Jan. 2, 1940. M. MORGAN ET AL 2,185,416

WIRE-DRAWING MACHINE

Filed March 5, 1937 4 Sheets-Sheet 1

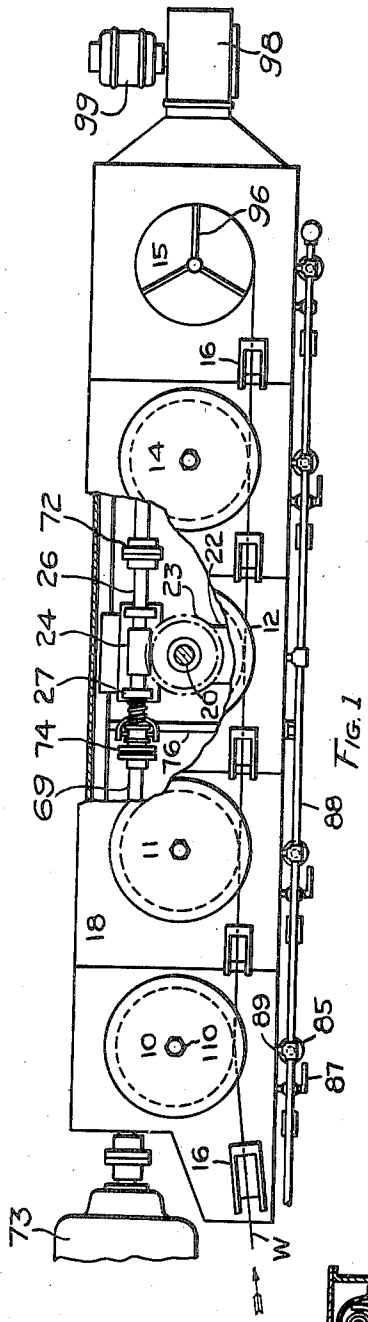


FIG. 1

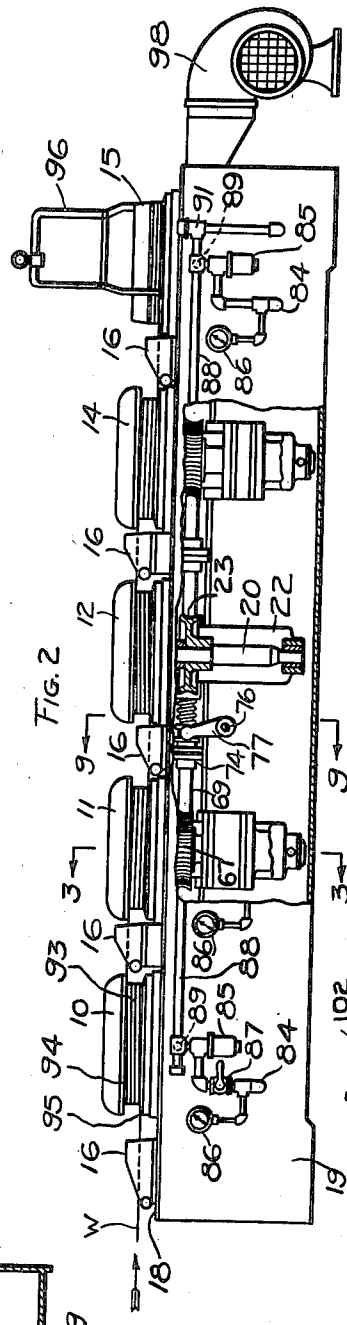


FIG. 2

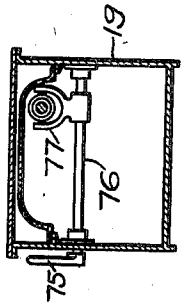


FIG. 9

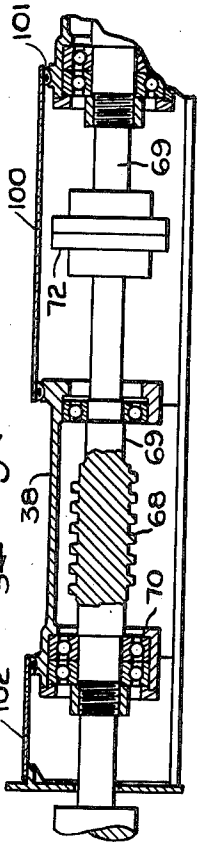


FIG. 8

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WIRE-DRAWING MACHINE

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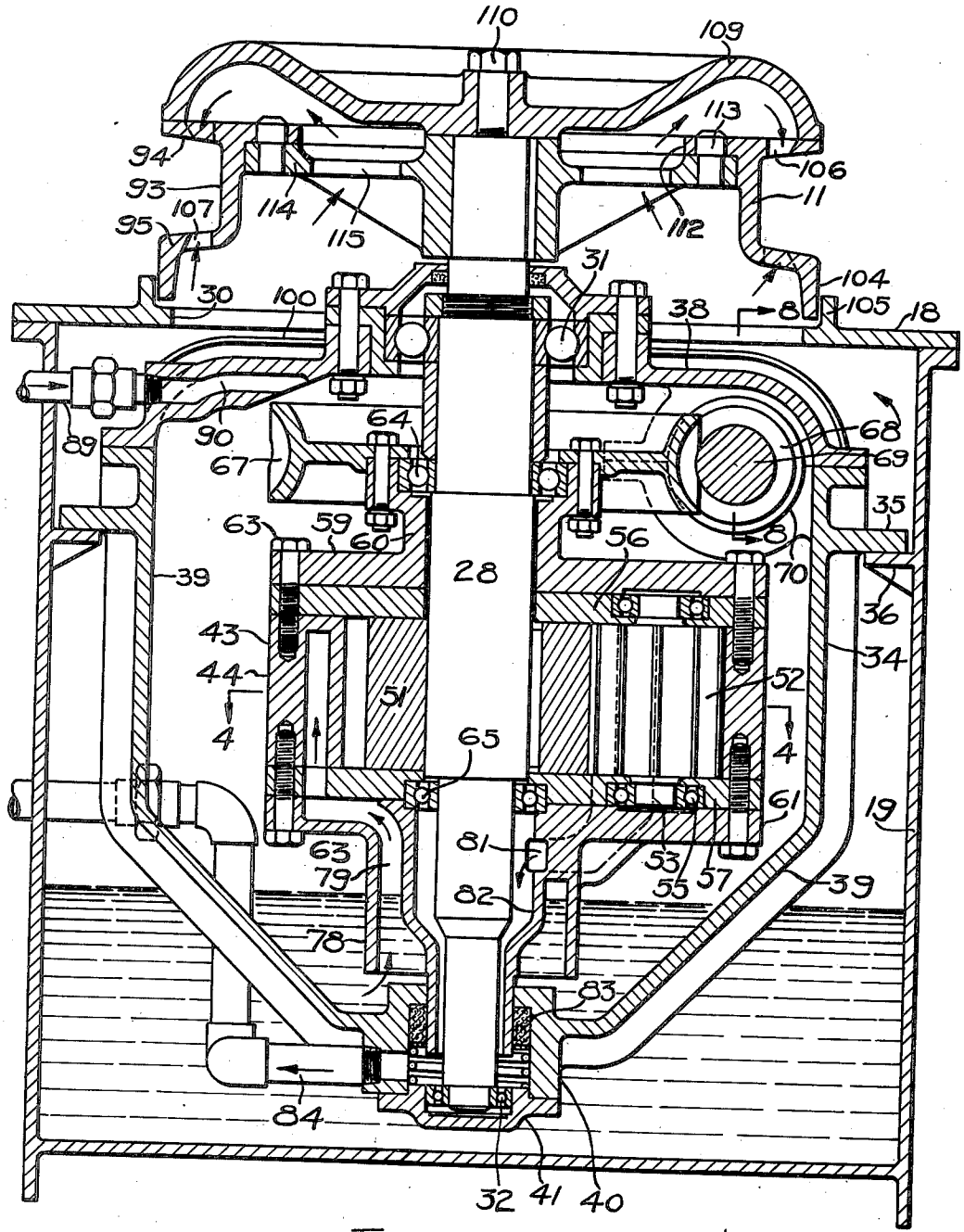


