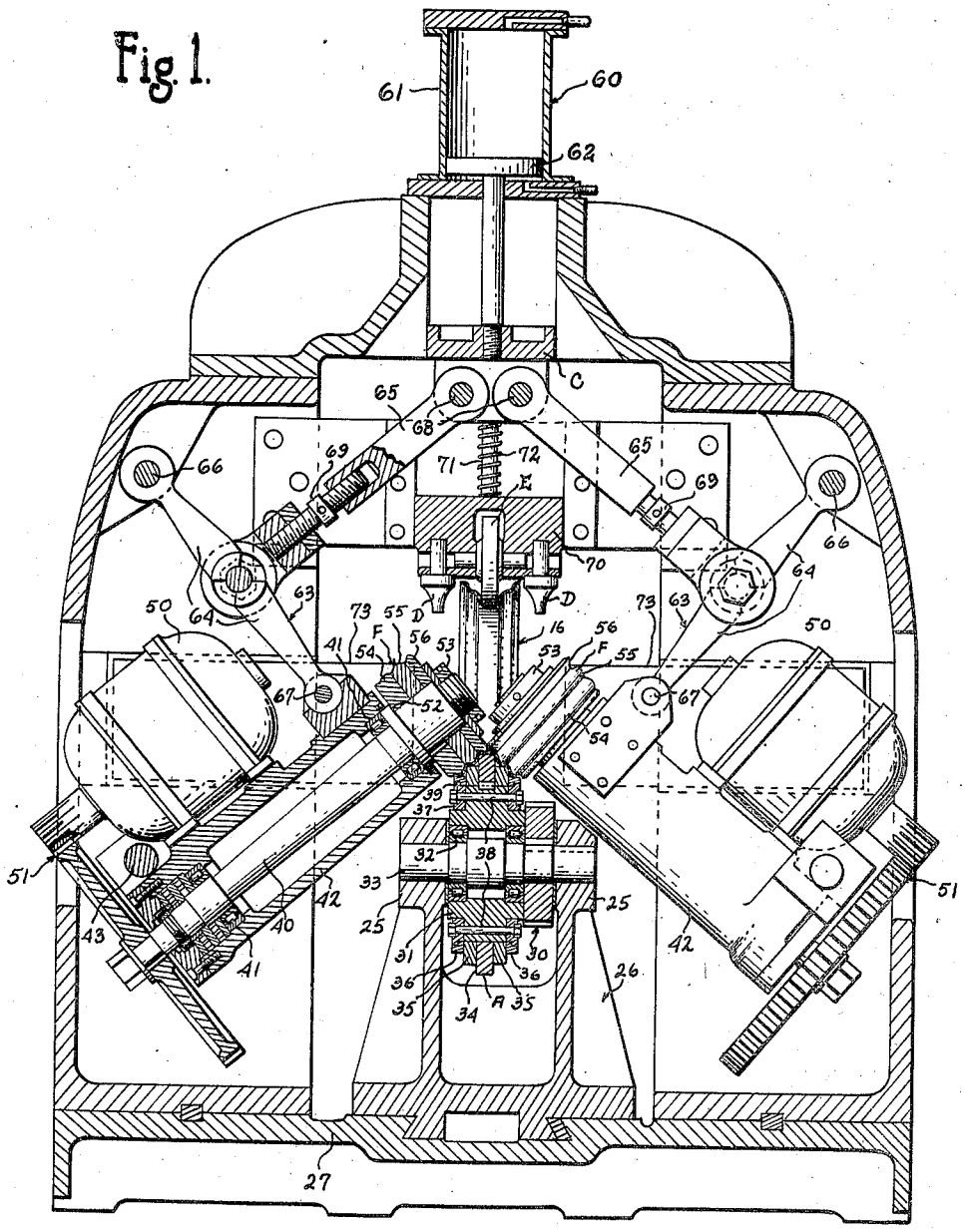
Dec. 3, 1940. O. M. WHITTEN 2,223,472

ROLLING MACHINE

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Fig. 1.



