove 100, as and for the purpose heretofore described in connection with the first form of the machine, and also having a section 101 of reduced diameter forming a shoulder 102 just beneath the forward edge of the second set of balls, over which shoulder these balls force the metal to reduce the inner diameter of the tube, simultaneously with the reduction of the thickness of the tube by the advance set of balls.

If desired, the mandrel may be cooled by fluid passed therein by means of a pipe 103 as described in connection with the first form of the invention. The two sets of die balls as herein used may be cooled, and the scale washed from the raceway in the same general manner as heretofore described, it being only necessary to provide passages 104 extending through the intermediate cheek plate 84 to connect the raceways 105 and 106, and to provide passages 107 from the last raceway to the inner surface of the hollow spindle. Water or other cooling fluid is delivered, as heretofore described, within the radially projecting lip or flange 108 of the cheek plate 85.

The operation of this form of the machine is in general similar to the operation of that heretofore described, except that the diameter of the dies at the second set of balls is adjusted by calculation or trial before the actual drawing of the commercial metal, whereas the forward set of balls may be adjusted while the machine is running.

While I have described in detail an apparatus embodying the present preferred form of my invention, it will be obvious to those skilled in the art, after understanding this invention, that various modifications and changes may be made therein within the scope of the appended claims.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent, is:—

1. In an apparatus for drawing metal, the combination with a ball die, of means for passing the metal through the die, means for relatively rotating the die and metal and means coöperating simultaneously with the aforesaid means for eradicating the ridges formed in the metal by the action of the balls.

2. In an apparatus for drawing metal, the combination with a ball die, of means for passing the metal through the die, means for relatively rotating the die and metal and a shoulder over which the metal passes for preventing ridges or marks formed by the action of the balls in the finished product.

3. In an apparatus for drawing metal

tubes, the combination with a ball die, means for drawing the metal through said die, means for relatively rotating the die and the metal operated upon, a mandrel extending within said die and having a groove, in substantially the plane of the balls, into which the metal is forced by the die balls in the drawing operation to prevent ridges in the finished product due to the action of the balls, the forward edge of the groove being higher than the rear edge.

4. In an apparatus for drawing metal tubes, the combination with a ball die, means for drawing the metal through said die, means for relatively rotating the die and the metal operated upon, a mandrel extending within said die and having a groove, in substantially the plane of the balls, into which the metal is forced by the die balls in the drawing operation to prevent ridges in the finished product due to the action of the balls, the edges of said groove being of different heights.

5. In an apparatus for drawing metal tubes, the combination with a ball die, means for drawing the metal through said die, means for relatively rotating the die and the metal operated upon, a mandrel extending within said die and having a groove, in substantially the plane of the balls, into which the metal is forced by the die balls in the drawing operation to prevent ridges in the finished product due to the action of the balls, said groove having a radius greater than that of the die balls.

6. In an apparatus for drawing metal tubes, the combination with a ball die, means for drawing metal through said die, means for relatively rotating the die and the metal operated upon, a mandrel extending within said die and having a groove, in substantially the plane of the balls, into which the metal is forced by the die balls in the drawing operation to prevent ridges in the finished product due to the action of the balls.

7. In an apparatus for drawing metal tubes, the combination of rotary die ball-supporting means having an annular raceway, die balls in said raceway, means for rotating said supporting means, and a mandrel having a part extending within the die, said mandrel being provided with a groove lying substantially in the plane of the raceway and into which the metal is forced by the die balls in the drawing operation to prevent ridges in the finished product, due to the action of the balls.

8. In an apparatus for drawing metal tubes, the combination of a plurality of die ball-supporting parts relatively adjustable axially of the "pass", said parts having an annular raceway formed between their adjacent surfaces, a series of die balls in said raceway, means for adjusting said die-supporting parts relatively to vary the diameter

of the die, means for rotating said supporting parts, a mandrel extending within the die and having a groove formed therein lying substantially in the plane of the race-
5 way, said groove being of larger radius than the radius of the die balls, whereby the metal of the tube will be crowded into the groove by the rotating balls and again

stretched as it leaves the exit side of the groove to prevent ridges in the finished 10 product due to the action of the die balls.

In testimony whereof I have signed my name to this specification this 1st day of September, 1916.

LOUIS H. BRINKMAN.