FIG. 3

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WIRE-DRAWING MACHINE

Filed March 5, 1937 4 Sheets-Sheet 3

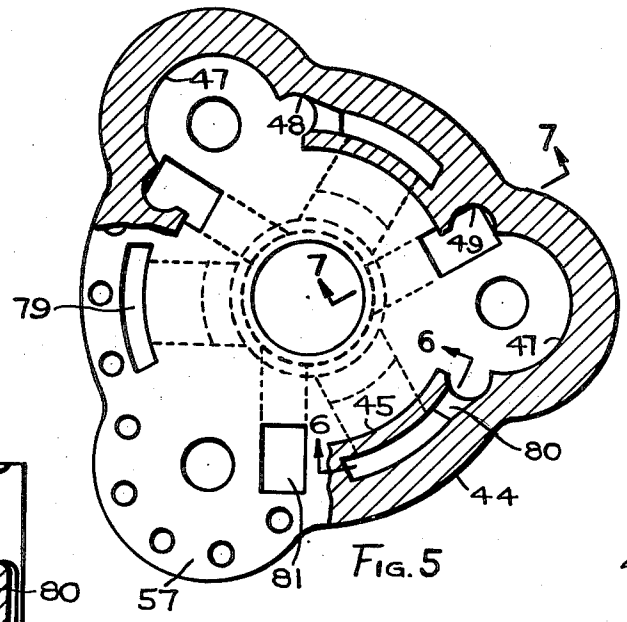


FIG. 5

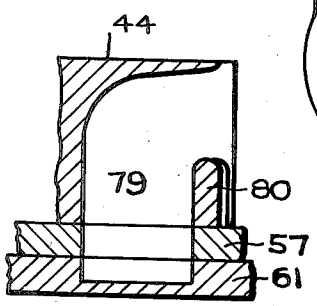


FIG. 6

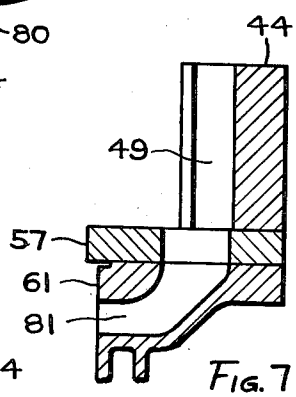


FIG. 7

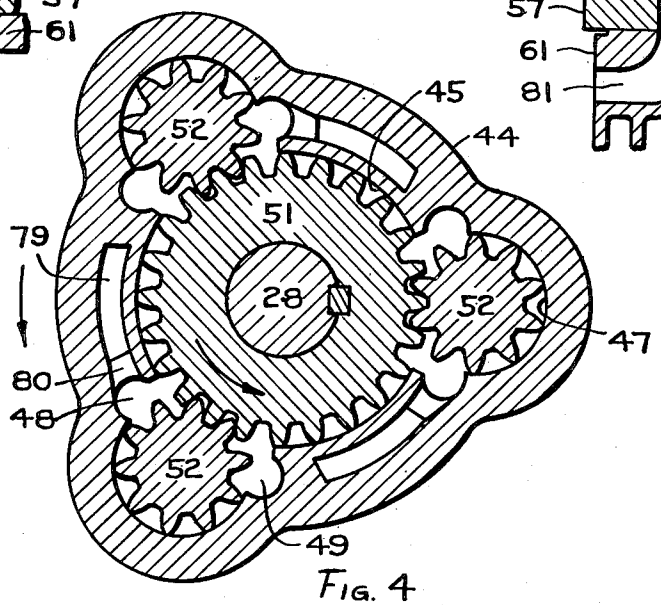


FIG. 4

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WIRE-DRAWING MACHINE

Filed March 5, 1937 4 Sheets-Sheet 4

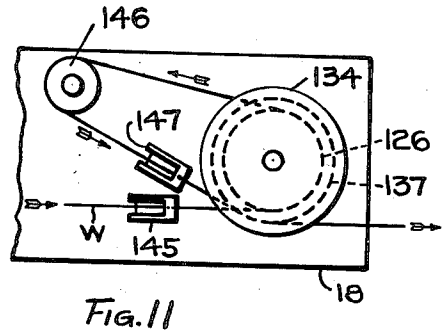


FIG. 11

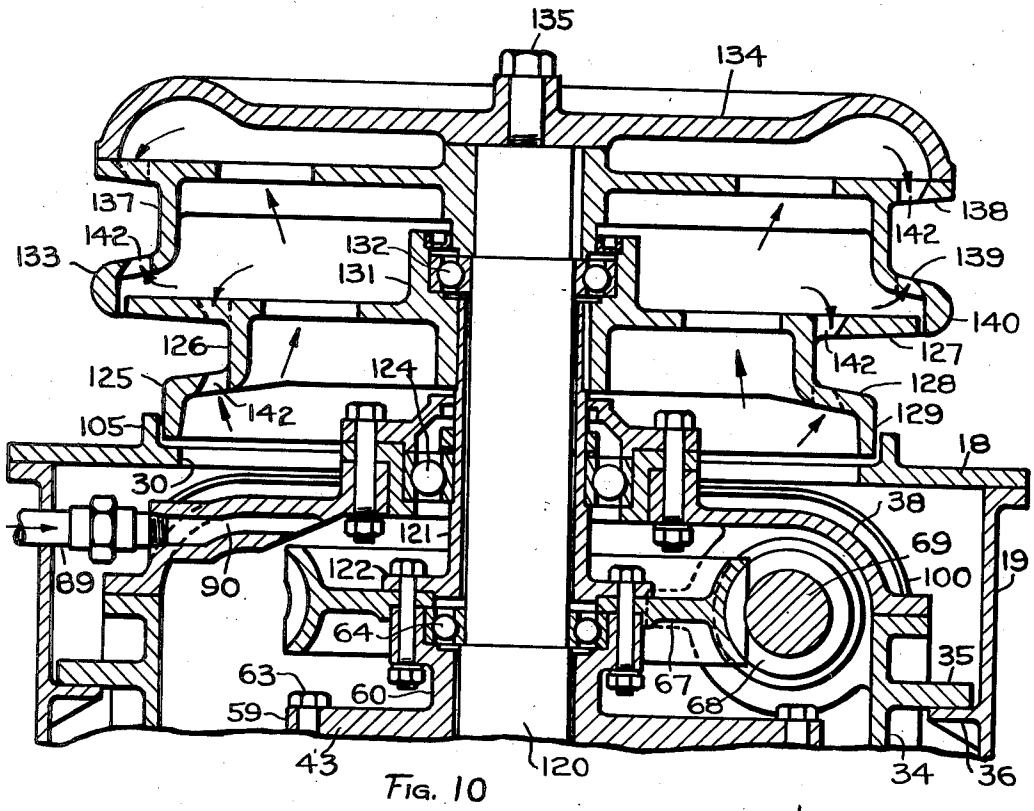


FIG. 10

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UNITED STATES PATENT OFFICE

2,185,416

WIRE-DRAWING MACHINE

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Application March 5, 1937, Serial No. 129,232

22 Claims. (Cl. 205—14)

This invention relates to wire-drawing machines, and more particularly to machines of the type having a series of dies through which the wire is drawn by means of rotating drums or blocks to effect successive reductions of the wire.

It has been recognized heretofore that certain advantages arise from the maintenance of an appreciable tension in the wire between each drum and the succeeding die. This so-called "back tension" not only decreases the power required to drive the machine, but it also prolongs the life of the dies by reducing the die friction and the resultant heat, and makes it possible to draw wire at higher speeds. While attempts have been made to construct machines which would operate in this manner, the prior machines have in general been complicated, expensive, unreliable, and difficult to maintain in proper adjustment.

It is accordingly one object of the invention to provide a simple, inexpensive and reliable wire-drawing machine of the type having rotatable drums to draw wire through a series of dies successively, the various parts being so constructed and arranged as to permit an accurate control of the back tension in the wire.

It is a further object of the invention to provide a wire-drawing machine having a plurality of rotatable drums, together with a simple and reliable mechanism for rotating the drums and applying a predetermined and readily adjustable torque to each of the drums.

It is a further object of the invention to provide a wire-drawing machine having a plurality of rotatable drums, together with a simple and reliable driving mechanism so arranged that each drum can be given a positive or substantially positive rotation for threading-up purposes and then a predetermined torque for the normal drawing operation.

