March 12, 1935. E. W. CARROLL 1,994,034

MACHINE AND METHOD FOR FORMING PROTUBERANCES ON SHEET METAL

Filed Feb. 6, 1933 2 Sheets-Sheet 1

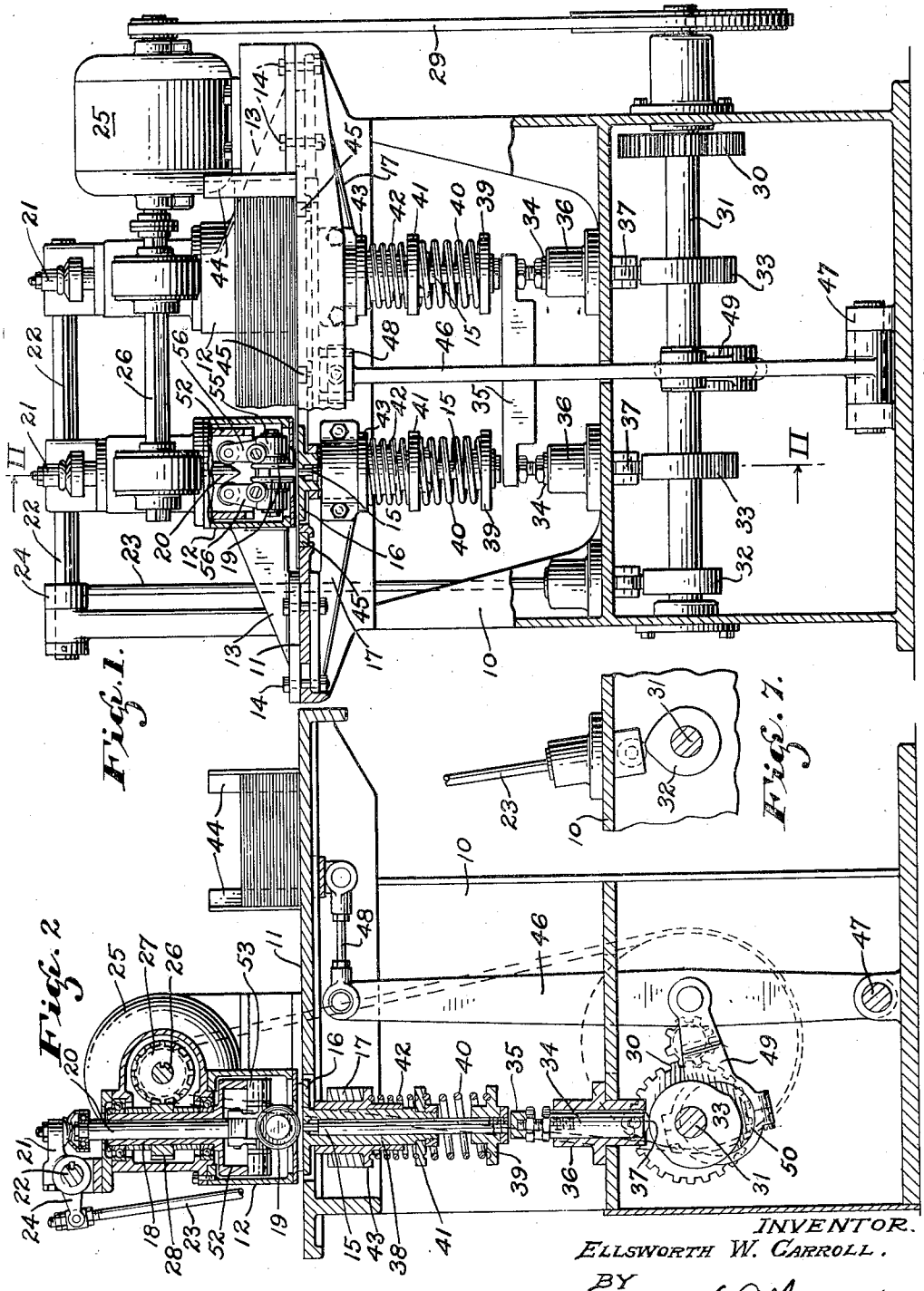


Fig. 1.

Fig. 1.

Fig. 2

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Fig. 3.

