Nov. 17, 1953 J. G. KAY 2,659,407

MACHINE FOR FORMING ANNULAR SHEET METAL WORKPIECES

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FIG. 1a.

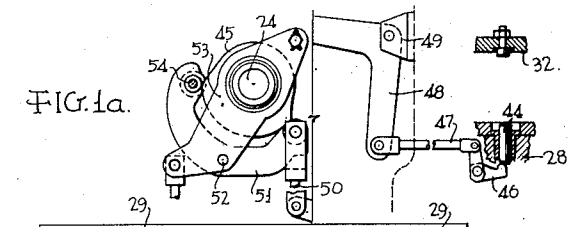
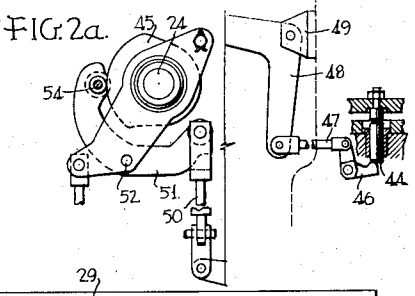


FIG. 2a.



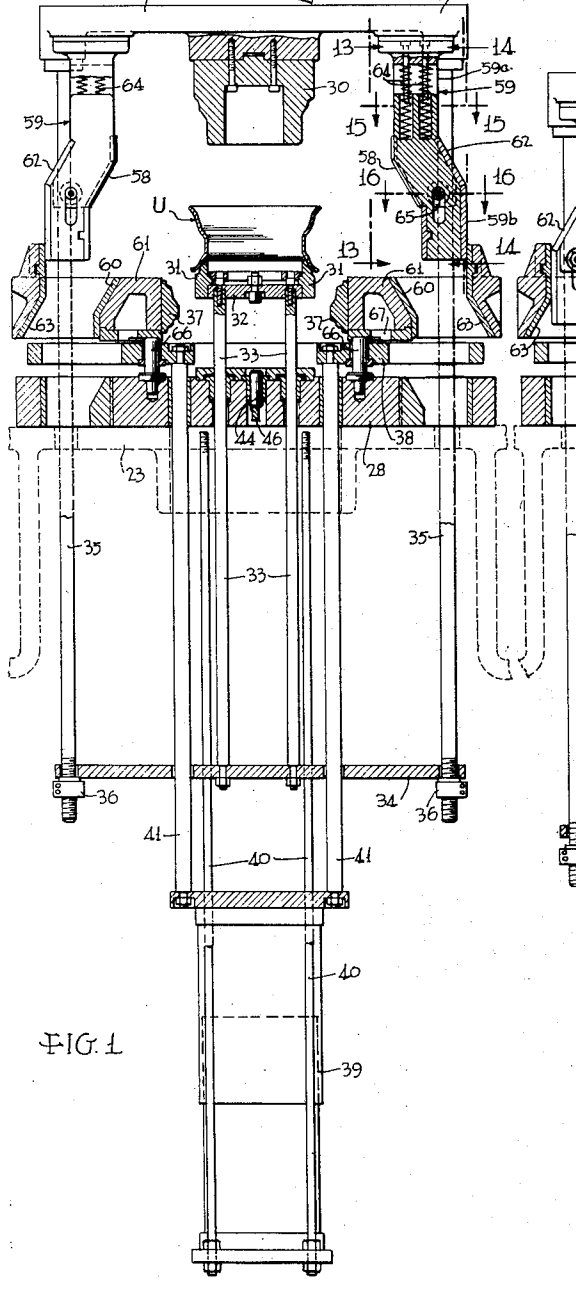


FIG. 1

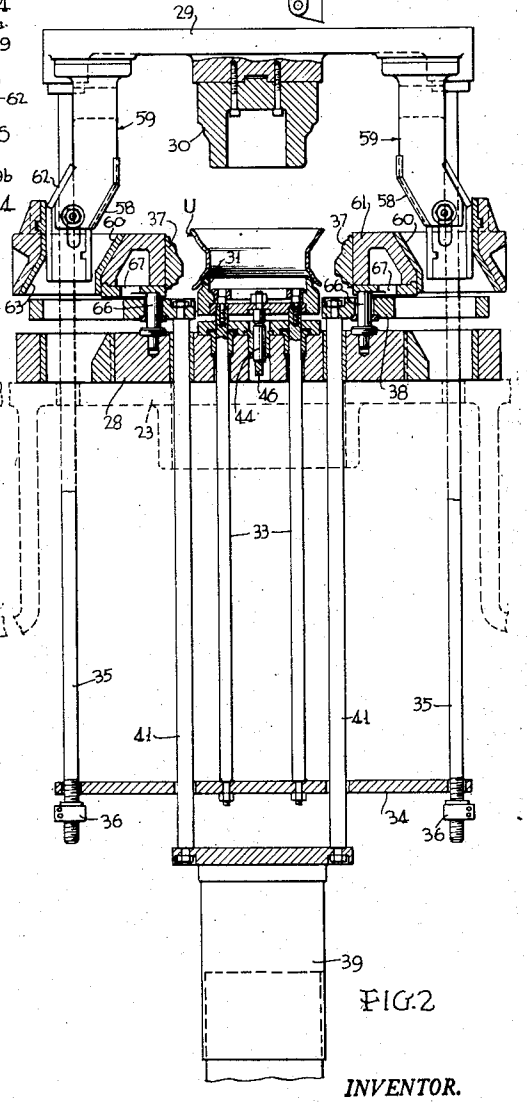


FIG. 2

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MACHINE FOR FORMING ANNULAR SHEET METAL WORKPIECES

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FIG. 3a.

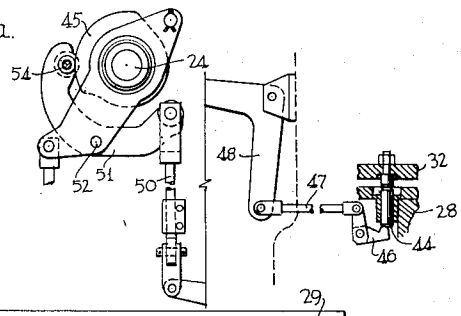
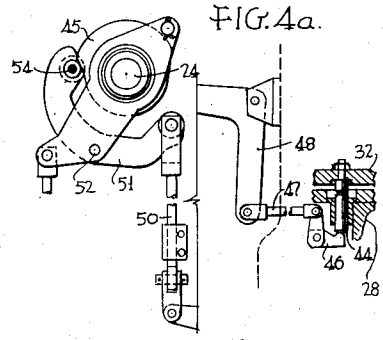



FIG. 4a.



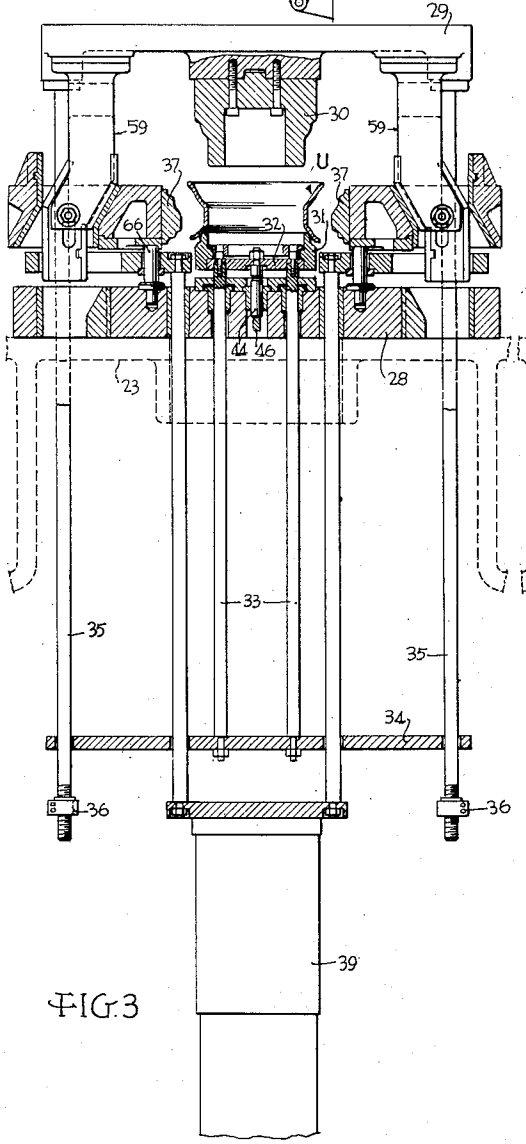




FIG. 3

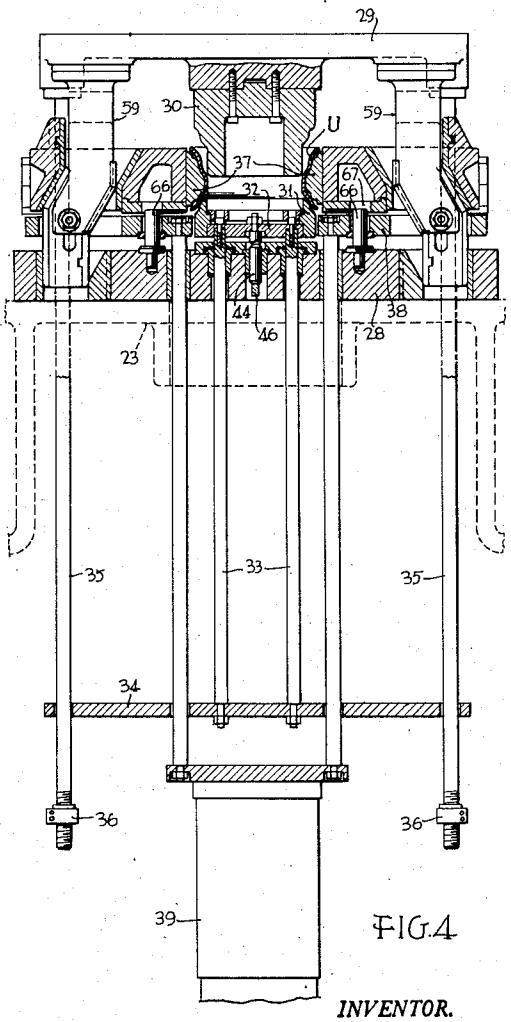



FIG. 4

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FIG. 5a.