It is a further object of the invention to provide a novel construction for a multiple die wire-drawing machine which is so arranged that the wire will neither slip on the drums nor continuously accumulate thereon during the operation of the machine.

It is a further object of the invention to provide a novel and advantageous arrangement of the drums and dies of a multiple die wire-drawing machine, whereby the wire may be properly aligned with the dies without the use of idler sheaves.

It is a further object of the invention to provide a simple construction for the drums of a wire-drawing machine, whereby the wire may be delivered to each drum in either of two parallel planes.

It is a further object of the invention to provide a simple and inexpensive construction for a wire-drawing machine, whereby the drums and the wire may be effectively cooled.

It is a further object of the invention to provide a compact and efficient construction for a wire-drawing machine having two axially aligned drums, so arranged that there will be no slippage or continuous accumulation of the wire on the drums.

With these and other objects in view, as will be apparent to those skilled in the art, the invention resides in the combination of parts set forth in the specification and covered by the claims appended hereto.

Referring to the drawings illustrating one embodiment of the invention and in which like reference numerals indicate like parts,

Fig. 1 is a top plan view of a wire-drawing machine, certain parts being broken away for clearness of illustration;

Fig. 2 is a front elevation of the machine, likewise partially broken away;

Fig. 3 is an enlarged section taken on the line 3—3 of Fig. 2;

Fig. 4 is a section taken on the line 4—4 of Fig. 3;

Fig. 5 is a view similar to Fig. 4, but with certain parts removed and others broken away for clearness of illustration;

Fig. 6 is a section taken on the line 6—6 of Fig. 5;

Fig. 7 is a section taken on the line 7—7 of Fig. 5;

Fig. 8 is a section taken on the line 8—8 of Fig. 3;

Fig. 9 is a section taken on the line 9—9 of Fig. 2;

Fig. 10 is a view similar to Fig. 3, showing a modification; and

Fig. 11 is a plan view of the construction shown in Fig. 10.