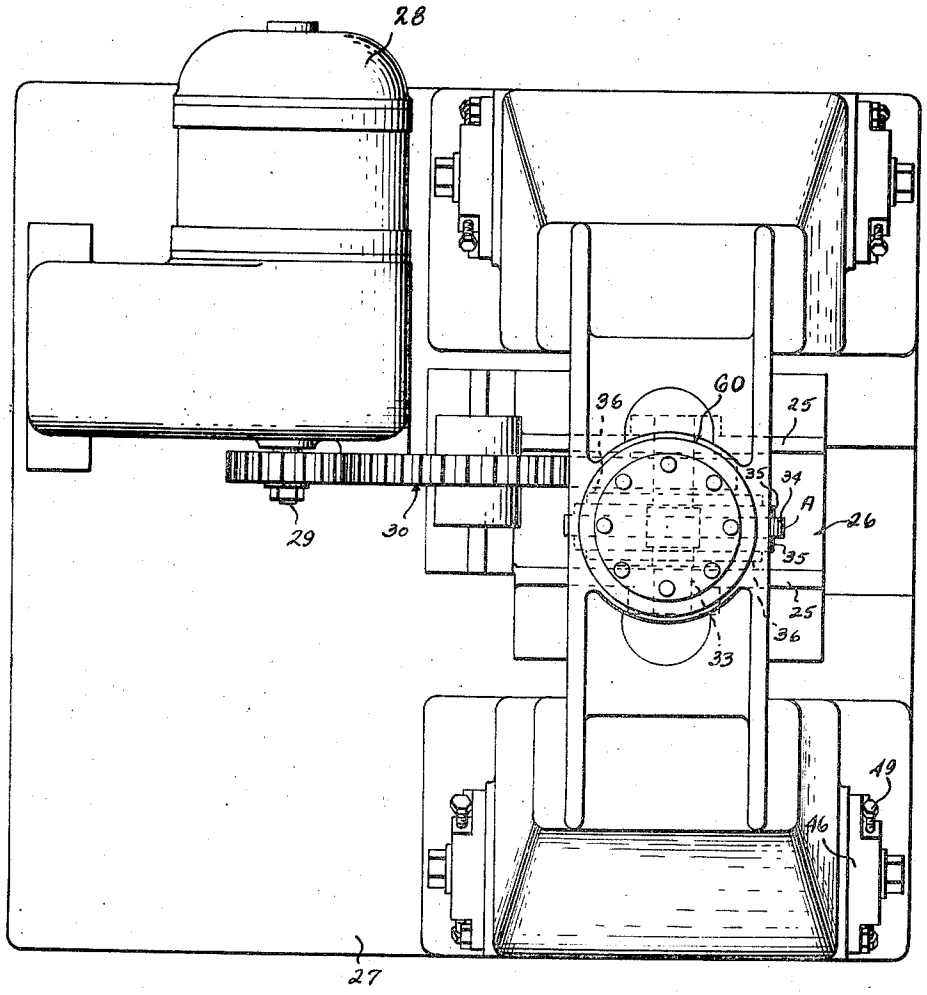
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ROLLING MACHINE

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Fig. 2.



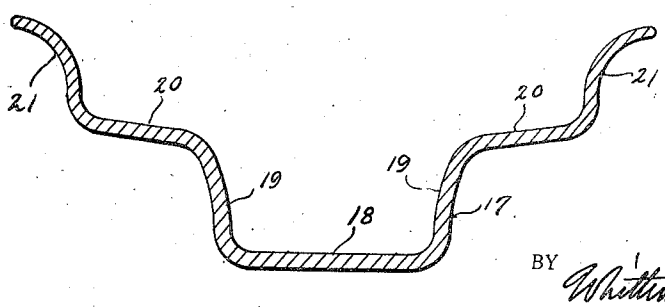


Fig. 13.

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ROLLING MACHINE

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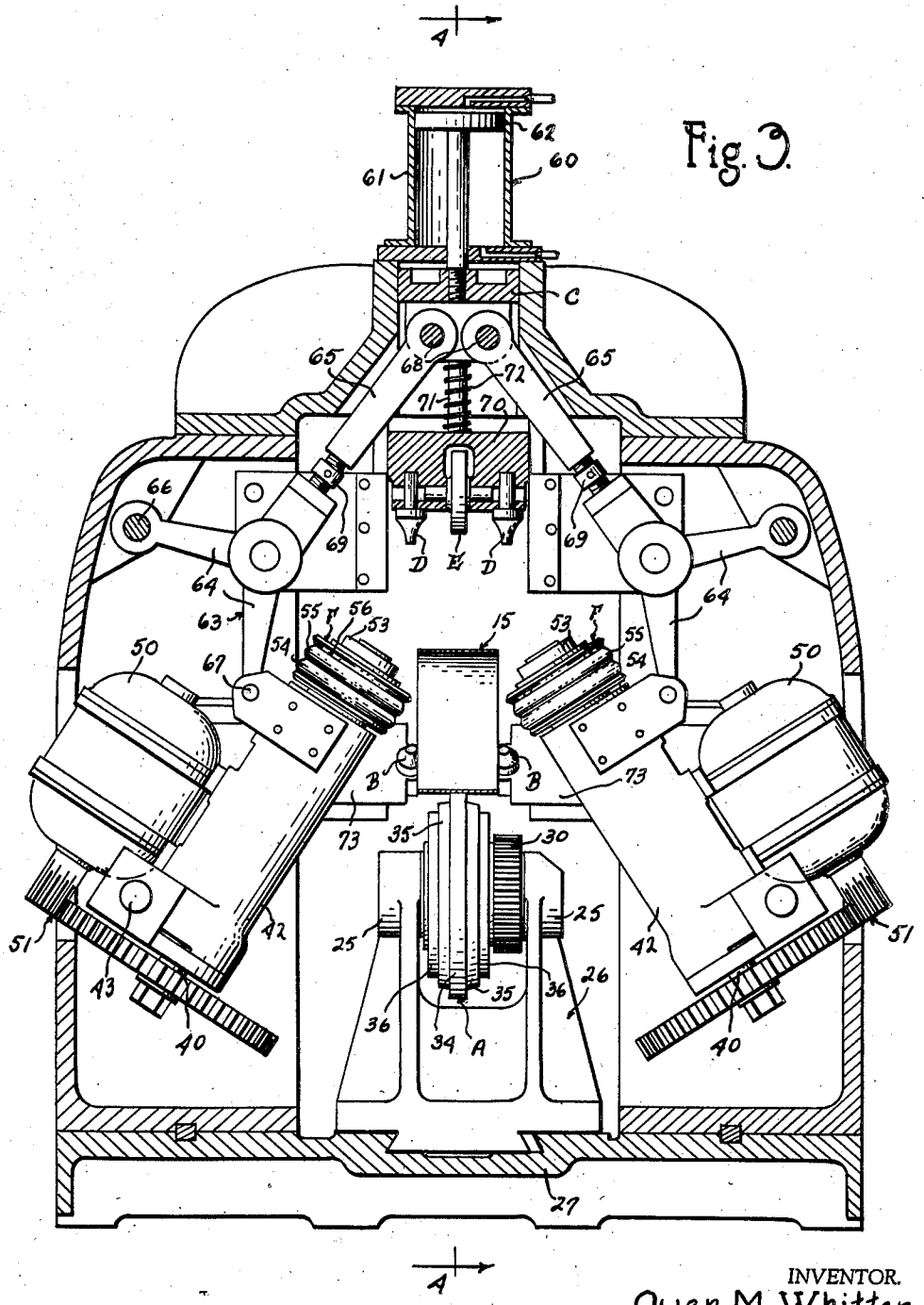


