

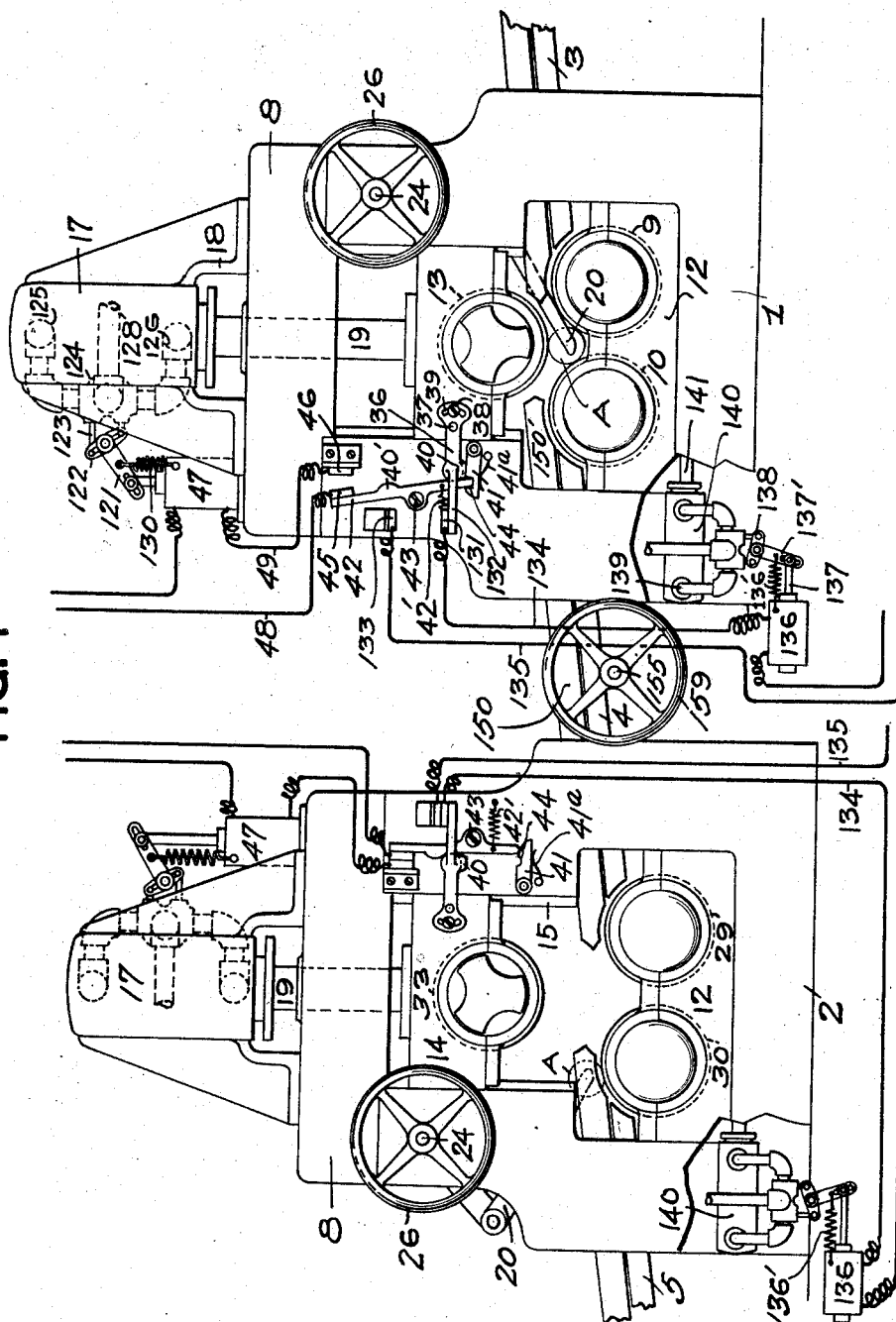
C. WERCKMEISTER.
 APPARATUS FOR THE MANUFACTURE OF AXLES.
 APPLICATION FILED NOV. 10, 1909.

1,015,412.

Patented Jan. 23, 1912.

5 SHEETS—SHEET 1.

FIG. 1



WITNESSES.

J. R. Keller
Robert C. Fother

INVENTOR.

