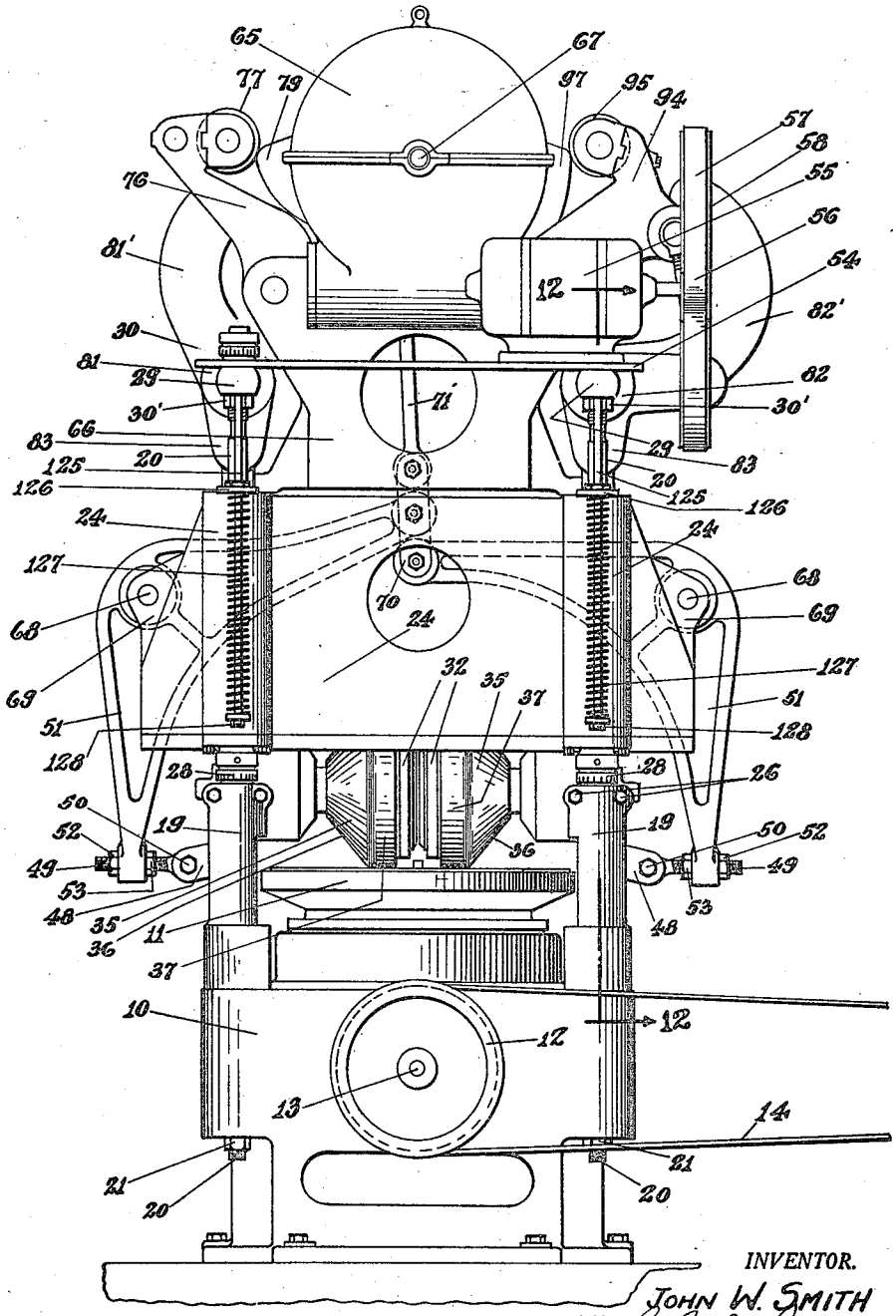
Nov. 16, 1926. 1,606,906

J. W. SMITH

MACHINE FOR ROLLING METALLIC DISKS

Filed May 24, 1923 9 Sheets-Sheet 1



INVENTOR.
JOHN W. SMITH
BY E. B. Desjardins
ATTORNEY

WITNESS:—
Walter M. Trout

FIG 1

Nov. 16, 1926. 1,606,906

J. W. SMITH

MACHINE FOR ROLLING METALLIC DISKS

Filed May 24, 1923 9 Sheets-Sheet 2

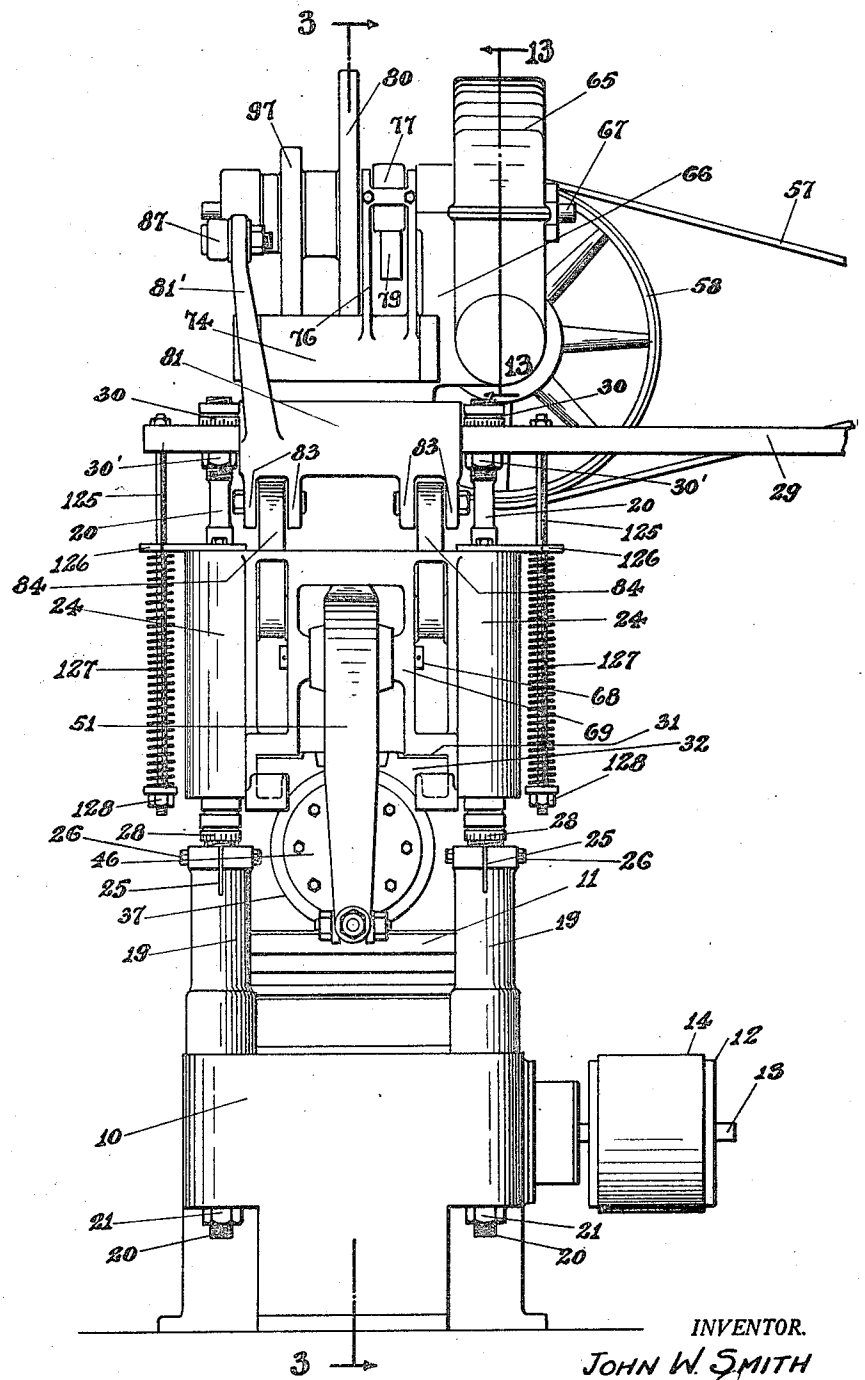


Fig 2.

