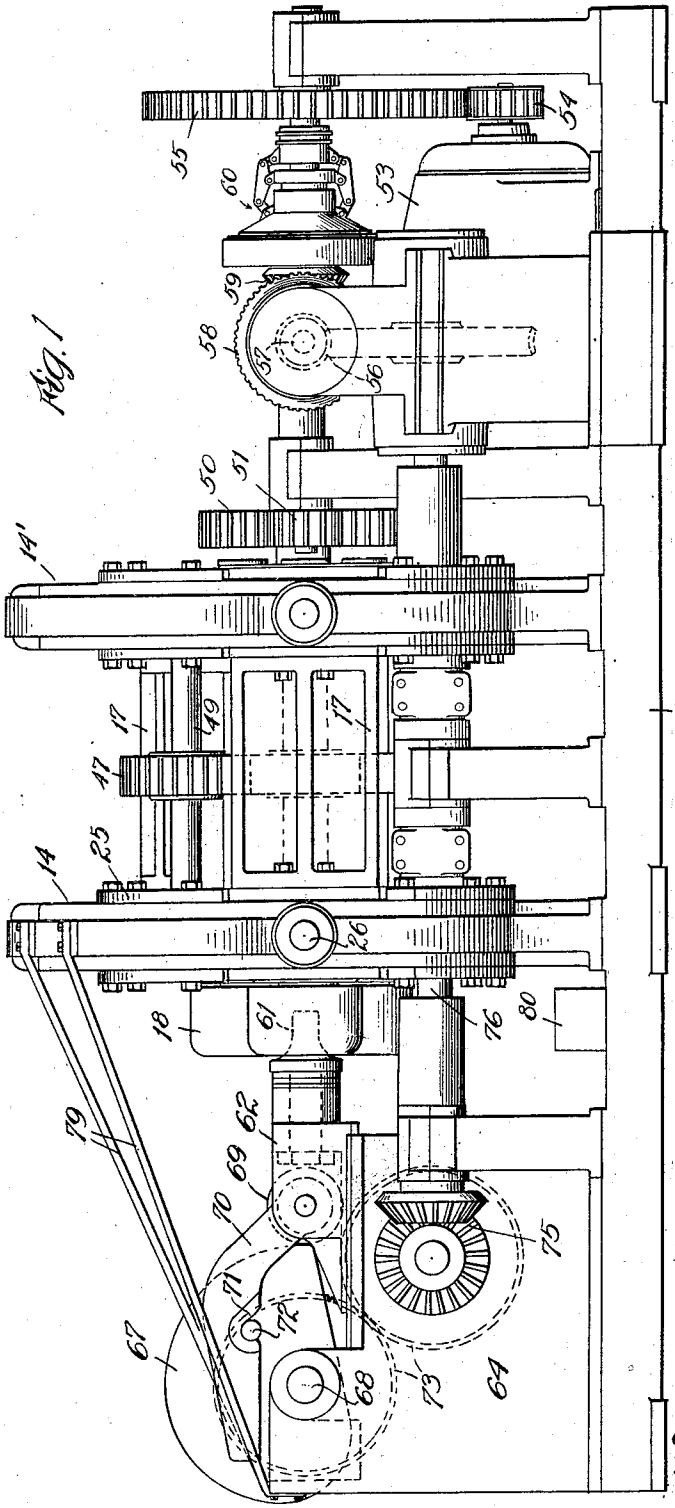
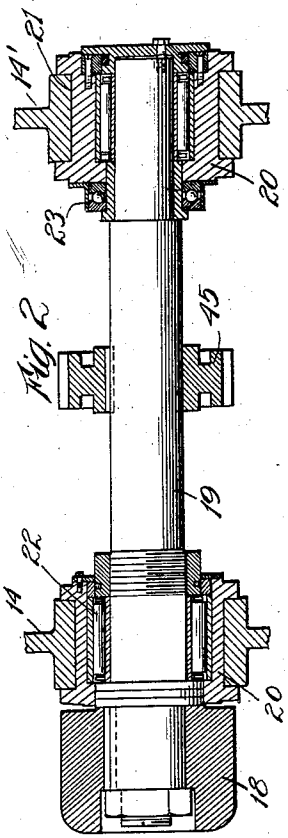
April 12, 1932. C. C. GROTNES 1,853,858

