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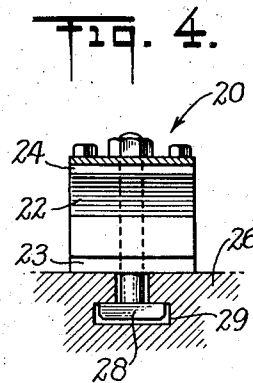
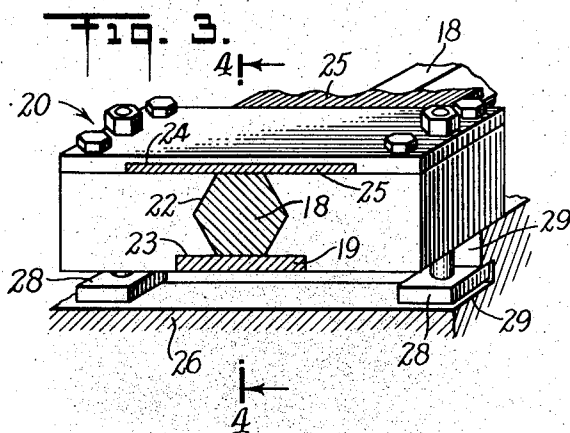
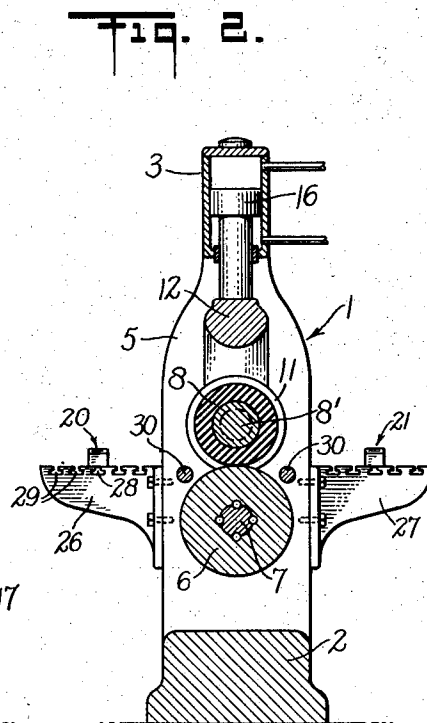
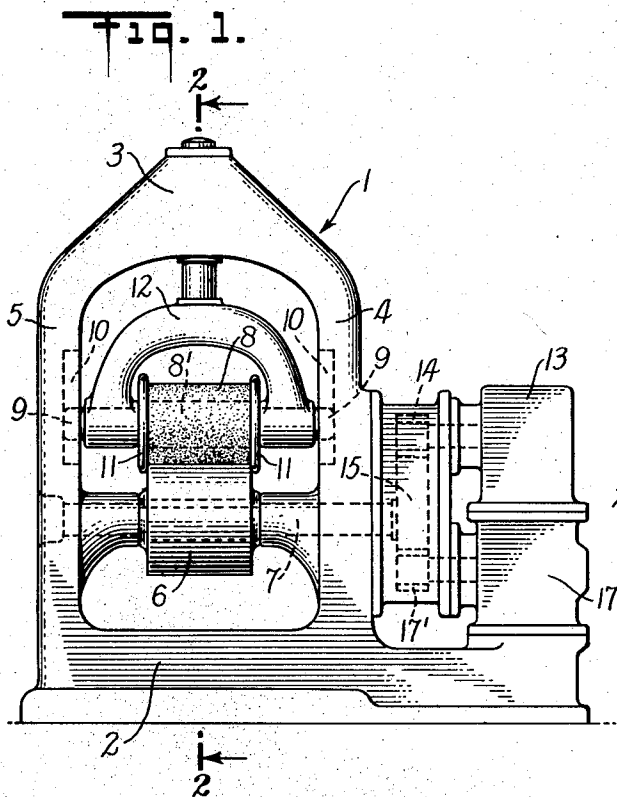
C. M. JOHNSON

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FORMER FOR SHEET METAL PARTS

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INVENTOR
Corydon M. Johnson
BY
Blair, Curtis & Hayward
ATTORNEYS

UNITED STATES PATENT OFFICE

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FORMER FOR SHEET METAL PARTS

Corydon M. Johnson, Freeport, N. Y.

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7 Claims. (Cl. 153—28)

This invention relates to a former for sheet metal parts.