INVENTOR.
JOHN W. SMITH
BY C. B. Dodgardine
ATTORNEY

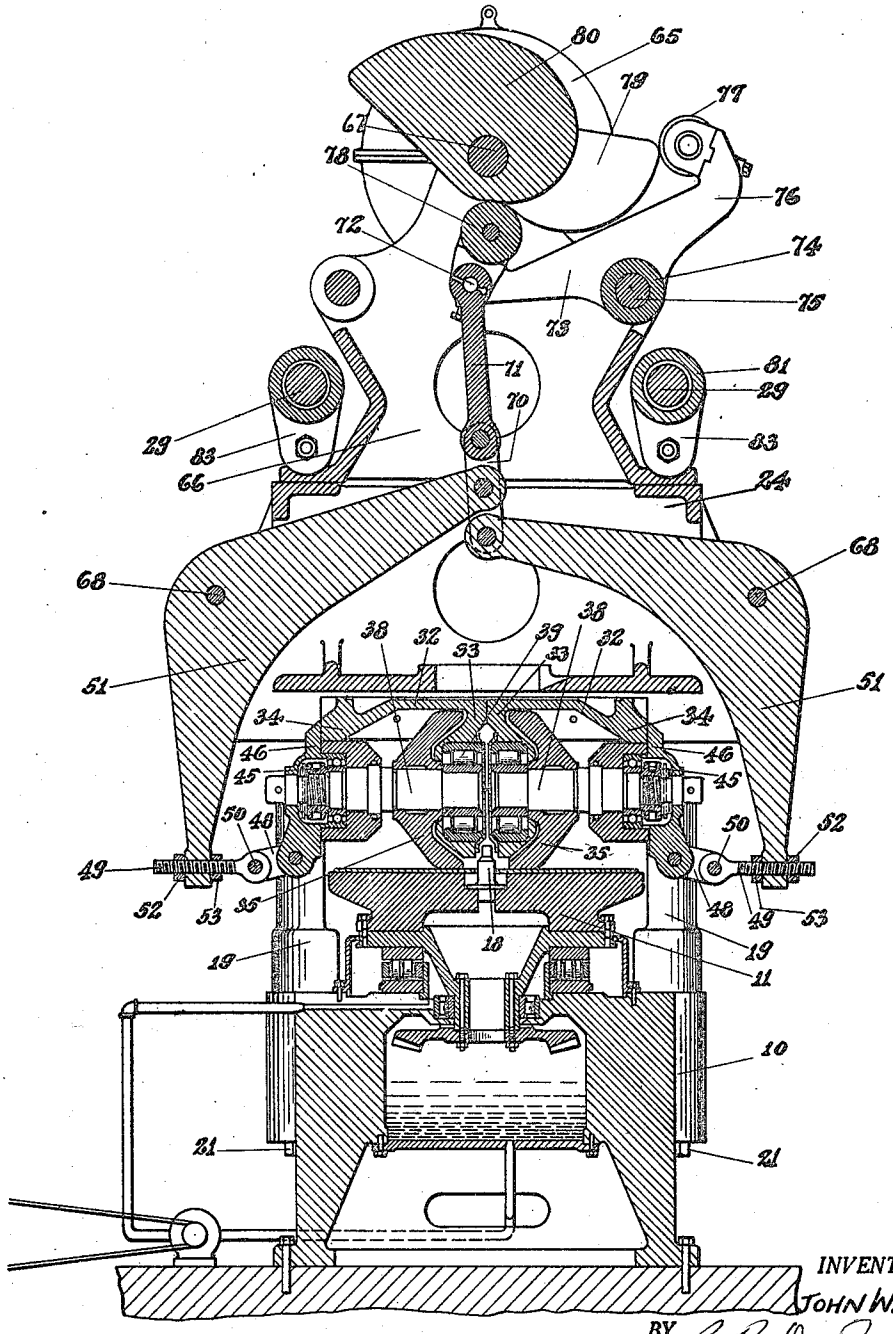
WITNESS:-
Walter M. Trout

Nov. 16, 1926. 1,606,906

J. W. SMITH

MACHINE FOR ROLLING METALLIC DISKS

Filed May 24, 1923 9 Sheets-Sheet 3



Witness:-
Walter M. Trout

Fig 3

INVENTOR.
JOHN W. SMITH
BY
C. B. DesJardins
ATTORNEY

Nov. 16, 1926. 1,606,906

J. W. SMITH

MACHINE FOR ROLLING METALLIC DISKS

Filed May 24, 1923 9 Sheets-Sheet 4

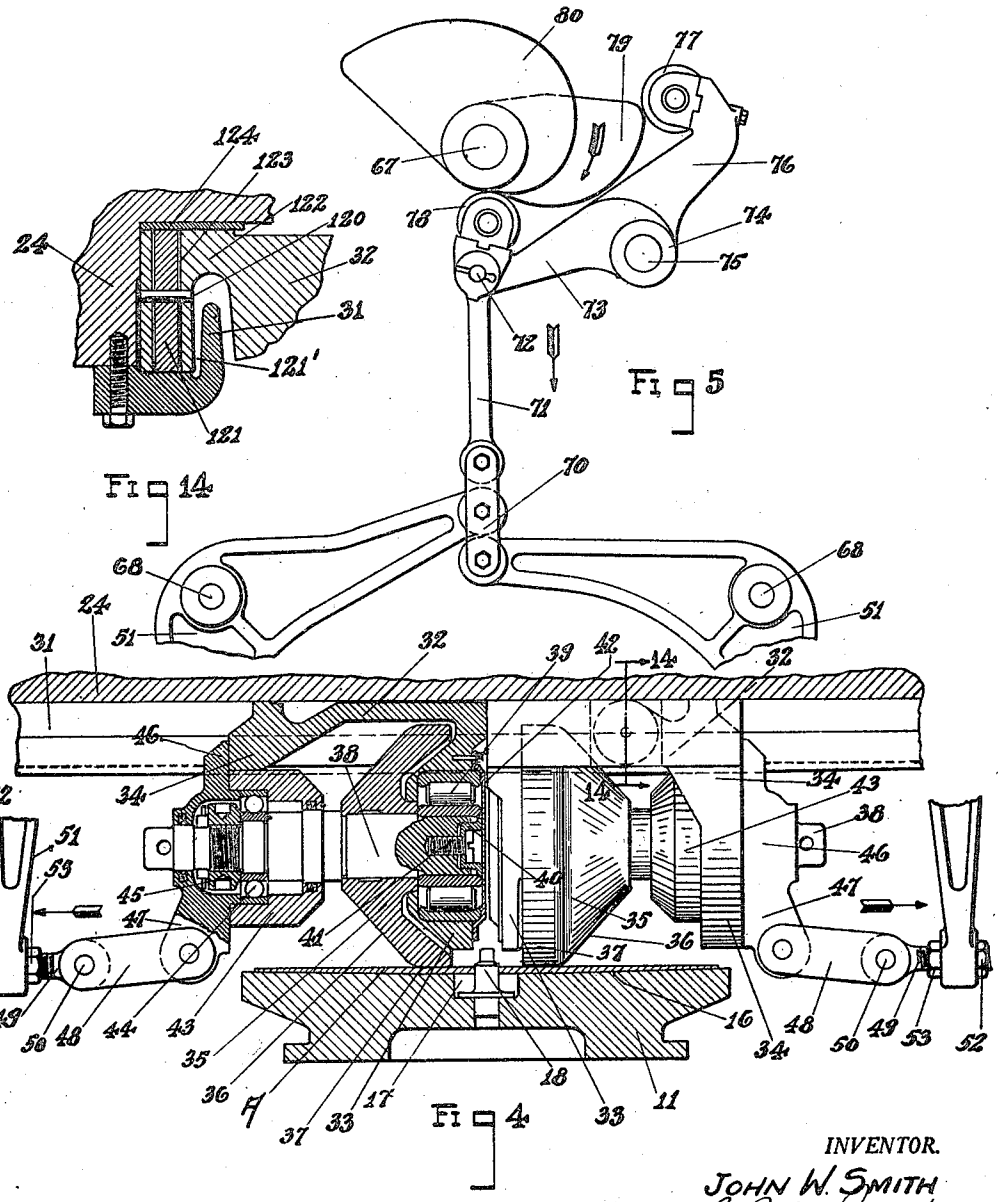


Fig 5

Fig 14

Fig 4

INVENTOR.
JOHN W. SMITH
BY C. B. Desjardins
ATTORNEY

WITNESS:—
Walter M. Frost.