METHOD OF AND MACHINE FOR ROLLING ANNULAR METALLIC ARTICLES

Filed May 20, 1929 5 Sheets-Sheet 1





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METHOD OF AND MACHINE FOR ROLLING ANNULAR METALLIC ARTICLES

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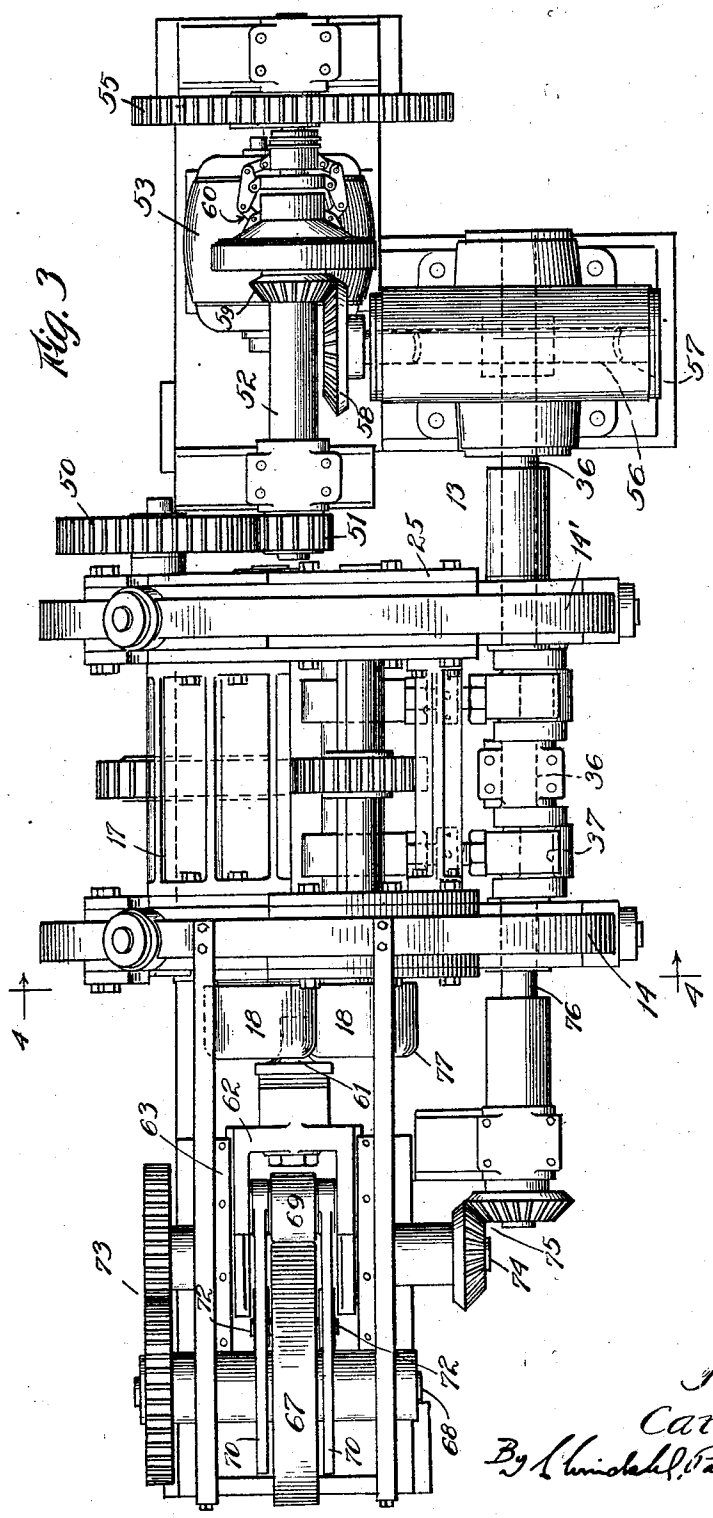
Fig. 3



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METHOD OF AND MACHINE FOR ROLLING ANNULAR METALLIC ARTICLES

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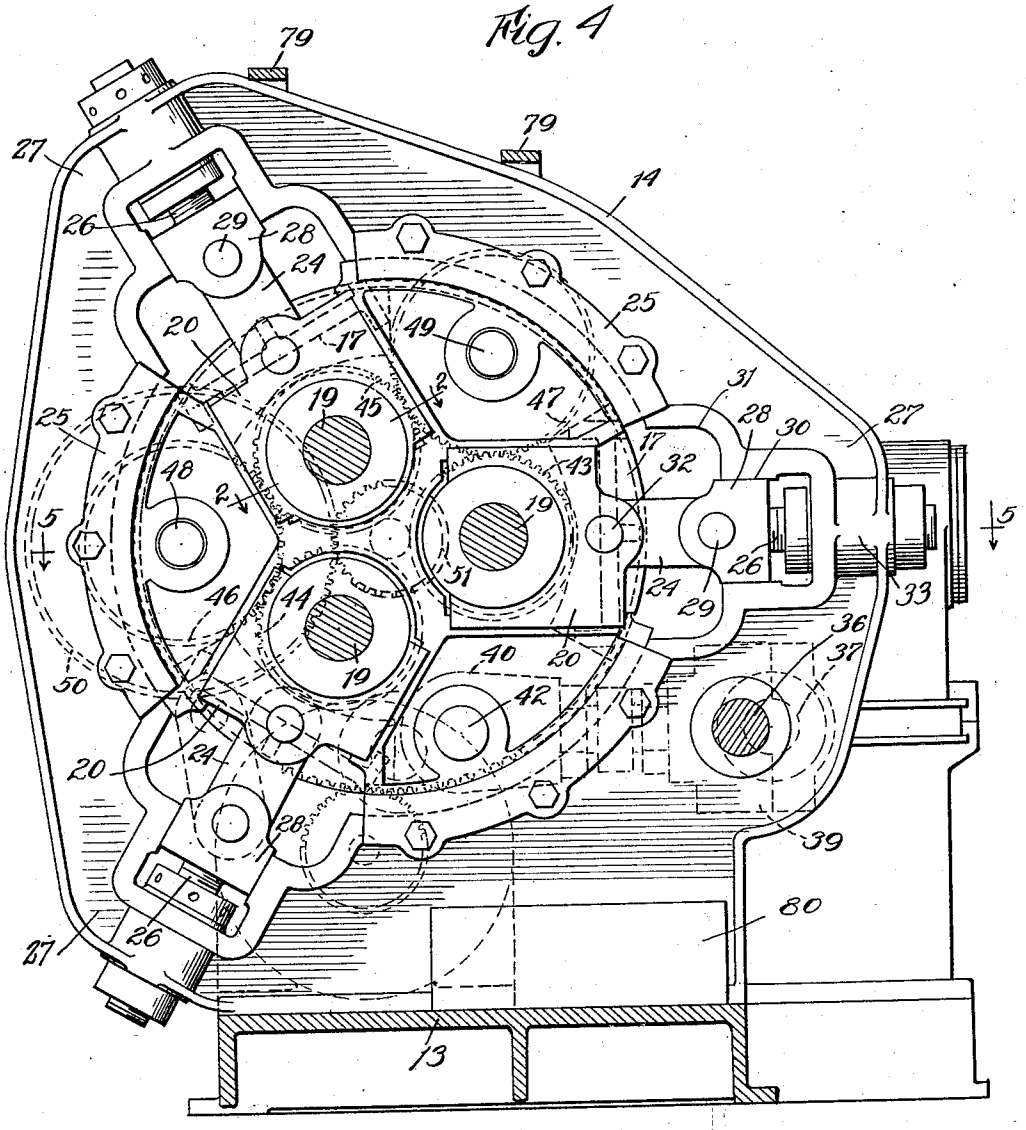
Fig. 4