Fig. 3.

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ROLLING MACHINE

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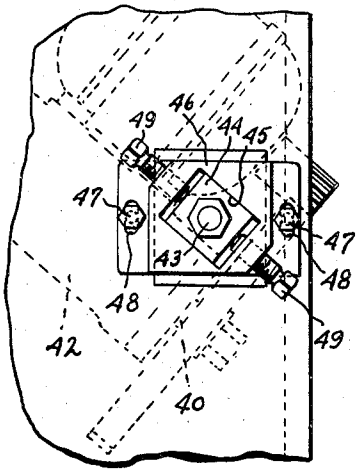


Fig. 5.

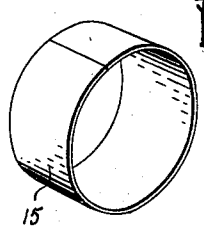


Fig. 12.

Fig. 4.

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ROLLING MACHINE

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Fig. 6.

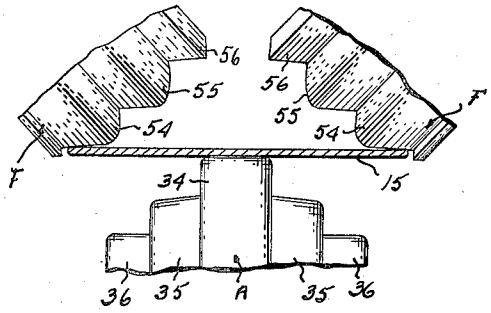


Fig. 7.

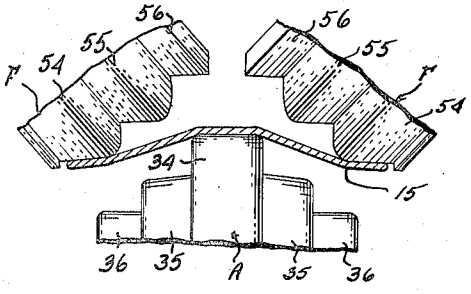


Fig. 8.

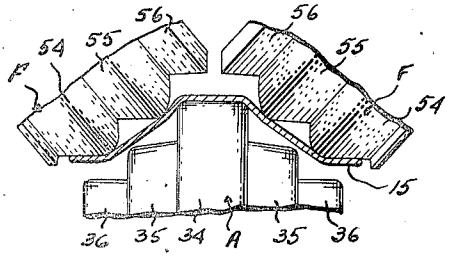


Fig. 9.

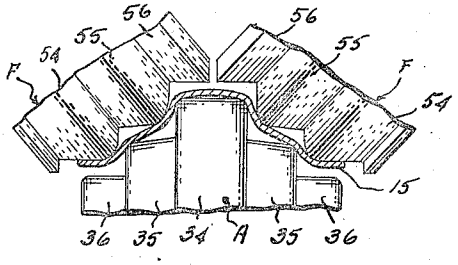
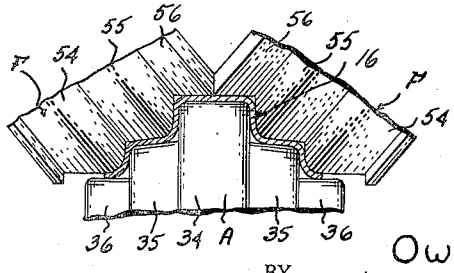


Fig. 10.