Nov. 16, 1926. 1,606,906

J. W. SMITH

MACHINE FOR ROLLING METALLIC DISKS

Filed May 24, 1923 9 Sheets-Sheet 5

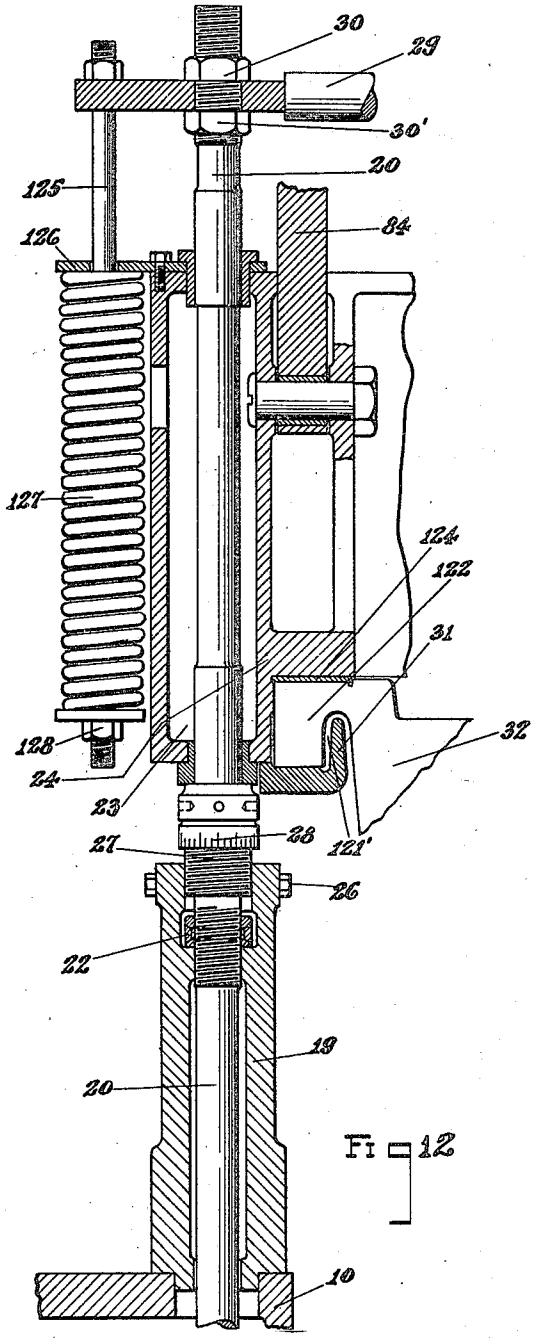


Fig 12

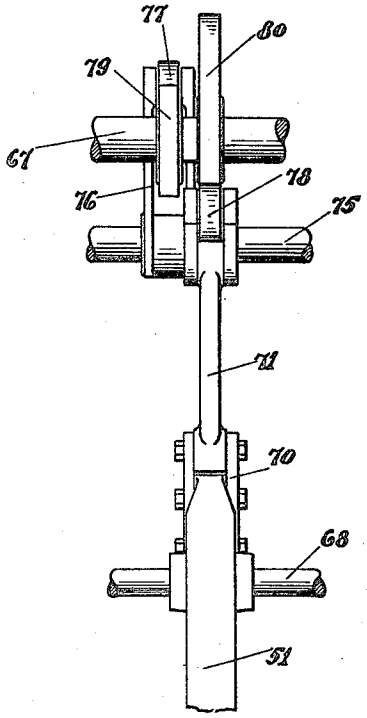


Fig 6

INVENTOR.
JOHN W. SMITH
BY C. B. Des Jardins
ATTORNEY

Nov. 16, 1926. 1,606,906

J. W. SMITH

MACHINE FOR ROLLING METALLIC DISKS

Filed May 24, 1923 9 Sheets-Sheet 6

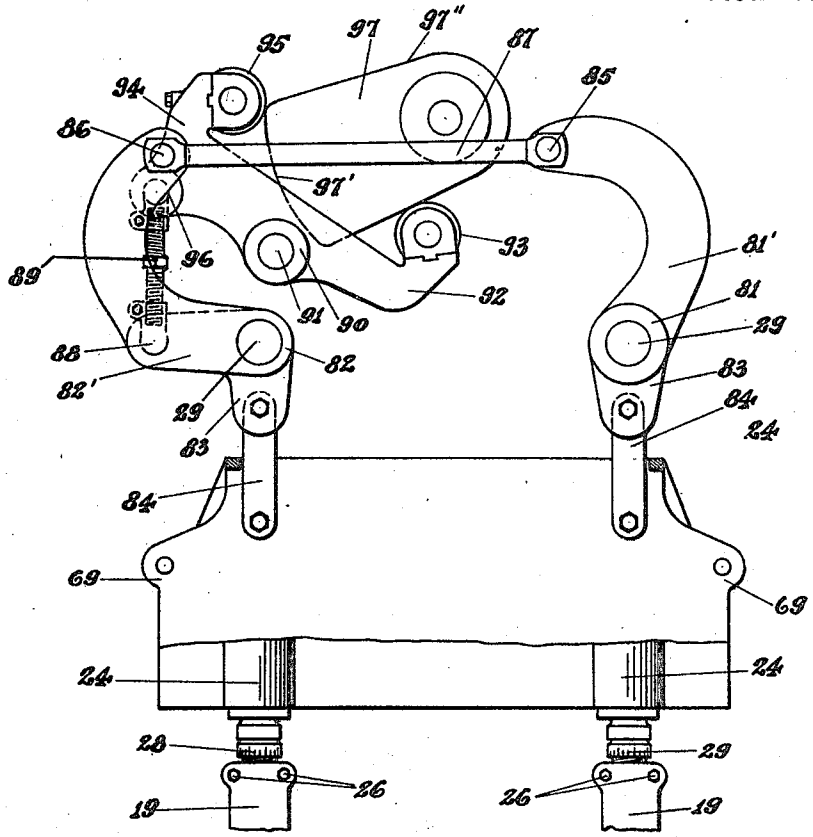


Fig 7

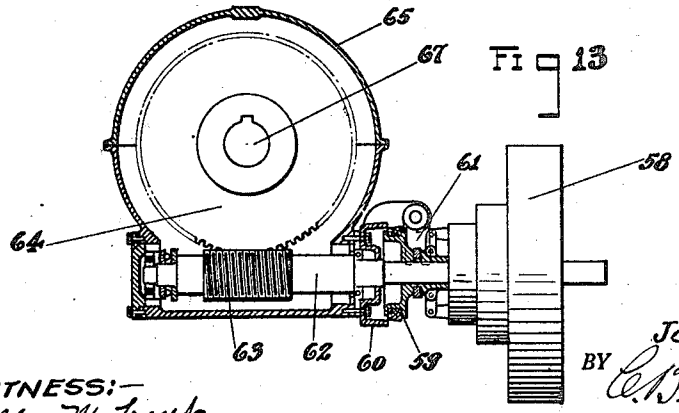


Fig 13

WITNESS:-
Walter M. Trout

INVENTOR.
JOHN W. SMITH
BY E. B. Des Jardins
ATTORNEY

Nov. 16, 1926. 1,606,906

J. W. SMITH

MACHINE FOR ROLLING METALLIC DISKS

Filed May 24, 1923 9 Sheets-Sheet 7

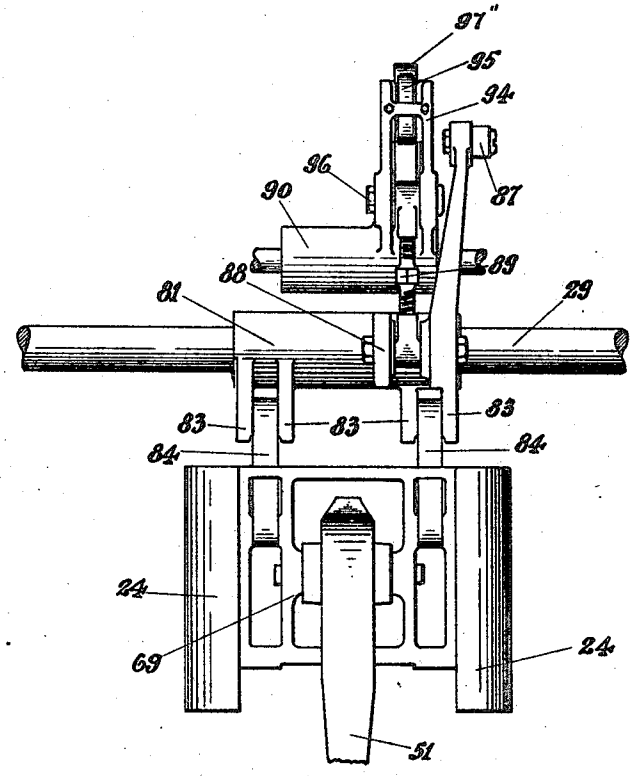


FIG 8

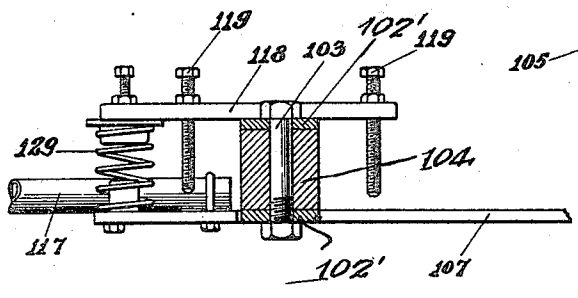


FIG 11

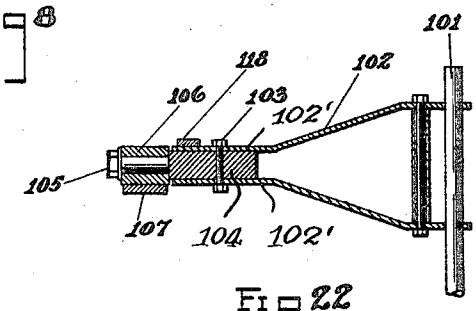


FIG 22

INVENTOR.
JOHN W. SMITH
BY C. R. Defendino
ATTORNEY

WITNESS:-
Walter M. Trout

Nov. 16, 1926. 1,606,906

J. W. SMITH

MACHINE FOR ROLLING METALLIC DISKS

Filed May 24, 1923 9 Sheets-Sheet 8

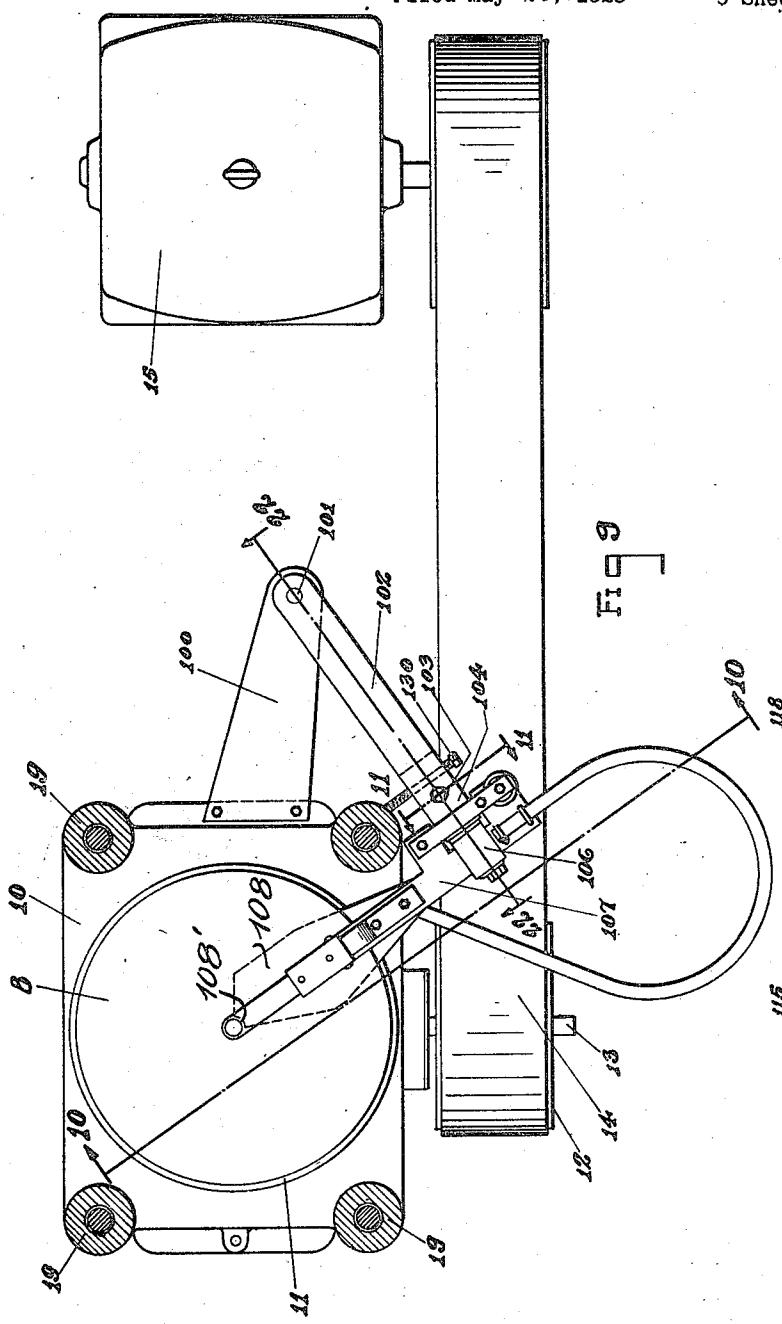


Fig 9

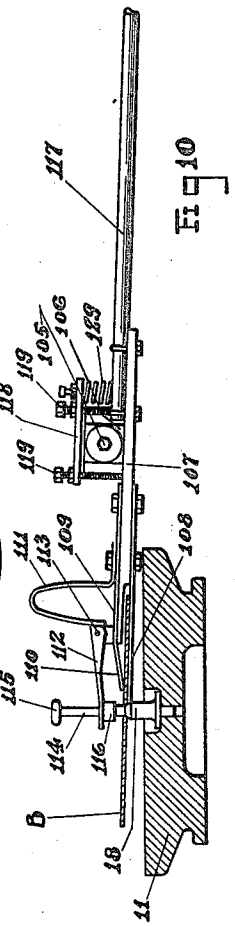


Fig 10

INVENTOR.
JOHN W. SMITH
BY C. B. DeJardins
ATTORNEY

WITNESS:—
Walter M. Trout

Nov. 16, 1926. 1,606,906

J. W. SMITH

MACHINE FOR ROLLING METALLIC DISKS

Filed May 24, 1923 9 Sheets-Sheet 9

Fig 15

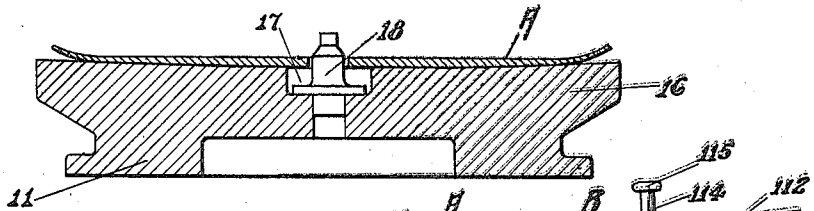


Fig 16

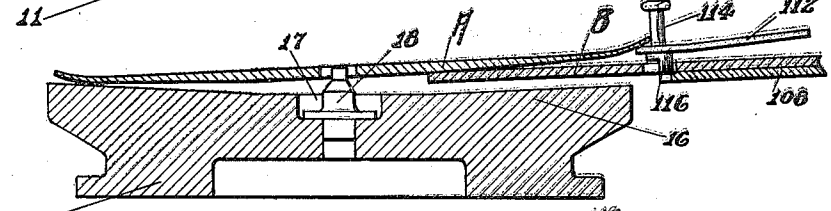


Fig 17

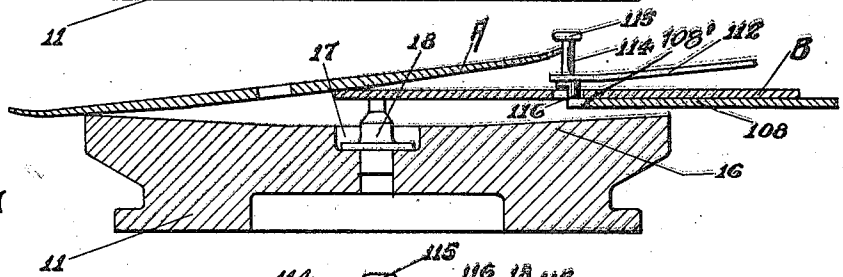


Fig 18

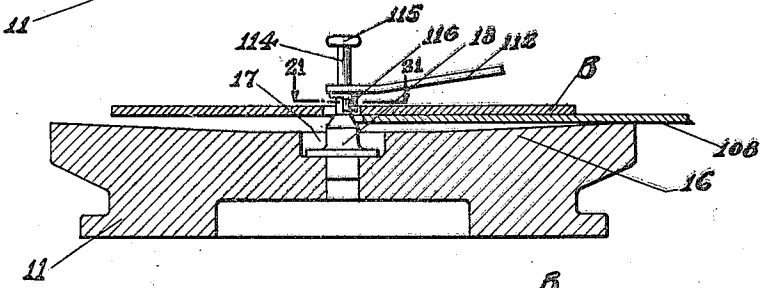


Fig 19

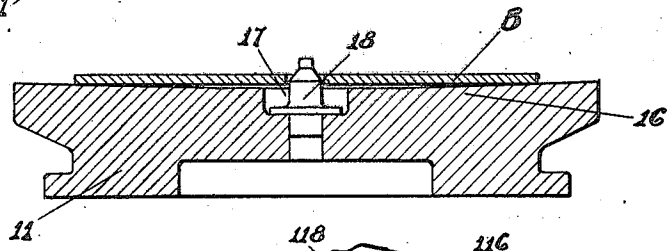
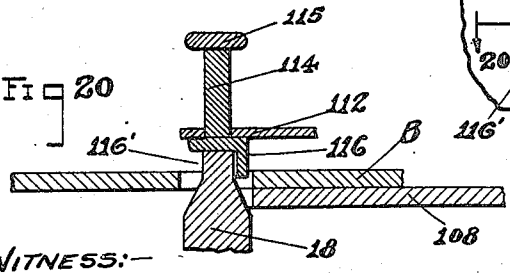


Fig 20



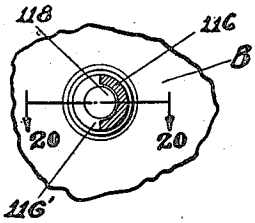


Fig 21

INVENTOR.
JOHN W. SMITH
BY E. B. Des Jardins
ATTORNEY.

WITNESS:—
Walter M. Trout

Patented Nov. 16, 1926. 1,606,906

UNITED STATES PATENT OFFICE.

JOHN W. SMITH, OF PHILADELPHIA, PENNSYLVANIA, ASSIGNOR TO BUDD WHEEL COMPANY, OF PHILADELPHIA, PENNSYLVANIA, A CORPORATION OF PENNSYLVANIA.

MACHINE FOR ROLLING METALLIC DISKS.

Application filed May 24, 1923. Serial No. 641,240.

My invention relates to improvements in machines for rolling metallic disks and has to do, more particularly, with disk rolling machines of the type described and claimed in my co-pending applications, Serial No. 408,231. process of and apparatus for rolling metallic disks, filed September 4, 1920, and Serial No. 414,848, machines for rolling disks, filed October 5, 1920.

In my pending applications, I have described and claimed machines for rolling metallic disks in which a blank is mounted upon a rotating table and acted upon by rolls which are traversed radially of the blank as the table rotates. These rolls are of such form that they have a combined spinning and rolling action upon the blank, which reduces it in thickness and increases its diameter, bringing the finished disk to any desired cross-section, depending upon the configuration of the table or support for the blank. The principal object of my present invention is to improve upon the machines of these pending applications so as to provide machines for rolling metallic disks which will be particularly efficient and capable of operation at comparatively high speed.

One object of my present invention is to provide improved means for raising and lowering the rolls with respect to the table and for traversing the rolls radially with respect to the axis of the table. A leading object of my present invention is to provide simpler and more effective mechanism for moving the rolls with respect to the table.

A further object of my present invention is to provide means for ejecting a finished disk from and feeding a blank to the machine without stopping it, so that the operation of the machine may be made substantially continuous.

Further objects, and objects relating to details and economies of construction and operation, will definitely appear from the detailed description to follow. In one instance, I accomplish the purposes of my invention by the devices and means described in the following specification. My invention is clearly defined and pointed out in the appended claims. A structure constituting a preferred embodiment of my invention is illustrated in the accompanying drawings, forming a part of this specification, in which:

Fig. 1 is a view in front elevation of a machine embodying my invention, the blank placing and ejecting means not being shown.

Fig. 2 is a view of the machine in side elevation.

Fig. 3 is a vertical, sectional view through the machine, taken on the line 3—3 of Fig. 2.

Fig. 4 is an enlarged view, partly in section and partly in side elevation, of the table supporting the blank, the rolls which act on the blank and the roll carriers.

Fig. 5 is a view in side elevation of the cams and connected parts causing radial movements of the rolls with respect to the axis of the blank.

Fig. 6 is a view of the parts shown in Fig. 5, looking from the left of said figure.

Fig. 7 is a view in side elevation of the cam and connections for raising and lowering the rolls with respect to the table on which the blank is supported.

Fig. 8 is a view of the parts shown in Fig. 7, looking at them from the left of Fig. 7.

Fig. 9 is a horizontal, sectional view through the machine, taken on a line just above the table and showing the feeding and ejecting device.

Fig. 10 is a detail, sectional view of such device, taken on the line 10—10 of Fig. 9.

Fig. 11 is a detail. sectional view, taken on the line 11—11 of Fig. 9.

Fig. 12 is a detail, sectional view, taken on the line 12—12 of Fig. 1.

Fig. 13 is a detail, sectional view, taken on the line 13—13 of Fig. 2, showing the means for driving the cam shaft.

Fig. 14 is a detail, sectional view taken on the line 14—14 of Fig. 4.

Figs. 15 to 19, inclusive, are sectional views through the table and a blank thereon, showing successive stages in the operation of ejecting a rolled disk and feeding a blank to the table.

Figs. 20 and 21 are enlarged, sectional views on lines 20—20 of Fig. 1 and 21—21 of Fig. 18, respectively, and

Fig. 22 is a sectional view through the feeding device, taken on line 22—22 of Fig. 9.

In the drawings, the same reference numerals refer to the same parts throughout the several views and the sectional views are taken looking in the direction of the arrows at the ends of the section lines.

In my said pending applications, Serial Nos. 408,231, and 414,848, the blank is supported on a rotating table and acted upon by rolls which engage the blank under pressure and are moved radially of the blank, from the center outwardly, while the table rotates. Means are provided for separating the rolls and the table to permit the removal of the rolled disk and the insertion of a blank to be rolled. In my application, Serial No. 414,848, I provide fluid-pressure means for actuating the rolls so as to give them the proper raising and lowering movements at the proper intervals and to cause an outward radial movement of the rolls with respect to the axis of the table and a return movement of the rolls toward the center or axis of the table. My present invention consists in providing cam mechanism for causing such movements of the rolls at the proper intervals. The rolls are carried by a part of the machine which is capable of vertical movement with respect to the table on which the blank is supported. This movable part of the machine carries suitably driven cams which not only cause this part and the rolls to rise and fall at regular intervals, but also cause radial movements of the rolls with respect to the axis of the table. These cams are such that the movement of the rolls from the center outwardly of the table may take place at a slower rate than the return movement of the rolls toward the central position, the latter movement taking place while the rolls are raised from the table to permit a change of blanks. This cam mechanism permits the vertical and radial movements of the rolls to follow each other in a predetermined sequence, so as to establish a cycle of operation in which these several movements follow one after the other and may take place at different rates of speed. This permits me to make the mechanism particularly speedy and efficient since return movements of the rolls may be made considerably faster than the working movements.