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METHOD OF AND MACHINE FOR ROLLING ANNULAR METALLIC ARTICLES

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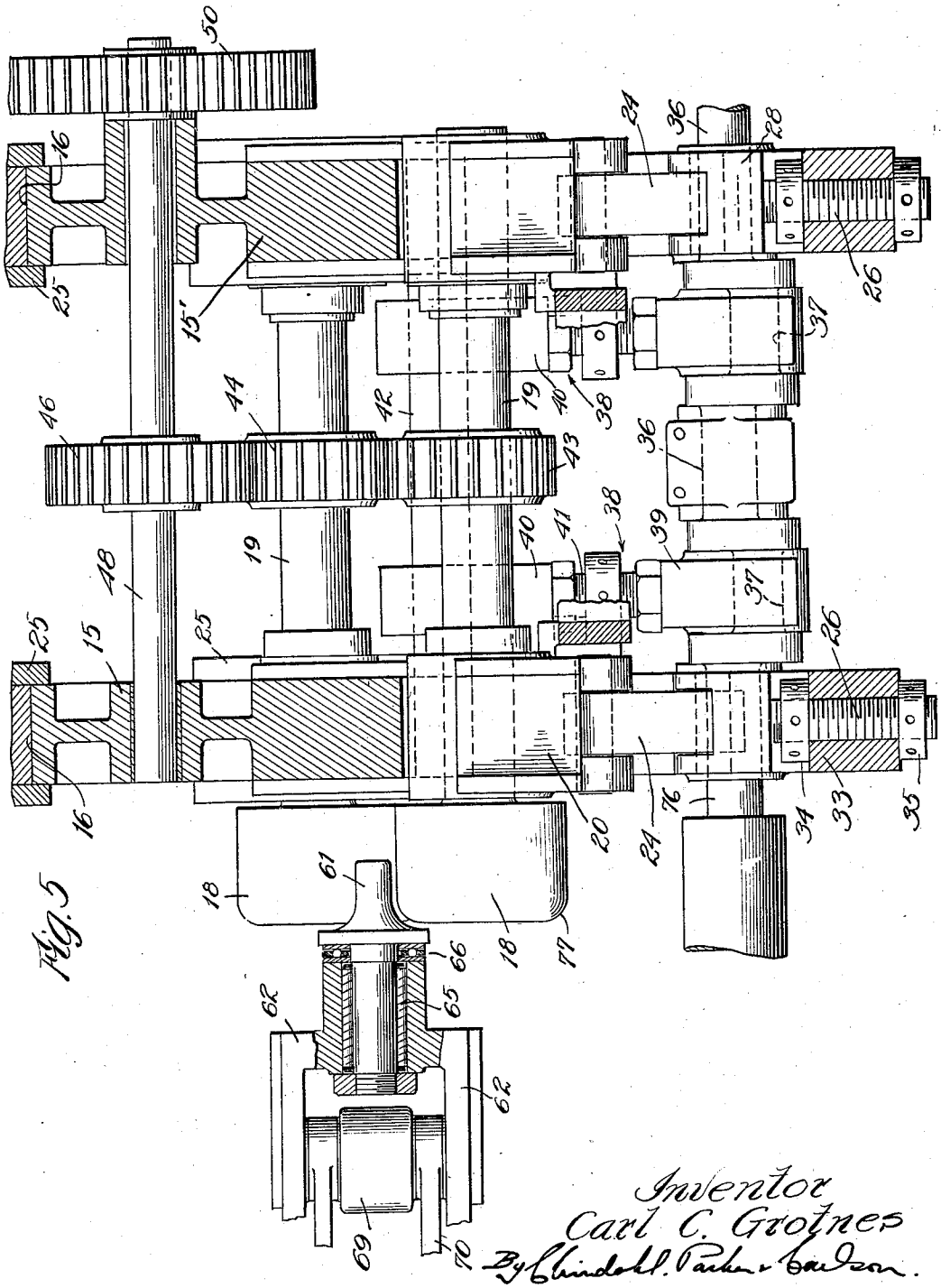

Fig. 5

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METHOD OF AND MACHINE FOR ROLLING ANNULAR METALLIC ARTICLES

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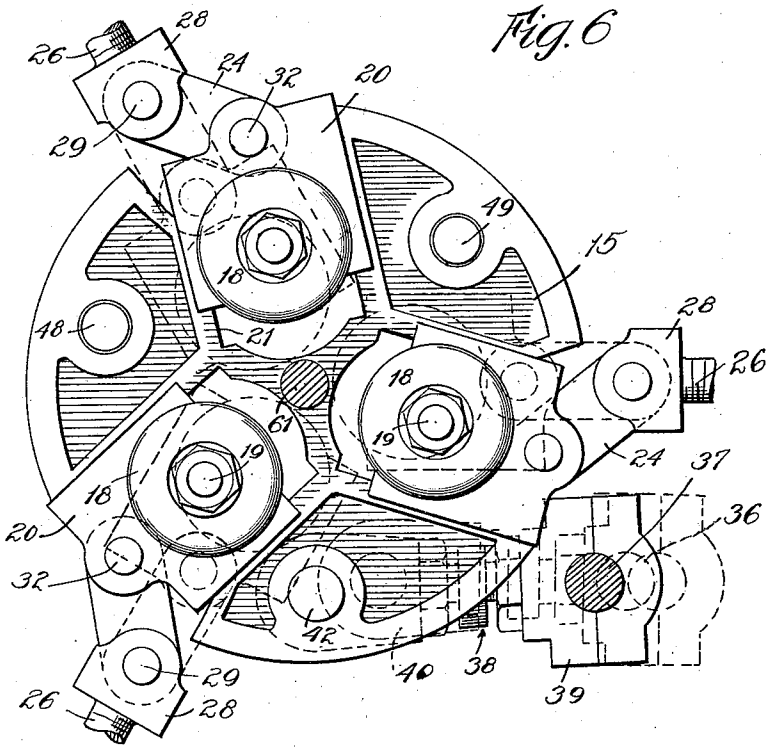
Fig. 6