The embodiment illustrated in Figs. 1 to 9 of the drawings comprises a series of four preliminary drawing drums or blocks 10, 11, 12, and 14, and a finishing drum 15, all five of the drums being rotatable about vertical axes located in a common vertical plane. A suitable die 16 is mounted in advance of each drum, the drums serving to draw the wire W through the dies and thus effect successive reductions of the wire. Each die 16 is mounted on a cover plate 18 secured to the top of a frame 19, this frame being

constructed to form an elongated rectangular tank having upright side walls and a closed bottom. The plate 18 is preferably divided into separate sections for the respective drums, as shown in Fig. 1.

One of the drums is rotated at a substantially constant speed irrespective of the load applied thereto, so that the wire will be drawn at a predetermined rate. In the particular machine illustrated the third drum 12 has been selected as the constant speed drum. This drum 12 is shown mounted on the upper end of a vertical spindle 20 which is rotatably supported in a bracket 22 mounted within the frame 19. A worm gear 23 is secured to the spindle 20, and this gear is driven by a worm 24 formed integral with a horizontal shaft 26. The shaft 26 is rotatably supported by means of bearings 27 in the bracket 22.

The remaining drums 10, 11, 14 and 15 are each driven by a mechanism which serves in normal operation to transmit a predetermined substantially constant torque, so that the tension in the wire may be accurately controlled. For this purpose there is preferably associated with each drum a pump having two relatively movable parts, one of these parts being driven at a substantially constant speed and the other part being connected to the drum to drive the same. The pump may be arranged to circulate a suitable fluid, such as oil, through a pressure relief valve, the latter serving to maintain a predetermined substantially constant pressure at the discharge of the pump. In Figs. 3 to 7 inclusive there is shown the preferred mechanism for driving the drum 11, and it will be understood that a similar mechanism may be provided for the remaining drums.

Referring now to Fig. 3, it will be seen that the drum 11 is mounted on the upper end of a vertical spindle 28 and directly above a circular opening 30 in the cover plate 18. The spindle 28 extends downwardly through the opening 30 into the tank 19 and is rotatably supported by means of an upper anti-friction bearing 31 located just below the drum and a lower anti-friction bearing 32 located at the lower end of the spindle. These bearings are supported in a bracket 34 provided with lugs 35 which project from opposite sides and engage horizontal ledges 36 on the sides of the tank 19. The upper portion 38 of the bracket 34 is separable from the remainder thereof along a horizontal plane, and this portion 38 serves both as a support for the upper spindle bearing 31 and as a protecting cover plate for certain parts therebeneath. The lower portion of the bracket 34 comprises a pair of depending arms 39 which converge at their lower ends and supports a small chamber 40. This chamber is closed at the bottom by a removable plate 41 in which is mounted the lower spindle bearing 32.

In order to transmit a predetermined driving torque to the spindle 28, there is mounted thereon between the bearings 31 and 32 a suitable pump 43 which in the preferred form illustrated is of the gear type. This pump comprises a casing 44 having a central bore 45 (Figs. 4 and 5) extending vertically therethrough and connecting laterally with three auxiliary bores 47 which also extend vertically through the casing. The auxiliary bores are uniformly spaced about the axis of the bore 45. At one side of each auxiliary bore there is provided an inlet chamber 48, and at the opposite side of each auxiliary bore there is provided an outlet chamber 49. These chambers 48 and 49 preferably extend vertically through the casing 44, and each of them communicates with both the corresponding auxiliary bore 47 and the central bore 45. A main gear 51 is mounted within the central bore 45 and keyed to the spindle 28, this gear meshing with a planetary idler gear 52 mounted within each of the auxiliary bores 47. Each idler gear 52 is provided at its opposite ends with trunnions 53 (Fig. 3) supported in anti-friction bearings 55, these bearings being mounted in upper and lower horizontal bearing plates 56 and 57 secured to the casing 44. Above the upper bearing plate 56 there is provided an upper end plate 59 having a hub 60 projecting upwardly therefrom in surrounding relation to the spindle 28. Below the lower bearing plate 57 there is provided a lower end plate 61. The end plates 59 and 61 and the bearing plates 56 and 57 are all fastened to the casing 44 by means of screws 63, these parts when assembled forming a pump housing which is rotatably supported on the spindle 28 by means of upper and lower anti-friction bearings 64 and 65 respectively. The upper bearing 64 is mounted in the hub 60, and the lower bearing 65 is mounted partially in the lower bearing plate 57 and partially in the lower end plate 61, thus ensuring proper alignment of these parts.

The pump housing is rotated at a predetermined speed slightly exceeding the desired speed of rotation of the drum 11. For this purpose a worm gear 67 is bolted to the hub 60, and this gear is driven by a worm 68 formed integral with a horizontal shaft 69. This shaft is rotatably supported by means of bearings 70 in the bracket 34. The shafts 69 for the drums 10, 11, 14 and 15 are aligned with the shaft 26 for the drum 12, and these shafts are connected by means of suitable flexible couplings 72. This construction provides in effect a single horizontal sectional shaft, which may be driven by a suitable electric motor 73 directly connected thereto (Fig. 1). It will be understood that the speed ratio of the several sets of worms and worm gears will be varied for the respective drums, for it is necessary that the peripheral speed of the drums should increase progressively to compensate for the elongation of the wire resulting from the successive drawing operations.

In order to facilitate the threading up of the machine, as will be described hereinafter, the shaft 26 of the drum 12 is preferably connected to the shaft 69 of the drum 11 by means of a suitable spring-loaded friction clutch 74, which takes the place of one of the couplings 72. This clutch should be of sufficient capacity to transmit the power required in the normal operation of the machine without slippage. The clutch illustrated may be released when desired by means of a handle 75 (Fig. 9) located at the front of the machine and connected by a horizontal shaft 76 to a clutch-releasing yoke 77.