The vertically-movable carriage, on which the rolls are mounted, carries a suitably driven cam shaft on which a plurality of cams are fastened. One of these cams acts upon a rocker arm which transmits rocking movement to a pair of bell-crank levers fulcrumed at fixed points in the frame of the machine and connected by links to the movable carriage, so that these bell-crank levers raise and lower the carriage and exert a powerful toggle action to force the carriage toward the table and cause the rolls to bear with considerable pressure upon the blank. One or more of the cams on the cam shaft act upon a rocker arm which is connected to a pair of bell-crank levers fulcrumed at opposite sides of the movable carriage and connected to roll-carriers which slide transversely of the carriage and which carry the rolls acting upon the blanks. The cams on the cam shaft may be so arranged with respect to each other that the rolls are, first, moved downward toward the blank, then moved radially toward the periphery of the blank, then raised, and, finally, moved radially inward toward the axis of the table to a position in which they are ready to repeat this cycle of operations.

In order to eject a rolled disk and feed a fresh blank to the machine without stopping it, I provide a feeding device consisting of an arm which is mounted so as to swing around both a vertical and a horizontal axis, the end of said arm being adapted to support a blank to be rolled. This arm is so mounted that a blank supported upon it may be swung into working position on the turning table. A blank is supported and held in centered position by this device and inserted between the rolled disk and the table so that it serves to lift the rolled disk from the centering device of the table and shove it from the machine by the same movement which brings the new blank into alignment with the centering device. The feeding device may then be withdrawn, leaving the blank in proper position on the table. This arm constitutes a carrier upon which a blank is mounted by the operator. When the blank in the machine has been rolled, the operator swings this arm so that the blank upon it is inserted between the rolled disk and the table and lifts the rolled disk from the table so that it clears the centering device. A part on the feeding device contacts with the periphery of the rolled disk and further movement of the arm ejects the rolled disk from the machine and brings the fresh blank to proper position for engagement with the centering device of the table. When the blank is properly engaged with such centering device, the arm may be withdrawn, leaving the blank in working position on the table, ready to be engaged by the rolls. This feature of my present invention consists in providing a carrier for the blank which may be moved into such relation with the rotating table as to eject a rolled disk therefrom and deposit the blank in working position upon the table.

The machine illustrated in the accompanying drawings constitutes one embodiment of my present invention which has been found to be satisfactory and which I believe, at the present time, to be preferred. Referring to the numbered parts of the drawing, this machine comprises a base, 10, on which is journaled the rotating table, 11, said table

being rotated by means of the shaft, 13, carrying the pulley, 12, and connected by belt, 14, with the motor, 15. The upper face, 16, of the table, 11, forms the support for the blank and its configuration determines the cross-section of the rolled disk. This particular machine is for rolling tapered disks which decrease in thickness toward the periphery and, therefore, the face, 16, is slightly conical and concave. At the center of the table, there is a cup-shaped recess, 17, within which is located a centering stud, 18, which extends somewhat above the face, 16, of the table and which is axially disposed with respect to the table.

From the four corners of the base, 10, the columns, 19, extend upwardly. Vertical tie-rods, 20, extend through the base, 10, and the columns, 19, and for a considerable distance above the upper ends of the columns, constituting guide rods upon which the vertically-movable carriage is mounted. These tie-rods, 20, are rigidly fastened to the base, 10, due to the engagement of the collars, 22, fixed on such rods, with internal shoulders in the columns, 19, and the engagement of the nuts, 21, threaded on the lower ends of the rods, 20, with shoulders on the base. The rods, 20, extend vertically upward through bores, 23, provided in the vertically-movable carriage, 24, and guide said carriage in its vertical movement. The upper end of each column, 19, is split, at 25, and internally threaded and receives an externally-threaded sleeve, 27, which may be adjusted in the upper end of said column and locked in adjusted position by means of the bolts, 26, which clamp the split portions of the column around said sleeves. The tie rods, 20, pass freely through these adjustable sleeves, 27, and the upper ends of such sleeves form stops to limit the downward movement of the carriage, 24. By adjusting these sleeves in the upper ends of the columns, 19, the lowermost position of the rolls with respect to the table, 11, may be determined, thus determining the thickness of the disk which is rolled. The sleeves, 27, may be provided with a series of markings, 28, so that the position of the rolls may be determined accurately and changed from time to time. The upper ends of the tie-rods, 20, extend through the cross rods, or bars, 29, and are rigidly secured thereto by nuts, 30 and 30′, screwed on the ends of the tie rods and engaging the upper and lower surfaces of such cross bars, respectively. The cross rods, 29, may be raised or lowered by adjusting the nuts, 30 and 30′, on the tie rods, 20, and, to facilitate the accurate adjustment of these parts, the nuts, 30, may have a series of graduations marked thereon. The end portions of the cross bars may have their upper and lower surfaces flattened, as shown, but the intermediate portions of such cross bars are cylindrical, so as to form bearing shafts for certain moving parts of the roll-actuating mechanism.

In the lower surface of the carriage, 24, there is a transverse guide-way, 31, which receives the sliding roll-carriers, 32. These carriers, 32, are each provided with ears, 122, extending from opposite sides thereof, and having slots, 123, within which the felt rollers, 121, are journaled on the pins, 120. These rollers work within the guide-way, 31, and bear upon the upper and lower surfaces of said guide-way in an oil trough, 121′, provided therein, to lubricate the phosphor-bronze strip, 124, secured to the upper wall of the guide-way, 31, and forming a track on which the roll-carriers, 32, slide, when shifting the rolls radially of the blank, under pressure, during the working stroke of the machine. There are two roll-carriers, 32, slidably supported in the guide-way, 31. Each of these roll-carriers has the spaced depending arms, 33 and 34, between which a roll, 35, is mounted so as to revolve. This roll, 35, has a conical, leading face, 36, and a cylindrical rolling surface, 37, and it is fastened to a shaft, 38, which is journaled in bearings carried by the arms, 33 and 34, respectively. On the inner end of the shaft, 38, there is mounted the cylindrical roller bearing, 39, which is held on the end of the shaft by the retaining member, 40. The member 40, engages the inner race of the bearing and is secured to the shaft, 38, by the screw, 41. The roller bearing, 39, is housed within a cup-shaped recess formed in the arm, 33, and it is retained in such recess by the plate, 42, which extends over the end of the bearing and the shaft, 32, and is bolted to the arm, 33. A cup-shaped member, 43, surrounds the other end of the shaft, 38, and is received in a seat formed for it in the arm, 34, of the roll-carrier. This cup-shaped member receives a ball bearing, 44, mounted on the shaft, 38. The ball bearing is held in place on the shaft by the nut, 45, screwed thereon. The cup-shaped member, 43, is retained in position in the arm, 34, by an end cap, 46, which is bolted to the cup-shaped member, 43, and also to the arm, 34, of the roll-carrier, 32. This end cap, 46, has a depending lug, 47, to which a link, 48, is pivoted. The opposite end of said link is pivotally connected, at 50, to a pin, 49, which is adjustably carried at the end of one arm of a bell-crank lever, 51. In order to provide for the adjustment of the pin, 49, with reference to the bell-crank arm, so as to vary the radial movement of the roll, the pin, 49, is threaded and nuts, 52 and 53, screwed on the threaded pin engage opposite faces of the bell-crank arm. It is evident that the movement of the rolls, 35, may be varied by adjusting these nuts on the pin, 49.

The cross rods, 29, are extended to one

side of the machine, as shown in Fig. 2, and support a platform, 54, on which an electric motor, 55, is mounted as shown in Fig. 1. The driving pulley, 56, mounted on the armature shaft of said motor, is connected by the belt, 57, with the pulley, 58, which is journaled on a support, 66, carried by the movable carriage, 24. A male clutch member, 59, turns with the shaft, 62, and cooperates with a fixed brake member, 60, or with a female clutch member turning with pulley, 58. This clutch mechanism is controlled by the lever, 61. A worm, 63, on the shaft, 62, meshes with worm gear, 64, on the shaft, 67. The worm and worm gear are housed within the casing, 65, carried by the support, 66. The shaft, 67, which is also journaled in the support, 66, is a cam shaft which carries the cams for moving the rolls.

The rods, 125, extend from the cross rods, 29, down through openings in plates, 126, which are fastened to the movable carriage, 24. Springs, 127, surround the lower portions of these rods, 125, and are compressed between the nuts, 128, screwed on the lower ends of the rods, and the plates, 126. These springs help to counterbalance the weight of the vertically-movable carriage, 24, and the parts carried thereby, so that less work is required of the cams and connected parts in order to raise the rolls, 35, from the table, 11.

The bell-crank levers, 51, to which reference has already been made, are journaled on pins, 68, carried by ears, 69, projecting from the sides of the vertically-movable carriage, 24. One arm of each of these bell cranks extends downwardly and is adjustably connected, in the manner which we have described, to one of the two roll carriers. The other arms of the bell-crank levers, 51, extend inwardly of the machine, substantially as shown in Fig. 1, and are pivotally connected to link, 70. (See Fig. 5.) The upper end of the link, 70, is pivotally connected to the lower end of a connecting rod, 71, the upper end of which is pivotally connected, at 72, to one arm, 73, of a rocker, 74, journaled on a cross shaft, 75, carried by the support, 66. One arm, 73, of this rocker member carries the roller, 78, and the opposite arm, 76, carries a roller, 77. The roller, 77, is engaged by a cam, 79, fast on the shaft, 67, and the roller, 78, is engaged by a cam, 80, which is also fast on the shaft, 67. As the cam shaft, 67, rotates, the rocker member, 74, is caused to rock back and forth on the shaft, 75, at predetermined intervals, thus imparting to the bell-crank levers, 51, the movements necessary to move the rolls in and out, radially of the table, at the proper intervals.