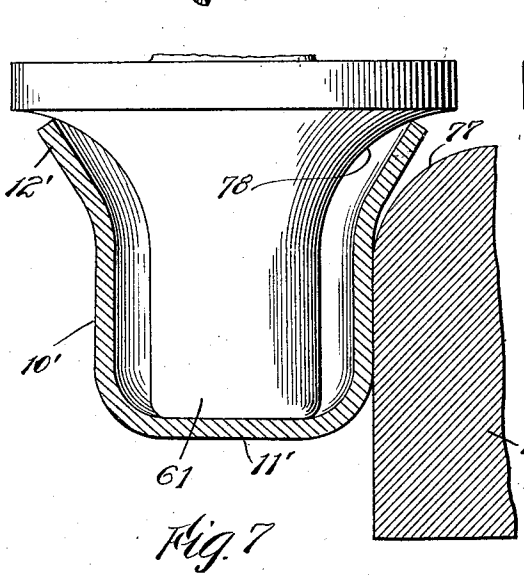


Fig. 7

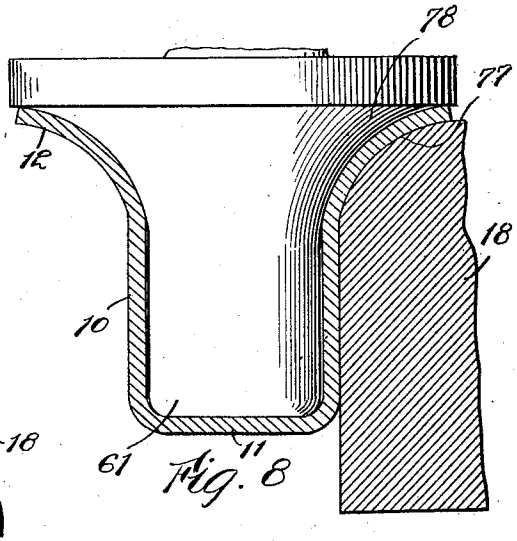


Fig. 8

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UNITED STATES PATENT OFFICE

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METHOD OF AND MACHINE FOR ROLLING ANNULAR METALLIC ARTICLES

Application filed May 20, 1929. Serial No. 364,384.

The invention has for its general aim the formation of annular metallic objects, such as wheel hubs, shells, etc., by rolling the same while cold from suitable blanks of heavy gage metal, in a novel and advantageous manner.

In the past it has been customary to draw automobile hubs and hub shells for wire wheels, and similar objects, from flat sheets of metal by means of a series of pressing operations, involving the use of costly presses, dies and other equipment, and in addition numerous handling operations.

The primary object is to simplify the art of making metallic hubs, hub shells and the like by simultaneously reducing and elongating a cup-shaped blank so as to form in one operation a main or body portion of substantial depth and a transverse end portion or flange of substantially greater diameter than the body portion.

A further object is to reduce the cost of producing articles of the character indicated by forming the same from a previously shaped blank in a single rolling operation.

A further object is to provide a novel and effectual rolling apparatus wherein a cup-shaped blank, positioned upon an axially disposed support is engaged simultaneously by a plurality of radially moving rolls, the support and rolls coacting to reduce and flange the blank in one operating cycle.

Another object is to provide a rolling machine of the character referred to, having extremely powerful means for moving the forming rolls inwardly of the blank to reduce its diameter.

Another object is to provide such a machine having a rapidly recurring operating cycle in each of which a complete article is produced, thereby insuring a constant high rate of production.

Another object is to provide a machine of this character in which the finished work pieces are automatically discharged from their position between the forming rolls.

The above and other objects are attained through the provision of a machine having a frame in which a plurality of driven forming rolls are rotatably mounted on parallel axes for advancing and retracting movement toward and from the outer periphery of a previously cupped blank, said rolls engaging the blank at spaced points. The blank is shaped by said rolls with the aid of a central axially movable support in the form of a revolving mandrel, and the machine has an actuating mechanism for advancing and retracting the rolls and the work support in predetermined timed relation to each other.

Other objects and advantages will become apparent from the following description taken in connection with the accompanying drawings, in which:

Figure 1 is a side elevational view of a machine embodying the invention.

Fig. 2 is a fragmentary sectional view taken on the line 2—2 of Fig. 4.

Fig. 3 is a plan view of the machine shown in Fig. 1.

Fig. 4 is an elevational view of the machine partially in section taken along the line 4—4 of Fig. 3.

Fig. 5 is a fragmental plan section taken along the line 5—5 of Fig. 4.

Fig. 6 is a fragmental end elevational view showing the various positions of the forming rolls.

Figs. 7 and 8 are diagrammatic views showing the work piece at the beginning and the end respectively of the forming operation.

While the invention is susceptible of various modifications and alternative constructions, I have shown in the drawings and will herein describe in detail the preferred embodiment, but it is to be understood that I do not thereby intend to limit the invention to the specific form disclosed, but intend to cover all modifications and alternative constructions falling within the spirit and scope of the invention as expressed in the appended claims.

The embodiment of the invention illustrated herein is intended for the high speed production of hubs for automobiles which have the form shown in Fig. 8. Such hubs have an annular wall or body portion 10 closed at one end by a wall 11, and having at its other end a radially extending annular flange 12. The hub is completely

formed in one rolling operation from a blank which has previously been drawn from a flat sheet of metal in a suitable die-press, the blank as shown (Fig. 7) having a generally cup-shaped form and comprising an annular body 10′ with an end wall 11′ and a flaring open end 12′.

The invention in its preferred form is illustrated as embodied in a rolling machine having a base 13 (Fig. 1) and a stationary upright frame formed with the base by a pair of upstanding frame members or standards 14 and 14′, said standards being positioned transversely of the base and spaced longitudinally thereof. Extending between the two standards and supported thereby is a second or inner frame having two end members (Fig. 6) in the form of circular plates 15 and 15′ (Fig. 5) rigidly secured in spaced relation to each other and respectively supported in circular openings 16 formed in the standards 14, 14′. The end plates 15, 15′ of the inner frame are held in rigid spaced relation to each other by means of a plurality of connecting members or bars 17 extending between the two end plates and secured at spaced points about the outer periphery thereof.