The pump 43 is arranged to deliver oil or other suitable fluid under pressure, so that torque may be transmitted to the drum 11. The tank 19 is preferably utilized as a reservoir for the oil, which is maintained at a level slightly below the lower end plate 61 of the pump, as shown in Fig. 3. In order to supply oil to the pump this end plate 61 is provided with a depending annular skirt or projection 78 which extends downwardly into the oil in coaxial relationship with the spindle 28. Three inlet ports 79 lead upwardly from the interior of the skirt 78 through the lower bearing plate 57 and the casing 44 into communication with the inlet chambers 48. It will be noted that a rib 80 (Figs. 4 and 6) extends across the

bottom of each port 79 near its connection with the inlet chamber, so that the oil cannot completely drain from the pump when it is standing idle, and the pump will thus retain its priming. The high pressure oil escapes from the pump through three outlet ports 81 which lead downwardly from the respective outlet chambers 49, through the lower bearing plate 57 and thence into the interior of a depending sleeve or annular skirt 82 formed integral with the plate 57 and located within the skirt 78. The lower end of the inner skirt 82 extends into the chamber 40 and is surrounded by packing 83 which serves to prevent leakage of oil between the rotating skirt and the surrounding stationary walls of the chamber. The interior of the skirt 82 is somewhat larger in diameter than the adjacent portion of the spindle 28, so that the oil may flow downwardly from the outlet ports 81 through the annular space between the spindle and the surrounding skirt and thence into the chamber 40.

The pressure of the oil delivered by the pump is preferably controlled automatically so that the torque applied to the spindle 28 may be predetermined. For this purpose a pipe 84 is provided to conduct the oil from the chamber 40 to a pressure relief valve 85 (Fig. 2) located outside the tank 19. This valve 85 is of any well known type adapted to maintain a predetermined substantially constant pressure in the pipe 84 and provided with means for adjusting the pressure. One suitable construction is disclosed in the patent to Terry No. 1,863,075. A gauge 86 is preferably connected to each pipe 84 to indicate the pressure therein, and a manually operable shut-off cock 87 is preferably installed in each pipe 84 (except in connection with the drum 15) for use in threading-up the machine, as will be hereinafter explained. This cock may have a small hole drilled through its plug, so that it cannot be closed perfectly tight. The oil discharged by the several relief valves 85 enters a horizontal header pipe 88, from which branch pipes 89 lead to passages 90 (Fig. 3) formed in the upper portions of the brackets 34 and the bracket 22. These passages discharge the oil over the worm gears 67 and 23, thus effectively lubricating these parts, the oil then falling to the bottom of the tank 19, whence it is recirculated. A pressure relief valve 91 (Fig. 2) may be connected to the header pipe 88 and arranged to discharge oil into the tank 19 whenever the pressure in the header pipe exceeds a predetermined value.

Since the torque required to drive the drums 14 and 15 will ordinarily be considerably less than that required to drive the drum 10 and 11, because of the decreasing diameter of the wire, the drums 14 and 15 are preferably actuated by means of pumps of smaller capacity. This reduction in capacity may be conveniently effected by reducing the axial dimensions of the pump casing and of the gears therein, as indicated in Fig. 2.

Each of the drums 10, 11, 12 and 14 is constructed, as shown particularly in Fig. 3, with a substantially cylindrical portion 93 having spaced upper and lower flanges 94 and 95 projecting outwardly therefrom and inclined slightly with respect thereto. This construction makes possible an advantageous arrangement of the dies with respect to the drums, whereby the wire may be properly aligned with the dies without the use of idler sheaves. Referring particularly to Fig. 2, it will be seen that the wire leaves the first die 16 and engages the surface of the lower flange 95 of the first drum 10, thence passing around the cylindrical portion 93 of the drum in the form of a right hand helix with a sufficient number of wraps to ensure full capstan effect without slippage, and leaving the drum tangentially at a point close to the upper flange 94. The second die 16 is located at a higher elevation than the first die and in direct line with the wire leaving the drum 10, the wire passing directly through this die and into engagement with the surface of the upper flange 94 of the second drum 11. The wire then passes around the cylindrical portion of the drum 11 in the form of a left hand helix and leaves the drum tangentially at a point close to the lower flange 95 thereof. This arrangement is continued throughout the entire machine, the wire passing around the drums alternately in the form of right and left hand helices. The dies are located alternately in line with the lower flanges and the upper flanges, so that the wire is wound around the drums first upwardly and then downwardly. The arrangement is such that the wire is wound upwardly on the finishing drum 15, and this drum is made without an upper flange, having instead the usual stripper 96 which serves to support the coil of finished wire. With this construction it is possible to make all the drums alike (except the finishing drum), and mount all of the drums at the same elevation.

Means is preferably provided to cool the drums and the wire which is wound thereon, in order to prevent overheating of the wire as a result of the heat generated in the drawing operation. For this purpose a fan 98 is provided to discharge air into the upper portion of the tank or frame 19. This fan is shown located at the finishing end of the machine, and it may be driven by a suitable electric motor 99. In order to prevent contamination of the oil in the tank 19 by dust carried in suspension by the air stream, plates 100 are provided to connect the upper portions 38 of adjacent spindle supporting brackets, as shown particularly in Fig. 8. Suitable gaskets 101 are shown beneath the edge portions of these plates to ensure tight joints. Similar plates 102 are provided at the ends of the machine.

It will be apparent from Fig. 3 from the air flows from the upper portion of the frame 19 upwardly through the openings 30 in the cover plates 18 and thus into the interior of the drums. In order to prevent excessive leakage of air between the drums and the cover plate, each drum is formed with a depending skirt 104 which fits closely within an annular flange 105 extending upwardly from the cover plate. The air is discharged from the interior of the drums through series of openings 106 and 107 provided in the outwardly extending flanges 94 and 95 respectively. The air is directed to the upper openings 106 by means of a circular cap 109 which engages the upper flange 94 outwardly of the openings, this cap being held in place against the upper end of the spindle 28 by means of a screw 110.

In order to facilitate the removal and replacement of the drums, each drum is provided with an inwardly extending annular flange 112 which is formed with a series of holes to receive dowel pins 113 carried on the rim of a spider 114. This spider is keyed to the upper portion of the spindle 28, and provided with apertures 115 through which the air may flow upwardly to reach the openings 106. It will be apparent that after re-

moval of the single screw 110 the cap 109 and the drum therebeneath can be readily removed from the spider 114.