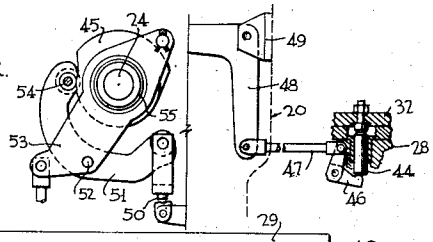
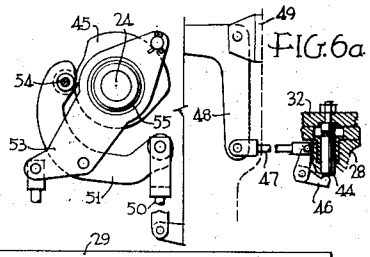



FIG. 6a



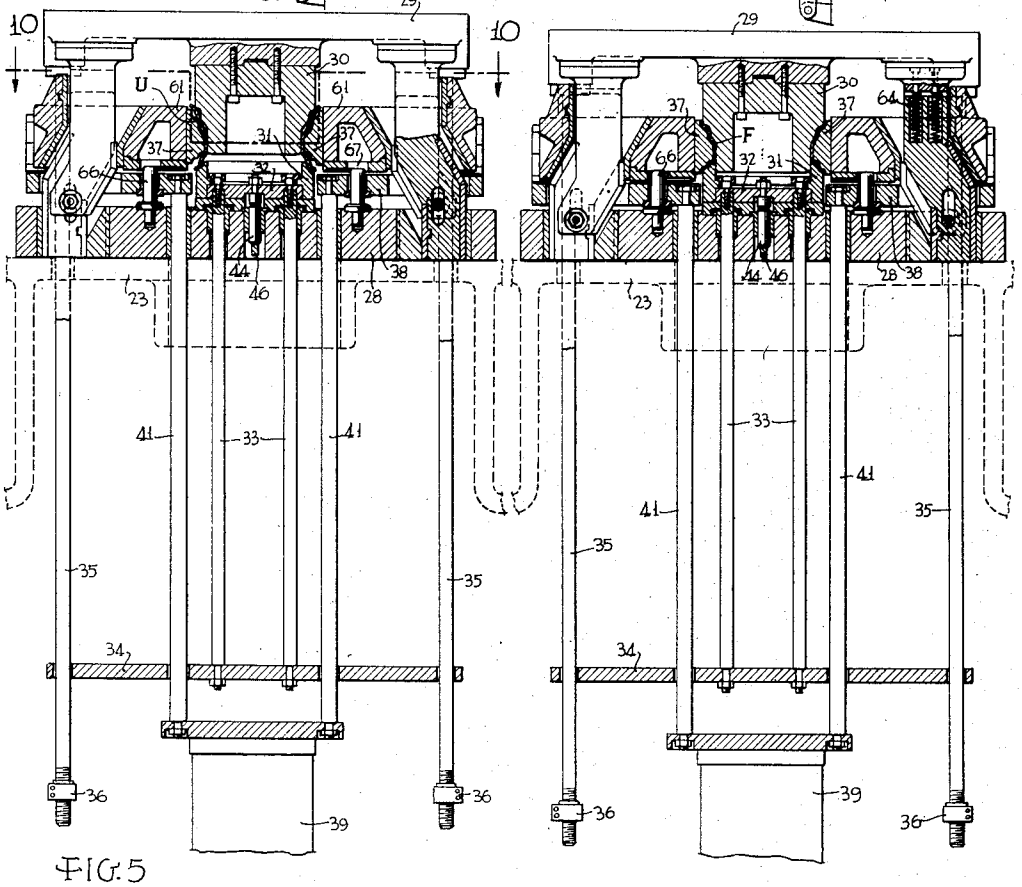




FIG. 5

FIG. 6

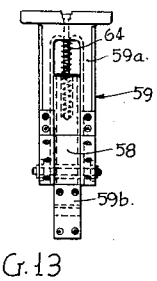



FIG. 13

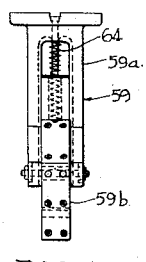



FIG. 14

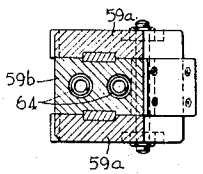



FIG. 15

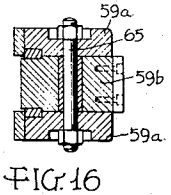



FIG. 16

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FIG. 7

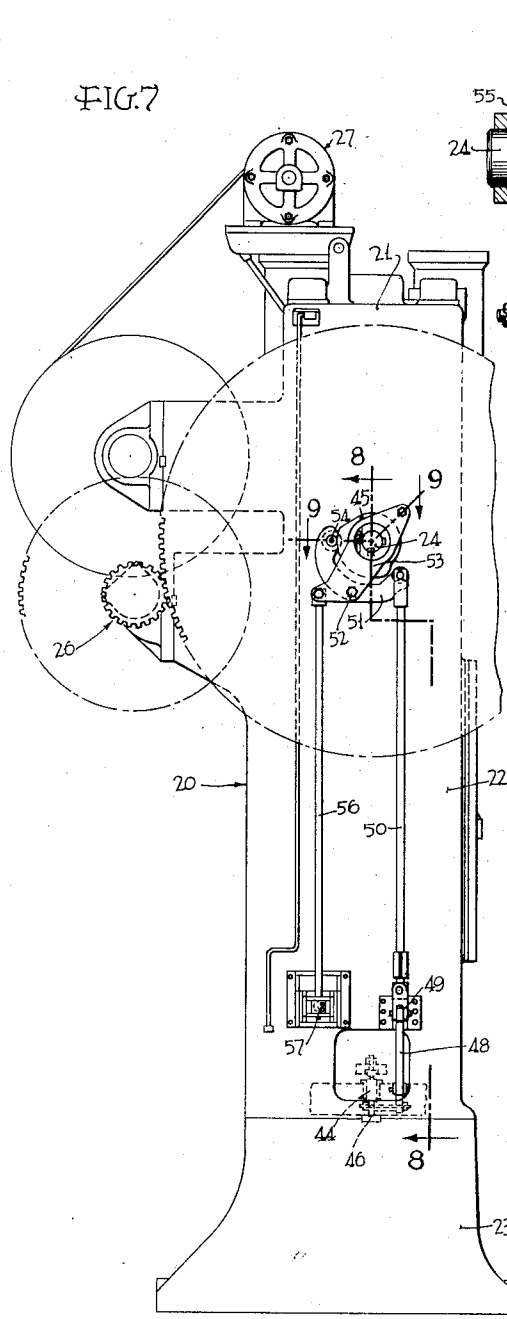



FIG. 8

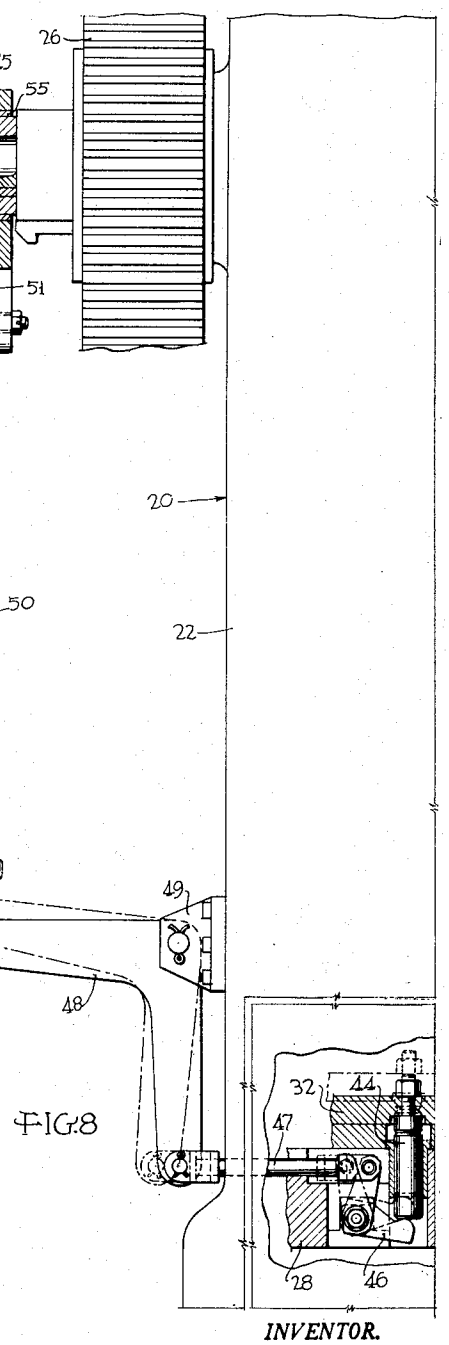
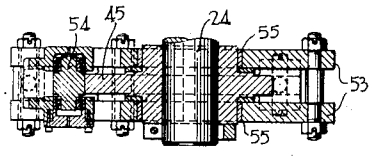