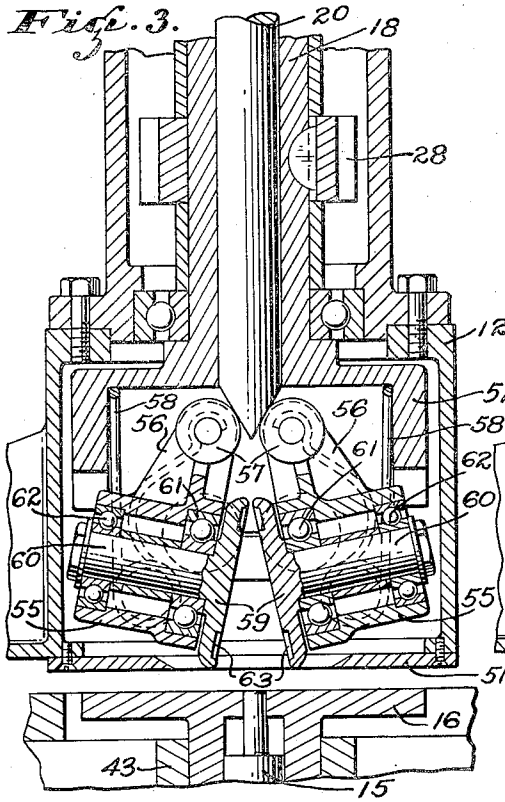


Fig. 5.

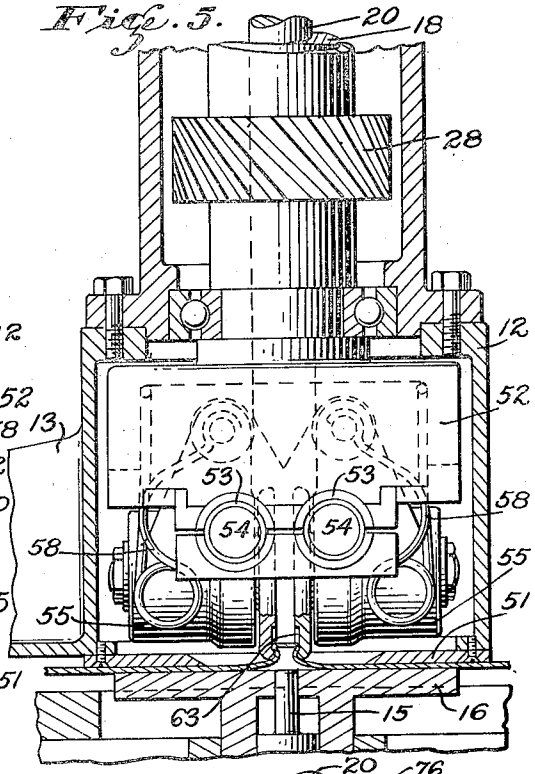


Fig. 4.

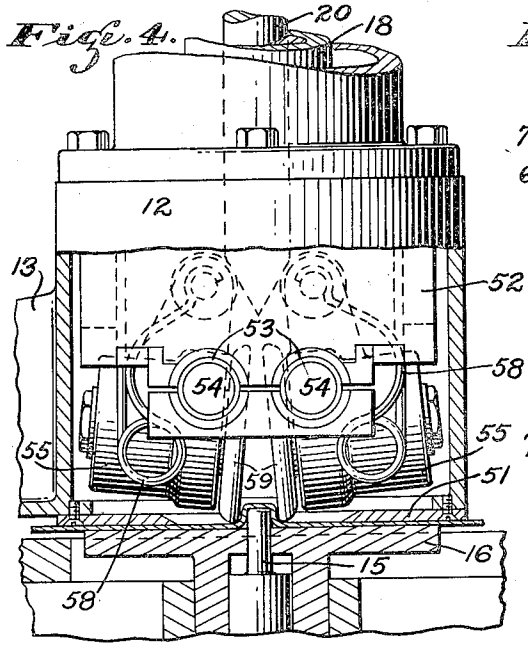
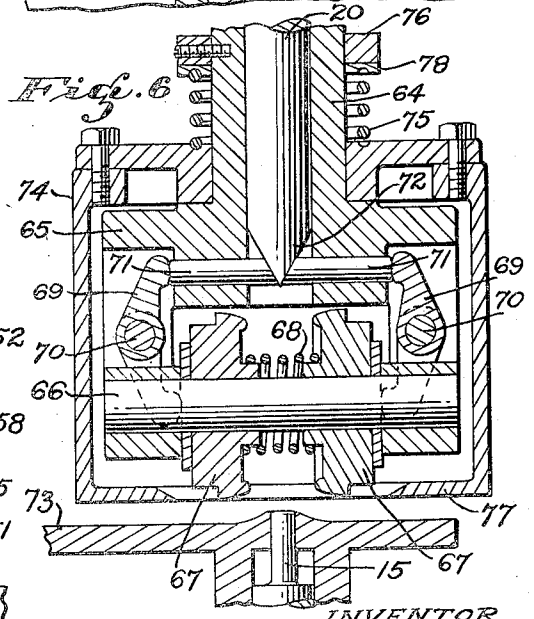


Fig. 6



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1,994,034

MACHINE AND METHOD FOR FORMING PROTUBERANCES ON SHEET METAL

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Application February 6, 1933, Serial No. 655,361

15 Claims. (Cl. 113—52)

This invention relates to sheet metal working apparatus and more particularly to a machine and combined spinning and drawing tool for forming a protuberance upon sheet metal.