As the cam shaft, 67, rotates in the direction of the arrow, (see Fig. 5) the cam, 80, engaging roller, 78, gradually rocks the member, 74, on its bearing and forces down the inner ends of the bell-crank levers, 51, thus moving the roll-carriers, 32, outwardly in the guideway, 31. This causes a gradual movement of the rolls, 35, radially of the blank. When the roller, 78, reaches the tip of cam, 80, and this movement ceases, there is a slight dwell, during which the rolls are raised from the blank by mechanism to be described, and then cam, 79, acts on roller, 77, and rocks the member, 74, in the opposite direction restoring the rolls to the central position which they occupy in Fig. 1. The cams, 79 and 80, are so arranged with respect to each other that, when the tip of cam, 79, is in engagement with roller, 77, the cam, 80, is just ready to act on roller, 78, so that the outward movement of the rolls takes place substantially at the end of their return movement. The cams, 79 and 80, are so shaped that cam, 79, acts during a little more than a quarter of a revolution of the cam shaft, 67, and cam, 80, acts during about two-thirds of a revolution of the shaft, so that the return movement of the rolls is effected in about half the time required for the outward movement.

On the cross rods, 29, the knuckle members, 81 and 82, are journaled. Each of these members has a cylindrical hub through which the corresponding cross rod, 29, extends. Near the ends of such hubs are provided the depending ears, 83, one pair of such ears being adjacent each end of each hub. Links, 84, pivotally connected to the movable carriage, 24, near the four corners thereof, have their upper ends pivotally connected to the ears of said knuckle members. Said ears and links are so connected as to form toggle linkages connecting the movable carriage, 24, and the fixed cross rods, 29. Arms, 81′ and 82′, extend upwardly from these knuckle members and a connecting link, 87, is pivotally connected at 85 with the upper end of the arm, 81′, and, at 86, to the upper end of the arm, 82′. This equalizes the motion of the knuckle members on opposite sides of the machine. An adjustable link, 89, is pivotally connected at 88 to the arm, 82′, and the upper end of this link is pivotally connected, at 96, to the rocker member, 90, which is journaled on the cross shaft, 91, carried by the support, 66. One arm, 92, of the rocker member, 90, carries a roller, 93, while the other arm, 94, carries a roller 95. These rollers engage a cam, 97, which is fixed on the cam shaft, 67.

As the cam shaft revolves, the cam, 97, imparts a rocking motion to the member, 90, and such rocking motion is transmitted to the knuckle members, 81 and 82. The ears, 83, of such members form, with the links, 84, toggles. In Fig. 7, the toggles are

shown in closed position, in which the carriage, 24, is forced downwardly and the rolls, 35, are forced against the blank on the table, 11, under great pressure. As the cam, 97, revolves in the direction of the arrow, (see Fig. 7) the rocker member, 90, will be held in the position which it occupies so long as the curved edge, 97′, of the cam, contacts with the roller, 95. This keeps the toggle linkages straight and the carriage is held in its lower position under great pressure, while the rolls are given a radial motion by the mechanism previously described. After the curved edge, 97′, moves out of engagement with the roller, 95, the rotation of the cam shaft, 67, brings the surface, 97″, into engagement with the roller, 93. This rocks the member, 90, in a direction to break the toggle linkages and to raise the carriage, 24, from the table, 11. When the curved surface, 97′, is engaged by the roller, 93, the carriage is held in such elevated position until the roller, 95, engages the edge, 97″, of the cam. This takes place at the instant when the roller, 93, moves out of engagement with the curved edge, 97′, and causes the movement of the toggle linkages to closed position so that the carriage, 24, is forced toward the table under great pressure.

I have provided a feeding device which cooperates with the rotating table, 11, to eject a rolled disk from such table and to deposit a new blank in working position upon the table, while the latter continues to rotate. In this embodiment of my invention (see Fig. 22), the feeding device consists of an arm, 102, pivoted, at 101, to a bracket, 100, projecting from the base, 10, of the machine. A block, 104, is journaled on a vertical pin, 103, at the end of the arm, 102, and this block carries a horizontal stud, 105, on which is journaled a block, 106, which is fastened to a lever, 107. A blank-supporting plate, 108, is fastened to the forward end of this lever and is shaped as shown in dotted lines in Fig. 9, having a concave recess, 108′, at its end, to fit the centering stud, 18, of the table, 11. This plate is adapted to support a blank to be rolled, as shown in Fig. 10. A strip, 109, is fastened to the upper surface of the lever, 107, and has its end 110 bent downwardly toward the plate, 108, so as to yieldingly engage the upper surface of a blank supported on said plate. The blank supported by said plate is held centered with respect thereto by means of an arm, 112, which is pivoted, at 113, to a bracket carried by the lever, 107, and which carries a rod, 114, at its free end, having an enlarged collar, 116, at its lower end, adapted to fit in a central opening formed in the blank. This rod has a handle, 115, and it is held yieldingly in position by a spring, 111, which engages the member, 112, at the hinge joint, 113. A handle, 117, is fastened to the lever, 107, by means of which the device may be tilted and swung from one side to the other, as may be necessary in ejecting a finished disk and feeding a new blank to the machine. A strap, 118, which is fastened to the arm, 102, carries two set screws, 119, which contact with the lever, 107, and limit its tilting movement about the stud, 105. A spring, 129, interposed between the plate, 118, and the lever, 107, serves to help counterbalance the weight of the blank supported in the device so as to make it easier to manipulate. A set screw, 130, carried by the arm, 102, engages one of the columns, 19, of the machine and limits the swinging movement of the device, about the pivot, 101, toward the machine. This set screw may be so set that the swinging movement will be stopped when the rod, 114, is in line with the centering stud, 18, in which position the new blank may be discharged from the device and deposited upon the rotating table, 11.

The operation of this machine will be apparent from the foregoing description of the parts thereof. When the rolls, 35, are raised from the table, 11, the blank, B, is placed upon the table with the centering stud, 18, positioned in a central opening formed in the blank. This may be done by means of the feeding device which we have described, or the machine may be stopped when the rolls are in elevated position and the blank placed upon the table by hand. The table, 11, rotates continuously, being driven by the motor, 15. Of course, suitable clutch means may be provided between the motor and the table for controlling the operation of the latter. The mechanism for actuating the rolls, to raise and lower them and move them radially of the table, is driven by the motor, 55. Such mechanism is actuated by the cam shaft, 67, which is carried by the movable carriage, 24, and rises and falls with the carriage. The belt connection, 57, between the motor, 55, and pulley, 58, permits of this movement of the cam shaft, 67, and the pulley, 58, with respect to the motor which is supported on the fixed cross rods, 29. A clutch is provided between the motor and the cam shaft, 67, so that the operation of the cam shaft may be controlled by the operator. As the cam shaft, 67, rotates, the cams, 79, 80 and 97 rotate with it and act upon the rocker members, 74 and 90. The action of the cams upon these rocker members has already been described. Assuming that the parts are in the position shown in Figs. 1, 4 and 5, the cam, 80, first acts on the rocker member, 74, to gradually move the rolls, 35, radially outward with respect to the table, 11. When the rolls have reached the limit of their outward movement, there is a slight dwell, during which

the rolls do not have any radial movement and, at that time, the cam, 97, begins to act on the rocker member, 90, swinging the knuckle members, 81 and 82, so as to break the toggles formed by the ears, 83, and links, 84, and lifting the vertically-movable carriage, 24. When this upward movement of the carriage commences, the cam, 79, begins to act on the roller, 78, of the rocker member, 74, and moves the rolls, 35, to their starting position adjacent the axis of the table. The curved edge, 97′, of the cam, 97, acts on the roller, 93, of the rocker member, 90, so as to hold the carriage in raised position for an interval long enough to permit the insertion of a new blank on the table. At the end of this interval, the edge, 97″, acts upon the roller, 95, swinging the rocker member, 90, to such position as to straighten out the toggle linkages, formed by the ears, 83, and the links, 84, and forcing the carriage, 24, toward the table, 11. When the carriage has thus been forced down to bring the rolls into operating contact with the blank on the table, the curved edge, 97′, of the cam engages the roller, 95, and holds the rocker member in such position that these toggle linkages must remain straight and the carriage is held clamped in such position as to press the rolls against the blank. At the end of the radial outward movement of the rolls, this pressure is released by the cam, the carriage is moved upward and the cycle of operations is repeated.

While the rolls, 35, are operating upon a blank placed upon the table, 11, to increase its diameter and reduce its thickness by a combined spinning and rolling action, the operator places a new blank upon the feeding device, which has been swung to one side. The blank, B, rests upon the supporting plate, 108, and extends between said plate and the end 110 of strip 109, which yieldingly engages the upper surface of the blank. The blank is so located upon the plate that the notch, 108′, at the end of the supporting plate, is in line with an opening formed in the center of the blank. After the blank has been placed in proper position on the supporting plate, the arm, 112, is swung down so that the collar, 116, on the lower end of the rod, 114, enters the central opening in the blank and cooperates with the notched end, 108′, of the supporting plate to hold the blank centered. The collar, 116, is cut away, at 116′, on the side opposite from the end of the lever, 107, for a purpose which will presently appear. The blank is positioned upon the supporting plate of the feeding device in the manner thus described, while the machine is operating to roll out a blank which has previously been placed upon the table. As soon as the rolling operation has terminated and the rolls, 35, rise from the table, 11, the operator swings the feeding device carrying a new blank toward the table to eject the rolled disk, A, and deposit the blank, B, in working position upon the rotating table. The operation of ejecting a rolled disk and feeding a blank to the table is shown very clearly in Figs. 15 to 19, inclusive. Fig. 15 shows the rotating table, 11, with a rolled disk, A, thereon.