Curt Werckmeister
By Kay & Fother
attorneys

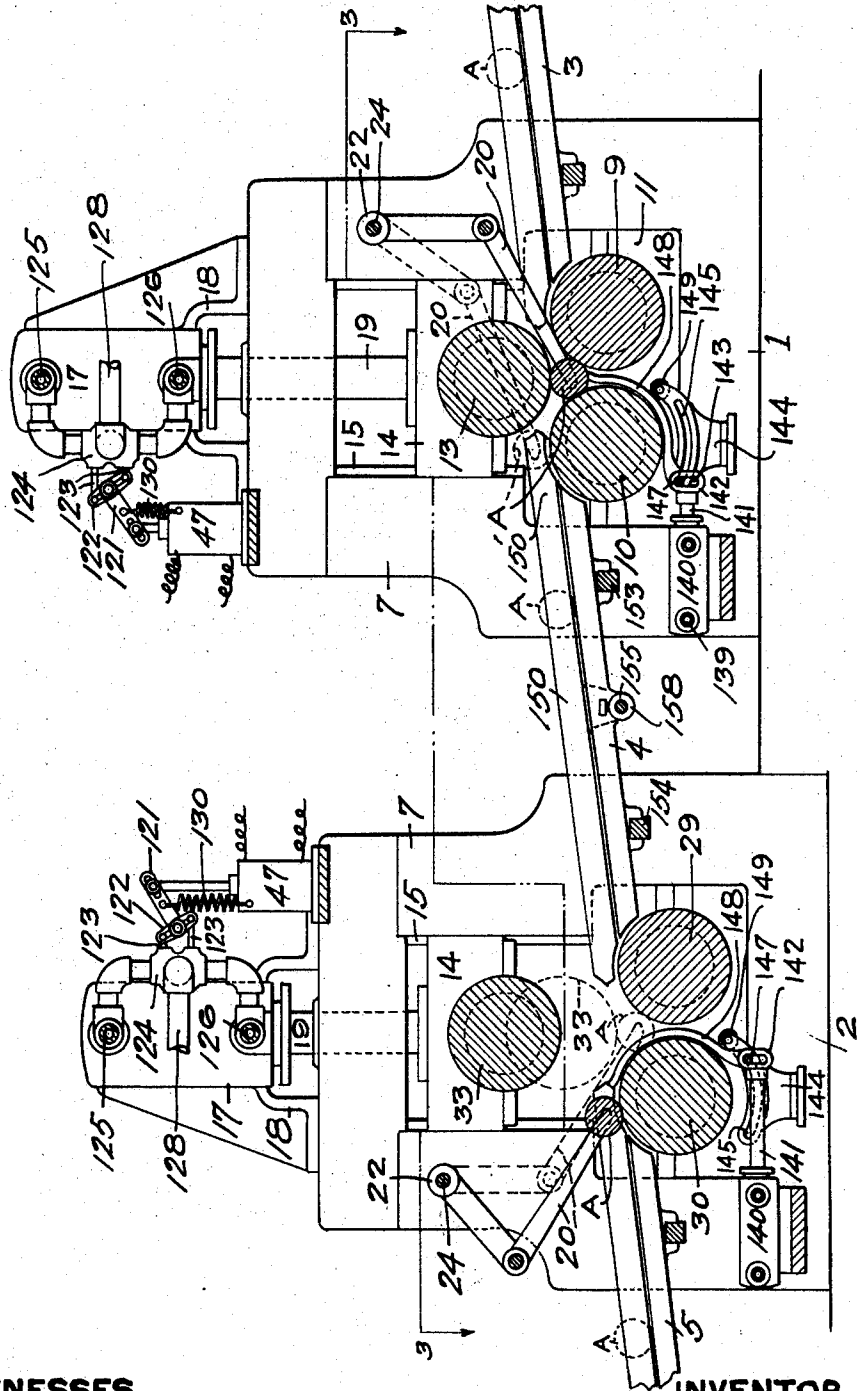
C. WERCKMEISTER.
 APPARATUS FOR THE MANUFACTURE OF AXLES.
 APPLICATION FILED NOV. 10, 1909.

1,015,412.

Patented Jan. 23, 1912.

5 SHEETS—SHEET 2.

FIG. 2



WITNESSES.

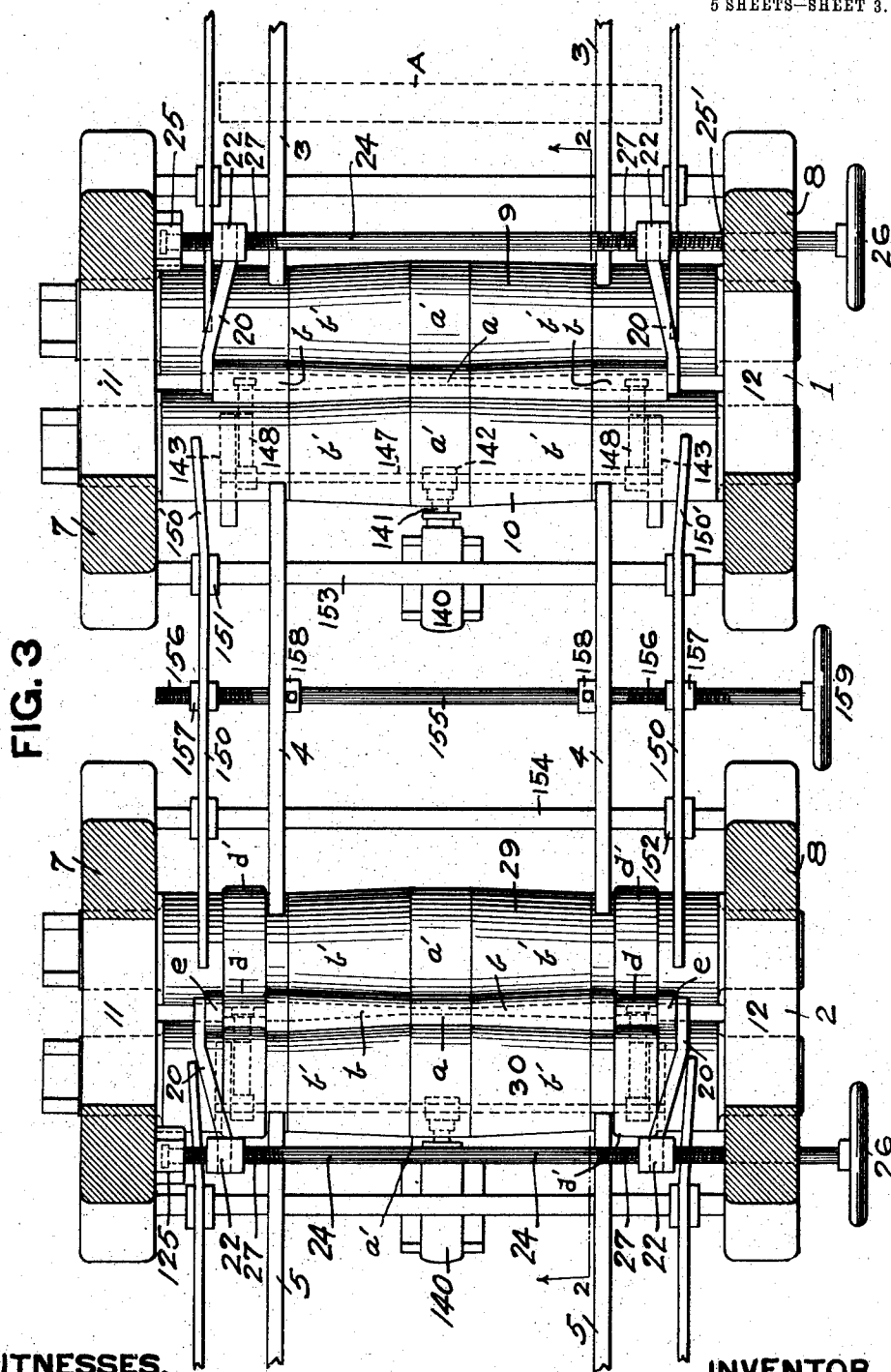
J. R. Keller
Robert C. Fother

INVENTOR.