FIG. 9



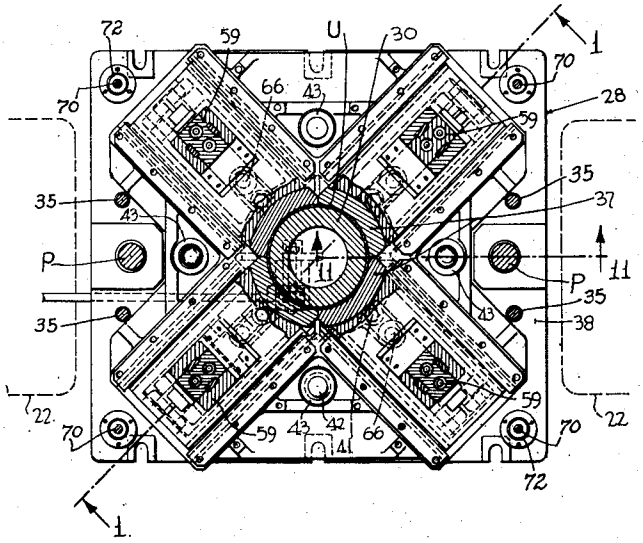

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Nov. 17, 1953 J. G. KAY 2,659,407

MACHINE FOR FORMING ANNULAR SHEET METAL WORKPIECES

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FIG. 10



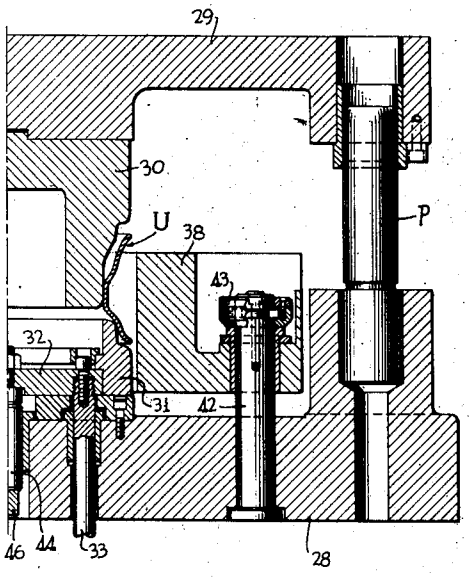
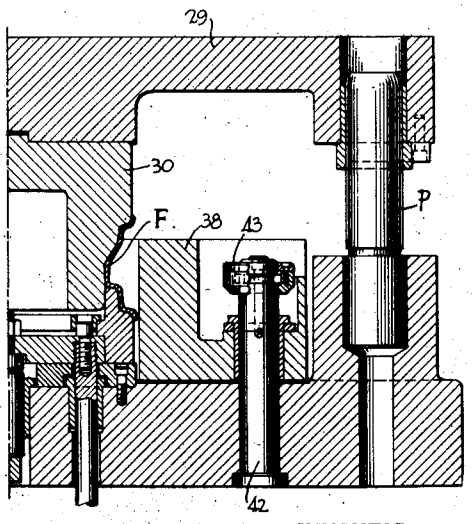




FIG. 11

FIG. 12




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MACHINE FOR FORMING ANNULAR SHEET METAL WORKPIECES

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FIG. 17

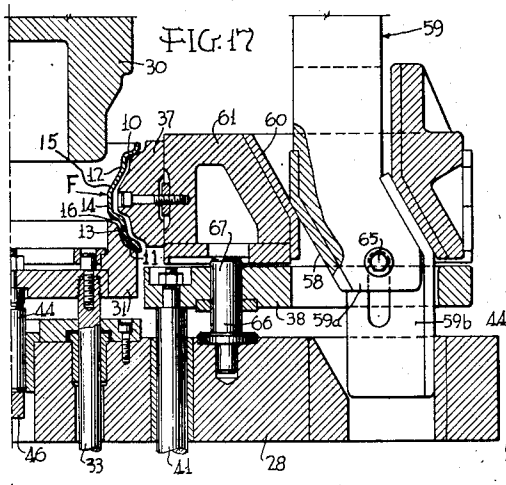



FIG. 18

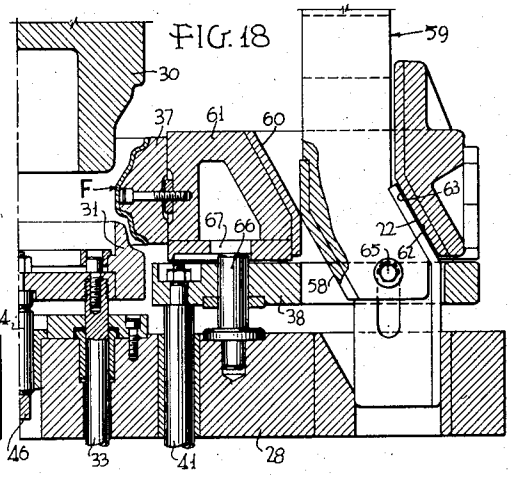



FIG. 19

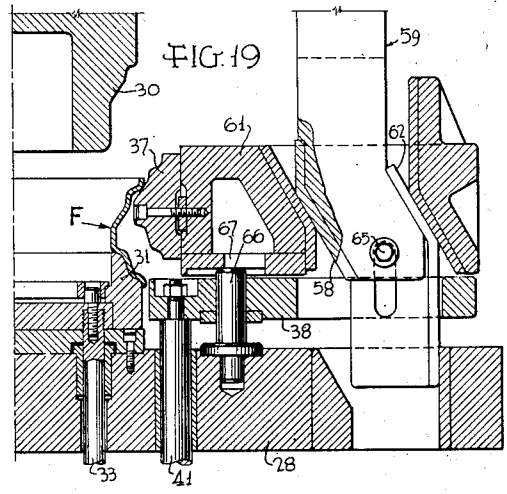
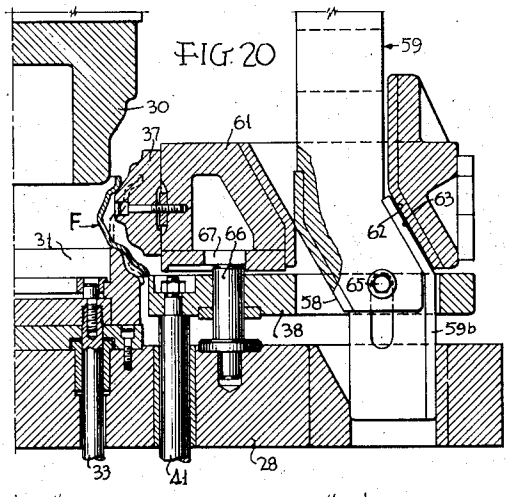