The inner frame carries at one end a plurality of forming rolls 18 (Figs. 1 and 6) suitably secured on the ends of roll shafts 19 (Fig. 2) projecting through the circular opening 16 in the standard 14. The roll shafts are mounted in the inner frame parallel to each other, their mounting being such as to permit radial movement of the forming rolls 18. To this end a plurality of bearing blocks 20 are mounted in the end plates 15, 15′ so as to slide in guideways formed by radial slots 21 (Fig. 6) formed in the end plates. In the present instance three roll shafts 19 are provided and three radial slots 21 spaced apart 120 degrees are formed in each end plate. The ends of the connecting bars 17 span the outer ends of the slots 21 (Fig. 4) to strengthen the end plates.

As illustrated in Fig. 2, the bearing blocks 20 are channeled so as to engage the guideways formed by opposite side edges of the slots 21. Two bearing blocks 20 support the respective ends of each roll shaft 19, being equipped with roller bearings 22 positioned near each end of the shaft. Also, a ball thrust bearing 23 is provided for each shaft to receive the end thrust thereon, said thrust bearing acting between a shoulder on the shaft and the block 20 remote from the roll. By this construction the forming rolls are effectually supported in outboard relation to the frame, so as to be movable radially thereof into engagement with the work conveniently positioned outside of the upright frame.

Since the machine is intended to operate upon metal of a comparatively heavy gauge, the means for obtaining radial movement of the roll shafts 19 must necessarily be of such a character that great force may be applied to move the rolls 18 inwardly. In the present instance, this means comprises a plurality of toggle links 24 (Figs. 4 and 6) operating between the roll-carrying blocks 20 and the outer frame. Operation of the toggles 24 is preferably obtained by a short rotative or rocking movement of the inner frame relative to the outer or main frame. The inner frame is therefore mounted for rocking movement in the circular openings 16 of the main frame standards 14, 14′, said openings providing arcuate bearing surfaces engaged by similar surfaces on the inner frame plates 15, 15′, intermediate the radial slots 21. A plurality of arcuate gib plates 25 (Fig. 4) secured on the outer frame standards 14, 14′ serve to maintain the inner frame in proper axial position.

The toggle links 24 are connected at their outer ends to the standards 14, 14′ by means of a plurality of screws 26 (Figs. 4 and 5) mounted in radial projections 27 of the standards and carrying abutment blocks 28 to which the outer ends of the links 24 are pivoted at 29. Said abutment blocks are adjustable in radial slots 30 which extend outwardly from enlarged openings 31 in the standards. The latter are provided to accommodate the angular or swinging movements of the toggle links, the inner ends of which are pivoted at 32 to the bearing blocks 20 for the roll shafts.

The screws 26 are mounted for radial adjustment in the projections 27 of the frame, formed for this purpose to provide radially bored bearing members 33 (Fig. 5). Nuts 34 and 35 engaging with opposite ends of said members 33 serve to hold the abutment blocks 28 in any desired position of adjustment as may be required by the varying sizes of articles to be formed.

For the purpose of operating the toggle links to effect radial movement of the roll shafts, the inner frame is rocked or oscillated in its bearings in the outer frame by means including a shaft 36 suitably mounted in the main frame near the periphery of the inner frame and parallel to the axis of the latter. The shaft 36 has two similar cranks 37 connected to the inner frame by a pair of links 38 each having heads 39 and 40 at opposite ends connected by a screw 41 for purposes of lengthwise adjustment. The outer heads 39 have suitable bearings to receive the respective cranks, and the inner heads are mounted near opposite ends of a shaft 42 mounted near the periphery of the inner frame.

It will be evident that upon continuous rotation of the crank shaft 36, the inner frame will be rocked so as to move the toggle links

24 about their fixed outer pivots, and thereby cause reciprocation of the forming rolls toward and from the axis of the inner frame. This operation is illustrated in Fig. 6, the inward or compression movement of the rolls being caused by movement of the links from the inclined positions shown in full lines, to the straightened positions shown in dotted outline. As a result, a powerful toggle action is obtained. Moreover, since the inward movement of the rolls gradually decreases in speed as the work approaches its final form, an improved finish is obtained.

It will also be observed that due to the use of the cranks 37, the rate of movement of the inner frame gradually decreases during the last half of its rocking movement in either direction. Thus a brief dwell is caused at each end of the reciprocatory movements of the several rolls.

The roll shafts 19 are arranged to be driven continuously and all at the same speed during the rocking movement of the inner frame and hence during the radial reciprocation of the rolls. To this end I provide three spur gears 43, 44 and 45, one on each of the roll shafts and positioned centrally thereof. The gear 44 and 45 both mesh with a driving gear 46, and similarly the gears 43 and 45 mesh with a gear 47, both of the gears 46 and 47 being mounted centrally on two spaced shafts 48 and 49 rotatably mounted near the periphery of the end plates 15, 15′ so as to extend therebetween parallel to the roll shafts 19. The arrangement is such that when one of the shafts 48, 49 is rotated, all of the roll shafts 19 will be rotated at the same speed and in the same direction, and this, it will be observed, regardless of the positions of the forming rolls radially of the inner frame.

For the purpose of thus driving the forming rolls, the shaft 48 carrying the gear 46 projects from the end plate 15′ and a gear 50 secured thereon engages a pinion 51 mounted on the end of a main drive shaft 52 (Fig. 3). The latter is rotatably mounted in spaced supports coaxially of the inner frame, so that the gear 50 and pinion 51 will be in continuous engagement during rocking movement of the inner frame. A motor 53 mounted on the base 13 provides power for driving the main shaft 52, and has a pinion 54 (Fig. 1) on its shaft engaging a gear 55 secured on the main drive shaft.