Curt Werckmeister
By Kay & Fother
attorneys

1,015,412.

5 SHEETS—SHEET 3.



J. R. Keller
Robert C. Follen

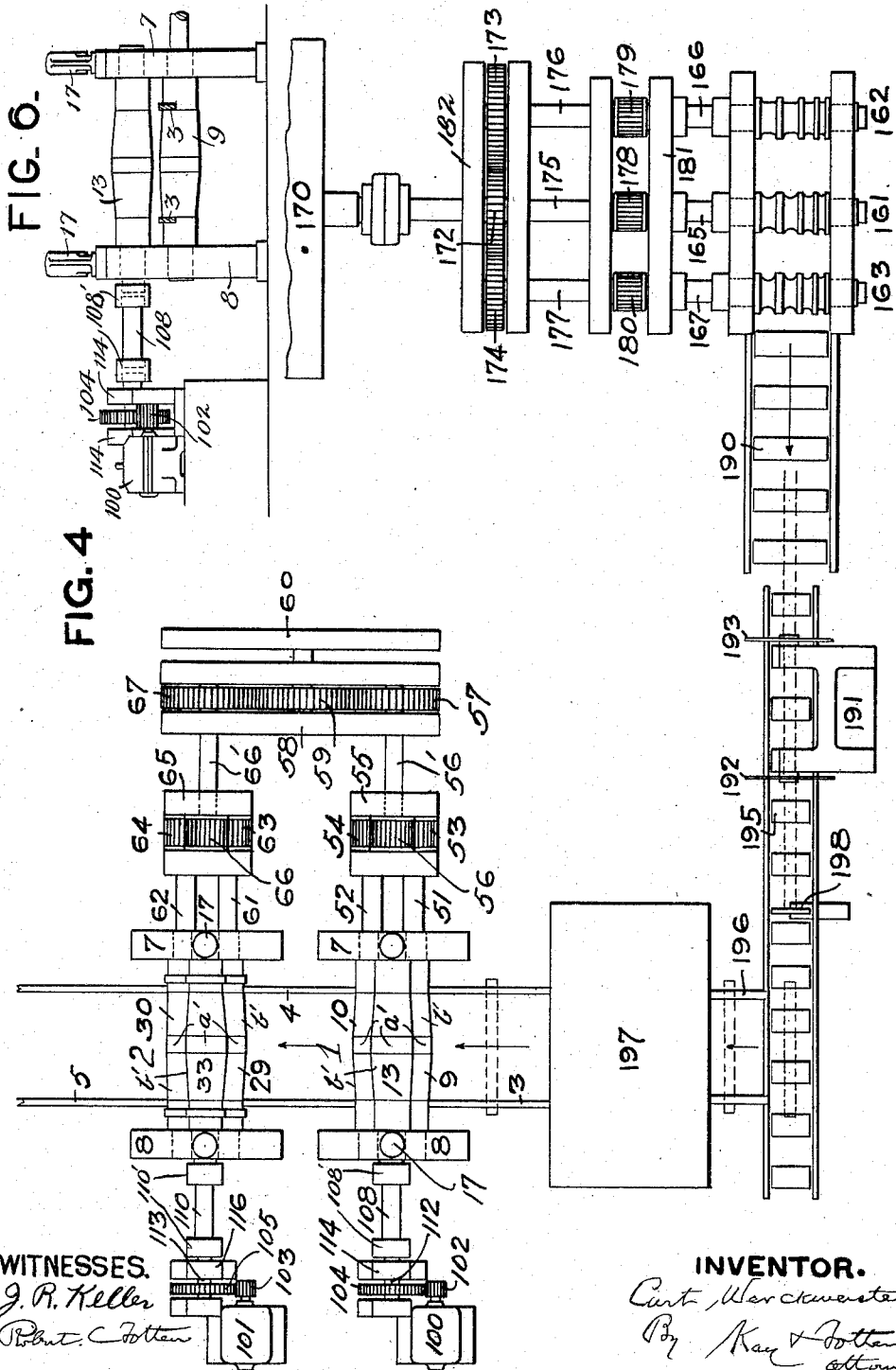
Carl Weckwerster
By Kay D. Jotter
attorneys

C. WERCKMEISTER.
 APPARATUS FOR THE MANUFACTURE OF AXLES.
 APPLICATION FILED NOV. 10, 1909.

1,015,412.

Patented Jan. 23, 1912.

5 SHEETS—SHEET 4.



WITNESSES.

J. R. Keller

Robert C. Follen

INVENTOR.

Curt Werckmeister

By Kay & Follen
 Attorneys

C. WERCKMEISTER.
 APPARATUS FOR THE MANUFACTURE OF AXLES.
 APPLICATION FILED NOV. 10, 1909.

1,015,412.

Patented Jan. 23, 1912.