One object of the invention lies in the provision of an apparatus by which sheet metal may be caused to conform to a die irrespective of the regularity or irregularity of the surface of the die and irrespective of whether or not the die surface includes undercut portions.

Another object of the invention is to provide such an apparatus that will form such metal parts as the stock travels through the apparatus.

Another object of the invention resides in an apparatus for continuously forming such parts as above referred to from sheet metal either in rectilinear or curvilinear form as the stock travels through the apparatus.

The invention is particularly applicable to the formation of relatively long parts, such for instance as tubes, irrespective of their cross sectional configuration, moldings and various parts such as used in aircraft construction.

It being impracticable in the drawings and in the specification to disclose and describe all applications of the invention, I have chosen to illustrate and describe it in connection with the formation of a hexagonally shaped channel, but it is to be understood, and it will be understood as this description progresses, that the invention is by no means limited to this particular application.

In the drawings I have illustrated an embodiment of my invention and will describe the invention as embodied in and with this specific apparatus, but it is to be understood that the invention is far broader than this specific embodiment. Thus I am to be limited only by the scope of the claims.

Figure 1 is an elevation of this specific embodiment;

Figure 2 is a vertical sectional view thereof;

Figure 3 is a view of the die and its guide that I have chosen for illustrative purposes only;

Figure 4 is a sectional view of the guide;

Figure 5 is an enlarged section showing the relation of the die and the rolls before pressure is applied;

Figure 6 is an enlarged sectional view taken at right angles to Figure 5;

Figure 7 is a sectional view showing the configuration of the rubber while pressure is being applied to the rolls and die;

Figure 8 is a view at right angles to Figure 7; and

Figure 9 is a sectional view of a modification of the guide for the die.

The embodiment of the apparatus illustrated

includes a frame 1 having a base 2, a head 3 and standards 4 and 5. A lower, substantially non-compressible roll 6 is mounted to rotate with the shaft 7. This roll may be of metal. An upper roll 8 is mounted to rotate on an axis substantially parallel with that of the roll 6. I have shown this roll as of a relatively deep compressible and expansible material, such as rubber, which is of a hollow cylindrical form and is mounted on a matrix 8' to which it is preferably banded and from which trunnions 9 extend into tracks 10 in the standards 4 and 5, so that the roll may have vertical sliding movement in upward and downward directions. Flanges 11 are located at the ends of the rubber roll 8 and are incapable of movement longitudinally of the axis of the roll, being preferably rigid with the matrix 8' and the trunnions 9. The roll 8 is carried by the yoke 12 in which the trunnions 9 are rotatably mounted.

It will be here noted that the length of the lower roll 6 is such that it snugly fits between the flanges 11 of the roll 8, as illustrated in Figure 1 of the drawings.

The flanges 11 of the upper roll 8 prevent any longitudinal expansion or movement of the rubber of the roll for a purpose which will later be described.

Relative rotative movement is imparted to the rolls 6 and 8. In the drawings I have illustrated this as being accomplished by means of an electric motor 13, which rotates the lower roll 6 by means of connecting gearing 14 and 15. The yoke 12 and the roll 8 are movable to and away from the roll 6, the horizontal position of the axis of the latter being fixed.

The movement of the roll 8 toward an enforced contact with the roll 6 is accomplished by suitable means such as a hydraulic jack 16 which may be of any of the usual types.

This jack is actuated by a fluid form of pump 17 which pump may be of any of the usual forms and actuated by a gear 17' which intermeshes with the gear 15 and the fluid action may be controlled by the usual valving (not shown). The roll 8 may be moved away from the roll 6 by any suitable means or manually.

In connection with these rolls 6 and 8 I contemplate the use of a forming die 18, which die is to be of the shape from which it is desired to form the ultimate part. For instance, if the part is to be substantially hexagonal the die will be hexagonal in cross section. If it is to be circular the die will be substantially circular in cross section. In other words, the die will take the cross sectional configuration of the part that is to be ulti-

mately formed. Longitudinally the die may have continuous rectilinear surfaces or it may have interrupted or non-rectilinear surfaces, depending upon the longitudinal formation of the part that is desired. Moreover the die need not follow the same cross sectional configuration throughout its length, but this may vary. For instance, part may be hexagonal and part circular.