The crank shaft 36 is preferably driven from the main drive shaft 52 by suitable means such as a worm gearing 56 (Figs. 1 and 3). The worm shaft 57 has a bevel gear 58 engaging with a bevel pinion 59 rotatably mounted on the drive shaft 52 and adapted for connection with the driven shaft by means of a clutch 60. By use of said clutch, the radial reciprocation of the forming rolls may be controlled at the will of the operator during continued rotation of the forming rolls.

Since the reciprocatory and rotative movements of the forming rolls are both derived from the same source, these two movements bear a definite relation to each other, and this relation is adapted to be easily changed by reason of the simple arrangement of driving gears employed. Thus if it is desired to change the speed of the rolls, it is only necessary to change the gear 50 and the pinion 51.

The blank work pieces are positioned between the forming rolls 18 by means of a reciprocating work support in the form of an inner roll or rotatable mandrel 61. As shown in Figs. 3 and 5, the mandrel is mounted in a carriage 62 slidable in horizontal ways 63 which are formed on an upstanding frame 64 positioned at one end of the bed 13 adjacent the forming rolls 18. The carriage in the form herein shown is in the form of a yoke and the mandrel is rotatably mounted centrally thereof, preferably through the medium of anti-friction bearings 65. A thrust bearing 66 is also provided between the mandrel and the yoke. It will be observed that the ways 63 are arranged so that the carriage 62 may be moved along the axis of the inner roll-carrying frame, from an inoperative or loading position remote from the rolls to an operative position in which the work is positioned between the rolls.

Means is provided for reciprocating the mandrel carriage 62 in timed relation to the reciprocatory movement of the forming rolls 18. This means is driven from the crank shaft 36 and hence from the main drive shaft 52, and comprises a cam 67 (Fig. 3) fast on a shaft 68 mounted transversely in the frame 64 between the ways 63. Coacting with the cam 67 is a cam follower in the form of a roller 69 mounted in the carriage 62, and the cam means thus provided is operable to move the carriage toward the rolls 18, first with a rapid-approach movement and then slowly to its innermost position.

The carriage is withdrawn rapidly from such operative position by the cam through the medium of a pair of hooked arms 70 (Fig. 1). These arms are pivoted at their forward ends to the cam follower shaft of the carriage 62 and have downwardly opening notches 71 adapted to be engaged by the ends of a pin 72 projecting from opposite sides of the cam disk. The arms extend rearwardly from the carriage and when not engaged by the pin are adapted to slide on the bearings for the cam (Fig. 3). It will be seen that with the cam rotating counterclockwise, the pin 72 is adapted to engage with the hooked arms just as the cam becomes disengaged from its follower, and in the continued rotation of the cam the carriage will be quickly withdrawn from its

operative position to its inoperative position so that a new work piece may be positioned thereon.

The cam shaft 68 is rotated by means of spur gears 73 from a counter-shaft 74 rotatably mounted in the frame 64; and the counter-shaft is driven through bevel gearing 75 from an extension 76 of the crank shaft 36. With this construction, the roll shafts 19 and the mandrel 61 may be reciprocated in a definite timed relation to each other and to the speed of rotation of the forming rolls.

Referring now to Figs. 5, 7 and 8, the outer ends of the rolls 18 are rounded in the present instance as at 77; and the mandrel 61 has a correspondingly curved shoulder 78. As thus shaped, the machine is operable upon a previously cupped blank shown in Fig. 7, to reduce it to a finished hub, as follows:

Assuming that a blank has been placed by the attendant on the mandrel 61 when the carriage 62 is in its withdrawn or loading position, the clutch 60 is operated to drive the crank shaft 36 and cam shaft 74. Thus the blank or work piece 10′ is moved rapidly in the operation of the cam means on the carriage to a position between the revolving forming rolls 18. The forming rolls simultaneously moving inwardly due to the rocking of the inner frame to straighten the toggle links 24, rotatably engage the blank so as to compress the same and reduce the diameter of the body portion 10′.

While the diameter of the annular body portion of the blank is thus being reduced, the mandrel 61 continues its axial movement at slow speed to form the flange 12 (Fig. 8). In this operation the end of the mandrel exerts endwise pressure on the end wall of the blank, so that as the material of the blank is being compressed it is also drawn out or elongated to form the flange. The entire wall portion of the hub thus produced has a substantially uniform thickness.

It will be understood that in the movement of the mandrel 61 toward the forming rolls, the curved shoulder 78 on the mandrel cooperates with the rounded ends 77 of the rolls until the outer peripheral portion of the flange is substantially perpendicular to the annular side wall 10 of the work piece. This latter operation requires the exertion of considerable force longitudinally of the rolls 18, and therefore the end frame 64 is connected to the top of the adjacent standard 14 by metallic straps 79.

It is also to be observed that when the rolls 18 have reached their innermost positions, they dwell in such positions for a short interval of time due to the nature of the toggle action, and also to the positions of the cranks 37 at this time in moving transversely with respect to the connecting rods 38. This dwell in the movement of the rolls 18 insures that the work shall be reduced accurately to the desired diameter.

After the forming operation, the pin 72 on the cam 67 immediately engages the arms 70 on the carriage 62 so as to cause rapid withdrawal thereof with a dwell before the next cycle, thus giving the operator ample time to position a new work piece on the mandrel.

To facilitate the withdrawal of the mandrel from the finished hub, the cylindrical portion thereof is made slightly smaller than the corresponding portion of the hub, as shown in Fig. 8.

As the rolls 18 are moved radially outwardly after the hub or other article has been finished and the mandrel 61 withdrawn, the space between the rolls increases and the finished article rapidly rotating drops downwardly onto a striking block 80 (Fig. 4), and then rolls off of the striking block transversely of the machine frame. Thus the operator is only required to place blanks periodically on the mandrel 61, the operation of the machine being entirely automatic after the work piece has been so positioned.

From the foregoing it will be apparent that the invention provides a new and improved method of forming hubs and the like whereby an unusually high rate of production may be attained; and it has been found that the machine produces the finished work with a minimum amount of loss due to cracking of the metal since the form of the blank is changed gradually and continuously during the operation.