5 SHEETS—SHEET 5.

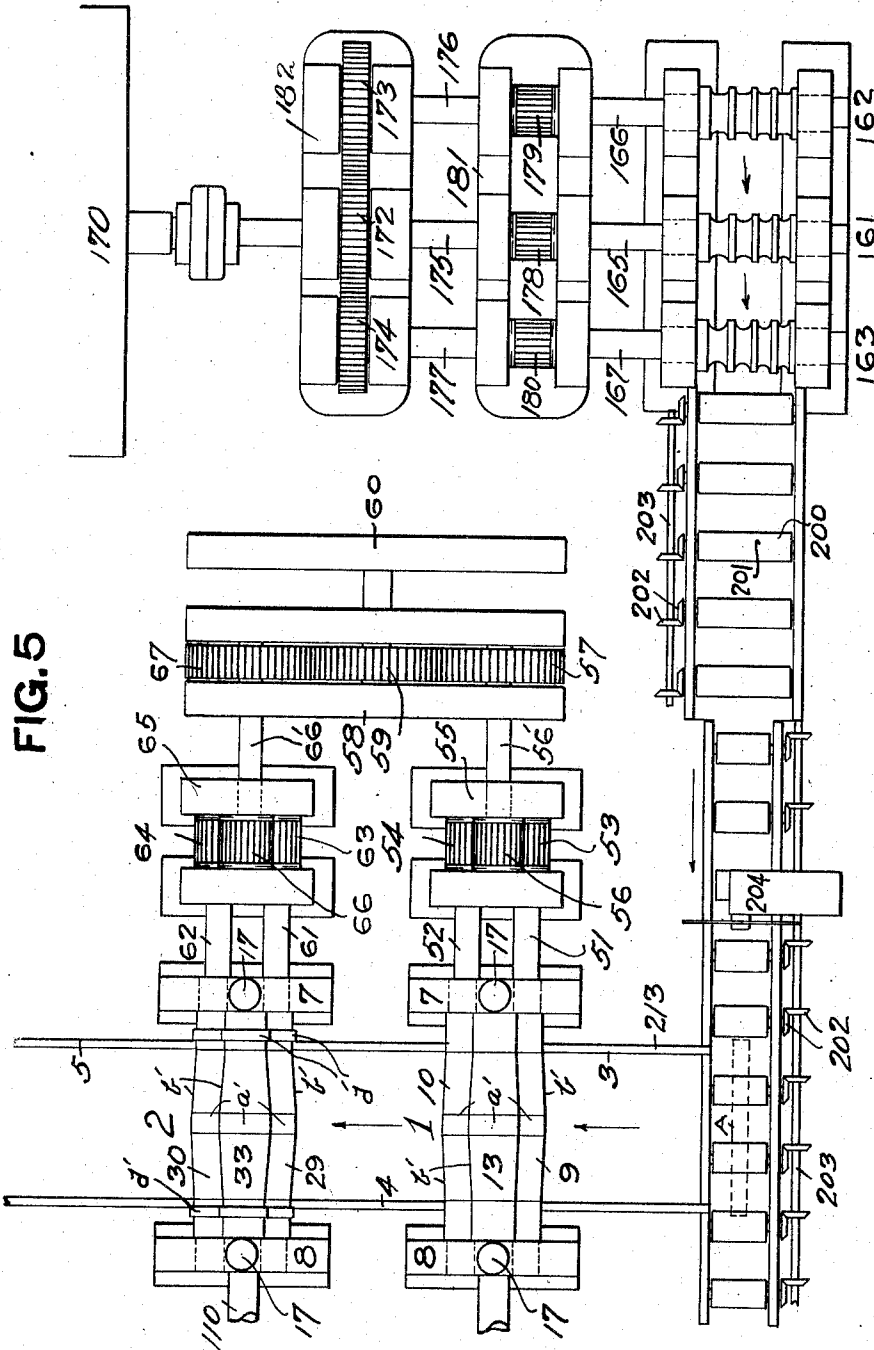


FIG. 5

WITNESSES.

J. R. Keller
Robert C. Fother

INVENTOR.

Curt Werckmeister
By Kay & Fother
attorneys

UNITED STATES PATENT OFFICE.

CURT WERCKMEISTER, OF HAZELWOOD, PENNSYLVANIA.

APPARATUS FOR THE MANUFACTURE OF AXLES.

1,015,412.

Specification of Letters Patent.

Patented Jan. 23, 1912.

Application filed November 10, 1909. Serial No. 527,229.

To all whom it may concern:

Be it known that I, CURT WERCKMEISTER, a resident of Hazelwood, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Apparatus for the Manufacture of Axles; and I do hereby declare the following to be a full, clear, and exact description thereof.

My invention relates to the rolling of elongated articles of varying cross section, such as axles and the like, and is particularly applicable to the rolling of steel railway axles. Its object is to provide an improved apparatus for such manufacture in an expeditious and economical manner.

My invention is defined in the appended claims, but consists, generally stated, in a cluster of rolls, preferably transversely or axially operated, and at least one of which is movable to and from rolling position, means for moving said movable roll and for forcing it inwardly in reducing the blank and means coöperating therewith for automatically controlling and reversing said motion when the required reduction in the blank is obtained. By my invention I thus provide an apparatus which is automatically operated to withdraw the movable roll to receive the blank, to return the said roll to rolling position and effect the reduction in the blank, and to automatically withdraw the movable roll; together with means for ejecting the rolled blank also preferably set in action by the movement of the roll.

My invention also comprises improved means for centering the blank in rolling position.

In the drawings Figure 1 is a side view, partly broken away, of two roll stands or clusters embodying my invention; Fig. 2 is a vertical section of the same, and Fig. 3 is a horizontal section of the same on the line (3—3) Fig. 2. Fig. 4 is a diagrammatic plan view illustrating a complete mill or apparatus suitable for the practice of my invention; and Fig. 5 is a like view illustrating a modified arrangement. Fig. 6 is a diagrammatic side view illustrating the means employed for driving the movable roll as illustrated in Fig. 4.