FIG. 20



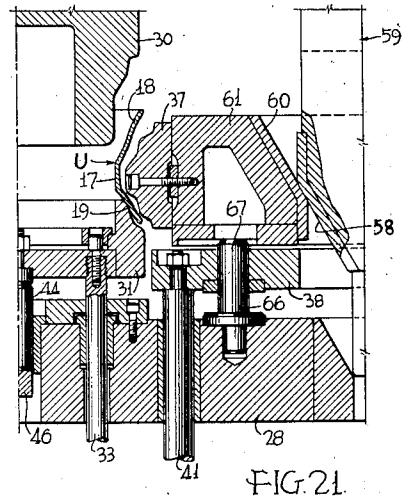




FIG. 21

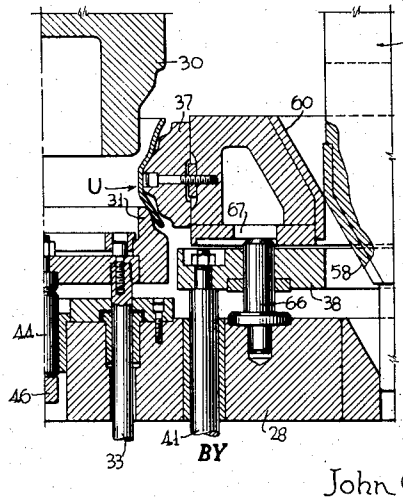



FIG. 22

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MACHINE FOR FORMING ANNULAR SHEET METAL WORKPIECES

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FIG. 23

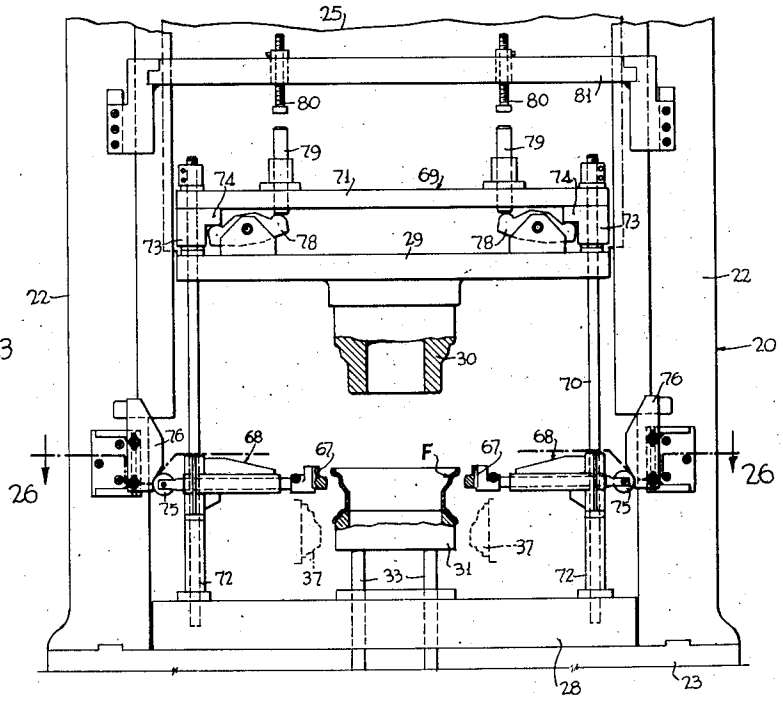



FIG. 24

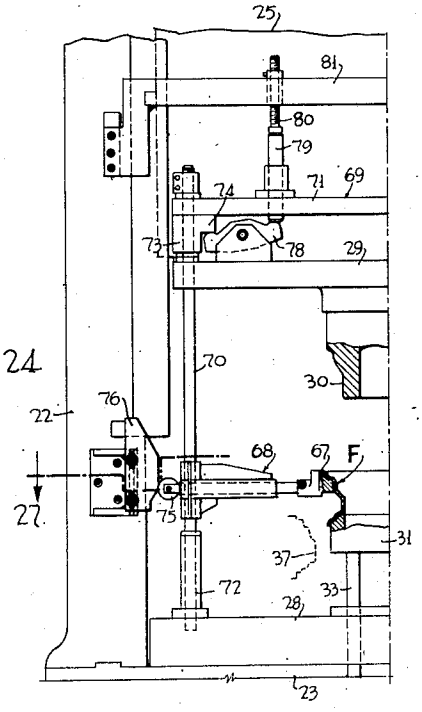
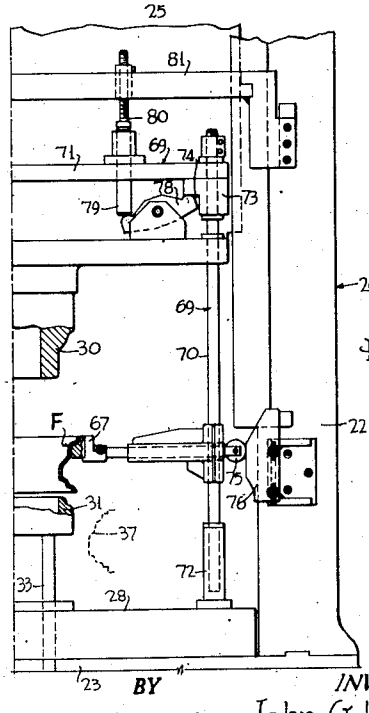



FIG. 25




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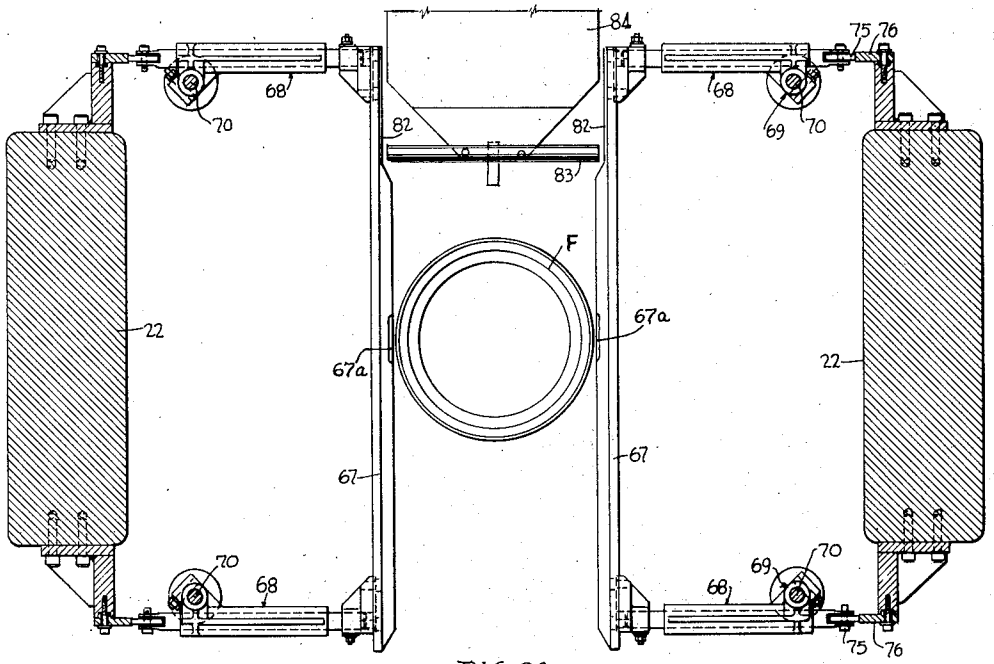



FIG. 26

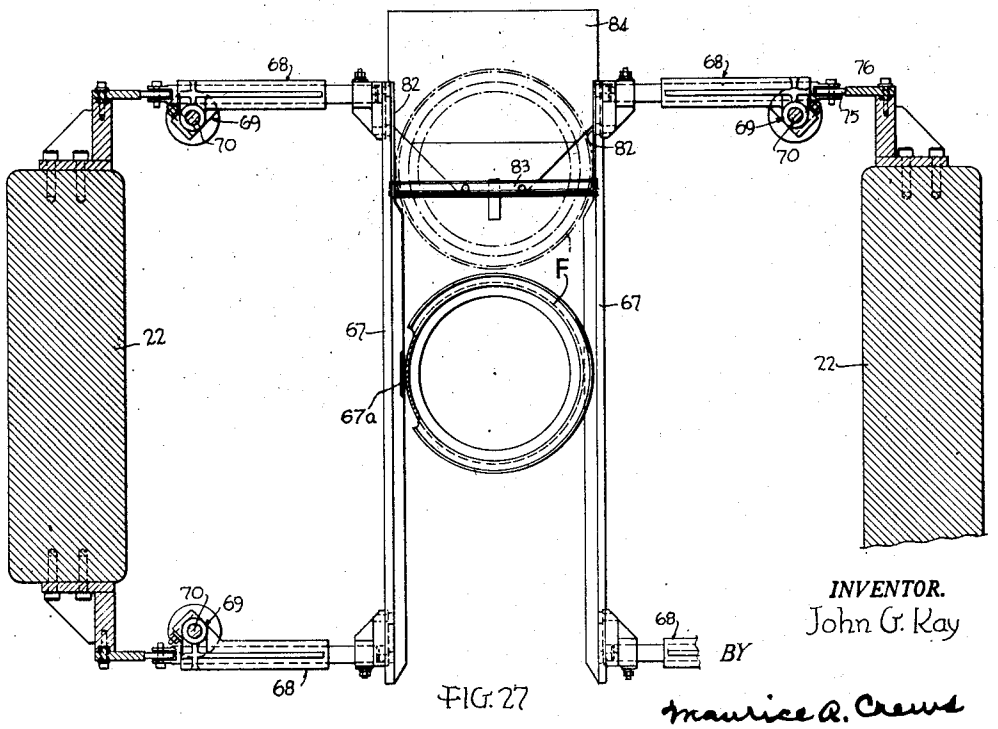



FIG. 27

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MACHINE FOR FORMING ANNULAR SHEET METAL WORKPIECES

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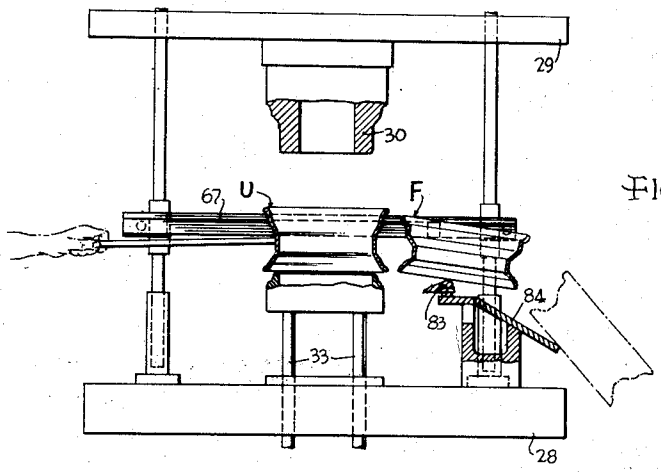



FIG. 29

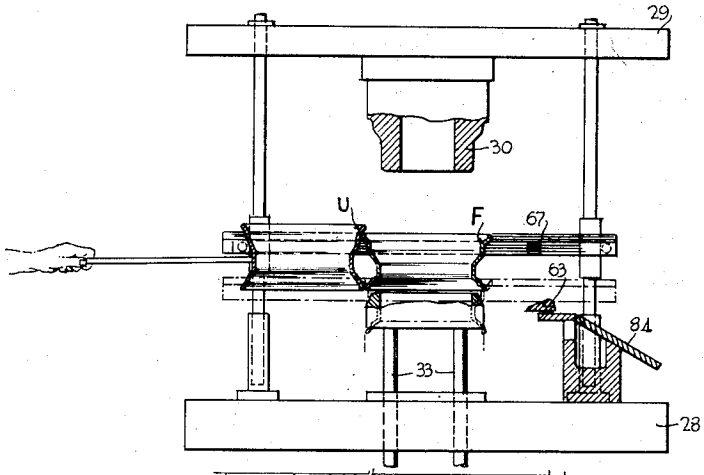



FIG. 28

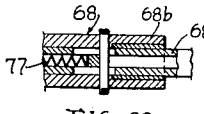



FIG. 33

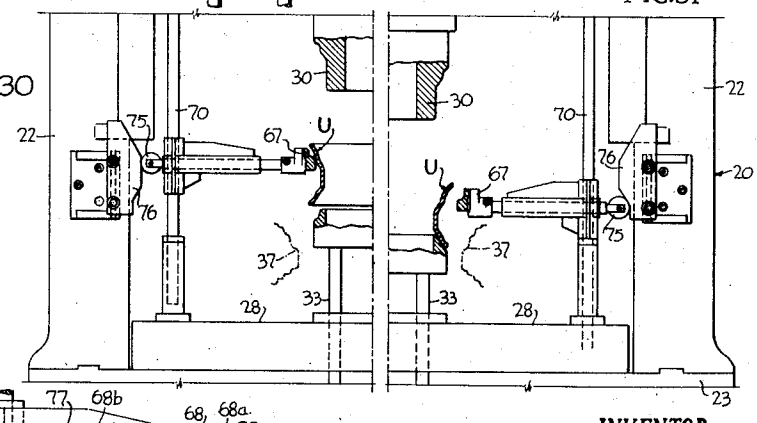



FIG. 31

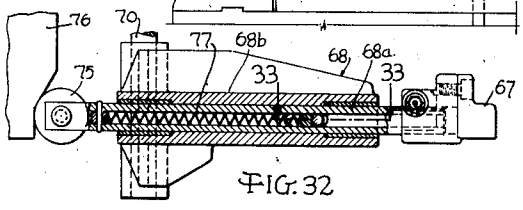



FIG. 32

FIG. 30

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Patented Nov. 17, 1953

2,659,407

# UNITED STATES PATENT OFFICE

2,659,407

## MACHINE FOR FORMING ANNULAR SHEET METAL WORKPIECES

John Gilchrist Kay, Detroit, Mich., assignor to The Budd Company, Philadelphia, Pa., a corporation of Pennsylvania