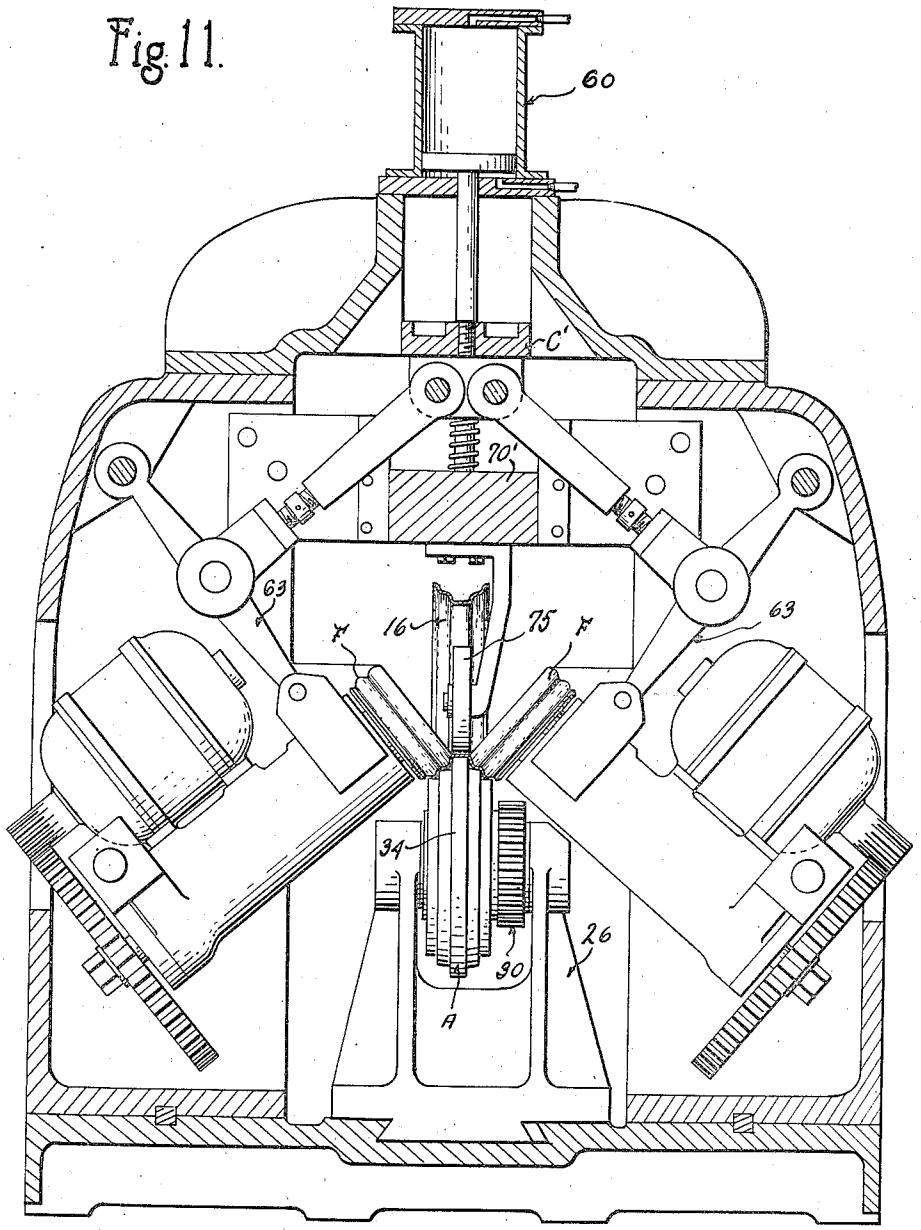
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ROLLING MACHINE

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Fig. 11.



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Patented Dec. 3, 1940

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UNITED STATES PATENT OFFICE

2,223,472

ROLLING MACHINE

Owen M. Whitten, Detroit, Mich., assignor to Kelsey-Hayes Wheel Company, Detroit, Mich., a corporation of Delaware

Application June 21, 1937, Serial No. 149,507

5 Claims. (Cl. 153—29)

This invention relates generally to rolling machines and refers more particularly to apparatus for forming vehicle wheel rims of the drop-center type.

Heretofore in forming vehicle wheel rims of the general type noted above, a rim blank was successively introduced to a plurality of separate rolling machines or presses embodying rolls or dies cooperating with each other to progressively change the shape of the blank to the predetermined desired contour of the completed rim. This procedure was considered necessary to avoid overworking the metal of the blank as the contour is changed from a cylindrical shape to the desired cross sectional contour of the finished rim and, although satisfactory in accomplishing this result, is expensive and slow in production. In the prevailing methods of rolling wheel rims from annular blanks, a plurality of machines are employed to progressively work the blank to the completed contour, and at least an equal number of operations are required. The multiplicity of operations noted above consume considerable time in handling of the blank and, in addition to requiring the use of expensive machinery, also necessitate a relatively large floor area.

It is one of the principal objects of this invention to reduce the number of operations and consequently the number of machines for manufacturing vehicle wheel rims to a minimum by providing a rolling machine capable of forming an annular blank to the predetermined desired contour of the rim by a single rolling operation effected in such a manner that the danger of overworking the metal is no greater, if as great, as encountered in the expensive progressive method of forming previously referred to. It necessarily follows, therefore, that the present invention materially reduces the time required to form a blank to a completed rim and, therefore, not only appreciably increases production, but also effects a substantial reduction in costs of manufacture.

A further advantageous feature of the present invention resides in the provision of a rolling machine constructed in such a manner that the rim resulting from the rolling operation possesses maximum strength with a minimum weight. In accordance with this invention, the metal is advantageously disposed during the rolling operation and is stretched in a manner that it tapers in thickness from the base of the rim to the peripheral edges of the flanges of the rim.

