April 28, 1925. 1,535,295

W. M. CONNERY

CORRUGATION FORMING DIES FOR METAL PLATES

Filed July 16, 1924 2 Sheets-Sheet 1

Fig. 1.

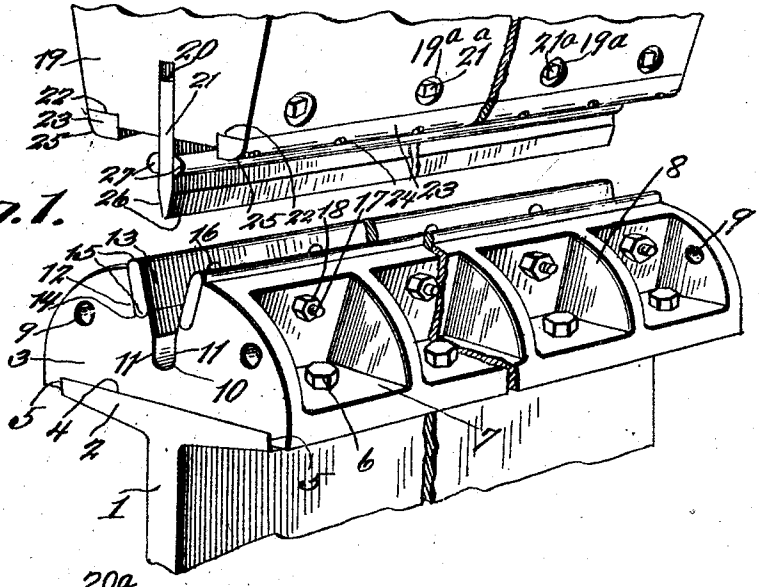


Fig. 2.

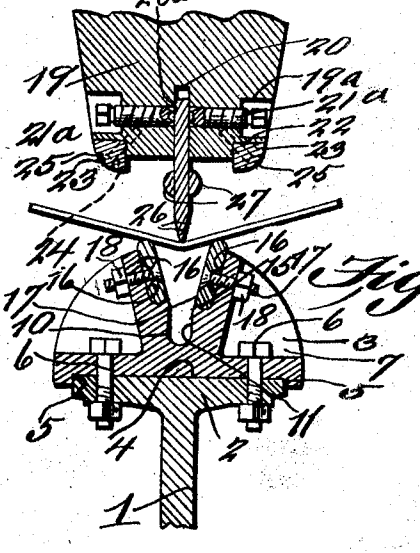
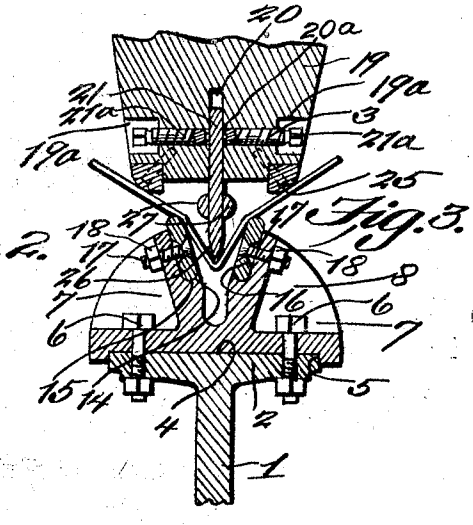


Fig. 3.



Inventor

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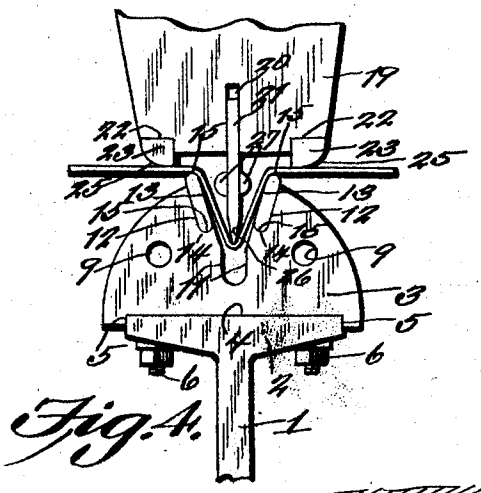


Fig. 4.