Application December 22, 1950, Serial No. 202,191

8 Claims. (Cl. 153—2)

1

The invention relates to a machine for die-pressing annular metal blanks having a depressed central portion and ends flaring outwardly from said central portion, for example, such blanks as form an intermediate stage in the manufacture of drop center rims for automobile wheels. Such machine is generally of the type disclosed in co-pending application S. N. 70,552, filed January 12, 1949, in the names of Robert O. Greenshields et al. and entitled "Method and Machine for Forming Rims and the Like," now Patent No. 2,586,029, February 19, 1952.

It is a general object of the invention to simplify the construction of such machine, to provide against serious injury to the machine due to careless operation, and to provide simple and reliable feeding mechanism for feeding the blanks to and from operative relation to the machine.

These and other objects and advantages and the manner in which they are attained will become fully apparent from the following detailed description when read in connection with the drawings forming a part of this specification.

In the drawings:

Fig. 1 is a central vertical sectional view, on line 1—1 of Fig. 10, through the die mechanism of the machine showing the workpiece to be formed in position, and the dies fully open; the position of the parts being that at the beginning of the downward stroke of the press;

Fig. 1*a* is a diagrammatic view showing the relative positions of a safety pin and a cam on the crankshaft of the press and parts associated therewith, corresponding to the stage of the press cycle shown in Fig. 1;

Fig. 2 is a view similar to Fig. 1, this view showing a stage in the downward stroke of the press in which the lower die is supported on the safety pin in slightly spaced relation to the lower die shoe, the weight of the lower die having just been transferred from its support by the upper die shoe to its support by the safety pin;

Fig. 2*a* is a view similar to Fig. 1*a* showing the relative position of the parts at the stage in the press cycle shown in Fig. 2;

Fig. 3 is a view similar to Fig. 1, this view showing a later stage in the downward stroke of the press in which cams carried by the upper die shoe have just engaged the cam faces on the radially-movable closing-in dies, which are held vertically-spaced a predetermined distance from the upper face of the lower die shoe;

Fig. 3*a* is a view similar to Fig. 1*a* showing the relative position of the parts at the stage in the press cycle shown in Fig. 3;

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Fig. 4 is a view similar to Fig. 1, this view showing a further stage in the downward stroke of the press in which the cams have moved the closing-in dies radially inwardly into engagement with the workpiece, and holes in the bottoms of the closing-in dies have been brought into vertical alignment with respective supporting pins projecting upwardly from the lower die shoe; at this stage, the lower die has started downward from its position indicated in the preceding figures but has not yet come in contact with the lower die shoe;

Fig. 4*a* is a view similar to Fig. 1*a* showing the relative position of the parts at the stage of the press cycle shown in Fig. 4;

Fig. 5 is a view similar to Fig. 1, this view showing a further stage in the downward stroke of the press in which the lower die support has come to rest upon the lower die shoe, with the safety pin in its lowered position; at this stage the lower parts of the telescoping cam projections carried by the upper die shoe have come into contact with the press bed and started to telescope; at this stage no work has yet been performed on the workpiece;

Fig. 5*a* is a view similar to Fig. 1*a* showing the relative position of the parts at the stage of the press cycle shown in Fig. 5;

Fig. 6 is a view similar to Fig. 1, this view showing the final stage in the downward stroke of the press in which the dies have closed to form the workpiece to the desired shape; in this final stage the upper and the closing-in dies move downwardly together and the supporting pins for the closing-in dies enter the holes in the bottoms of the respective such dies;

Fig. 6*a* is a view similar to Fig. 1*a* showing the relative positions of the parts at the stage of the press cycle shown in Fig. 6;

Fig. 7 is a side elevational view, partly diagrammatic, of a press to which the invention has been shown applied, this view illustrating particularly the cam on the end of the crankshaft of the press and the means associated therewith and connecting it to the safety pin (shown in dotted lines) to control the vertical movements of the latter;

Fig. 8 is a fragmentary enlarged view, as seen from the front of the press, parts being broken away and shown in section, the line of section being indicated by the line 8—8 of Fig. 7;

Fig. 9 is an enlarged detail sectional view, the section being taken along the line 9—9 of Fig. 7;

Fig. 10 is a horizontal sectional view, the section being taken substantially along the line 10—10 of Fig. 5;

Fig. 11 is an enlarged detail sectional view through a stop pin for limiting the upward movement of the plate carrying the closing-in dies; this view showing the plate at the upper limit of its movement and the section being taken substantially along the line 11—11 of Fig. 10;

Fig. 12 is a view similar to Fig. 11, but showing the closing-in die carrying plate in its lowered position;

Fig. 13 is an inside elevational view of one of the cam supports carried by and projecting downwardly from the upper die shoe, as seen from the line 13—13 of Fig. 1;

Fig. 14 is an outside elevational view of said cam support, as seen from the line 14—14 of Fig. 1;

Figs. 15 and 16 are enlarged detail sectional views taken respectively on the lines 15—15 and 16—16 of Fig. 1;

Fig. 17 is a fragmentary sectional detail view on an enlarged scale, showing the relative position of the dies as the closing-in dies approach their radially inner position; in this position they engage under the upper flange of a finished workpiece to support it, in the event the operator is careless enough to leave a finished workpiece in the press, and then operates the press to execute its cycle of operation; the safety pin is here shown in its raised position, holding the lower die support and the finished workpiece in a raised position which makes possible the engagement of the closing-in dies under its upper flange to support it;

Fig. 18 is a view similar to Fig. 17, but at a later stage of the cycle in which the closing-in dies have moved radially inwardly to grip the workpiece and the lower die support has started downwardly with the dropping of the safety pin; it will be seen that the die operation can be completed, from this position of the parts, and the workpiece restruck, without damage to the machine;

Figs. 19 and 20 are views similar, respectively, to Figs. 17 and 18, but showing what would happen if a finished workpiece were left in the machine and restruck, without the provision of the safety device of this invention; in this event, the lower die and the workpiece would descend to their lower position as shown, before the closing-in dies have contracted to support the workpiece, with the result that the workpiece would be distorted somewhat as shown in Fig. 20, and serious injury to the machine would result;

Figs. 21 and 22 are views similar, respectively, to Figs. 17 and 18, showing the action of the dies upon an unfinished workpiece, these views being shown for ready comparison with Figs. 17 and 18 where the dies are operating on a finished workpiece;

Fig. 23 is an elevational view of a portion of the front of the machine, showing the feeding mechanism in its relation to the cooperating parts of the machine, the upper die shoe and press plunger or ram being shown near the upper limit of their movement and just engaging the feeding mechanism to lift it in their further upward movement; the finished workpiece is shown seated on the lower die which moves with the upper die in this portion of the stroke of the press;

Fig. 24 is a similar view of the left-hand side of the machine with the parts shown in a further raised position in which the guiding rails have been moved inwardly, by the stationary cams on the press frame, to engage under the top flange of the finished workpiece; in this view the mechanism for accelerating the upward movement of the feeding mechanism is about to become operative in the further upward movement of the press plunger;



Fig. 25 is a similar view of the right-hand side of the machine showing the workpiece lifted off the lower die by the accelerated movement of the feeding mechanism over that of the plunger of the press in the last of the upward stroke thereof;

Fig. 26 is a plan view of the feeding mechanism with parts shown more or less diagrammatically and in section, the position of the parts in this view corresponding generally to that shown in Fig. 23;

Fig. 27 is a similar plan view of the feeding mechanism with the parts positioned substantially as shown in Fig. 25, a finished workpiece being shown in full lines in central position and in dot-and-dash lines in a position about to be discharged from the machine;

Fig. 28 is a side elevational view of the feeding mechanism, parts being shown in vertical section through the center line of the machine, this view showing a finished workpiece about to be pushed, by a workpiece to be formed in the machine, along the rails toward the discharge end thereof;

Fig. 29 is a similar view of the feeding mechanism, showing the finished workpiece leaving the rails and the unfinished workpiece located centrally of the machine in axial alignment with the upper and lower dies; this view also shows in dot-and-dash lines, a further position of the finished workpiece as it leaves the machine;

Fig. 30 is a view similar to Fig. 25, but showing only the left-hand side of the machine, showing the unfinished workpiece and the associated parts in positions corresponding to their positions in Fig. 29;

Fig. 31 is a view similar to Fig. 23, but showing only the right-hand side of the machine, with the rails moved outwardly and the workpiece dropped down and resting on the lower die;

Fig. 32 is a detail part-sectional view through the rail supports, showing the spring means for at all times urging the rails outwardly against the cams on the press frame; and

Fig. 33 is a sectional view taken on the line 33—33 of Fig. 32.