An object of the invention is to provide a new and novel machine for forming a protuberance upon sheet metal which combines both a spinning and a drawing operation.

A further object of the invention is to provide a novel combined spinning and drawing tool for forming a protuberance, having an enlarged end, upon a sheet of metal.

More specifically the object of the present invention is to provide a machine and spinning tool for forming, upon sheet metal, a protuberance of the character contemplated by my copending application for Letters Patent, Serial Number 602,915, filed April 4, 1932, and entitled Bail ear.

In the above referred to application for patent there is shown and described a protuberance having an enlarged head or a beading at its end. This form of protuberance, as stated in the prior application, provides a simple and effective bail attaching ear for a pail or the like, and while the apparatus and tool to be herein disclosed is to be described in connection with the formation of a bail ear protuberance upon a pail and/or a pail forming blank of sheet metal, it is to be understood that the present invention will find many fields of usefulness apart from the manufacture of pails and bail ears.

In accordance with one aspect of the present invention, the sheet of metal upon which the protuberance is to be formed is disposed over the end of a normally stationary anvil and then spun down over the anvil by means of a pair of spinning rollers which engage the sheet of metal at a distance from the anvil and move inwardly toward the anvil as the spinning operation proceeds. The spinning rollers are undercut on their adjacent faces and at a time prior to the final spinning operations the anvil is withdrawn to permit the spinning rollers to complete the operation by spinning the side of the protuberance inwardly to leave an enlarged head at the end thereof.

In another embodiment of the present invention the protuberance is formed upon the sheet of metal by bringing the sheet into contact with the spinning rollers and drawing the protuberance during the spinning operation by projecting an anvil between the spinning rollers at a speed sufficient to take up the slack in the metal produced by the spinning operation, and finally withdrawing the anvil when the protuberance is extended its full length to permit the spinning rollers to complete the operation by reducing the diameter of the protuberance to provide the enlarged head at the end thereof.

For a better understanding of the invention reference should be had to the accompanying drawings wherein there is shown by way of illustration and not of limitation preferred embodiments thereof.

In the drawings wherein like numerals designate like parts throughout the several views;

Figure 1 is a front elevation of a machine embodying the present invention with parts broken away and in section to show the details of construction,

Figure 2 is an end elevation in section taken along line II—II of Figure 1, looking in the direction of the arrows,

Figure 3 is a vertical sectional view taken along the center line of the spinning head with the parts in their initial position,

Figure 4 is a vertical view with the parts broken away and showing the forming rollers in substantially their middle operating position and the anvil extended part way,

Figure 5 is a vertical view partly in section showing the forming rollers in their final position and the anvil fully withdrawn,

Figure 6 is a vertical sectional view of a modified form of spinning head built in accordance with the present invention, and

Figure 7 is a fragmentary sectional view showing the forming roller operating cam and follower.

For the purpose of this description the present invention is illustrated, in Figures 1 and 2 of the drawings, as embodied in an automatic machine which simultaneously forms two protuberances or bail ears upon a pail forming blank. This machine is adapted to be disposed in a line of machines which perform different operations in the manufacture of a pail and therefore the machine is provided with an automatic work feeding mechanism. The feeding mechanism is only incidental to the particular machine illustrated and since it is not a necessary part of the present invention it will not be described in detail.

As illustrated in these figures of the drawings, the protuberance forming elements of the invention are shown as continuously driven and periodically operated in an automatic manner so that the operations will be carried out upon the blanks as they are successively advanced to the spinning and drawing station by the automatic feeding mechanism.

The machine, as illustrated in the drawings, has a base or supporting frame 10, across the top of which there is provided a work supporting surface 11 and mounted upon the surface 11 there is shown a pair of spindle supporting heads 12. These supporting heads 12 are adjustable toward and away from each other so as to provide for the spinning of protuberances upon pail forming blanks of different dimensions. This adjustability is accomplished by slidably mounting the spindle supporting heads 12 upon the surface 11 by means of a flanged bracket 13 and bolts 14 which pass through elongated slots in the surface 11. Disposed below the spindle supporting heads 12 there is also provided an anvil 15 and a pressure plate 16. The anvil 15 and the pressure plate 16 are supported by a bracket 17 which is adjustably secured below the surface 11 by means of the bolts 14 so that the anvil and pressure plate can be moved along with the spindle supporting heads 12 to any desired position.