The foregoing, as well as other objects, will be made more apparent as this description proceeds, especially when considered in connection with the accompanying drawings, wherein:

Figure 1 is a transverse sectional view of a rolling machine constructed in accordance with this invention and having certain parts shown in elevation;

Figure 2 is a top plan view of the machine shown in Figure 1;

Figure 3 is a view similar to Figure 1 showing the cooperating forming rolls in their inoperative positions;

Figure 4 is a sectional view taken substantially on the plane indicated by the line 4—4 of Figure 3;

Figure 5 is an enlarged elevational view illustrating the adjustment for the forming rolls;

Figures 6 to 10, inclusive, are diagrammatic views illustrating the manner in which the metal of the blank is worked to form the drop center rim;

Figure 11 is a view similar to Figure 1 showing a modified form of rolling machine;

Figure 12 is a perspective view of the blank employed to form the drop center rim; and

Figure 13 is a cross sectional view through a drop center rim formed by the rolling machine forming the subject matter of this invention.

Both of the embodiments selected herein for the purpose of illustrating the present invention are capable of fashioning an annular blank 15 of the type shown in Figure 12 to the predetermined cross sectional contour of the drop-center rim 16 illustrated in Figure 13 by a single rolling operation, without overstressing any portion of the metal. It will, of course, be understood as this description proceeds, that the present invention is by no means limited to forming the blank to the specific contour shown in Figure 13, since this contour, or for that matter, the type of rim may be readily changed by incorporating cooperating forming rolls of different configuration. However, the drop-center rim contour shown in Figure 13 is selected for the purpose of illustrating the invention because the complicated shape of this construction is perhaps the most difficult to form in one operation from a cylindrical blank. In detail, the rim shown in Figure 13 is provided with a portion 17 substantially channel-shaped in cross section having an annular base 18 and having radially outwardly extending side walls 19 at opposite edges of the base. The radially outer edges of the side walls 19 are formed with axially outwardly extending tire

bead engaging seats 20 and the latter terminate in the usual tire bead retaining flanges 21.

Referring generally to the embodiment of the invention illustrated in Figures 1 to 10, inclusive, it will be noted from Figure 3 that a blank 15 of predetermined diameter is positioned on the master roll A by the tapered positioning rollers B, when the several parts of the machine are in the positions thereof shown in Figure 3. The positioning rollers B are disposed in pairs on opposite sides of the vertical center line of the blank and are arranged to engage the opposite side edges of the blank at points below the axis of this blank. After the blank 15 is positioned on the periphery of the master roll A by the positioning rollers B, the cross head C is lowered to engage a third pair of positioning rollers D with the opposite edges of the blank at the top of the latter, and thereby insure supporting the blank on the periphery of the roll A with the axis of the blank substantially parallel to the axis of the roll A. As the cross head C continues to move in a downward direction, the roller E engages the top of the blank 15 diametrically opposite the portion of the blank supported on the periphery of the forming roll A to assist in positioning the blank. While positioning rollers are illustrated in the present instance, other positioning means such as slides might be used to position the blank.

Upon continued downward movement of the cross head C, the pair of cooperating forming rolls F are swung into opposite ends of the blank in a direction toward the master roll A to cooperate with the latter roll in working the metal of the blank 15. It will be noted from the drawings that the master roll A has a peripheral cross sectional contour corresponding substantially to the cross sectional contour of the finished rim, and that the peripheral cross sectional contour of each of the rolls F corresponds substantially to one-half of the peripheral cross sectional contour of the master roll A, so that when the rolls F are in their final positions shown in Figure 1, they cooperate with the forming roll A to fashion the rim to the contour shown in Figure 13. In other words, when the forming rolls F are in the positions thereof shown in Figure 1, the adjacent edges of the same are preferably spaced very slightly from each other adjacent the median plane of rotation of the master forming roll A, and the peripheral surfaces of the rolls F cooperate with each other to form a substantially continuous surface corresponding to the peripheral contour of the master roll A.

The manner in which the metal of the blank 15 is worked to form the desired rim, as the forming rolls F are angularly moved toward the master roll A, is shown in Figures 6 to 10, inclusive. It will be observed from these figures that the rolls F cooperate with the master roll A to work the metal at generally right angles to the direction of approach of the rolls F and, as a consequence, the metal is substantially uniformly worked without overworking any portion thereof. Upon completion of the rolling operation, the cross head C is raised to return the rolls F and positioning rollers D to the position thereof shown in Figure 3, wherein sufficient clearance is provided to permit withdrawing the completed rim from the apparatus.

Referring now more in detail to the particular construction of rolling machine selected herein for the purpose of illustration, it will be noted that the master roll A is rotatably supported between the furcations 25 of a bracket 26 mounted upon the base 27 of the machine for sliding movement in directions perpendicular to the axis of rotation of the roll to facilitate assembly and replacement. In the present instance, the master roll A is positively driven by a prime mover 28 supported on the base 27 of the machine and having a drive shaft 29 operatively connected to the master roll A through the medium of gearing 30.