Fig. 16 illustrates the beginning of the operation of ejecting the rolled disk. The edge of a blank, B, mounted on the feeding device, is inserted between the table, 11, and the disk, A, and may be shoved between these two parts until the rod, 114, of the feeding device, engages the periphery of the disk, A. With the blank, B, in this position, the operator may pry the disk, A, from the table by tilting the lever, 107, about the horizontal stud, 105. This serves to lift the disk, A, so that the central opening in such disk clears the centering stud, 18, of the table. The operator continues to move the feeding device so as to bring the central opening of the blank, B, into line with the centering stud, 18, of the table and, since the periphery of the rolled disk, A, is engaged by the rod, 114, or the collar, 116, carried by it, this movement of the feeding device forces the rolled disk, A, from the table and discharges it from the opposite side thereof, at the same time that the blank, B, is centered with respect to the table. This operation is clearly illustrated in Fig. 17. When the blank has been brought to centered position, the notch, 108′, of the supporting plate, 108, engages the centering stud, 18, of the table and by tilting the lever, 107, the blank is allowed to drop to working position on the table and in this movement the end of the centering stud, 18, engages the notch, 116′, formed in the collar, 116, of the rod, 114, and lifts the collar, 116, from the central opening of the blank. This position of the parts is shown in Figs. 18 and 20. The operator now withdraws the feeding device while the centering stud, 18, engages in the central opening in the blank to hold it centered on the table. The supporting plate, 108, is moved from between the blank, B, and the table, 11, and the blank, B, drops to working position upon the table. The collar, 116, being cut away, at 116′, at the side opposite the lever, 107, permits this withdrawal movement. At the same time, the cutaway portion, 116′, of the collar, 116, engages with the centering stud, 18, when the blank is moved to centered position and helps the operator to guide the device and center the blank properly. Fig. 19 shows the blank in working position upon the table after the withdrawal of the feeding device. The operation of ejecting the rolled disk and feeding the new blank to the table can be readily performed by what is practically one continuous movement of the feeding device. The operator can do this very

easily and quickly so that the rolled disk can be ejected and a new blank fed to the table during the interval in which the cam mechanism holds the rolls, 35, in elevated position. The table, 11, may rotate continuously during this feeding operation and it is not necessary to stop the rotation of the cam shaft, 67, since an operator may easily discharge the roller disk and feed a new blank to the table during the interval in which the rolls are held raised in the normal operation of the cam mechanism.

It will be noted that the feeding device is pivoted on a pin, 103, carried by the arm, 102, and that the arm, 102, is also pivoted, at 101, on a vertical axis. In the usual movements of the feeding device, it swings around the axis, 101. In case the rolls, 35, should descend and engage the blank before the feeding device has been withdrawn, the action of the rolls upon the blank would tend to turn the feeding device around the axis, 103, so that it would be swung away from the table without doing any harm. The block, 104, which carries the stud, 105, on which the lever, 107, of the feeding device is pivoted, is frictionally connected with the arm, 102, so that, ordinarily, it does not turn around the axis, 103, although it may do so in case extra stress is put upon it. This frictional connection is effected by forming the arm, 102, of two spaced straps, 102′, between the outer ends of which the block, 104, is located. The bolt providing the axis, 103, is carried by the outer ends of these straps and passes through the block, 104, as shown in Fig. 22. This bolt, or an additional bolt (not shown), connects the two straps adjacent the block, 104, and draws them toward each other so that they engage the block, 104, frictionally, and tend to hold it against turning movement on the axis, 103. This arrangement acts as a safety device in case the rolls should descend before the feeding device has been withdrawn.

The machine which I have described herein may be used for rolling disks either hot or cold. Of course the movements of the rolls will be varied so as to regulate the amount of reduction in thickness of the blank, which will be different when the blank is heated before rolling, from what it would be when operating upon a cold blank. This machine may be used for tapering a blank of uniform thickness or it may be used with a blank of tapering cross section which it is desired to roll in order to effect some reduction in thickness and increase in diameter and in order to improve the surface of the blank. I have found that the surfaces of tapered disks will be very much improved, so that they take paint or enamel more satisfactorily, if they are rolled in this machine so as to cause a flow of metal and a reduction in thickness and increase in diameter. I have shown a machine in which the surface, 16, of the table, 11, is so formed as to produce a tapered disk, but this machine may also be used for forming disks of other cross-sections and the formation of the table may be changed without departing from my invention. If desired, the cams may be so constructed that the radial movement of the rolls stops before the rolls reach the periphery of the blank so that the peripheral portion of the blank is not acted upon by the machine except as it is bent into a flaring flange by the action of the rolls upon the central portion of the blank. Such changes in the cams to vary the radial movement of the rolls or the periods during which the rolls are raised and lowered, may be made without departing from my invention.

The disk rolling machine which is illustrated in the drawings and described specifically in this specification, constitutes one embodiment of the invention set forth and claimed herein. There are many variations and modifications of the construction disclosed which will appear to those skilled in this art and which may be made without departing from the spirit of my invention. I desire, therefore, to claim my invention broadly, as indicated by the appended claims.

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

1. A machine of the class described comprising a rotating support for a blank to be rolled, a roll adapted to operate on a blank on said support, and cam mechanism for raising, lowering and moving said roll radially of the blank in a predetermined sequence and at predetermined intervals.

2. A machine of the class described comprising a rotating support for a blank to be rolled, a pair of rolls adapted to operate on a blank on said support, and cam mechanism for raising, lowering and moving said rolls radially of the blank, toward and from each other, in a predetermined sequence and at predetermined intervals.

3. A machine of the class described comprising a rotating support for the blank to be rolled, a pair of rolls adapted to operate on a blank on said support, cam mechanism for raising and lowering said rolls with respect to said support, and cam mechanism for moving said rolls radially of the blank.

4. A machine of the class described comprising a rotating support for the blank to be rolled, a pair of rolls adapted to operate on a blank upon said support, a suitably driven cam shaft, and cams carried by said shaft and connected to raise, lower and move said rolls radially of the blank in a predetermined sequence and at predetermined intervals.

5. A machine of the class described comprising a rotating support for a blank to be rolled, a pair of rolls adapted to operate on a blank on said support, a suitably driven cam shaft, a cam on said shaft connected to move said rolls away from each other, radially of the blank, a second cam on said shaft connected to move said rolls toward each other, radially of the blank, and a third cam on said shaft connected to raise and lower said rolls with respect to the support.

6. A machine of the class described comprising a rotating table, a carriage vertically movable with respect to said table, a roll carried by said carriage and adapted to be moved transversely thereof, cam mechanism for raising and lowering said carriage, and cam mechanism for moving said roll transversely of the carriage.

7. A machine of the class described comprising a blank support and a radially traversing blank working roll having a relative movement of approach and separation to present the work to and remove it from the action of the roll, and mechanism for causing the relative approach and separation movement and the traverse movement of the roll deriving the power to operate it from a common prime mover.

8. A machine of the class described comprising a rotating table adapted to support a blank to be rolled, a carriage vertically movable with respect to said table, a roll carried by said carriage and adapted to operate on a blank supported on said table, and cam mechanism carried by said carriage and connected to raise and lower the carriage and to move said roll radially of the table in a predetermined sequence and at predetermined intervals.

9. A machine of the class described comprising a frame, a rotatably mounted table adapted to support a blank to be rolled, a carriage vertically movable with respect to said table, a roll carried by said carriage and adapted to operate on the blank supported on said table, a motor supported by said frame, and cam mechanism movable with said carriage and driven by said motor, said mechanism being connected to raise and lower the carriage and move the roll radially of the table in a predetermined sequence and at predetermined intervals.

10. A machine of the class described comprising a frame, a rotatably mounted table adapted to support a blank to be rolled, a carriage vertically movable with respect to said table, a roll carried by said carriage and adapted to operate on a blank supported on said table, a cam shaft journaled on said carriage, cams on said shaft connected to raise and lower the carriage and to move the roll radially of the table, and a motor mounted on the frame and having driving connections with said cam shaft.

11. A machine of the class described comprising a frame, a rotatably mounted table adapted to support a blank to be rolled, a carriage vertically movable with respect to the table, a roll carried by said carriage and adapted to operate on a blank supported on said table, a cam shaft journaled on said carriage, cams on said shaft connected to raise and lower the carriage and move the roll radially of the table, a motor mounted on the frame, and driving connections between said motor and the cam shaft including a clutch and a driving belt permitting vertical movement of the shaft with respect to the motor.

12. A machine of the class described comprising a rotatably mounted table adapted to support a blank to be rolled, a carriage vertically movable with respect to the table, a pair of rolls carried by said carriage and adapted to operate on a blank supported on said table, a support carried by said carriage, a cam shaft journaled in said support, connections between said cam shaft and the carriage and rolls for raising and lowering the carriage and moving the rolls radially of the table, and means for driving said cam shaft.

13. A machine of the class described comprising a rotatably mounted table adapted to support a blank to be rolled, a carriage vertically movable with respect to the table, a pair of rolls carried by said carriage and adapted to operate on a blank supported on said table, and cam mechanism carried by said carriage for raising and lowering the carriage with respect to the table.

14. A machine of the class described comprising a rotatably mounted table adapted to support a blank to be rolled, a carriage vertically movable with respect to the table, a pair of rolls carried by said carriage and adapted to operate on a blank supported on said table, and cam means for raising and lowering said carriage with respect to the table, said cam means being such as to hold the carriage in raised and lowered positions for predetermined intervals.

15. A machine of the class described comprising a frame, a rotatably mounted table adapted to support a blank to be rolled, a carriage vertically movable with respect to the table, a roll carried by said carriage and adapted to operate on a blank supported on the table, and means for raising and lowering said carriage including a toggle linkage, connecting said carriage and a fixed point on the frame, and means on said carriage for actuating said toggle linkage.

16. A machine of the class described comprising a frame, a rotatably mounted table adapted to support a blank to be rolled, a carriage vertically movable with respect to the table, a pair of rolls carried by said carriage and adapted to operate on a blank

supported on the table, a pair of knuckle members journaled on the frame, arms on said knuckle members, links connecting said arms with the carriage, and means for rocking said knuckle members on their pivots.