The operation of this embodiment of the invention will now be apparent from the above disclosure. In threading up the machine the motor 73 is stopped and the wire is pointed, inserted through the first die 16 and secured by the usual gripping device (not shown) to the first drum 10. The relief valve 85 corresponding to this drum has been previously adjusted to a predetermined pressure which will provide the desired torque on the drum in normal operation with a predetermined back tension in the wire leaving the drum. Since this back tension is not present when threading up, the normal torque will be insufficient to pull the wire through the first die. However, by starting the motor 73 and closing the hand valve 87, ample torque will be made available since the closed valve will allow only a slight discharge of oil from the corresponding pump, and the drum 10 will be compelled to rotate at substantially the same speed as the worm gear 67 associated therewith. The slight oil flow which does take place will prevent overheating of the oil in the pump. As soon as a sufficient number of coils of wire have been wrapped about the first drum, the motor 73 will be stopped and the hand valve 87 opened, whereupon the wire will be inserted through the second die and secured to the second drum 11, the operation being then repeated. When the wire has been secured to the third drum 12, which is normally driven at a predetermined speed rather than by a predetermined torque, the friction clutch 74 is held released during the starting of the motor and then engaged smoothly. This avoids breakage of the wire which might otherwise occur by reason of the tendency of the mechanically driven drum 12 to pick up its load somewhat more quickly than the first two drums, to which torque is delivered solely through hydraulic means. The wire is passed through the remaining dies and around the remaining drums 14 and 15 in a similar manner. It will be noted that no hand valve 87 is provided in connection with the finishing drum 15, since sufficient torque must be applied to this drum to ensure continuous operation without the assistance of any back tension.

It will now be understood that once the entire machine is in full operation, each worm gear 67 and the pump housing secured thereto will rotate at a slightly higher speed than the corresponding drum and main gear 51. As a result of this difference in speed the teeth of each gear 51 and the idler gears 52 meshing therewith will draw oil upwardly from the supply at the bottom of the tank 19 through the inlet ports 79 and deliver it under pressure through the outlet ports 81, chamber 40 and pipe 84. The pressure will be maintained at a predetermined value by the action of the relief valve 85, and this predetermined pressure in reacting upon the constant area of the teeth of the gear 51 will transmit a substantially constant torque to this gear and to the drum associated therewith. This arrangement ensures a predetermined difference between the tension in the wire approaching the drum and the tension in the wire leaving the drum (back tension). If desired, the pressure gauges 86 can be readily calibrated to read directly in units of torque or in units of net pull transmitted to the wire. By properly adjusting the several relief valves 85 it is possible to maintain any desired back tension on the wire as it approaches the respective dies 16, except the first die, which is operated without back tension. For experimental purposes, the net pull on each die, that is, the difference between the forward tension in the wire and the back tension therein, can be readily determined by supporting the dies by means of calibrated springs in a well-known manner, and the most desirable torque for the several drums under a particular condition of wire drawing and rate of reduction can be easily ascertained. In this manner a substantial saving in power and in die maintenance cost can be effected. It will be understood that the drum 12, which is driven at a predetermined speed, controls the rate at which the wire passes through the entire machine.

The oil which flows past the several relief valves 85 enters the header pipe 88, and is distributed by this pipe to the pipes 89 which deliver it to the several worm gears to lubricate the same, the oil then returning by gravity to the reservoir. In this manner correct lubrication of the gears is ensured even during the threading-up period, when all the pumps may not be supplying oil simultaneously.

Air is supplied by the fan 98 to the upper portion of the frame 19, and this air flows upwardly through the openings 30 into the interior of the drums, whence it escapes through the openings 106 and 107. These openings direct the air in jets over the wire which is coiled about the cylindrical portion 93 of each drum. In this manner the drums and the wire are effectively cooled.

Each drum can be readily removed from the machine by first removing the screw 110 and the cap 109. Moreover, the sectional construction of the top plate 18 and of the worm shafts 69 makes it possible to withdraw each of the driving units for the drums independently of the other units. The novel arrangement of the dies and drums eliminates the necessity for idler sheaves, and allows all the drums to be mounted at the same height and without excessive overhang on their respective spindles. Most of the wear on the drum surfaces is caused by the first few wraps of the on-coming wire, so that some of the drums wear near the lower flange and some near the upper flange. By interchanging the drums after they have been thus worn it is possible to double their useful life.

In Figs. 10 and 11 there is shown a modified form of the invention in which one drum is arranged in axial alignment with another, thus providing a very compact construction. This arrangement can also be used to replace the positively driven drum 12 in the machine previously described, thus changing say a five-drum machine to a six-drum machine.

As shown particularly in Fig. 10, the spindle 28 of Fig. 3 is replaced by a somewhat longer spindle 120 which projects upwardly from the pump 43. This spindle 120 is surrounded by a sleeve 121 having an outwardly extending flange 122 at its lower end which is bolted to the worm gear 67 and thus positively rotated at the same speed as the pump housing. The sleeve is supported above the flange 122 by means of an anti-friction bearing 124 carried by the upper portion 38 of the bracket 34.

A drawing drum 125 is keyed to the upper portion of the sleeve 121 directly above the opening 30 in the cover plate 18. This drum is constructed with a substantially cylindrical portion

126 having spaced upper and lower flanges 127 and 128 projecting outwardly therefrom, the lower flange 128 having a depending skirt 129 which fits closely within the annular flange 105 on the cover plate 18. The drum 125 is provided with a hub portion 131 which extends above the sleeve 121 and carries an anti-friction bearing 132 forming a rotatable support for the spindle 120.

A second drawing drum 133 is keyed to the upper portion of the spindle 120 above the drum 125, this drum 133 being held in place by means of a circular cap 134 which is secured to the upper end of the spindle by means of a screw 135. The upper drum 133 is constructed with a substantially cylindrical portion 137 having spaced upper and lower flanges 138 and 139 projecting outwardly therefrom, the lower flange 139 having a depending skirt 140 which closely surrounds the upper flange 127 of the lower drum. Each of the flanges 127, 128, 138 and 139 is provided with a series of openings 142 for the discharge of cooling air which is delivered to the hollow interiors of the drums through the opening 30.

Referring now to Fig. 11, it will be seen that the wire W, after passing through a die 145, engages the cylindrical portion 126 of the lower drum 125. The wire then passes around an idler sheave 146 and through a second die 147 to the cylindrical portion 137 of the upper drum 133. A sufficient number of wraps are passed around each drum to ensure the desired capstan effect. Since the upper drum is rotated at a somewhat lower speed than the lower drum, and yet the linear speed of the wire engaging the upper drum must be higher because of the reduction in size effected in the die 147, the diameter of the cylindrical portion 137 of the upper drum is shown considerably greater than the diameter of the cylindrical portion 126 of the lower drum.