In view of the fact that the peripheral cross sectional contour of the master roll A is irregular with respect to the axis of rotation of the roll A, it necessarily follows that the portions of different diameter of the roll will have different peripheral speeds and this is objectionable in that it causes rubbing between the roll and work. In order to reduce rubbing action between the rolls and work to the minimum, each of the three rolls is formed of a plurality of sections and certain of the sections are supported in such a manner as to permit the same to rotate freely. In the case of the master roll A, it will be noted that this roll comprises an inner hub section 31 connected to the prime mover 28 through the gearing 30 and journalled on bearings 32 which are supported on the roll shaft 33. Keyed, or otherwise permanently secured to the hub section 31 for rotation as a unit, is an annular ring 34 having a peripheral surface corresponding to the base 18 of the drop-center rim shown in Figure 13. Positioned upon opposite sides of the ring 34 are rings 35 freely rotatably mounted on the hub section 31 and having a diameter less than the diameter of the ring 34 by an amount approximating the radial dimension of the side walls 19 of the drop-center rim 16. The axial extent of the peripheral surfaces of the rings 35, and the shape of these surfaces is determined to correspond to the annular tire bead engaging seats 20 of the rim 16. Positioned on opposite sides of the rings 35 are additional rings 36 supported for rotation relative to the hub section 31 and rings 35. The diameter of the rings 36 is less than the diameter of the rings 35 by an amount approximating the radial dimension of the tire retaining flanges 21. The rings 35 and 36 are held in assembled relation with the hub section 31 by means of the annular clamping members 37 secured to the opposite sides of the hub section 31 by means of the fastener elements 38 and having radially outwardly extending shoulders 39 cooperating with annular shoulders on the rings 36 to prevent axial displacement of the latter, as well as the rings 35. Thus, it will be seen that the center portion 34 of the master roll A is driven from the prime mover 28, and that the two rings on opposite sides of this center portion are supported for movement relative to each other and to the center portion. As will be presently described, the cooperating forming rolls F are similarly constructed so that rubbing caused by different peripheral speeds of portions of the rolls is reduced to the minimum.

As briefly described above, the forming rolls F are supported upon opposite sides of the master forming roll A for swinging movement from the position thereof shown in Figure 3 to the position of the same illustrated in Figure 1. In detail, each of the forming rolls F is mounted upon the inner end of a spindle 40 having portions adjacent the opposite ends thereof journalled in bearings 41 supported in a housing 42 having the outer end pivotally connected to the frame of the machine by the pivot 43. In the present instance,

the pivots 43 are adjustable in such a manner as to not only permit relative axial displacement of the two housings, but to also provide for relatively adjusting the forming rolls in a substantially vertical plane. The two mentioned adjustments are important in that by reason of the same the angle of approach of the forming rolls F to the work may be varied in accordance with the general contour of the work being rolled and in accordance with the desired disposition of the metal during the rolling operation. In detail, each of the pivots 43 is carried by a block 44 which, in turn, is mounted in a recess 45 formed in the plate 46. The plate 46 is secured to the frame of the machine by means of fastener elements 47 extending through slots 48 in the opposite side edges of the plate 46. The slots 48 are elongated vertically in order to secure the up-and-down adjustment of the pivot 43 previously referred to. Upon reference to Figure 5, it will also be noted that the recess 45 for receiving the block 44 is elongated in the direction of the axis of the spindle 40 to permit displacement of the pivot 43 in the latter direction. The block 44 is predeterminedly positioned in the recess 45 by means of the adjusting screws 49 threadedly mounted in the plate and extending into the opposite ends of the elongated slot 45 for engagement with the adjacent sides of the block 44.

In the present illustrative embodiment of the invention, the spindles 40 are rotated through the medium of the prime mover 50 mounted upon the upper side of each of the housings 42. As shown in Figure 1, the axis of the drive shaft of each of the prime movers 50 extends parallel to the axis of the associated spindle and is operatively connected to the extreme outer end of the latter by means of the gearing 51. The arrangement is such that the spindles 40, housing 42, and driving mechanism for the spindles are movable as a unit about the pivots 43.

It has been stated above that the forming rolls F are mounted upon the extreme inner ends of the spindles 40 and it will be noted from Figure 1 that the latter ends of the spindles are shouldered, as at 52, to cooperate with the clamping nuts 53 in securing the forming rolls F against axial displacement relative to the spindles. Reference has also been made above to the fact that the forming rolls F are composed of a plurality of sections in order to cooperate with the master roll A in compensating for the different peripheral speeds of the portions of the rolls that vary in diameter. In detail, each forming roll F comprises an outer ring 54 positioned against the annular shoulder 52 and keyed to the spindle 40 for rotation therewith as a unit. This positively driven section of the forming rolls F engages the blank directly opposite the freely rotatably mounted sections 35 and 36 of the master roll and thereby minimizes any rubbing action on the metal between these sections of the rolls. Freely rotatably mounted on the spindle 40 at the inner side of the section 54 is a second section 55 having the periphery thereof engageable with the blank opposite the fixed and freely rotatable sections 34 and 35, respectively, of the master roll. A third section 56 is freely rotatably mounted on the spindle 40 at the inner side of the section 55 and the latter sections of the two rolls cooperate with one another to form a coextensive peripheral surface engageable with the inner surface of the base 18 of the drop center rim 16 opposite the peripheral surface of the fixed section 34 of the master roll. Thus, it will be readily apparent that any rubbing action on the metal caused by different peripheral speeds of the forming rolls is reduced to the minimum.