Each of the supporting heads 12 carries a vertically disposed spindle or quill shaft 18 which supports a pair of oppositely positioned spinning tools or forming rollers 19 and extending through the quill shaft 18 there is provided a pusher or wedge rod 20 that functions to move the forming rollers 19, as will hereinafter appear. Each wedge rod 20 is engaged by a rocker arm 21 which is splined upon a shaft 22 that extends along the tops of the spindle supporting heads 12. This shaft 22 is driven with an oscillating movement by means of a cam rod 23 which connects with a crank 24 secured to the shaft 22.

The quill shafts or spindles 18 with their forming rollers 19 are rotated at a comparatively high speed by a motor 25 that drives a shaft 26 which carries spiral gears 27. These spiral gears 27 are splined upon the shaft 26 so that they can slide therealong while in mesh with spiral pinions 28 carried by the quill shafts 18. The motor 25 is also connected, through a belt 29 and a reduction gear 30, to drive a cam shaft 31 which is located upon the frame 10 below the work supporting surface 11. At one end of the shaft 31 there is provided a cam 32, as shown in Figure 7 of the drawings, which serves to impart a reciprocating movement to the cam rod 23 and thus oscillate the shaft 22. The shaft 31 also carries a pair of cams 33 which operate in unison to periodically raise and lower the anvils 15 and the pressure plates 16 as the spindle or quill shafts 18 and the forming rollers 19 are rotated. The cams 33 are fixed upon the shaft 31 and, therefore, in order to permit the above referred to lateral adjustment of the anvils and pressure plates, these cams are associated with a pair of pusher rods 34 which carry a bridging member 35 at their upper ends. The pusher rods 34 are mounted in vertical guides 36 and have cam following rollers 37 which engage the cams 33. With this arrangement it will be seen that as the shaft 31 and the cams 33 rotate the bridging member 35 will move up and down with a predetermined frequency as provided for by the contour and rotation of the cams 33.

As illustrated in Figure 2 of the drawings, the anvil 15 is shown as extending centrally through a cylindrical stem 38 which has a mushroom like head that forms the aforementional pressure plate 16. The stem 38 is slidably mounted upon the bracket 17 and the anvil 15 is adapted to slide freely therethrough. The anvil 15 also extends downwardly below the bracket 17 and rests upon the bridging member 35. At its lower end the anvil has a collar or supporting seat 39 which serves as a bearing for the lower end of a relatively strong spring 40. At the lower end of the stem 38 there is also provided a similar spring support 41 which rests upon the spring 40 and carries a relatively weaker spring 42. The upper end of the spring 42 engages a stationary bearing sleeve 43 which is carried by the bracket 17. The function of the weaker spring 42 is to bias the anvil 15 and the pressure plate 16 to their lowermost positions and the length of the stronger spring 40 is such that when it is released the end of the anvil 15 will be substantially flush with the surface of the pressure plate 16. With this arrangement it will be seen that when the bridging member 35 moves upwardly it will push the anvil 15 and the pressure plate 16 against the action of the weaker spring 42 and that, as soon as the pressure plate engages the sheet of metal and clamps it against the spindle supporting head 12, the spring 40 will be subjected to compression and permit the anvil 15 to continue beyond the surface of the pressure plate and up between the forming rollers 19. In actual practice it is contemplated that yielding rubber collars, such as are commonly used in can making machinery, may be substituted for the springs 40 and 42.

Before referring to the remaining figures of the drawings, in connection with which other details and the method of operation are to be explained, attention is directed to the automatic feed mechanism employed by the machine illustrated in Figures 1 and 2 of the drawings. In this machine the blanks of sheet metal, which have been previously cut to the proper size, are stacked in a magazine or holding frame 44, the lower part of which is open so that the blanks can be removed one at a time from the bottom of the pile. Sliding in recesses formed in the surface 11 of the frame 10 there is provided a plurality of feed members 45 which carry fingers or gripping means (not shown) that engage the blanks of sheet metal and feed them, one at a time, from the holding frame 44 toward the spindle supporting heads 12. The feed members 45 are connected together and are adapted to be driven with a backward and forward movement by means of a lever arm 46 which is pivoted at the point 47 upon the frame 10. The lever arm 46 is connected to the feed members 45 by means of an adjustable link 48 and intermediate its ends it carries a connecting rod 49 that engages an eccentric 50 provided upon the cam shaft 31.