The invention has been shown in connection with a machine for manufacturing drop center rims to substantially their final form in which they have, as is perhaps best seen in the enlarged view of Fig. 17, side flanges 10 and 11, adjacent bead seats 12 and 13, respectively, and a central drop center base 14, interconnected with the bead seats by inclined side walls 15 and 16, respectively. The rim is shown as an asymmetrical rim in which one side wall, as 15, is inclined more gently than the other; but it will be understood that the invention is equally applicable, by the selection of suitable die faces, to other forms of rims or to other contoured annular members.

This finished or formed workpiece is designated throughout the views generally by the reference letter F. The unfinished workpiece, or the workpiece to be formed, on the other hand, is designated generally by the reference letter U.

This unfinished workpiece U comprises, as clearly shown in Fig. 21, a depressed central portion 17, of substantially the diameter of the depressed portion 14 of the finished workpiece

F and flared end portions tapering radially outwardly from said central portion and designated, respectively, 18 and 19. The diameter of the margins of said tapered portions corresponds generally to the diameter of the margins of the finished workpiece F.

The die mechanism forming a main feature of the invention is designed for association with a single-action vertical press of the type in which, at each cycle of operation of the press, a plunger or ram, guided by the standards or side frames of the press, descends from a raised inoperative position to a lower working position and is returned automatically to its raised position, after which the cycle of operation is repeated.

Such a press is shown full length in Fig. 7 in side elevation, and comprises a frame designated generally by 20 resting on a suitable floor foundation and having mounted in its upper head portion 21, carried by spaced standards or side frames, as 22, rising from the base or bed 23 of the press, the usual crankshaft 24. This crankshaft 24 is connected in a usual manner to the plunger or ram 25, see Fig. 23, to reciprocate it. The drive to the crankshaft 24 is through the usual gearing, designated generally by 26 and a motor 27 supported on top of the frame 17 and driving the gearing through the usual belt and pulley connection.

Since the press per se forms no part of the invention, its general working need be no further described. Where the press has been modified to incorporate the invention, such modification will be explained in the following description.

Referring now to Figs. 1 to 22, showing the die mechanism and the manner in which it is controlled in the operation of the press, it will be seen that such mechanism comprises a lower die shoe 28 seated on the press bed 23 and an upper die shoe 29 secured to the plunger 25, see Fig. 23, and movable with it in the press cycle. Pilot guide pins P operating in suitable guides (Figs. 10, 11 and 12) are provided between the upper and lower die shoes 28 and 29. Centrally of the upper die shoe and rigidly secured thereto is an upper die 30, adapted to engage the radially inner face of the upper end of the workpiece in the descent of the plunger. Opposed to this upper die is a lower die 31 carried by a plate 32. This lower die is adapted to engage the radial inner face of the lower end of the workpiece, and is adapted to support the workpiece. It is movable from a raised position, shown in Fig. 1, in which the workpiece is seated thereon, to a depressed position in which it seats on the lower die shoe. Its movement is controlled in part by the movement of the plunger of the press and in part by the crankshaft of the press.

Through the first part of the downward movement of the plunger and attached upper die 30, the lower die 31 moves with them, since its carrying plate 32 is supported through rods, as 33, by a plate 34 disposed below the press bed, these rods sliding in openings in the lower die shoe 28. The plate 34 is, in turn, supported from the upper die shoe 29 by rods, as 35, whose lower ends pass freely through holes in the plate 34, and support it through adjustable screw-threaded abutments 36 on the lower ends of the rods 35.

For cooperation with the upper and lower dies 30 and 31, an annular series of normally outwardly-located radially movable closing-in dies 37 are provided. These dies are slidably carried by a plate 38 which is normally held raised a predetermined slight distance above



the lower die shoe 28, see Figs. 1, 2, and 11. The means for so holding it may comprise an air cushion of telescopic cylinder-piston type 39 the piston of which is supported from the press bed by rods, as 40, see Fig. 1, and the cylinder of which supports the plate 38 through rods, as 41, slidable in openings in the lower die shoe 28 and freely passing through openings in the plate 34.

To limit the upward movement of the closing-in dies under the action of the air cushion, stop means are provided. As clearly shown in Figs. 11 and 12, such stop means may comprise pins 42 secured in the lower die shoe 28 and having sliding engagement with openings in the plate 38 carrying the closing-in dies. At their upper ends, these pins have enlargements 43 which engage the top of the plate 38 to limit its upward movement under the yielding pressure of the air cushion 39.

To provide for the safe operation of the machine, even if the operator carelessly leaves a finished blank in the machine, and operates the press for a restrike of the finished blank, safety means are provided to insure that no harm can result in such event.

Such means comprises a positive stop to arrest the downward movement of the lower die 31, at a point slightly raised above the lower die shoe, so that the workpiece is held in this slightly raised position until the closing-in dies have been moved inwardly to engage the radially outer face of the blank, by means to be hereinafter described.

Such positive stop is shown as comprising a vertically sliding pin 44 mounted in the lower die shoe 28 and whose movements are timed with the press cycle and controlled by a cam 45 on the end of the crankshaft 24. See Figs. 1*a* to 6*a* inclusive, 7, 8, and 9. This pin is normally, that is, during most of the vertical stroke of the press, held in raised position, as shown in Figs. 1, 2, and 3, by a lever-linkage mechanism operatively interconnecting the pin and cam. Such lever-linkage mechanism comprises a bell crank lever 46 mounted in the lower die shoe 28 and having one arm engaging the lower end of the pin 44, a link 47, connecting the other arm of said lever 46 to one arm of a second bell crank lever 48 pivotally mounted on a bracket 49 secured to the adjacent side frame 22 of the press frame 20. A long link 50 connects the other arm of the bell crank 48 to one end of a curved lever 51, which lever is pivoted intermediate its ends at 52 to a bracket 53 and has at its opposite end a cam-follower roller 54.

To provide for adjustment between the cam and cam-follower roller, the bracket 53 is pivotally mounted on the axis of the cam shaft through bearings 55 and has one end thereof connected to a rod 56, see Fig. 7, having an adjustable connection 57 at its lower end to the press frame 17. This provides for the accurate timing of the release of the safety pin with the press cycle.

The closing-in dies 37 are moved inwardly on the descent of the press plunger through the interaction of cam faces 58 carried by cam supports 59 secured to the lower face of the upper die shoe, and corresponding cam faces 60 on the respective die carriers 61 for the closing-in dies 37. One such cam support is provided for each closing-in die and, since all of them are similarly constructed, a description of the construction of one will suffice.

On the outer face of each cam support is provided a cam face 62 which is arranged to engage a co-acting face 63 on the die carrier 61 to cause the outward or opening movement of the dies 37 on the return stroke of the press.

In the present construction, the cam supports 59 are made of two telescopic parts, see Figs. 1 and 13 to 15 inclusive, an upper part 59*a* and a lower part 59*b*, these two parts being held extended by springs 64 and limited in their relative telescoping movement by the pin and slot connection 65. This telescopic construction is provided to avoid cutting holes into the press bed to receive the cam-carrying supports.

Referring to Figs. 1, 2, and 3, it will be seen that the closing-in dies 37 are positively held in their raised position by short pins 66 projecting upwardly from the lower die shoe 28 through openings in the plate 38 to slidingly engage the underside of the closing-in die carriers 61. When the dies have been moved radially inwardly to the position shown in Fig. 4, where they are shown moved into engagement with the radially outer face of the workpiece, these pins are brought into vertical alignment with the openings 67 in the respective die carriers, after which the air cushion alone opposes the descent of the die carriers and closing-in dies 37. These positive holding pins are provided to prevent bouncing of the closing-in dies and their carriers on the air cushion, when the cams 58, 59 engage to force the closing-in dies inwardly.

After the closing-in dies 37 have been engaged with the work, as shown in Fig. 4, further descent of the press plunger 25 causes the upper die 30 to descend into engagement with the workpiece, so that the workpiece is gripped by the dies, as shown in Fig. 5. Up to this time, no work has been done on the workpiece. The lower die has been released to descend and rest on the lower die shoe, and the upper and closing-in dies are about to descend together in the final downward movement of the press plunger and the upper die and thus close in and form the workpiece, as shown in Fig. 6.

The enlarged views of Figs. 17 and 18 and 21 and 22 show the relative position of the dies in the final stages of the downward movement. Figs. 17 and 18 show them when operating upon a finished workpiece F upon restrike, and Figs. 21 and 22 are similar views showing the dies operating upon an unfinished workpiece U.

The condition shown in Figs. 19 and 20, which would result in damage to the machine, can never happen by reason of the fact that the safety stop pin 44 positively prevents the descent of the lower die, as here shown, before the closing-in dies have moved in to engage and support the workpiece independently of the lower die.

With the machine as so far described, it will be seen that the die operation is adapted for either closing-in upon a finished or an unfinished blank equally without causing any damage to the machine. It is thus made foolproof and insured against the possibility that a finished blank is left in the machine and the press then operated.

To speed up the operation, the machine is further provided with a work-feeding and discharge mechanism which facilitates the feeding of the unfinished work U into the machine and the discharge of the finished piece F therefrom. This feeding mechanism is shown in Figs. 23 to 33 inclusive in association with related parts of the press and the dies.



This feeding mechanism comprises as a main element thereof, two spaced guiding and supporting rails 67, 67 which extend fore and aft of the machine between the side frames 22, see Figs. 26 and 27, and are supported thereby for limited vertical movement as well as movement toward each other to engage the workpiece or away from each other to release it. Each rail 67 is mounted on a pair of horizontal arms 68, one engaging each of the rails at one end thereof and having its opposite end secured to a vertically slidable frame, generally designated 69. Such a vertically slidable frame is provided at both the fore and aft sides of the machine to support the respective ends of the rails. Each of these frames comprises vertical rods as 70 interconnected at the top by a transverse member 71, see Figs. 23, 24, and 25. The vertical rods have their lower ends slidably mounted in tubular sockets 72 secured to the lower die shoe 28. Abutment blocks 73 having an inwardly extending shoulder 74 are secured on the rods just below the top transverse member 71. The rods also pass through openings in the upper die shoe 29.