It will now be apparent that the lower drum 133 will be driven positively by the worm gear 67, preferably at a substantially constant speed, and this drum will control the rate at which the wire will travel through the machine. The upper drum, on the other hand, will be driven at a predetermined substantially constant torque through the medium of the pump 43 and the spindle 120. It will thus be possible to control the back tension in the wire passing around the idler sheave 146 and entering the die 147. There will be no slippage of the wire on the drums and no accumulation of the wire thereon. The construction is very compact, and provides a simple and highly advantageous means for increasing the number of reductions in an existing machine. Certain features of construction disclosed herein are claimed in our divisional application Serial No. 282,236, filed June 30, 1939.

Having thus described our invention, what we claim as new and desire to secure by Letters Patent is:

1. A wire-drawing machine comprising a die, a rotatable drum arranged to draw wire through the die, an oil reservoir, a pump arranged to withdraw oil from the reservoir and having two relatively rotatable parts, means connecting one of said parts to the drum, gears arranged to rotate the other part, means to regulate the pressure of oil discharged by the pump and thereby control the torque applied to the drum, and means to conduct oil discharged by the pump to said gears to lubricate the same.

2. A wire-drawing machine comprising a series of dies, a series of drums rotatable about vertical axes and arranged to draw wire through the dies successively, vertical spindles connected at their upper ends to the drums to drive the same, an upper and a lower bearing for each spindle, an annular worm gear surrounding each spindle close to and beneath the upper bearing, a hydraulic power transmission located between each worm gear and the lower bearing and connecting the worm gear to the spindle to drive the same, a horizontal rotatable drive shaft, a series of worms on the drive shaft which mesh with said worm gears, means providing an oil reservoir beneath the power transmission, the said lower bearing being submerged in oil in said reservoir, and means to conduct oil from the reservoir to the power transmission.

3. A wire-drawing machine comprising a series of dies, a plurality of rotatable drums arranged to draw wire through the dies successively, worm gears located adjacent the drums, a rotatable shaft, worms mounted on the shaft and meshing with the worm gears, a plurality of pumps each having two relatively rotatable parts, means connecting one of said parts of each pump to the adjacent drum, means connecting the other part of each pump to the adjacent worm gear, and means to regulate independently the pressure of fluid discharged by the respective pumps and thereby control independently the torque applied to the respective drums.

4. A wire-drawing machine comprising a die, a drum rotatable about a vertical axis and arranged to draw wire through the die, a vertical spindle connected at its upper end to the drum to drive the same, a bearing supporting the spindle adjacent to the drum, an annular worm gear surrounding the spindle adjacent the bearing, a horizontal rotatable worm in mesh with the worm gear, a hydraulic power transmission located beneath the worm gear and connecting the worm gear to the spindle to drive the same, means providing a reservoir for liquid beneath the power transmission, and means to conduct liquid from the reservoir to the power transmission.

5. A wire-drawing machine comprising an elongated tank arranged to form a reservoir for oil, a series of brackets mounted in the tank, an upper and a lower bearing on each bracket, vertical spindles rotatably supported in said bearings, a rotatable drum mounted on the upper end of each spindle, an annular worm gear surrounding each spindle, a horizontal rotatable drive shaft formed in separate connected sections for the respective brackets, a worm on each section of the shaft in mesh with the adjacent worm gear, a pump mounted on each spindle, each pump having a rotor connected to the spindle and a housing surrounding the rotor and connected to the worm gear, the housing having an inlet port through which oil may enter from the reservoir and an outlet port, and means to control independently the pressure of the oil discharged through the respective outlet ports.

6. A wire-drawing machine comprising a die, a rotatable drum arranged to draw wire through the die, a spindle connected at one end to the drum to drive the same, a bearing to support the spindle adjacent to the drum, a bearing to support the other end of the spindle, a pump mounted on the spindle between the two bearings, said pump having a rotor connected to the spindle and a housing surrounding the rotor, means to rotate the housing, the housing having an inlet port and an outlet port through which

fluid is caused to flow by the relative rotation of the housing and rotor, and means to regulate the pressure of the fluid discharged by the pump and thereby control the torque applied to the drum.

7. A wire-drawing machine comprising a die, a rotatable drum arranged to draw wire through the die, a spindle connected at one end to the drum to drive the same, a bearing to support the spindle adjacent to the drum, a bearing to support the other end of the spindle, a pump rotor surrounding the spindle between the bearings, the rotor being connected to the spindle to drive the same, a pump housing surrounding the rotor, means to rotate the housing, the housing having an inlet port and an outlet port through which fluid is caused to flow by the rotation of the housing relative to the rotor, and means to regulate the pressure of the fluid discharged through the outlet port and thereby control the torque applied to the drum.

8. A wire-drawing machine comprising a die, a rotatable drum arranged to draw wire through the die, a spindle connected at one end to the drum to drive the same, a bearing to support the spindle adjacent to the drum, a bearing to support the other end of the spindle, a pump mounted on the spindle between the two bearings, said pump having a rotor connected to the spindle and a housing surrounding the rotor, an annular worm gear surrounding the spindle and connected to the housing to rotate the same, a rotatable worm in mesh with the worm gear, the housing having an inlet port and an outlet port through which fluid is caused to flow by the relative rotation of the housing and rotor, and means to regulate the pressure of the fluid discharged by the pump and thereby control the torque applied to the drum.

9. A wire-drawing machine comprising a die, a rotatable drum arranged to draw wire through the die, a spindle connected at one end to the drum to drive the same, a bearing to support the spindle adjacent to the drum, a bearing to support the other end of the spindle, a pump mounted on the spindle between the two bearings, said pump having a rotor connected to the spindle and a housing surrounding the rotor, an annular worm gear surrounding the spindle between the first mentioned bearing and the housing and connected to the housing to rotate the same, a rotatable worm in mesh with the worm gear, the housing having an inlet port and an outlet port through which fluid is caused to flow by the relative rotation of the housing and rotor, and means to regulate the pressure of the fluid discharged by the pump and thereby control the torque applied to the drum.