When the machine is in operation the feed mechanism will first deposit a sheet metal blank beneath the spindle supporting heads 12 and as soon as this blank is in position the pressure plates 16 will move upwardly and clamp the sheet of metal against the under side of the heads 12. At this point it should be stated that each of the heads 12 is provided with a flat under surface which forms an abutment 51 against which the sheet metal is firmly held by the adjacent pressure plate 16. When the sheet of metal is thus held against the abutment 51 it will be engaged by the forming rollers 19 which are spinning around at high speed. The spinning and forming operations will then continue until the protuberance or bail ear is fully formed, as will be pointed out in detail hereinafter. The pressure plate will then return to its lowermost position to release the sheet metal blank, and the automatic feeding mechanism will then discharge the finished blank or pass it on to the next station for a subsequent operation. At the same time a new

sheet metal blank will be delivered to the spinning and drawing station and the above operation will be repeated.

For an understanding of the spinning head construction of one embodiment of this invention reference should be had to Figures 3, 4 and 5 of the drawings, wherein the parts are shown in different operating positions. As illustrated in these figures of the drawings, the spindle 18 has an enlarged head 52 at its lower end which provides a support for the oppositely disposed forming rollers 19. The enlarged head 52 has a pair of oppositely disposed bearings 53 in which trunnions 54, carried by pivotal bearing members 55, are journaled. The bearing members 55 are adapted to pivot toward and away from each other about the axis of the trunnions 54 and for the purpose of imparting this pivotal movement thereto each bearing member 55 carries an upwardly extending arm 56 which has a roller or cam follower 57 at the end thereof. These cam followers 57 are biased against the wedge rod 20 by means of suitable springs 58 which engage the sides of the enlarged head 52. The forming rollers 19 are shown as having flat head portions 59 and centrally disposed shanks 60 which extend into the pivotal bearing members 55 where they are rotatably mounted upon ball bearings 61 and 62. With this arrangement the forming rollers 19 may be said to be disposed radially with respect to the axis of the spindle 18. At this point it should also be noted that the opposed faces of the forming rollers 19 are undercut as at 63. This undercutting of the rollers 19 is to provide a clearance when the protuberance is being reduced in diameter to provide the head at the end thereof.

The operation of the protuberance forming elements of the improved machine may be described as follows:

It will be assumed that the spinning head is constructed as illustrated in Figures 3, 4 and 5 of the drawings, and that the parts are in the positions shown in Figure 3, with the spindle 18 in rotation. When the anvil 15 and the pressure plate 16 are in their lowermost positions, as shown, the sheet of metal to be worked upon can be inserted beneath the spinning head 12. The placing of the sheet of metal beneath the spinning head will be so timed that as the pressure plate 16 moves up it will engage the sheet of metal and clamp it against the abutment 51 in its proper location. This upward movement of the pressure plate 16 will also bring the upper surface of the sheet of metal into contact with the forming rollers 19 which, as has been assumed, are rotating about the axis of the spindle 18, and as a result the forming rollers 19 will roll in a circle over the surface of the sheet metal and reduce its thickness by a spinning action. As the metal is thus reduced in thickness the metal will tend to buckle unless some provision is made to displace the metal so extended into a proper path. At this point the anvil 15 will begin to function and draw the metal upwardly between the opposed faces of the forming rollers 19 to form the protuberance. During the upward movement of the anvil 15 the forming rollers 19 will be moved toward each other or inward toward the axis of rotation and in this manner the metal will be drawn into proper shape as the forming rollers 19 deform the metal by the spinning operation. As soon as the anvil 15 has extended the metal sufficiently to form the desired length of protuberance and just before the forming rollers have completed their inward movement the anvil will be retracted to permit a reduction in the diameter of the protuberance. The location of the several parts before the retraction of the anvil 15 is clearly shown in Figure 4 of the drawings. After the anvil 15 has moved out of the protuberance the forming rollers 19 will continue to move inwardly toward each other and thus reduce the diameter of the protuberance intermediate its ends to provide for the head at the end thereof, as shown in Figure 5 of the drawings. After the protuberance is finally formed the forming rollers 19 will separate and the pressure plate will drop to release the sheet metal blank so that it can be removed and a new sheet inserted for a repetition of the operation.