I claim as my invention:

1. A rolling machine of the class described comprising a support for a piece of work mounted for reciprocatory movement, a plurality of forming rolls mounted for movement transversely of the axis of said support, and means for reciprocating said support and said moving rolls in timed relation to each other throughout the work performing movement of the rolls.

2. A rolling machine of the class described comprising a support for a piece of work mounted for reciprocatory movement, a plurality of forming rolls mounted for movement transversely of the axis of said support, means for reciprocating said support and said rolls in timed relation to each other while the rolls are operating on the work, and means for driving certain of said rolls during their reciprocation.

3. A rolling machine comprising, in combination, a base, a standard on said base, a plurality of forming rolls, supporting means in said standard in which said rolls are mounted in circumferentially spaced relation for movement toward and from a common center, said rolls projecting from one side of said standard, a work support reciprocable

axially on said center, and means for actuating said rolls and support in timed relation to each other while the rolls are operating upon the work.

4. A rolling machine comprising a base, a pair of standards mounted in spaced relation on said base, a rigid frame extending between said standards and rotatably mounted therein, a plurality of shafts extending in parallel relation longitudinally of said frame and spaced apart substantially equi-distantly, a plurality of forming rolls one on each of said shafts, means on said frame for supporting opposite ends of said shafts for movement toward and from a common center, said forming rolls being arranged at one end of said frame in outward relation to one of said standards, and means acting upon opposite ends of said shafts and operable as an incident to the rotational movement of the frame to reciprocate said rolls.

5. A rolling machine comprising a base, a pair of standards mounted in spaced relation on said base, a rigid frame extending between said standards and rotatably mounted therein, a plurality of shafts extending in parallel relation longitudinally of said frame and spaced apart substantially equidistantly, a plurality of forming rolls one on each of said shafts, means in said frame for supporting opposite ends of said shafts for movement toward and from a common center, said forming rolls being arranged at one end of said frame in outboard relation to one of said standards, means acting upon opposite ends of said shafts and operable as an incident to the rotational movement of the frame to reciprocate said rolls, means providing a gearing connection between said shafts within said frame, and drive means for the last mentioned means operable in such rotational movements of the frame.

6. A rolling machine comprising a main stationary frame, a second frame mounted for rotational movements in said stationary frame, three equidistantly spaced shafts mounted in said second frame for radial movement therein, a forming roll on each of said shafts, means for imparting rotational movements to said second frame relative to the main frame, means operable as an incident to such relative movements to move said shafts radially, a drive shaft disposed axially of said second frame, a pair of driven shafts in said second frame each having a gear thereon meshing with the gears on two of the roll shafts, and a gearing connection between said drive shaft and one of said driven shafts.

7. A rolling machine comprising a main stationary frame, a second frame mounted for rotational movements in said stationary frame, three equidistantly spaced shafts mounted in said second frame for radial movement therein, a gear on each of said shafts, a forming roll on each of said shafts, means for imparting rotational movements to said second frame relative to the main frame, means operable in such relative movements to move said shafts radially, a drive shaft disposed axially of said second frame, a pair of driven shafts in said second frame each having a gear thereon meshing with the gears on two of the roll shafts, and a gearing connection between said drive shaft and one of said driven shafts, said gearing connection comprising a pair of gears arranged externally of said inner frame.

8. A rolling machine comprising a rotatable frame, three shafts mounted in equidistantly spaced relation about the axis of said frame, a forming roll on each of said shafts, means for supporting said shafts for radial movement in said frame, each of said roll shafts having a gear wheel thereon, driving gears interposed between and meshing with the gears on adjacent shafts, means for actuating one of said driving gears, and means operable in the rotation of said shafts and in the rotational movements of the frame to impart radial movements to said forming rolls.

9. A rolling machine having a frame mounted for rotational movements, a pair of forming rolls mounted in said frame for radial movement relative thereto, a drive shaft disposed axially of said frame and having a driving pinion thereon, a driven shaft mounted in the frame and having a gearing connection with said pinion and also a gearing connection with the roll shafts, the last mentioned connection being adapted to permit of radial movements of the roll shafts, and means operable in the rotation of said frame to impart such radial movement to the roll shafts.

10. A rolling machine having a stationary frame, a second frame mounted in the stationary frame for rotational movements, a roll shaft, a bearing block for said shaft mounted in said second frame for radially sliding movement, an abutment mounted in said main frame for radial adjustment, a toggle link interposed between said bearing block and said abutment, and means operable to oscillate said second frame to carry said toggle link from an initial inclined position with respect to the bearing block into substantially perpendicular relation thereto whereby to impart radial motion to said roll shaft.

11. A rolling machine comprising a stationary frame, a second frame mounted for rotational movements in said stationary frame and having a plurality of radial slots therein, a plurality of roll shafts each having a bearing block mounted in one of said slots, toggle links interposed between the main frame and the respective bearing blocks, a crank shaft, and means connecting said crank

shaft to said second frame whereby to rock the latter in the stationary frame and actuate said toggle links.

12. A rolling machine having a main frame, a second frame mounted for rotational movements in said main frame, a plurality of forming rolls mounted for radial movements in said second frame, means including a reciprocable support adapted to position a piece of work between said forming rolls, means for oscillating the second frame, means operable as an incident to the oscillation of the second frame to reciprocate said rolls, said oscillating means including a driven shaft, and means actuated from said shaft for reciprocating said support.

13. A rolling machine having a plurality of forming rolls arranged in circumferentially spaced relation and adapted for relative movement into engagement with a piece of work disposed between them, a mandrel reciprocable into and out of position between said rolls, means for actuating said forming rolls to move them into engagement with a piece of work on said mandrel, and cam means for actuating said mandrel in timed relation to the roll-actuating means.

14. A rolling machine having a plurality of forming rolls arranged in circumferentially spaced relation and adapted for relative movement into engagement with a piece of work disposed between them, a mandrel reciprocable into and out of position between said rolls, means for actuating said forming rolls to move them into engagement with a piece of work on said mandrel, and cam means for actuating said mandrel in timed relation to the roll-actuating means, said cam means being operable to cause a substantial dwell in the withdrawn position of the mandrel.