I shall first describe the apparatus illustrated in Figs. 1, 2, and 3 by which the heated cylindrical blank is successively rolled to final form. This heated blank A is first obtained from an ordinary bloom or oblong billet by suitable heating and roll-

ing operations. These operations will be described herein, as in the preferred form illustrated, they embody part of my complete apparatus for the reason that by them I produce a cylindrical blank of the required structure of metal to be rolled into an axle of the greatest strength. In Figs. 1, 2, and 3, I have illustrated two stands or clusters of rolls 1 and 2. The blank A is conveyed to the clusters of rolls 1 by the gravity skid 3, and after the first rolling operation in the cluster 1 is completed, it is ejected therefrom and conveyed by the skid 4 to the second cluster of rolls 2, where it is subjected to the second rolling operation, and after being ejected therefrom is conveyed, as by the skid 5, to any suitable desired point from which it may be taken for a final trimming or machining operation when necessary. The roll stands or clusters 1 and 2 have each two housings 7 and 8, the housings for one cluster being similar to those of the other. Each cluster of rolls comprises preferably three rolls, the two lower rolls 9 and 10 of the cluster 1 in the apparatus illustrated, turning in the fixed bearings 11 and 12 in the housings 7 and 8. The upper roll 13 is vertically movable, being carried by the movable bearings 14 which slide in the guides 15 of the housing. The upper roll 13 is raised and lowered by the hydraulic cylinders 17, one of which is preferably located near each end of the roll clusters or stands and carried by the bracket 18 thereon. The hydraulic cylinder 17 is provided with the ram or plunger 19 attached to the bearings 14. The upper roll 13 of the cluster 1, and the upper roll 33 of the cluster 2, are each turned by suitable wabblers and pinions from a suitable source of power, in the same direction as the bottom rolls of the cluster. It is preferred that the top rolls shall be driven by power independent of that driving the bottom rolls. All the rolls of the cluster must, to produce the result desired, be positively driven, so that the blank will both be rotated and compressed as the rolls are forced together, and in such operation the metal is forced longitudinally of the blank and the blank elongated while held to true cylindrical shape. In addition to this as the rolls first engage the blank in the mid-portion thereof, the frictional contact of the blank with the upper roll is not sufficient to drive it, and consequently it is necessary to provide

means for power driving that roll to give the above result in working or rolling the blank axially.

In Figs. 4 and 6 are illustrated diagrammatically the motors 100 and 101 which separately drive the movable top rolls 13, 33, respectively, independently of the lower rolls 9, 10 and 29, 30. The motors 100 and 101 and the couplings connecting them with the top rolls 13, 33, respectively, are shown for convenience of illustration as arranged on the opposite side of the roll clusters from the connections for driving the lower rolls, although it will be understood that any other arrangement of apparatus by which the movable roll is driven continuously through a coupling directly connecting it to the source of power independently of the connections for driving the other or non-movable rolls is within the spirit of my invention. It is preferable, however, to drive the top or movable rolls 13, 33 from power sources, such as the motors 100 and 101, which are distinct and separate from the source of power for driving the lower rolls as 9, 10, so that the movable roll as 13, through which the reducing pressure is applied, will act immediately on the blank at the start of the rolling operation, thereby obviating the injurious piping of the blank caused by the blank driving the movable roll. This will occur where a gear connection between the couplings for driving the movable and other rolls, such as gear wheels carried by the spindles for each roll, is employed, as the movable roll will always then have a tendency to lag behind due to play in such connection. As illustrated, the top rolls 13, 33 are driven respectively through flexible couplings in line therewith comprising the wabblers or spindles 108, 110, which are constructed in connection with the coupling boxes 108' and 110' so as to provide a continuous driving connection between the rolls 13, 33 and the shafts or journals 112, 113 in the housings 114, 116, respectively. The gear wheels 102, 103 carried by the motor shaft mesh with the gear wheels 104 and 105 carried by the journals 112, 113, respectively. The top rolls 13 or 33 may thus be positively rotated, as by closing the electric circuit of the motors 100 or 101 at exactly the same time as the lower rolls 9, 10 and 29, 30, respectively.

In the apparatus of Fig. 4 the lower rolls 9, 10 and 29, 30 are driven by the spindles 51, 52 and 61, 62, respectively carrying the pinions 53, 54 and 63, 64 journaled in the pinion housings 55, 65 respectively. Above the pinions 53 and 54 is the driving pinion 56 carried by the shaft 56', and above the pinions 63 and 64 on the spindles 62 and 63 is the driving pinion 66 carried by the shaft 66'; the shafts 56' and 66' being driven by the gear wheel 59 through the pinions 57 and 67.

In the operation of my apparatus the cylindrical blank is conveyed by the skids 3 to the roll stand 1, and is delivered into the seat or space between the two lower rolls 9, 10 the top roll 13 being in its raised position. Since the ends of the blank are left perfectly free to elongate during my process, and no collars or other confining means are provided in the rolls of this cluster to confine the ends of the blank, the blank is first preferably centered in position by the following device: The arms 20 are provided with the threaded sleeves 22. The adjusting bar 24 turns in the bearings 25 and 25', of the housings 7, and is provided with the handle or wheel 26, and the threaded portions 27 secured within the threaded sleeves 23. The arms 20 rest on the lower roll 9, and when the heated cylindrical blank is delivered to the seat between the lower rolls 9, 10, the hand wheel is turned by the operator so as to force the arms 20 toward each other until the blank is grasped between them. As the relative motion toward the center of the rolls of each of the arms 20 is identical, the blank when jointly grasped must be accurately centered in the rolls. The upper roll 13 is then lowered until it comes into initial contact with the cylindrical blank, the central portion *a'* of the roll only meeting the blank, the arms 20 extending between the upper roll 13 and the lower roll 9 and not interfering in any manner with the rolling operation on account of the thickness of the cylindrical blank to be rolled, which is in every case greater than that of the arms. The arms 20, which grip the blank to center the same, naturally will follow the blank to some extent during the ejection from the cluster of rolls. Thus in Fig. 2 the arms 20 are illustrated in dotted lines in the roll cluster 1 in the position assumed just as the blank starts to roll down the skids 4. The dotted line position of the arms 20 shown in the roll cluster 2 is that assumed during the centering of the blank, and the full line position is that taken just as the roll is leaving the cluster. The three rolls of this cluster 1 have the contour illustrated in Fig. 3, the central portion *a'* being larger than the tapering portion *b'* on each side thereof. As the rolls are turned axially as indicated by the arrows, no positive turning of the upper rolls would be required if a sufficient space of contact between the upper roll and the blank were provided at the start of the rolling operation. As, however, the mid-portion *a'* of the rolls is comparatively short, I prefer to provide turning means for the upper roll such as above described, so as to insure the immediate positive turning of the roll and therefore effective rolling of the blank to reduced form, as well as preventing any ill effects on the blank by having the upper roll idle when the operation is