17. A machine of the class described comprising a frame, a rotatably mounted table adapted to support a blank to be rolled, a carriage vertically movable with respect to the table, a pair of rolls carried by said carriage and adapted to operate on a blank supported on the table, a pair of knuckle members journaled on the frame, downwardly-extending ears on said knuckle members, links connecting said ears and the carriage, upwardly-extending arms on said knuckle members, means connecting said upwardly-extending arms whereby said knuckle members are forced to turn in unison, and means for rocking said knuckle members on their pivots.

18. A machine of the class described comprising a frame, a rotatably mounted table adapted to support a blank to be rolled, a carriage vertically movable with respect to the table, a pair of rolls carried by said carriage and adapted to operate on a blank supported on the table, a pair of knuckle members journaled on the frame, connections between said knuckle members and the carriage, a rocker member journaled on the carriage, a cam acting on said rocker member, and connections between said rocker member and the knuckle members.

19. A machine of the class described comprising a frame, a rotatably mounted table adapted to support a blank to be rolled, a carriage vertically movable with respect to the table, a pair of rolls carried by said carriage and adapted to operate on a blank supported on the table, a pair of knuckle members journaled on the frame, each of said knuckle members having a pair of spaced ears, links connecting said ears with the four corners of the carriage, and means for rocking said knuckle members in unison on their pivots.

20. A machine of the class described comprising a frame, a rotatably mounted table adapted to support a blank to be rolled, a carriage vertically movable with respect to the table, a pair of rolls carried by said carriage and adapted to operate on a blank supported on the table, a pair of knuckle members journaled on the frame, connections between said knuckle members and the carriage, a rocker member pivoted on the carriage, a cam shaft journaled on the carriage, a cam carried by said shaft and acting on the rocker member, and an adjustable link connecting said rocker member and one of said knuckle members.

21. A machine of the class described comprising a frame, a rotatably mounted table adapted to support a blank to be rolled, a carriage vertically movable with respect to said table, a pair of rolls carried by said carriage and horizontally movable with respect thereto, said rolls being adapted to operate on a blank supported on the table, and cam means carried by the carriage for moving said rolls transversely thereof.

22. A machine of the class described comprising a frame, a rotatably mounted table adapted to support a blank to be rolled, a carriage vertically movable with respect to said table, a pair of rolls carried by said carriage and horizontally movable with respect thereto, said rolls being adapted to operate on a blank supported on the table, a suitably driven cam shaft journaled on the carriage, and a pair of cams carried by said cam shaft and connected to move the rolls horizontally with respect to the carriage, one of said cams moving the rolls in one direction and the other in the opposite direction.

23. A machine of the class described comprising a frame, a rotatably mounted table adapted to support a blank to be rolled, a carriage vertically movable with respect to said table, a pair of rolls carried by said carriage and horizontally movable with respect thereto, said rolls being adapted to operate on a blank supported on the table, a suitably driven cam shaft journaled on the carriage, a rocker member pivoted on the carriage, a pair of cams on said shaft acting on said rocker member, and connections between said rocker member and the rolls for moving the rolls horizontally with respect to the carriage.

24. A machine of the class described comprising a frame, a rotatably mounted table adapted to support a blank to be rolled, a carriage vertically movable with respect to said table, a pair of rolls carried by said carriage and horizontally movable with respect thereto, said rolls being adapted to operate on a blank supported on the table, a pair of bell crank levers pivoted on the carriage, one arm of each of said levers being connected to one of said rolls, a rocker member pivoted on the carriage and connected to the other arms of said bell crank levers, a cam shaft journaled on said carriage, and a pair of cams on said shaft acting on said rocker member.

25. A machine of the class described comprising a rotatably mounted table adapted to support a blank to be rolled, a carriage vertically movable with respect to said table, a pair of roll carriers slidably mounted on said carriage so as to move horizontally with respect thereto, a roll mounted in each of said carriers and adapted to operate on a blank supported on the table, a pair of bell crank levers pivoted on the carriage, an adjustable connection between one arm of each of said levers and one of

the roll carriers, and cam-actuated means for rocking said bell crank levers on their pivots.

26. A machine of the class described comprising a rotatably mounted table adapted to support a blank to be rolled, a vertically movable carriage having a horizontal guideway in its lower face provided with horizontal tracks at the sides thereof, a roll-carrier provided with rollers running on said tracks, a roll rotatably mounted on said carrier and adapted to operate on a blank supported on the table, means for raising and lowering the carriage, and means for shifting the roll-carrier horizontally along said guideway.

27. A machine of the class described comprising a rotatably mounted table adapted to support a blank to be rolled, a vertically movable carriage having a horizontal guideway in its lower face extending transversely thereof, said guide-way having upper and lower tracks at the sides thereof, a roll-carrier having ears provided with slots, rollers positioned in said slots and journaled on the carrier, said rollers being adapted to engage the upper or lower tracks, a roll rotatably mounted in said carrier and adapted to operate on a blank supported on the table, means for raising and lowering the carriage, and means for shifting the carrier along said guideway.

28. A machine of the class described comprising a rotatably mounted table adapted to support a blank to be rolled, a carriage movable with respect to said table, a roll-carrier slidably mounted on said carriage for movement transversely thereof, said carrier having a pair of spaced depending portions, a shaft journaled in said portions of the carrier, a roll fixed on said shaft and rotating between said portions, said roll being adapted to operate on a blank supported on the table, an end cap fastened to one of said portions, means for shifting said carrier transversely of the carriage, connected to said end cap, and means for raising and lowering said carriage.

29. A machine of the class described comprising a rotatably mounted table adapted to support a blank to be rolled, a carriage movable with respect to said table, a roll-carrier slidably mounted on said carriage for movement transversely thereof, said carrier having a pair of spaced depending portions, a cup-shaped member fitted in the outermost of said portions, anti-friction bearings carried by said cup-shaped member and the other depending portion of the carrier, a shaft journaled in said anti-friction bearings, a roll carried by said shaft and adapted to operate on a blank supported on the table, an end cap bolted to said cup-shaped member and the corresponding portion of the carrier, and means, connected to said end cap, for shifting said carrier transversely of the carriage.

30. A machine of the class described comprising a rotatably mounted table adapted to support a blank to be rolled, a carriage movable with respect to said table, a roll-carrier slidably mounted on said carriage for movement transversely thereof, said carrier having a pair of spaced depending portions, a shaft journaled in said portions, a roll mounted on said shaft and rotating between such portions, said roll being adapted to operate on a blank supported on the table, an end cap fastened to the outermost of said depending portions of the carrier and having a projecting lug, and means connected to said lug for shifting said carrier transversely of the carriage.

31. A machine of the class described comprising a rotatably mounted table adapted to support a blank to be rolled, a carriage vertically movable with respect to the table, a roll carried by said carriage and adapted to operate on a blank supported on the table, means for raising and lowering the carriage, and spring means acting on the carriage and partially supporting the weight thereof in raised position.

32. A machine of the class described comprising a frame, a rotatably mounted table adapted to support a blank to be rolled, vertical guide-rods carried by said frame, a carriage vertically movable on said guide-rods, bars secured to a fixed part of the frame and extending through portions of the movable carriage, and springs compressed between fixed parts on said bars and said portions of the carriage.

33. A machine of the class described comprising a base, a rotatably mounted table adapted to support a blank to be rolled, guide-rods extending vertically from said base, cross rods secured to and connecting the upper ends of said guide-rods, a carriage vertically movable on said guide-rods, a roll carried by said carriage and adapted to operate on a blank supported on the table, a motor supported by said cross rods, and means actuated by said motor and carried by said carriage for shifting said roll radially of the blank and raising and lowering the carriage.

34. A machine of the class described comprising a base, a rotatably mounted table adapted to support a blank to be rolled, guide-rods extending vertically from said base, cross rods secured to and connecting the upper ends of said guide-rods, a carriage vertically movable on said guide-rods, a roll carried by said carriage and adapted to operate on a blank supported on the table, knuckle members journaled on said cross rods and connected to said carriage, and means supported by said carriage for rocking said knuckle members on their bearings.

35. A machine of the class described comprising a base, a rotatably mounted table adapted to support a blank to be rolled, guide-rods extending vertically from said base, cross rods secured to and connecting the upper ends of said guide-rods, a carriage vertically movable on said guide-rods, a roll carried by said carriage and adapted to operate on a blank supported on the table, knuckle members journaled on said cross rods and connected to said carriage, a motor supported by said cross rods, cam mechanism supported by said carriage and actuated by said motor, and connections between said cam mechanism and knuckle members for rocking the latter on their bearings.

36. A machine of the class described comprising a rotating support for a blank to be rolled, a roll adapted to operate on a blank on said support, and cam mechanism for causing a relative movement of approach and separation between said support and roll for causing a relative movement of the support and roll in a direction radially of the blank, all in a predetermined sequence and at predetermined intervals.

37. A machine of the class described comprising a support for a blank to be rolled and a cooperating roll, said roll and blank support being adapted to execute a complete cycle of movements relative to each other consisting of an approach movement, a traverse movement radially of the blank, a separation movement, and a retraverse movement, and means for causing said approach, traverse, separation and retraverse movements to succeed each other automatically.

38. A machine of the class described comprising a support for a blank to be rolled and a cooperating roll, said roll and blank support being adapted to execute a complete cycle of movements relative to each other consisting of an approach movement, a traverse movement radially of the blank, a separation movement and a retraverse movement, means for causing said movements to succeed each other automatically, and means for repeating the cycle without attention on the part of the operator.

39. A machine of the class described comprising a rotating support for the blank, a carriage supported above said support for vertical movement with respect thereto, a pair of roll carriers slidably mounted for horizontal movement in said carriage, a roll carried by each of said carriers and adapted to engage a blank on said support, means for moving the carriage toward and from said support at predetermined intervals, and means for moving said carriers substantially horizontally with respect to said support.

In testimony whereof, I affix my signature.

JOHN W. SMITH.