I have chosen a continuous surface hexagonal die for illustrative purposes. This die 18 is carried by a platen 19, which may or may not be rigid with the die. The die and the platen are adapted to pass between the rolls 6 and 8 together, and are guided in their passage by guides 20 and 21. The guide 20 on the feed side of the rolls 6 and 8 is provided with an opening 22 for guiding the die with an opening 23 for guiding the platen and an opening 24, for guiding the strip of material 25 from which the part is to be formed. Of course the form of die 18 will vary according to the form of the part that is to be formed.

As the strip of material from which the part is being formed will have conformed to the shape of the die after passage between the rolls 6 and 8, the guide 21 need not be of the same form as that of the guide 20. This will be modified to the extent that the guiding opening 24 will be omitted and the guiding opening 22 for the die will be enlarged sufficiently to receive not only the die but the formed part.

The guide 20 is mounted removably and replaceably on a work table 26 while the guide 21 is similarly mounted on a work table 27. Each of these guides is provided with a tongue 28 which is adapted to engage with and be secured in a correspondingly shaped slot 29 in the work table, and each guide is capable of adjustment transversely of the work table, or otherwise stated, longitudinally of the rolls so that the work may be put through the rolls in contact with the desired portion of their surfaces. This removability of the guides is to permit guides of various configurations to be used in connection with the particular part that is to be formed.

If it is desired to form a rectilinear part the die will be rectilinear and the guides of the form shown in Figures 2, 3 and 4 of the drawings. If on the other hand it is desired to form a curvilinear part, the die will be curvilinear and the guides will be of the form shown in Figure 9.

Of course if the part that is formed is symmetrical in cross section, then it will be unnecessary to use the die 21 at the exit end of the apparatus because by its own form the part will ride with the die after its formation, but this die 21 should be used when the part is unsymmetrical, as for instance if it were of an obtuse angle shape in cross section interposed between the work tables 26 and 27 on supporting rollers 30 over and in contact with which the platen passes. These rollers provide support for the platen and the die adjacent the rolls and at the point where the rubber expands to contact longitudinally with the strip of metal from which the part is being formed.

In operation, when it is desired to form a tubular part which has, for instance, five sides of the hexagon, which I have chosen for illustrative purposes, the platen and the die are fed through the guide 20, as illustrated in Figure 3 of the drawings. At the same time the strip of metal is fed through the guiding portion 24 of the guide 20 and lies in contact with the upper surface of the die. As the platen, die and strip of metal pass between the rolls 6 and 8, while the latter

are rotating, they will be fed through the apparatus by that rotation, and the strip of metal will take the form of the die both transversely and longitudinally, irrespective of whether or not the die has undercut portions, as for instance those portions in the hexagon which lie below the horizontal center thereof.

I have illustrated in Figures 5 through 8 conventionally the passage of the platen, the die and the metallic strip between the rolls and the formation of the part by the pressure of the rolls.

In Figures 5 and 6 the positions of these parts prior to the application of force to the upper roll is illustrated.

As the platen, die and metallic strip are fed to and meet the rolls the hydraulic jack is actuated to force the upper roll 8 downwardly into such a position as shown in Figures 1 and 2 and the lower roll 6 is set into rotative movement by means of the electric motor and gearing heretofore described. The rotation of the lower roll will of course, because of the created pressure between the upper and lower rolls, set the upper roll in motion. Thus the platen, the die and the strip will be fed through the apparatus.

As it is fed through the rubber of the rolls will become deformed.

In Figure 7 I have shown a cross sectional view illustrating the deformation of the rubber and the manner in which it bends the metallic strip around the die.

It will be noted that the flanges 11 of the upper roll 8, being incapable of any movement longitudinally of that roll, prevent any expansion of the rubber longitudinally of its axis. Thus all the expansion and the deformation is effective to bend the metal strip around the die. In other words, the die and strip, together with the platen being forced into the surface of the rubber so to speak makes it necessary for the rubber to deform from its original cylindrical form. This applies pressure against the flanges 11 and this reacts against the die and strip to form the strip around the die. It will be noted that this deformation and this reactive pressure bends the strip into the undercut portions of the die as well as those that lie above the horizontal center when the hexagonal die is used, for instance.

In Figure 8 I have illustrated a longitudinal section of the rollers with the platen, die and strip passing therethrough, and from this it will be observed that the application of pressure by the rubber on the metallic strip to bend the latter around the die extends to a considerable extent longitudinally of the die, and thus gives the strip a smooth surface.