started. The mid-portion *a* of the blank is obtained by this operation and the enlarged portions *b* on each side thereof are developed. The metal is forced longitudinally of the rolls and its length is increased. There is no upsetting or distortion of the metal within the blank during this rolling operation and therefore no crystallization of the metal, but the metal after this step is of a fibrous nature throughout. The enlarged portions *b* are not greater in diameter at any point than the original diameter of the cylindrical blank. After the required reduction in the mid-portion is obtained, the rolling operation is automatically stopped and the top roll raised, the following apparatus preferably being employed: The movable roll bearing or cross-head 14 is provided with an adjustable arm 36. The arm 36 is preferably attached to the cross-head 14 by the pivot 37 and is adjustably fixed in position by the screw 38 within the slot 39 of the arm 36. The arm 36 is provided at its outer end with a cam head 40 and is so adjusted that when the required reduction of blank is obtained the cam head 40 moves the latch 41 to release the switch lever 42. The switch lever 42 is pivoted at 43 to the roll housing and fits at its lower end into the slot 44 of the latch 41, which is held in locking contact with the switch lever 43 by the spring 41^a. The switch lever 42 is provided at its upper end with the contact blade 45 which is adapted to close the circuit through the contact 46 fixed to the housing. The solenoid 47 is supported upon the housing and is in circuit with the contacts 45, 46 through the wires 48, 49 illustrated diagrammatically. The armature of the solenoid 47 is pivotally connected to the link 121 provided with the arm 122, which is pivoted at each end of the valve rods 123 which operate the valve 124 of the hydraulic cylinder 17. The passages 125, 126 lead to opposite ends of the hydraulic cylinder 17, the water for which is supplied from any suitable source of hydraulic pressure, as by the pipe 128. The coil spring 130 operates as a flexible fulcrum about which the arm 121 is turned to operate the valve rods 123. As soon as the latch 41 is released at the completion of the rolling operation, the switch lever 42 is moved by the spring 42' to make the contact 45, 46. The solenoid 47 is then energized and the hydraulic fluid admitted to the lower side of the cylinder 17 by the movement of the valve 124. The upper roll is then raised until the contact 131 carried by the arm 132 of the adjustable arm 36 meets the fixed contact 133 upon the roll housing 8. The contacts 131, 133 are in circuit through the wires 134, 135 with the solenoid 136, the armature piston 137 of which actuates through the rod 137' the valve gear 138 to admit the hydraulic fluid into the end 139 of the cylinder 140. The

valve gear 138 is similar in operation to that employed in operating the hydraulic cylinder 17, the spring 136' acting as a fulcrum for the rod 127' on the forward movement of the armature 137, and also tending to return said armature piston 137 to its retracted position. The cylinder 140 is provided with the piston 141 which has at its outer end the cross arm 142 provided with the slot 143. The bracket 144 carried by the roll housing has the segmental guide slot 145, in which the pin 147 of the arm 148 plays. The arm 148 is of curved construction and extends upwardly between the two lower rolls 9, 10 resting upon the roller 149 at the upper end of the bracket 144. The pin 147 fits within the slot 143, so that when the armature piston 141 is forced upwardly the arm 148 is forced in a curved course upwardly between the lower rolls and ejects the roll blank from the roll 10 and onto the skid 4. The closing of the contacts 131, 133, near the upward limit of travel of the upper roll, thus has the effect of actuating the ejecting mechanism to expel the blank from the open cluster of rolls. As the contacts 131, 133 are of suitable blade construction they maintain sliding contact for a slight distance until the cam head 40 contacts with the cam 40' on the switch lever to open the circuit through the contacts 45, 46. The movement also locks the switch lever in position with the latch 41. The solenoid 47 is thus deenergized and the spring 130 retracts the arm 121 so as to admit the hydraulic fluid to the upper end of the cylinder 17. At about this time the next blank to be rolled is introduced into the seat or niche between the lower rolls from the skid 3. The lowering of the piston 19 by the hydraulic cylinder 17 first breaks the contacts 131, 133 and thereby effects the withdrawal of the ejecting arm 148 through the medium of the spring 136. It then brings the upper roll 13 into rolling contact with the cylindrical blank, and the rolling operation in this cluster of rolls again actively commences. The lower rolls may be turned continuously or may be operated intermittently so as to turn only when the blank is in position, as desired. The upper roll 13 if actuated through the medium of an electric motor drive as shown in Fig. 4, may also be turned continuously, but by the device illustrated it is only turned when brought into rolling contact as described above. As soon as the required reduction in the blank is obtained the cam head 40 again opens the latch 41 and the above described automatic operations are repeated.

The elongated and reduced blank *A* when ejected from the first cluster of rolls 1 is guided on the skids 4 by the adjustable guiding arms 150. These arms are provided with the sleeves 151, 152, which are movable along the rods 153, 154 secured to