It is believed that the means for imparting the above referred to movements to the several parts of the machine and the operation thereof will be fully understood, however, it may be stated that the radial or inward movement of the forming rollers 19 is produced by a downward movement of the wedge rod 20 which moves between the cam followers 57 carried by the arms 56 on the pivotal bearing members 55 that support the forming rollers. It should also be added that the cams 33 which control the movements of the anvil 15 and the pressure plate 16 are so shaped that the initial retractile movement of the anvil will be independent of the pressure plate 16 and thus permit the latter member to remain stationary and hold the sheet of metal against the abutment 51 until the protuberance is fully formed and released by the forming rollers 19. The positions of the parts during the final operation are clearly shown in Figure 5 of the drawings.

In Figure 6 of the drawings there is illustrated a modified form of spinning head which embodies a construction contemplated by the present invention. In this embodiment there is a spindle 64 which, like the spindle 18, has an enlarged head 65 at the lower end thereof. Extended transversely across the lower part of the enlarged head 65 there is a shaft 66 upon which a pair of oppositely disposed forming rollers 67 are mounted. These forming rollers 67 are biased apart by means of a spring 68 and engaging the outer ends of each of the forming rollers 67 there is a forked rocker arm 69 which serves to move them toward each other against the action of the spring 68 when the spinning operation is in progress. These rocker arms 69 are mounted upon pivots 70 carried by the head 65 so that they engage a forming roller 67 at one end and a cam follower 71 at the other end. The cam followers 71 are slidably mounted in the head 65 and at their inner ends they engage a tapered or wedge surface 72 provided upon the end of the wedge rod 20.

From the above it will be seen that the forming rollers 67, of the last described embodiment of this invention, function in substantially the same manner as do the forming rollers 19 of the embodiment illustrated in Figures 3, 4 and 5 of the drawings. In this latter embodiment, however, the forming rollers 67 slide radially upon the shaft 66 rather than pivot about the trunnions 54, as do the forming rollers 19.

Another difference in the construction of the embodiment illustrated in Figure 6, over that previously described, is that the pressure plate 16 has been omitted and a stationary plate 73 substituted therefor. The spindle 64 is also mounted so that it can be raised and lowered with respect to the plate 73. In order to provide for a clamping of the sheet of metal upon the plate 73 the spindle 64 is provided with a yieldably supported housing 74 which is biased downwardly

by a helical spring 75 that engages a stationary collar 76 secured upon the spindle 64. The housing 74 has a bottom plate 77 which is adapted to engage the sheet of metal and hold it upon the plate 73 and over the anvil 15 when the spinning head is lowered to form the protuberance. The housing 74 is held against rotation in any suitable manner. At the top of the spring 75 there is provided a bearing ring 78 to minimize friction between the spring 75 and the collar 76. The operation of this embodiment of the present invention may be described as follows:

After the sheet of metal has been disposed beneath the spinning head and over the anvil 15 the spindle 65 will move downwardly and bring the forming rollers 67 at the end thereof into engagement with the sheet of metal where they will operate upon the metal in an annular area about the anvil. At the same time the housing 74 will also move downwardly and clamp the sheet of metal against the plate 73 about the spinning area. As the forming rollers continue to roll upon the sheet of metal the anvil 15 will be projected upwardly and the wedge rod 20 will move downwardly and cause the forming rollers 67 to approach the anvil as they spin therearound.

During this stage of the operation the sheet of metal will be extended upwardly between the forming rollers 67 and just before the final spinning operation the anvil 15 will be retracted to permit the forming rollers to reduce the diameter of the protuberance intermediate its ends and thus provide for the enlarged head at the end thereof. As soon as the protuberance has been completely formed the wedge rod 20 will be released and the spindle 64, together with the housing 74, will be raised to permit the removal of the sheet of metal. In this embodiment it will be noted that the stationary plate 73 is curved slightly upward about the end of the anvil 15 and that the forming rollers 67 are shaped so as to draw the metal upwardly at this point.

For the sake of clearness, and in order to disclose the present invention so that the same can be readily understood, it is described and illustrated as embodied in specific devices and arrangements, and while the drawings show the spinning head as having two oppositely disposed forming rollers it is to be understood that the invention can be carried out with a single forming roller or with more than two forming rollers. It is to be also further understood that this invention is not limited to the specific means and arrangements described but may be embodied in other ways that will suggest themselves to persons skilled in the art. It is believed that this invention is broadly new and it is desired to claim it as such so that all changes as come within the scope of the appended claims are to be considered as part of this invention.

Having thus described my invention, what I claim and desire to secure by Letters Patent is—

1. The method of forming a protuberance upon sheet metal which consists in clamping the sheet of metal between two opposed surfaces that surround the area where the protuberance is to be formed engaging one side of the sheet metal with a pair of oppositely disposed forming rollers that gyrate about an axis extending through the clamped area and at right angles to the surface of the sheet and roll in a circular path to thereby deform the sheet by a spinning operation, and engaging the opposite side of the sheet with an axially movable anvil to draw the metal within the clamped area during the spinning operation between the adjacent faces of the forming rollers.