The vertical movement of the rails 67 is imparted to them by the vertical movement of the press plunger and the attached upper die shoe, and the in and out movement of the rails is imparted to them through the engagement of roller cam followers 75 with cooperating cams 76 fixedly mounted at the fore and aft sides of the side frames 28. To cause the rail movement to follow the cams, horizontal members 68 carrying the rails are formed as telescoping members 68*a*, 68*b*, one 68*a* carrying the rail and follower and sliding on the other 68*b*, which is rigidly secured to the adjacent rod 70. The rails are constantly urged outwardly by a spring 77 housed in the telescoping support member, see Figs. 32 and 33.

To lift the finished workpiece off the lower die there is provided an accelerated movement to the rail-carrying frame 69 in the final upward movement of the press plunger. According to the invention, this accelerated movement is attained by mounting two-armed levers, as 78, on the top of the upper die shoe 29 in such position that one end of each lever is in position to engage the adjacent shoulder 74 on the frame 69 to cause the other end to rise and lift a pin 79, slidably mounted in the transverse member 71. This pin 79 is in position to engage an adjustable stop pin 80 mounted in a transverse member 81 rigidly carried by the side frames 22 of the press.

As the press plunger approaches the top of its stroke, the parts are in the position shown in Fig. 23, with the upper die shoe 29 engaging the abutments 73 and starting to lift the frame 69. The rails 67 are located directly opposite the workpiece F in position to engage under the top flange thereof when moved inward. In the further upward movement from the position shown in Fig. 23, the frame 69 moves with the upper die shoe 29 and the cams 76 force the rails inwardly as shown in Fig. 24 to engage under the upper flange of the workpiece. At this point the pins 79 engage the associated stops 80, and these act through the two-armed levers 78 to accelerate the upward movement of the frame 69 over that of the upper die shoe, and thereby lift the finished workpiece off the lower die, as shown in Fig. 25.

While the press is stopped in this upper posi-

tion, the finished workpiece F, see Figs. 28 and 29, is pushed along the rails toward the back of the machine by the operator feeding an unfinished workpiece U onto the rails and to the center of the machine, see Figs. 28 and 29. As shown in Figs. 26 and 27, the rails are cut away at 82 at the rear of the machine so that the finished rim F falls down to the position shown in full lines in Fig. 29, where it strikes a tilting bar 83, which causes it to tip over and slide down an incline 84 away from the machine. The unfinished blank U is readily centered in the machine by depressions 67a cut into the rails at this central location, see Figs. 26 and 27.

Now when the press is operated with the workpiece U in position shown in Figs. 29 and 30, the rails 67 are caused to move down and then separate as shown in Fig. 31, and the workpiece is deposited on the lower die.

The operation of the machine with the workpiece so in place on the lower die will now be described. The parts are now in substantially the position shown in Fig. 1, with the closing-in dies 37 radially removed from the path of the lower die 31 and workpiece U seated thereon, and are positively held in slightly raised position above the lower die shoe by the pins 66, and further yieldingly by the air cushion 39. At this stage of the press cycle, the upper and lower dies are moving downwardly together since the lower die 31 is supported by the rods 35 moving with the upper die 30. The safety pin 44 is held in the raised position by the cam 45, the follower 54 having just engaged the high portion of the cam, through the interconnected lever-linkage, as shown in Fig. 1a. The cam supports 59 from the upper die shoe 29 engage the closing-in die carriers 61 to hold the closing-in dies 37 in radially outward position.

In the further downward movement of the press plunger and upper die 30 attached thereto, as shown in Fig. 2, the lower die has moved down to seat upon the pin 44, where it is raised slightly above the lower die shoe 28, so that the workpiece is supported in horizontal aligned position for engagement by the closing-in dies 37, the closing-in dies are still held in their outer position, and the upper die 30 is moving downwardly independently of movement of the lower die, since the abutments 36 on rods 35 have moved away from the plate 34. As shown in Fig. 2a, the cam 45 is still holding the pin 44 in the raised position.

In the succeeding stage shown in Fig. 3, the lower and closing-in dies are still in the position of Fig. 2, but the upper die has approached the workpiece. The cams 58 on the upper die shoe are just engaging the cams 60 on the closing-in die carriers 61 to move them radially inwardly. The safety pin 44 still is held in operative position by the cam 45, as shown in Fig. 3a.

In the next stage shown in Fig. 4, the closing-in dies 37 have been moved inwardly to engage the workpiece; the upper die 30 is about to engage the workpiece, the lower die 31 is being released by the cam 45, see Fig. 4a, to allow it to be lowered, and the lower die 31 is shown approaching its lowest position.

In the next stage shown in Fig. 5, all the dies have engaged the workpiece, but no material work has yet been done on it, the lower die 31 has descended to rest on the lower die shoe 28, and the upper die 30 and the closing-in dies 37 are about to descend. As shown in Fig. 5a, at this stage the safety pin 44 is in inoperative lowered position.

In the final stage of the forming operation shown in Fig. 6, the press plunger has descended to its lower limit, and the dies have closed in upon the work to form it to its desired shape. In this and the preceding stage, the cam supports 59, having engaged with the press bed 23, are shown with their parts telescoping. The upward stroke of the press starts with the parts in the position of Fig. 6, and the movement is generally the reverse of that described in the working stroke, except that now the finished workpiece is raised by the lower die 31 to the position shown in Fig. 23, after which the feeding mechanism takes hold, as already described, and lifts it off the lower die, as shown in Fig. 25. It can then be pushed out of the machine by feeding a new workpiece along the rails 67 toward the center of the machine, as shown in Figs. 27, 28, and 29. After the new workpiece has been centered on the machine, the press is again operated, and in this first of the downward movements of the plunger, the workpiece is deposited on the lower die, as shown in Figs. 30 and 31, after which, in the further cycle of the press, the operation above described is repeated.

While a specific machine has been herein fully described in detail, it will be understood that changes and modifications may be made, by those skilled in the art, without departing from the spirit and scope of the invention, as expressed in the appended claims.

What is claimed is:

1. In a machine for forming an annular sheet metal workpiece, such as a drop-center automobile wheel rim, the machine including a vertical single-action press having a bed, side frames supported on and rising from the bed, and a plunger mounted for vertical sliding movement between the side frames toward and away from the press bed in a cycle of operation of the press, the combination therewith of a lower die shoe supported in fixed position on said press bed, a lower die mounted for vertical movement in the press above said lower die shoe, the lower die in its uppermost position standing clear of adjacent parts for receiving an annular workpiece thereon, means on said press for positively stopping said lower die temporarily in an intermediate position when moving downward wherein it is held slightly raised above its final lower position where it rests on said lower die shoe, an upper die shoe secured to said plunger, an upper die carried by said upper die shoe in opposed relationship to the lower die, a group of radially movable dies mounted on the press in such position and relationship that when moved radially in one direction they engage the annular workpiece between the upper and lower dies which engage it on the opposite surface, said radially movable dies also being mounted for limited vertical movement above said lower die shoe, means on said press for positively supporting said radially movable dies temporarily above the lower press shoe while the radially movable dies are located in a position away from the workpiece but freeing them to move down upon the lower die shoe when they have moved fully against the workpiece, and means on said press timed with the movement of said dies for releasing said lower die from its temporary positive stopping means after all of said dies have fully engaged the workpiece, whereby the assembly of dies and workpiece will be brought down upon

the lower die shoe to provide a solid reaction to the final working movement of the dies.

2. In a machine for forming an annular sheet metal workpiece, such as a drop-center automobile wheel rim, the machine including a vertical single-action press having a bed, side frames supported on and rising from the bed, and a plunger mounted for vertical sliding movement between the side frames toward and away from the press bed in a cycle of operation of the press, the combination therewith of a lower die shoe supported in fixed position on said press bed, a lower die mounted for vertical movement in the press above said lower die shoe, the lower die in its uppermost position standing clear of adjacent parts for receiving an annular workpiece thereon, means on said press for positively stopping said lower die temporarily in an intermediate position when moving downward wherein it is held slightly raised above its final lower position where it rests on said lower die shoe, an upper die shoe secured to said plunger, an upper die carried by said upper die shoe in opposed relationship to the lower die, a group of radially movable dies mounted on the press in such position and relationship that when moved radially in one direction they engage the annular workpiece between the upper and lower dies which engage it on the opposite surface, said radially movable dies also being mounted for limited vertical movement above said lower die shoe, means on said press for positively supporting said radially movable dies temporarily above the lower press shoe while the radially movable dies are located in a position away from the workpiece but freeing them to move down upon the lower die shoe when they have moved fully against the workpiece, and means on said press timed with the movement of said dies for releasing said lower die from its temporary positive stopping means after all of said dies have fully engaged the workpiece, whereby the assembly of dies and workpiece will be brought down upon the lower die shoe to provide a solid reaction to the final working movement of the dies, said temporary positive stopping means for the lower die including a vertically slidable pin mounted beneath the lower die, said releasing means for the lower die holding said pin positively in its upper position until the dies have converged on the workpiece and then freeing said pin to drop down.