the housings 7, 8 respectively. The adjusting bar 155 has the threaded portions 156 turning within the threaded sleeves 157 of the adjusting arms 150, and is supported in the bearings 158 carried by the skids 4. The forward portions 150' of the adjusting rods are flared so as to form a funnel shaped channel into which the blank A is forced and along which it is carried by gravity upon the skids 4 to the second cluster of rolls 2. The guide arms 150 are adjusted to the desired width by turning the wheel 159 of the bar 155, operating in a manner similar to the guide arms 20 as described above. The blank coming from the skids 4 is delivered to the second cluster or stand of rolls 2 when the upper roll 33 is in raised position. The upper roll 33 is then lowered by an apparatus in all respects similar to that described in connection with the first cluster or stand of rolls, and this apparatus is therefore not specifically described here. However, it will be noticed that in Fig. 1 in the apparatus, as illustrated in connection with the roll cluster 1, the upper roll 33 is in raised position. The same reference numerals are used to designate the various parts of the roll adjusting and blank ejecting devices, however, and their operation will be understood without a specific reference thereto. After the blank is received, it is centered upon the roll in the manner already described, and the upper roll is lowered until its enlarged portions d' come into contact with the blank near its end. The rolling operation then results in the production of the reduced end portions or journal-portions d in the blank by the enlarged portions d' of the rolls. While the portions $a' b'$ of the rolls are necessarily not in contact with the blank at the first stage of this rolling operation, or until the journal-portions d have been partially developed, still there is no substantial displacement or distortion of the metal in the portions a, b of the blank, but its fibrous nature is maintained. This is for the reason that the development of the journal-portions d results merely in a compression of the portions a, b longitudinally of the blank for a time. This feature therefore merely amounts at the most to a slight forging operation and the total effect on the metal of the middle portion is beneficial, there being no permanent transverse displacement thereof. The rolling down of the reduced journal-portion d has the effect of greatly compressing and compacting the metal therein. This is of great advantage as these portions are subjected to the greatest surface wear in use. The extreme end portions e of the blank are produced mainly by the longitudinal displacement of metal from the journal-portions d . At all times the extreme ends of the blank are left unconfined by any collar

on the rolls. There is therefore a substantial freedom of end flow in the metal during the entire operation, and constantly a gradual lengthening of the blank. The blank in finished form is ejected from the second cluster of rolls in a manner similar to that described in connections with the first rolling stand, and delivered to the skids or way 5, to be taken therefrom for actual use, or for any finishing or end trimming machine operation, if employed.

As it is necessary that the cylindrical blank to be used in the axial rolling process of my invention be of the required homogeneous and fibrous structure, I prefer to prepare it by either one of the two alternative mills or arrangements of rolling, shearing and conveying apparatus illustrated diagrammatically in Fig. 4 or Fig. 5. In Fig. 4 the three stands of concentric grooved rolls 161, 162 and 163 are arranged to be driven by any suitable means, those illustrated comprising the motor 170, which connects by the shaft with the gear wheel 172 enmeshed with the gear wheels 173 and 174 in the gear housings 182. Gear wheels 172, 173, 174 connect by means of the shafts 175, 176 and 177 with the pinions 178, 179, 180 in the pinion housings 181. The lower rolls on each stand 161, 162, 163, are driven through suitable pinions or couplings (not shown) in the usual manner but well understood in the art. The bloom employed is taken from a suitable blooming mill and passed through the stands or reducing rolls 161, 162, and 163 for the required number of passes to reduce the bloom to a cylindrical elongated billet or blank. The billet thus produced has undergone entirely longitudinal rolling and is therefore of the required fibrous structure. It passes to the conveying rollers 190 and is transferred to position in connection with the shearing or sawing device 191. This device is of adjustable construction, preferably employing two severing members 192, 193 so that the elongated heated billet carried by the roll-table 195, after striking the stop 198, will be sheared by the pair of severing members 192 and 193, and from it formed at each shearing operation two blanks of equal length. As the billets are rolled conveniently approximately a multiple length of blank, the waste sheared from the ends of them is not great. From here the blank is transferred by the conveying roll table 195 to position in front of the conveyer 196 leading into the continuous heating furnace 197. This heating furnace is primarily a storage furnace to maintain the blank at rolling temperature, as numerous blanks are formed from a single rolled billet and it is desirable to raise them to and hold them at proper rolling heat for feeding to the first cluster of rolls 1 at proper intervals accord-

ing to the proper speed of operation. From the heating furnace 197 the cylindrical blank is delivered to the conveying skids 3 as desired for rolling by my improved method as above described.

Fig. 5 illustrates an alternative means of producing a cylindrical blank for delivering to the axially operated rolls. By this method the bloom taken from the blooming mill is rolled longitudinally in the stands of rolls 161, 162, 163, which are similar in all respects to the like stands employed in the apparatus of Fig. 4, and are preferably driven by similar means. The bloom employed, however, is preferably of smaller size, and therefore when rolled from its oblong or rectangular form to the required cylindrical form is of much less length than that produced by the above described preliminary rolling process. It is delivered to the conveying table 200 having the positively driven rollers 201 actuated by the bevel gears 202 which are driven by the shaft 203 or in any desired fashion. It is carried by the rollers 201 to the severing device 204, by which it is trimmed off if necessary. The rollers 201 lead beyond the severing device to the delivering table or skid 213 perpendicular to the roller table, which delivers the blank to the first cluster of axially operated rolls 1. The billet employed by this method of rolling is a lighter one, so that some slight trimming or shortening as by the severing device 204 is all that is required to put the cylindrical blank in condition for axial rolling. The blanks are not supplied by the longitudinal rolls 161, 162, and 163 at too fast a rate to be taken care of by the clusters of axial rolls 1 and 2. A reheating or storing furnace is thus dispensed with.

What I claim is:

1. In rolling apparatus the combination with a cluster of axially operated rolls, of means for moving one of the rolls to and from rolling position in the cluster and mechanism automatically controlled by the motion of said roll to reverse the same and effect each succeeding movement.

2. In rolling apparatus the combination with a cluster of axially operated rolls, of means for moving one of the rolls to and from rolling position in the cluster, mechanism automatically controlled by the motion of said roll to reverse the same and effect each succeeding movement, and means for continuously driving said movable roll.

3. In rolling apparatus the combination with a cluster of axially operated rolls, of means for moving one of the rolls to and from rolling position in the cluster, mechanism automatically controlled by the motion of said roll to reverse the same and effect each succeeding movement, and mechanism set in action by the motion of said movable

roll when the same is moved from rolling position to eject the rolled blank.

4. In axial rolling apparatus, a cluster of rolls, means for withdrawing one of said rolls from the cluster, an arm entering between two adjacent rolls to eject the blank when the movable roll is withdrawn, and means for actuating said arm.