In the brief description of the invention noted above, reference has been made to the fact that the forming rolls F are movable from the positions thereof shown in Figure 3 about the pivots 43 in directions toward the master roll A to progressively fashion the blank 15 in the manner shown in Figures 6 to 10, inclusive, to the finished contour of the rim in one rolling operation. In the present instance, the two forming rolls F are simultaneously swung about their respective pivots 43 by means of a fluid actuated device 60 comprising a cylinder 61 connected to a source of fluid supply and a piston 62 reciprocably mounted in the cylinder. Any suitable control means (not shown) may be provided for alternately introducing fluid under pressure into the cylinder 61 at opposite sides of the piston to raise and lower the latter in timed relationship. In the present instance, the piston 62 is secured to the cross head C slidably mounted in the machine frame and having the lower end operatively connected to toggles 63 which, in turn, are connected to the inner ends of the housings 42 adjacent the forming rolls F.

In detail, each of the toggles 63 comprises a pair of links 64 having the inner ends pivotally connected to the lower or outer end of a connecting rod 65 and having the outer ends respectively pivotally connected to the machine frame, as at 66, and to the inner end of each housing 42, as at 67. The upper or inner end of the connecting link 65 is pivotally connected to the cross head, as at 68. As shown in Figure 1, each of the forming roll units F is operated by the cross head C through the medium of a connection of the character previously set forth.

The above arrangement is such that when the cross head is in its lowermost position, the toggle links 64 of each toggle approach a position wherein the same are coextensive and the forming rolls F are in their final positions shown in Figure 10. On the other hand, when the cross head is moved to its uppermost position shown in Figure 3, the links 64 of each toggle are collapsed to such an extent as to position the forming rolls F beyond opposite sides of the completed rim. Attention is called to the fact at this time that the effective length of the connecting links 65 may be varied by the adjustment 69 in order to control the extent of swinging movement of the forming rolls F in dependence upon the travel of the cross head C. In actual practice, the adjustment 69 is preferably such that the forming rolls F assume their final positions shown in Figure 1 before the links 64 of each toggle assume their straight-line or locked positions. With this arrangement, the constant pressure of the fluid cylinder 62 is exerted on the work through the forming rolls F during the entire rolling operation. Also, the adjustment 69 of the connecting links 65 provides for maintaining the desired operation of the toggles, irrespective of the adjustment of the pivots 43 about which the forming roll units F swing.

In accordance with the present invention, the upper pair of positioning rollers D are actuated by the cross head C in timed relation to swinging movement of the forming rolls F into and out of operative relation with the master roll A. In detail, the positioning rolls D and the postioning roll E are mounted upon a vertical slide 70 having a lost motion connection 71 with the cross

head C. The lost motion connection comprises studs threaded in the slide 10 and slidably engaging in the cross head C. Suitable springs 12 are supported on the studs between the cross head C and the slide 10 normally maintaining the latter in its lowermost position with respect to the cross head. The arrangement is such that initial downward movement of the cross head C engages the positioning members D with the opposite edges of the blank at the upper edge of the latter and engages the roll E with the central portion of the blank diametrically opposite the portion of the latter engaged by the ring 34 of the master roll A. Continued downward movement of the cross head compresses the springs 12 and permits the forming rolls F to be swung toward the master roll A relative to the slide 10. It may be pointed out at this time that the positioning rollers D cooperate with the positioning rollers B to insure accurately locating the blank 15 prior to the rolling operation. As previously described, the rollers D engage opposite side edges of the blank at the top of the latter, and the two pairs of rollers B engage the opposite side edges of the blank at opposite sides of the vertical center line of the blank and below the axis of the latter. The rollers B are shown in Figure 4 as being supported on suitable slides 13 to permit accurately positioning these rollers relative to the rollers E.

The operation of the rolling machine to form the blank 15 to the desired predetermined cross sectional contour in one rolling operation has been clearly defined in the general description of the apparatus. Accordingly, it is not believed necessary to complicate this description by a more detailed repetition of this operation.

Referring now to the embodiment of the invention illustrated in Figure 11, it will be noted thta this modification differs from the one previously described in that the inner end sections 56 of the forming rolls F are eliminated and the function thereof is accomplished by another forming roll 75. The forming roll 75 has an axial dimension approximating the corresponding dimension of the section 34 of the master roll A and the periphery thereof engages the opposite side of the base 18 of the drop center rim 16. In this embodiment, the peripheral cross sectional contour of the forming rolls F merely conform to the cross sectional contour of the rim from the opposite edges of the base 18 to the extremity of the tire bead retaining flange 21.

In the construction shown in Figure 11, the forming roll 75 is connected to the slide 10' for movement therewith as a unit and since the latter is connected to the cross head C' in the same manner as the slide 10, in the first form of the invention, is connected to the slide C, it follows that the roll 75 exerts a yielding pressure on the inner surface of the blank opposite the ring 34 of the master roll A to clamp the blank to the periphery of this ring. Thus, the roll 75 also cooperates with the positioning rollers B to properly locate the blank 15 prior to the rolling operation and the rollers D, as well as the pressure roller E, in the first described form of the invention may be eliminated.

The modified form of construction is such that upon initial downward movement of the cross head C', the pressure roller 75 engages the inner surface of the blank directly opposite the periphery of the ring 34 on the master forming roll A and as the cross head continues to move downwardly, the roll 75 exerts a yielding pressure on this portion of the blank. During continued downward movement of the cross head C', the forming rolls F are swung into opposite sides of the blank toward the master roll A in the same manner as the rolls F are operated in the first described form of the invention.