3. In a machine for forming an annular sheet metal workpiece, such as a drop-center automobile wheel rim, the machine including a vertical single-action press having a bed, side frames supported on and rising from the bed, and a plunger mounted for vertical sliding movement between the side frames toward and away from the press bed in a cycle of operation of the press, the combination therewith of a lower die shoe supported in fixed position on said press bed, a lower die mounted for vertical movement in the press above said lower die shoe, the lower die in its uppermost position standing clear of adjacent parts for receiving an annular workpiece thereon, means on said press for positively stopping said lower die temporarily in an intermediate position when moving downward wherein it is held slightly raised above its final lower position where it rests on said lower die shoe, an upper die shoe secured to said plunger, an upper die carried by said upper die shoe in opposed relationship to the lower die, a group of radially movable dies mounted on the press in such position and relationship that when moved radially in one direction they engage the annular workpiece between the upper and lower dies which engage it on the opposite surface, said radially movable dies also being mounted for limited vertical movement above said lower die shoe, means on said press for positively supporting said radially movable dies temporarily above the lower press shoe while the radially movable dies are located in a position away from the workpiece but freeing them to move down upon the lower die shoe when they have moved fully against the workpiece, and means on said press timed with the movement of said dies for releasing said lower die from its temporary positive stopping means after all of said dies have fully engaged the workpiece, whereby the assembly of dies and workpiece will be brought down upon the lower die shoe to provide a solid reaction to the final working movement of the dies, the press including a crankshaft for moving the plunger, and said means for releasing the lower die being actuated from a cam on said crankshaft.

4. In a machine for forming an annular sheet metal workpiece, such as a drop-center automobile wheel rim, the machine including a vertical single-action press having a bed, side frames supported on and rising from the bed, and a plunger mounted for vertical sliding movement between the side frames toward and away from the press bed in a cycle of opertaion of the press, the combination therewith of a lower die shoe supported in fixed position on said press bed, a lower die mounted for vertical movement in the press above said lower die shoe, the lower die in its uppermost position standing clear of adjacent parts for receiving an annular workpiece thereon, means on said press for positively stopping said lower die temporarily in an intermediate position when moving downward wherein it is held slightly raised above its final lower position where it rests on said lower die shoe, an upper die shoe secured to said plunger, an upper die carried by said upper die shoe in opposed relationship to the lower die, a group of radially movable dies mounted on the press in such position and relationship that when moved radially in one direction they engage the annular workpiece between the upper and lower dies which engage it on the opposite surface, said radially movable dies also being mounted for limited vertical movement above said lower die shoe, means on said press for positively supporting said radially movable dies temporarily above the lower press shoe while the radially movable dies are located in a position away from the workpiece but freeing them to move down upon the lower die shoe when they have moved fully against the workpiece, and means on said press timed with the movement of said dies for releasing said lower die from its temporary positive stopping means after all of said dies have fully engaged the workpiece, whereby the assembly of dies and workpiece will be brought down upon the lower die shoe to provide a solid reaction to the final working movement of the dies, the press including a crankshaft for moving the plunger, said temporary positive stopping means for the lower die including a vertically slidable pin mounted in the lower die shoe beneath the lower die, and said means for releasing the lower die being actuated from a cam on said crankshaft.

5. In a machine for forming an annular sheet metal workpiece, such as a drop-center automobile wheel rim, the machine including a vertical single-action press having a bed, side frames

supported on and rising from the bed, and a plunger mounted for vertical sliding movement between the side frames toward and away from the press bed in a cycle of operation of the press, the combination therewith of a lower die shoe supported in fixed position on said press bed, a lower die mounted for vertical movement in the press above said lower die shoe, the lower die in its uppermost position standing clear of adjacent parts for receiving an annular workpiece thereon, means on said press for positively stopping said lower die temporarily in an intemediate position when moving downward wherein it is held slightly raised above its final lower position where it rests on said lower die shoe, an upper die shoe secured to said plunger, an upper die carried by said upper die shoe in opposed relationship to the lower die, a group of radially movable dies mounted on the press in such position and relationship that when moved radially in one direction they engage the annular workpiece between the upper and lower dies which engage it on the opposite surface, said radially movable dies also being mounted for limited vertical movement above said lower die shoe, means on said press for positively supporting said radially movable dies temporarily above the lower press shoe while the radially movable dies are located in a position away from the workpiece but freeing them to move down upon the lower die shoe when they have moved fully against the workpiece, and means on said press timed with the movement of said dies for releasing said lower die from its temporary positive stopping means after all of said dies have fully engaged the workpiece, whereby the assembly of dies and workpiece will be brought down upon the lower die shoe to provide a solid reaction to the final working movement of the dies, the press including a crankshaft for moving the plunger, said temporary positive stopping means for the lower die including a vertically slidable pin mounted in the lower die shoe beneath the lower die, and said means for releasing the lower die being actuated from a cam on said crankshaft through lever-linkage means including a lever pivoted adjacent the axis of said crankshaft and carrying a follower engaging said cam.

6. In a machine for forming an annular sheet metal workpiece, such as a drop-center automobile wheel rim, the machine including a vertical single-action press having a bed, side frames supported on and rising from the bed, and a plunger mounted for vertical sliding movement between the side frames toward and away from the press bed in a cycle of operation of the press, the combination therewith of a lower die shoe supported in fixed position on said press bed, a lower die mounted for vertical movement in the press above said lower die shoe, the lower die in its uppermost position standing clear of adjacent parts for receiving an annular workpiece thereon, means on said press for positively stopping said lower die temporarily in an intermediate position when moving downward wherein it is held slightly raised above its final lower position where it rests on said lower die shoe, an upper die shoe secured to said plunger, an upper die carried by said upper die shoe in opposed relationship to the lower die, a group of radially movable dies mounted on the press in such position and relationship that when moved radially in one direction they engage the annular workpiece between the upper and lower dies which engage it on the opposite surface, said radially movable dies also being mounted for limited vertical movement above said lower die shoe, means on said press for positively supporting said radially movable dies temporarily above the lower press shoe while the radially movable dies are located in a position away from the workpiece but freeing them to move down upon the lower die shoe when they have moved fully against the workpiece, and means on said press timed with the movement of said dies for releasing said lower die from its temporary positive stopping means after all of said dies have fully engaged the workpiece, whereby the assembly of dies and workpiece will be brought down upon the lower die shoe to provide a solid reaction to the final working movement of the dies, the press including a crankshaft for moving the plunger, said temporary positive stopping means for the lower die including a vertically slidable pin mounted in the lower die shoe beneath the lower die, and said means for releasing the lower die being actuated from a cam on said crankshaft through lever-linkage means including a lever pivoted adjacent the axis of said crankshaft and carrying a follower engaging said cam, the pivot of said lever being mounted for angular adjustment relative to said cam and crankshaft axis.

7. In a machine for forming an annular sheet metal workpiece, such as a drop-center automobile wheel rim, the machine including a vertical single-action press having a bed, side frames supported on and rising from the bed, and a plunger mounted for vertical sliding movement between the side frames toward and away from the press bed in a cycle of operation of the press, the combination therewith of a lower die shoe supported in fixed position on said press bed, a lower die mounted for vertical movement in the press above said lower die shoe, the lower die in its uppermost position standing clear of adjacent parts for receiving an annular workpiece thereon, means on said press for positively stopping said lower die temporarily in an intermediate position when moving downward wherein it is held slightly raised above its final lower position where it rests on said lower die shoe, an upper die shoe secured to said plunger, an upper die carried by said upper die shoe in opposed relationship to the lower die, a group of radially movable dies mounted on the press in such position and relationship that when moved radially in one direction they engage the annular workpiece between the upper and lower dies which engage it on the opposite surface, said radially movable dies also being mounted for limited vertical movement above said lower die shoe, means on said press for positively supporting said radially movable dies temporarily above the lower press shoe while the radially movable dies are located in a position away from the workpiece but freeing them to move down upon the lower die shoe when they have moved fully against the workpiece, and means on said press timed with the movement of said dies for releasing said lower die from its temporary positive stopping means after all of said dies have fully engaged the workpiece, whereby the assembly of dies and workpiece will be brought down upon the lower die shoe to provide a solid reaction to the final working movement of the dies, said plunger carrying vertically moving cam means for operating said radially movable dies inwardly and outwardly, said cam means having elements providing for the necessary vertical movement of said radially movable dies after they have been moved into engagement with the workpiece.

8. In a machine for forming an annular sheet metal workpiece, such as a drop-center auto-

mobile wheel rim, the machine including a vertical single-action press having a bed, side frames supported on and rising from the bed, and a plunger mounted for vertical sliding movement between the side frames toward and away from the press bed in a cycle of operation of the press, the combination therewith of a lower die shoe supported in fixed position on said press bed, a lower die mounted for vertical movement in the press above said lower die shoe, the lower die in its uppermost position standing clear of adjacent parts for receiving an annular workpiece thereon, means on said press for positively stopping said lower die temporarily in an intermediate position when moving downward wherein it is held slightly raised above its final lower position where it rests on said lower die shoe, an upper die shoe secured to said plunger, an upper die carried by said upper die shoe in opposed relationship to the lower die, a group of radially movable dies mounted on the press in such position and relationship that when moved radially in one direction they engage the annular workpiece between the upper and lower dies which engage it on the opposite surface, said radially movable dies also being mounted for limited vertical movement above said lower die shoe, means on said press for positively supporting said radially movable dies temporarily above the lower press shoe while the radially movable dies are located in a position away from the workpiece but freeing them to move down upon the lower die shoe when they have moved fully against the workpiece, and means on said press timed with the movement of said dies for releasing said lower die from its temporary positive stopping means after all of said dies have fully engaged the workpiece, whereby the assembly of dies and workpiece will be brought down upon the lower die shoe to provide a solid reaction to the final working movement of the dies, means for continuously urging said radially movable dies upward toward their topmost position, and said means for positively supporting said radially movable dies temporarily holding said dies at the proper height to accurately engage the surface of the workpiece before all of said dies are moved down with the workpiece.



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