5. In axial rolling apparatus, a cluster of rolls, mechanism for withdrawing one of said rolls from rolling position and mechanism set in action by said withdrawing mechanism for positively ejecting the rolled blank when the movable roll is in withdrawn position.

6. In axial rolling apparatus, a cluster of rolls and mechanism for withdrawing one of said rolls therefrom, mechanism for ejecting the rolled blank when the movable roll is withdrawn, a fluid pressure cylinder operating said ejecting mechanism, and means set in action by the withdrawal of said movable roll for actuating said fluid pressure cylinder.

7. In axial rolling apparatus, a cluster of three rolls means for withdrawing the top roll therefrom, and a curved arm entering between the lower rolls and set in action by said withdrawing means to eject the blank from rolling position.

8. In axial rolling apparatus, a set of axially operated rolls and means for positioning the blank and holding it in determinable longitudinal position between the rolls.

9. In axial rolling apparatus a set of rolls arranged to form an axle blank by transverse rolling pressure and hinged arms for positioning the blank and holding it in determinable longitudinal position between the rolls, said arms entering between two of the rolls.

10. In axial rolling apparatus a set of transversely operated rolls, arms for adjusting the blank longitudinally of the rolls, and means for simultaneously adjusting said arms toward and from each other to determinably position the blank longitudinally of the rolls.

11. In axial rolling apparatus, a set of transversely operated rolls adapted to form an axial blank and arms for determinably positioning the blank longitudinally of the rolls, said arms being supported by double hinged mechanism so that the free ends of the arms can enter between the rolls, and thereby permitting the swinging of the arms laterally of the rolls.

12. In axial rolling apparatus, a set of transversely operated rolls adapted to develop an axle blank or the like, means for feeding the blank into the rolls, and two arms simultaneously adjustable between the rolls for adjusting the blank in determinable longitudinal position therewithin.

13. In axial rolling apparatus, a cluster of

rolls, one of which is reciprocally movable to and from rolling position in the cluster, means for moving said roll, means for ejecting a roll blank, and an electric connection
5 operated by the movement of said movable roll to cause the actuation of said ejecting means.

14. In axial rolling apparatus a cluster of rolls, means for lifting and lowering one
10 of said rolls including a hydraulic cylinder, a solenoid adapted to be switched into circuit, a valve gear on said hydraulic cylinder operated by said solenoid and adapted to raise said roll, an electric circuit of which
15 said solenoid is a part comprising a fixed contact and a movable contact, and an arm carried with said roll and adapted to cause the closing of said movable contact.

15. In axial rolling apparatus a cluster of
20 rolls, means for lifting one of said rolls, an ejecting mechanism entering between two of said rolls, a hydraulic cylinder adapted to actuate said ejecting mechanism, a solenoid controlling the operation of said hydraulic
25 cylinder, a fixed contact and a movable contact carried with said movable roll to actuate said solenoid.

16. In axial rolling apparatus, a cluster of transversely operated rolls, mechanism for
30 withdrawing and returning one of said rolls to the cluster, an electric circuit adapted to control said mechanism, mechanism for ejecting the rolled blank from the cluster when the movable roll is withdrawn, and an
35 electric circuit controlled by the movement of said roll to control said ejecting mechanism.

17. In rolling apparatus the combination with a set of rolls, one of which is movable
40 to and from rolling position, of means for reciprocally moving said roll, and electric mechanism cooperating therewith to control said roll moving means.

18. In axial rolling apparatus, a cluster of
45 transversely operated rolls, means for withdrawing one of said rolls from the cluster to admit the blank and for returning the roll to the cluster to effect the rolling therein, and electromagnetic means cooperating
50 therewith including an electric circuit adapted to be closed when the required rolling reduction is obtained in the blank to control said roll withdrawing means.

19. In axial rolling apparatus, means for
55 withdrawing one of the rolls from rolling position so as to allow the entrance of a heated blank, means for guiding said blank into position to be rolled, and means for centering the blank longitudinally of the
60 rolls comprising two arms extending along

said guiding means, and mechanism for positioning said arms so as to guide the blank and adjust it longitudinally of the rolls.

20. In axial rolling apparatus, two stands
65 each containing a cluster of rolls, means for withdrawing one of said rolls in each of said clusters, and thereby allowing for the ejection and entrance of the blank to be rolled, suitable skids leading to the first cluster,
70 skids connecting said clusters and adapted to receive the ejected blank after the rolling operation in the first cluster and feed it to the second cluster, means for ejecting the
75 blank from each of said roll clusters, guides situated between said roll clusters and parallel to said skids and movable toward the axis thereof, provided with flaring arms toward the first cluster, and means for simultaneously equally adjusting each of said
80 pair of guides transversely of said skids.

21. In axial rolling apparatus, the combination with a cluster of rolls one of which is movable from rolling position, of mechanism arranged to be automatically actuated
85 on a given reduction in the blank for moving said movable roll from rolling position.

22. In axial rolling apparatus, a cluster of rolls one of which is movable relative to the cluster in combination with means for
90 moving said roll to admit the blank, returning it to rolling position and further forcing it into the cluster to effect the required reduction in the blank, and mechanism automatically set in action when the required
95 reduction to the motion of the movable roll is obtained for controlling said roll moving means.

23. In axial rolling apparatus, a cluster of rolls including a roll movable relative to
100 the others to admit a blank and effect a reduction therein, and means automatically controlled by the motion of said roll for moving the same.

24. In axial rolling apparatus, a cluster
105 of rolls including a roll movable relative to the others to admit a blank and effect a reduction therein, means automatically controlled by the motion of said roll for moving the same, connections for driving the non-
110 movable rolls, and a flexible coupling independently connected to a power source and adapted to continuously drive said movable roll.

In testimony whereof, I the said CURT WERCKMEISTER have hereunto set my hand.

CURT WERCKMEISTER.

Witnesses:

ROBERT C. TOTEN,
J. F. WILL.