I have found that when the rubber of the roll 8 is secured to the matrix 8' the greatest reactive force is obtained since it is impossible for the rubber to receive any great deformation or deflection on the side of the roll opposite to that on which the die is located.

It will be realized that as the platen, die and strip are passed between the rolls as the latter rotate and as pressure is applied as heretofore described, a continuous metallic part may be formed and the formation of the part will be progressive as the feeding continues. Indeed the length of the part is only limited by the length of the die and the length of the strip from which the part is to be formed.

It will be realized that many modifications in the structure and in the method of procedure may be made without departing from the spirit

of the invention or without exceeding the scope of the claims, and since I have selected the particular embodiment for illustrative purposes it is to be understood that I do not wish to be limited to this embodiment except in so far as it is necessary by the scope of the claims.

I claim:

1. An apparatus for progressively causing a sheet of metal to conform to the successive parts of a moving die which includes: a non-yieldable rotatable roll, a rigid rotatable matrix, a deep rubber cylindrical covering for said matrix, a pair of end flanges on the matrix to confine the ends of said rubber covering, the said rotatable roll being adapted snugly to fit between said flanges and to support the die and sheet metal, means for causing the roll and rubber covered matrix to have relative rotative movement, and means for forcing the rubber covered matrix toward the roll to embed the die and sheet metal in the rubber and to bend the sheet metal around the die as the latter moves progressively between the roll and the rubber.

2. In an apparatus for progressively causing a sheet of metal to conform to the successive parts of a moving die which includes: a die, a pair of pressure elements one of which is non-yieldable and the other of which is deformable to an extent sufficient to embed the sheet metal and the die, and means for causing said elements to have pressure contact, means for supporting the die to be fed between said elements, means for moving said pressure elements in the direction of movement of the die, and means for directing the forces developed by the passage of the die between said elements and the embedding of the die and sheet metal toward said die to bend the sheet metal around the die.

3. In an apparatus for progressively causing a sheet of metal to conform to the successive parts of a moving die which includes: a die, a pair of pressure elements one of which is non-yieldable and the other of which is deformable to an extent sufficient to embed the sheet metal and the die, and means for causing said elements to have pressure contact, means for moving said pressure elements in the direction of movement of the die, and means for directing the forces developed by the passage of the die between said elements and the embedding of the die and sheet metal toward said die to bend the sheet metal around the die.

4. In an apparatus for bending a sheet of metal around a die, a die, a non-yieldable supporting

surface for the die, a rotatable rubber-like cylinder sufficiently deep to substantially embed the die, means for forcing the cylinder into pressure contact with said supporting surface whereby when the cylinder is rotated the die lying between the cylinder and the supporting surface will be fed between the two, and means for directing the forces developed by the embedding of the die in the material of the cylinder that tend to move away from the die toward the die.

5. In an apparatus for bending a sheet of metal around a die, a die having undercut surfaces, a non-yieldable supporting surface for the die, a rotatable rubberlike cylinder sufficiently deep to substantially embed the die, means for forcing the cylinder into pressure contact with said supporting surface whereby when the cylinder is rotated the die line between the cylinder and the supporting surface will be fed between the two, and means for directing the forces developed by the embedding of the die in the material of the cylinder that tend to move away from the die toward the die.

6. In an apparatus for bending a sheet of metal around a die, a die, a non-yieldable rotatable roller supporting the die, a rotatable rubber-like roller arranged in opposition to the first-mentioned roller and sufficiently deep to substantially embed the die when the two rollers are forced together, means for forcing the two rollers into pressure contact with each other whereby the rubber-like material will be forcibly caused to envelop the die along an area greater than the diameter of the cylinder, and means for rotating the opposed rollers in opposite directions while in forcible contact with each other.

7. In an apparatus for bending a sheet of metal around a die, a die, a non-yieldable rotatable roller supporting the die, a rotatable rubber-like roller arranged in opposition to the first-mentioned roller and sufficiently deep to substantially embed the die when the two rollers are forced together, means for forcing the two rollers into pressure contact with each other whereby the rubber-like material will be forcibly caused to envelope the die along an area greater than the diameter of the cylinder, with a gradually increasing pressure toward the line where a vertical plane passes longitudinally through the axes of the rollers and with a gradually decreasing pressure away from said line, and means for rotating the opposed rollers in opposite directions while in forcible contact with each other.

CORYDON M. JOHNSON.