2. The method of forming a protuberance upon sheet metal which consists in clamping the sheet of metal between two opposed surfaces that surround the area where the protuberance is to be formed, engaging the sheet of metal on one side within the clamped area with a pair of oppositely disposed forming rollers that gyrate about an axis at right angles to the surface of the sheet and roll in a circular path to thereby deform the sheet by a spinning operation, engaging the opposite side of the sheet within the clamped area with an axially movable anvil to draw the metal during the spinning operation between the adjacent faces of the forming rollers, and causing the forming rollers to move inwardly toward the anvil as the spinning proceeds.

3. The method of forming a protuberance upon sheet metal which consists in clamping the sheet of metal between two opposed surfaces that surround the area where the protuberance is to be formed, engaging the sheet of metal within the clamped area on one side with a pair of oppositely disposed forming rollers that gyrate about an axis at right angles to the surface of the sheet and roll in a circular path to thereby deform the sheet by a spinning operation, engaging the opposite side of the sheet with an axially movable anvil which extends through to the clamped area to draw the metal during the spinning operation between the adjacent faces of the forming rollers, causing the forming rollers to move inwardly toward the anvil, and finally withdrawing the anvil to permit the forming rollers to reduce the diameter of the protuberance and complete the spinning operation.

4. In a machine for forming a protuberance upon a sheet of metal, the combination of a work supporting surface, an overhanging support adapted to cooperate with said work supporting surface and clamp the sheet of metal about the area where the protuberance is to be formed, a spindle journaled upon said support, means for driving said spindle, a pair of transversely movable and freely rotatable forming rollers carried by said spindle, means for moving said forming rollers toward and away from each other as the spindle rotates, and an anvil disposed in axial alignment with said spindle and extending through the clamped area for drawing the sheet metal into the space between said forming rollers as they move toward each other to form the protuberance thereon.

5. In a machine for forming a bail ear upon a sheet of metal, the combination of a work supporting surface, an overhanging support adapted to cooperate with said work supporting surface and clamp the sheet of metal about the area where the protuberance is to be formed, a spindle rotatably mounted upon said support, means for driving said spindle, a pair of transversely movable spinning rollers mounted at the end of said spindle and adapted to roll over a sheet of metal within the clamped area when in engagement therewith, means for moving said spinning rollers toward the axis of said spindle, and an anvil disposed in axial alignment with said spindle adapted to extended up through the clamped area for drawing the sheet metal into the space between said forming rollers as they roll over the sheet to form the bail ear.

6. In a machine for forming a protuberance upon sheet metal, the combination of a stationary annular abutment against which a sheet of metal may be held, a spinning head disposed centrally

of and at the rear of said annular abutment, a plurality of freely rotatable forming tools carried by said spinning head having their working edges substantially in line with the surface of said annular abutment, means for causing said forming tools to move toward and away from each other as the spinning head rotates, means engaging the sheet of metal about the area thereof upon which said forming tools operate and clamping it against said annular abutment, and a reciprocating anvil for drawing the clamped portion of the sheet metal toward and between said forming tools as the spinning head rotates.

7. In a machine for forming a protuberance upon a relatively large sheet metal, the combination of a spinning head, a plurality of freely rotatable forming tools transversely mounted upon said spinning head and having their working edges disposed to contact with the surface of a sheet of metal, means for causing said forming tools to move toward and away from each other as the spinning head rotates, a reciprocating anvil opposite and in axial alignment with said spinning head for projecting a portion of the sheet of metal between said forming tools as the spinning head rotates to form the protuberance, and means surrounding the area worked upon by said forming tools and reciprocating anvil for clamping the sheet of metal to prevent distortion thereof as a result of the spinning and drawing operations.

8. In a machine for forming a protuberance upon a relatively large sheet of metal, the combination of a stationary annular abutment against which a sheet of metal may be clamped, a spinning head disposed centrally at the rear of said annular abutment, a plurality of freely rotatable forming tools carried by said spinning head having their working edges substantially in line with the surface of said abutment, means carried by said spinning head for causing said forming tools to move toward and away from each other as the spinning head rotates, a reciprocating anvil for drawing the sheet metal between said forming tools as said forming tools approach each other, means whereby the anvil will be withdrawn from between said forming tools before the protuberance is completely formed and thus permit the rotatable forming tools to reduce the diameter of the protuberance intermediate its ends and means surrounding said reciprocating anvil for clamping the sheet of metal against said annular abutment during the spinning and anvil withdrawing operations.