10. A wire-drawing machine comprising a die, a rotatable drum arranged to draw wire through the die, a second die to which the wire is delivered by the drum, means to draw the wire through the second die and maintain a substantial tension in the wire between the drum and the second die, hydraulic means to apply to the drum a predetermined torque which is sufficient to rotate the drum in normal operation but insufficient to draw wire through the first die except with the assistance of the said substantial tension, and means to apply an increased torque to the drum when threading up the machine.

11. A wire-drawing machine comprising a die, a rotatable drum arranged to draw wire through the die, a pump having two relatively rotatable parts, means connecting one of said parts to the drum, means to rotate the other part, a conduit for fluid discharged by the pump, means associated with the conduit and arranged normally to maintain automatically a predetermined fluid pressure in the conduit and thereby provide a predetermined torque to drive the drum, and manually operable means whereby the fluid pressure in the conduit may be temporarily increased beyond the said predetermined pressure to increase the torque applied to the drum and facilitate the threading-up of the machine.

12. A wire-drawing machine comprising a die, a rotatable drum arranged to draw wire through the die, a pump having two relatively rotatable parts, means connecting one of said parts to the drum, means to rotate the other part, a conduit for fluid discharged by the pump, a pressure relief valve associated with the conduit to maintain automatically a predetermined fluid pressure in the conduit and thereby provide a predetermined torque to drive the drum, and a valve so arranged that it may be closed to prevent flow in the conduit when desired and thus increase the torque applied to the drum and facilitate the threading-up of the machine.

13. A wire-drawing machine comprising a die, a rotatable drum arranged to draw wire through the die, a spindle connected at one end to the drum to drive the same, a gear secured to the spindle, a pump housing surrounding the gear and rotatable relative thereto, means to rotate the pump housing, a planetary idler gear rotatably mounted within the pump housing and meshing with the first mentioned gear, the pump housing having an inlet port and an outlet port through which fluid is caused to flow by the action of the gears, a stationary chamber located adjacent the pump housing, a sleeve carried by the pump housing and coaxial with the spindle, the sleeve and spindle providing a passage therebetween which connects the outlet port with the chamber, and means to regulate the pressure of the fluid in the chamber and thereby control the torque applied to the drum.

14. A wire-drawing machine comprising a die, a rotatable drum arranged to draw wire through the die, a spindle connected at one end to the drum to drive the same, a bearing to support the spindle adjacent to the drum, a second bearing to support the other end of the spindle, walls forming a chamber supporting and enclosing the second bearing, a gear secured to the spindle between said bearings, a pump housing surrounding the gear and rotatable relative thereto, means to rotate the pump housing, a planetary idler gear rotatably mounted within the pump housing and meshing with the first mentioned gear, the pump housing having an inlet port and an outlet port through which fluid is caused to flow by the action of the gears, a sleeve carried by the pump housing and surrounding the spindle, the sleeve connecting the outlet port with the chamber, and means to regulate the pressure of the fluid in the chamber and thereby control the torque applied to the drum.

15. In combination with a series of dies and a plurality of rotatable drums arranged to draw wire through the dies successively, driving mechanism for one of said drums comprising a pump having a rotary element, means connecting the rotary element to the drum and arranged to subject the drum to the same torque as the rotary element, and means to regulate the pressure of fluid discharged by the pump and thereby control the torque applied to the drum.

16. A wire-drawing machine comprising a

series of dies, a plurality of rotatable drums arranged to draw wire through the dies successively, one of the drums being arranged to rotate at a predetrmined speed, a pump for each of the remaining drums, each pump having two relatively movable parts, means connecting one of the parts of each pump to the corresponding drum, a rotatable shaft, gears connecting the shaft to the other parts of all the pumps and to the said predetermined speed drum, an oil reservoir, a header pipe, the pumps being arranged to withdraw oil from the reservoir and deliver it to the header pipe, means to conduct oil from the header pipe to the gears to lubricate the same, and means to regulate independently the pressure of the oil discharged by the respective pumps and thereby control independently the torque applied to the corresponding drums.

17. A wire-drawing machine comprising a series of dies, a plurality of rotatable drums associated with the dies and arranged with their axes parallel, and means to rotate the drums in the same direction, the dies being so positioned with respect to the drums that after leaving each die the wire passes around the corresponding drums in the form of a helix, with the helices for successive drums alternately right-hand and left-hand.

18. A wire-drawing machine comprising a series of dies and a plurality of rotatable drums associated with the dies and arranged with their axes parallel, each drum having a pair of spaced flanges extending outwardly therefrom, the dies and drums being so positioned relatively that the wire is delivered first to one flange and then to the other on successive drums.

19. A wire-drawing machine comprising a series of dies and a plurality of rotatable drums associated with the dies and arranged with their axes parallel, each drum having a pair of spaced flanges extending outwardly therefrom, the dies and drums being so positioned relatively that the wire is delivered first to one flange and then to the other on successive drums, and the drums being so constructed that successive drums may be interchanged when one flange on each becomes worn, thereby prolonging the useful life of the drums.

20. A wire-drawing machine comprising a series of dies, and a plurality of drums rotatable about spaced parallel axes, each drum having a pair of spaced flanges extending outwardly therefrom and aligned with the flanges on the other drums, the dies being mounted in a staggered arrangement so that the wire may be delivered first to one flange and then to the other on successive drums.

21. A wire-drawing machine comprising two dies, two axially aligned rotatable drums arranged to draw wire through the dies successively, a pump having two relatively rotatable parts, means to rotate one of said parts and one of the drums at a predetermined speed, means connecting the other of said parts to the other drum, and means to regulate the pressure of fluid discharged by the pump and thereby control the torque applied to the said other drum.

22. A wire-drawing machine comprising two dies, two axially aligned rotatable drums arranged to draw wire through the dies successively, a pump having a rotor in axial alignment with the drums and a housing surrounding the rotor, means connecting the housing to the nearer of the drums, a spindle connecting the rotor to the other drum, means to rotate the housing and the drum connected thereto, and means to regulate the pressure of fluid discharged by the pump and thereby control the torque applied to the said other drum.

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