15. A rolling machine having a plurality of forming rolls arranged in circumferentially spaced relation and adapted for relative movement into engagement with a piece of work disposed between them, a mandrel reciprocable into and out of position between said rolls, means for actuating said forming rolls to move them into engagement with a piece of work on said mandrel, and cam means for actuating said mandrel in timed relation to the roll-actuating means, said cam means including a cam disk having a pin thereon and an arm connected to the mandrel and adapted to be engaged by said pin during part of the revolution of the cam.

16. A machine for rolling wire wheel hubs and similar objects from a cup-shaped blank comprising a plurality of forming rolls arranged in circumferentially spaced relation and mounted for radial movement, said rolls being adapted to receive between them a blank to be operated upon, a rotatable mandrel, and means for moving said mandrel axially and the forming rolls radially into engagement with the blank simultaneously to reduce and elongate the blank, said mandrel being enlarged at one end and said forming rolls being adapted to cooperate with said enlarged end of the mandrel to form a transverse flange at one end of the work.

17. A rolling machine having a plurality of forming rolls arranged in circumferentially spaced relation and mounted for relative radial movement, a rotatable mandrel mounted for axial movement and adapted to position between said forming rolls a blank having an annular body portion and an outwardly flared end, means for simultaneously actuating said forming rolls to compress the annular body portion, means operable upon said mandrel during such compressing action to exert endwise movement relative to said blank, and means for driving certain of said rolls, said forming rolls and mandrel coacting to elongate the body portion so as to produce from said flaring end of the blank a substantially radial flange.

18. The method of making wire wheel hubs and similar articles which consists in simultaneously reducing the diameter of a cup-shaped blank and elongating the same while shaping one end of the elongated blank to form a transverse outwardly extending flange.

19. The method of forming metallic wheel hubs and the like from a cup-shaped blank having an annular body portion with a closed end wall and an open end portion flared outwardly, which consists in exerting a radial pressure by means of a plurality of forming rolls on the outer periphery of the blank, simultaneously exerting endwise pressure on the end wall of the blank so as to elongate the annular portion, and shaping the open end of the blank between said forming rolls and an inner revolving roll or mandrel to form a transversely extending flange.

20. A rolling machine of the character described comprising a plurality of forming rolls arranged in spaced circumferential relation and radially movable toward and from a common center to compress an annular piece of work therebetween, a support for moving the work into an operative position between said rolls, said rolls being arranged in their movement away from a finished piece of work to provide a downwardly opening space between two of said rolls through which space said work may drop, and means operable in timed relation to the radial movement of said rolls to move said support to an inoperative position out of contact with the work before said rolls have been separated a sufficient distance to drop the work.

21. A rolling machine having a plurality of forming rolls arranged in circumferentially spaced relation and adapted for relative advancing movement toward each other into engagement with a piece of work disposed

between them, a mandrel reciprocable into and out of position between said rolls, means for actuating said forming rolls to move them into engagement with a piece of work on said mandrel, and means operable to move said mandrel gradually into its operative position in timed relation to the advancing movement of said rolls and operable after the completion of the advancing movement of the rolls to rapidly withdraw said mandrel from its operative position.

22. A rolling machine having a plurality of forming rolls arranged in circumferentially spaced relation and mounted for relative advancing movement toward each other and into engagement with a piece of work disposed between the rolls, said rolls having rounded edges on one end thereof, a mandrel mounted for advancing movement longitudinally with respect to said rolls into position between said rolls, an annular flange on said mandrel spaced from the end thereof adjacent said rolls, said flange being rounded to correspond to the curved end edges of said rolls, and means operable to advance said rolls and said mandrel through a work performing operation in timed relation to each other.

23. In a rolling machine the combination of a plurality of forming rolls rotatable about parallel axes and movable transversely of said axes toward and from a common center, a rotatable mandrel movable along said center parallel to the axes of the rolls into a position between said rolls, said rolls having rounded end edges, and a curved outwardly extending annular flange on one end of said mandrel adapted to cooperate with said rounded edges of said rolls to form a flange on an annular piece of work.

24. A rolling machine comprising a main stationary frame, a second frame mounted for rotational movements in said stationary frame, a plurality of circumferentially spaced shafts mounted in said second frame for radial movement therein, a forming roll on each of said shafts, means for imparting rotational movements to said second frame relative to the main frame, means operable as an incident to such relative movements to move said roll shafts radially, a driven shaft mounted on said second frame for rotational movement therewith, gearing on said second frame connecting said roll shaft to said driven shaft and arranged to drive said roll shafts during radial movement thereof in said second frame, a driving gear mounted on a fixed axis on said stationary frame, and a driven gear mounted on said second frame and connected to said driven shaft and arranged to engage and be driven by said driving gear continuously during rotational movements of said second frame.

25. The method of forming metallic wheel hubs or the like from a cup-shaped blank having an annular body portion open at one end and having a closed end wall, which consists in exerting inward radial pressure by means of a plurality of rotating forming rolls acting on the annular body adjacent to said closed end wall and exerting endwise pressure on the end wall to reduce the diameter of and simultaneously elongate said body portion, and simultaneously exerting outward radial pressure on said annular body portion adjacent to its open end to expand that end of the body and form a flange thereon.

26. A rolling machine of the character described comprising a stationary outer frame, an inner frame mounted in said stationary frame for oscillatory movement, a plurality of bearing blocks mounted in said inner frame for radial movement toward and away from the axis of oscillation of said inner frame, a plurality of forming rolls mounted one on each of said blocks, toggle links interposed between said outer frame and each of said blocks, and means operable to oscillate said inner frame to carry said toggle links from initial inclined positions with respect to the radial paths of their bearing blocks to positions substantially parallel to said radial paths whereby to move said rolls simultaneously through strokes of predetermined length during which a work piece positioned between the rolls is engaged and reduced to a predetermined diameter.

In testimony whereof I have hereunto affixed my signature.

CARL C. GROTNES.