9. In a bail ear forming machine, the combination of a stationary spindle support, a rotatable spindle mounted upon said support, a pair of oppositely disposed forming rollers mounted upon the end of said spindle, means for causing the working surfaces of said forming rollers to move toward the axis of said spindle as the latter rotates, a stationary annular abutment surrounding said forming rollers against which a sheet of metal to be formed may be clamped, a clamping member adapted to hold the sheet of metal against said annular abutment and prevent distortion of the sheet of metal upon which the bail ear is formed, and an axially movable anvil disposed in alignment with said spindle adapted to extend the sheet of metal between the forming rollers and be withdraw therefrom before the final spinning operation to thereby form a protuberance upon the sheet of metal, said forming rollers being undercut on their adjacent faces and the movement of said anvil being such that said protuberance will have an enlarged head at the end thereof when completed.

10. In a sheet metal working machine, the combination of a stationary spindle support, a rotatable spindle mounted upon said support, a pair of oppositely disposed forming rollers carried upon the end of said spindle, means for causing the working surfaces of said forming rollers to move inwardly toward the axis of said spindle, a stationary annular abutment surrounding said forming rollers against which the sheet of metal to be formed may be clamped, a clamping member adapted to hold the sheet of metal against said annular abutment to prevent distortion of the sheet of metal, and an axially movable anvil disposed in alignment with said spindle adapted to extend the sheet of metal and form a protuberance between the forming rollers, said forming rollers being undercut on their adjacent faces and said anvil being withdrawn from said protuberance prior to the final spinning operation and while the sheet of metal is clamped against said annular abutment to permit the forming rollers to reduce the diameter of the protuberance intermediate its ends.

11. In a spinning machine for forming a protuberance upon sheet metal, the combination of a rotatable spindle, a plurality of forming rollers disposed upon the end of said spindle, said forming rollers being mounted so that their working surfaces will engage the sheet metal and move radially with respect to the axis of said spindle, means cooperating with said forming rollers for imparting said radial movement thereto as the spindle rotates, and means for clamping the sheet of metal about the area upon which the protuberance is being formed to thereby limit the spinning operation to a small area and prevent distortion of the sheet of metal.

12. In a spinning head for forming a protuberance upon sheet metal, the combination of a rotatable spindle, a plurality of forming rollers disposed upon the end of said spindle and adapted to engage a sheet of metal, said forming rollers being mounted upon movable supports, whereby their working surfaces may be moved radially with respect to the axis of said spindle, means cooperating with said movable supports for imparting radial movement to the forming rollers when the spindle is rotating, and a clamping means surrounding said forming rollers for holding the sheet of metal flat and preventing a distortion thereof.

13. In a bail ear forming machine, the combination of a frame, a pair of vertically disposed spinning heads adapted to operate simultaneously upon a sheet metal blank, each of said spinning heads having a plurality of pivotally supported forming rollers which move transversely to the axis of the spinning head as the latter rotates, an axially movable anvil disposed in alignment with each of said spinning heads adapted to periodically move toward and away from said forming rollers during their inward travel over the sheet metal, means for moving said forming rollers radially and said anvils axially to simultaneously subject the sheet of metal to both a drawing and a spinning operation at two points, and means whereby said spinning heads and anvils may be moved upon said frame without disconnecting the driving connections of any of the operating parts.

14. In a sheet metal working machine of the character described, the combination of an overhanging support, a spinning head journaled upon

said support having a pair of forming rollers disposed upon the end thereof, an annular abutment carried by said overhanging support having its surface substantially in alignment with the working surfaces of said forming rollers, an axially movable anvil disposed in alignment with said spindle, a yielding annular pressure plate disposed about said anvil adapted to hold a sheet of metal against said annular abutment, means for periodically moving the anvil toward said forming rollers, and a yielding driving connection between said anvil and said annular pressure plate for causing the latter to engage and clamp the sheet of metal against said annular abutment when said anvil and forming rollers engage the sheet of metal.

15. In a sheet metal working machine of the character described, the combination of an overhanging support, a spindle journaled upon said support having a pair of forming rollers disposed upon the end thereof, a surrounding surface adjacent said forming rollers against which a sheet of metal may be clamped, a yielding pressure plate disposed opposite said surface for clamping a sheet of metal thereagainst at a point surrounding said forming rollers, an axially movable anvil disposed in alignment with said spindle, means for periodically producing a relative axial movement between said anvil and said forming rollers, and a yielding driving connection for moving said yielding pressure plate and causing the latter to engage and clamp the sheet of metal against said surface when said anvil and forming rollers engage the sheet of metal.

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