The method of working the metal with the modified form of rolling machine is the same in principle as disclosed in Figures 6 to 10, inclusive, and from this group of figures, it will be noted that the blank is progressively formed in a single rolling operation to the desired cross sectional contour, without overworking or otherwise abusing the metal.

The reason that both of the embodiments of the invention render it possible to form the blank 15 to the predetermined cross sectional contour shown in Figure 13 in one rolling operation is due largely to the principle of moving the cooperating forming rolls toward the master roll throughout paths angularly disposed with respect to the median plane of rotation of the master roll, and this is true irrespective of the specific method employed in mounting the rolls for movement throughout the desired angular paths. In other words, if it is found that additional clearance is desired between the forming roll sections when the latter are in their inoperative positions, these sections may be mounted to have a compound movement. That is to say, the cooperating rolls may be first moved laterally toward each other to predeterminedly position the same with respect to opposite sides of the blank and then moved through either rectilinear or swinging paths which are at an angle to the median plane of rotation of the master roll and converge to effect the rolling operation. Various other combinations of movements of the cooperating rolls may be resorted to so long as the actual rolling operation is effected during the interval the rolls are moved throughout an angular path and, for this reason, reservation is made to make such changes in the details of construction as may come within the purview of the accompanying claims.

What I claim as my invention is:

1. In a machine for rolling an annular blank to a predetermined cross sectional contour, supporting means for an annular blank, a forming roll having a peripheral surface corresponding in shape to the cross sectional contour aforesaid and engageable with the blank intermediate the ends thereof, a member supported for reciprocation toward and away from said forming roll, means effective upon initial movement of the member toward the forming roll to exert a pressure on the blank opposite the forming roll and thereby clamp the blank against said forming roll, a pair of cooperating rolls supported at opposite ends of the blank for angular movement toward the forming roll aforesaid into engagement with the blank, and means effective upon continued movement of said member in a direction toward the first named forming roll to move the cooperating forming rolls along their respective angular paths into engagement with the blank.

2. In a machine for rolling an annular blank to a predetermined cross sectional contour, a forming roll having a peripheral surface corresponding in shape to the predetermined cross sectional contour aforesaid and engageable with the outer surface of the blank intermediate the ends of the latter, a member movable toward and away from the forming roll and having means effective upon initial movement of the blank toward the forming roll to clamp the blank against said

roll, a pair of cooperating forming rolls mounted on opposite sides of the median plane of rotation of the first named roll for angular movement toward the latter into engagement with the inner surface of the blank opposite said first mentioned forming roll, and means operated by said member upon continued movement of the latter toward the first mentioned forming roll to move the cooperating forming rolls along their respective angular paths into engagement with the blank.

3. In a machine for rolling an annular sheet metal blank to a predetermined cross sectional contour, a forming roll having a peripheral surface corresponding in shape to said predetermined cross sectional contour and engageable with the outer surface of the annular blank intermediate the ends of the latter, a member movable toward and away from the forming roll and having means effective upon initial movement toward the forming roll to clamp the blank against said forming roll, a pair of cooperating forming rolls pivotally supported beyond opposite ends of the blank for swinging movement into engagement with the inner surface of the blank opposite said first named forming roll and having peripheral surfaces cooperating with each other in the innermost position of the rolls to form a continuous peripheral surface corresponding in shape to the predetermined cross sectional contour aforesaid, and toggle linkage connecting each of the cooperating forming rolls with said member and effective upon continued movement of the member toward the first named forming roll to swing the cooperating forming rolls into engagement with the blank.

4. In a machine for rolling an annular blank to a predetermined cross sectional contour, a forming roll having an intermediate portion engageable with the surface of one side of the blank intermediate the ends of the latter, a member supported for reciprocation toward and away from the forming roll, means effective upon initial movement of the member toward the forming roll to clamp the blank against the intermediate portion of said forming roll, cooperating forming rolls positioned on opposite sides of the median plane of the blank and movable along converging paths toward the median plane of the blank into engagement with the opposite end portions of the blank to cooperate with the first named roll in fashioning the end portions of the blank to the contour of the adjacent surfaces of the first named forming roll, and toggle linkage actuated by the reciprocable member upon continued movement of the latter in a direction toward the first named forming roll to move the cooperating forming rolls along the converging paths aforesaid.

5. In a machine for rolling an annular blank to a predetermined cross sectional contour, a forming roll having an intermediate portion engageable with the outer surface at one side of the annular blank intermediate the ends of the latter, a member supported for reciprocation toward and away from the forming roll, clamping means located within the annular blank and effective upon initial movement of the member toward the forming roll to exert a pressure on the inner surface of the blank opposite the intermediate portion aforesaid of the forming roll to clamp the blank therebetween, cooperating forming rolls positioned on opposite sides of the median plane of the blank and movable along converging paths toward the median plane of the blank into engagement with the opposite end portions of the blank to cooperate with the first named roll in fashioning the end portions of the blank to the cross sectional contour of the adjacent portions of the first named forming roll, and means effective upon continued movement of said member in a direction toward the first named forming roll to move the cooperating forming rolls along the converging paths aforesaid.

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