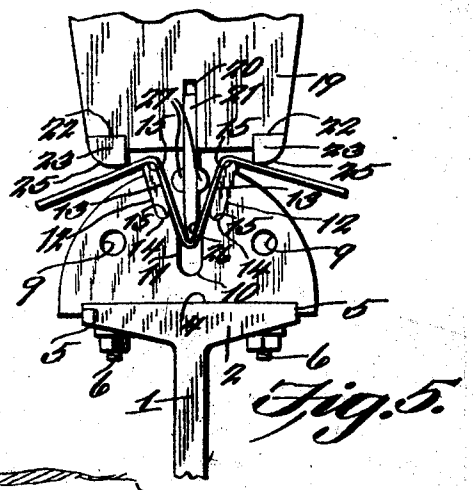


Fig. 5.

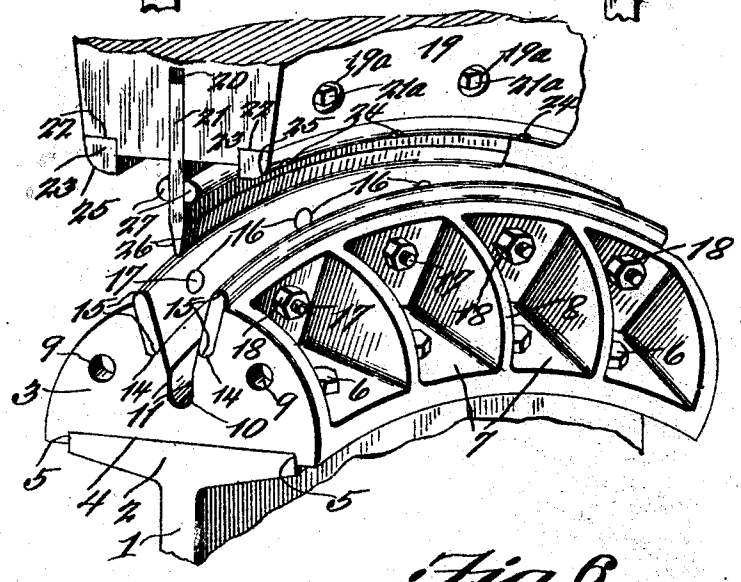


Fig. 6.

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UNITED STATES PATENT OFFICE.

WILLIAM M. CONNERY, OF PHILADELPHIA, PENNSYLVANIA.

CORRUGATION-FORMING DIES FOR METAL PLATES.

Application filed July 16, 1924. Serial No. 726,348.

To all whom it may concern:

Be it known that WILLIAM M. CONNERY, a citizen of the United States of America, residing at Philadelphia, county of Philadelphia, and State of Pennsylvania, has invented new and useful Corrugation-Forming Dies for Metal Plates, of which the following is a specification.

Corrugated sheet metal and forming machines or dies therefor are well known in the art.

However, corrugated sheet metal is made of relatively thin material and the corrugations are successively formed. The corrugations are constructed by forming machines or by means of dies where the forming faces come together closely and also where the forming faces have successive projections and depressions. These articles of manufacture are commercially known as corrugated sheet metal, and in some cases the walls of the corrugations are fluted according to the forming faces of the dies. In other words, the dies or the forming parts of a machine have their forming faces fluted, so as to construct the walls of the corrugations with flutes or other shapes.

There is no claim made, in the present invention, for the production of what is commercially known as corrugated sheet metal or for dies to form such material, whether or not fluted surfaces are used.

On the 16th day of May, 1922, United States Letters Patent No. 1,416,334 was issued to William M. Connery, setting forth and claiming a flue and flue sections as well as a plate metal section wherein corrugations at infrequent intervals are used for constructing a flue or flue section.

It is, therefore, the purpose of the present invention to provide an improved corrugation forming die to be used in connection with metal forming machines for pressing the corrugation or indentation into a relatively thick plate metal. In fact, corrugations or indentations having flat sloping or other shaped sides or walls at infrequent and varying intervals are to be formed in thick plate metal, whereby flues and flue sections or other articles having walls may be stiffened in such wise as to permit the walls to expand and contract or to permit the walls to relatively move, due to vibrations.

It is also well known that metal, when rolled to form plate metal, varies in thickness at various points throughout the area of the metal. These varying thicknesses may occur in the severed portion of the metal plate or toward the edges, due to the rolls of the rolling mill yielding too much at their ends or their central portions. The metal used for making various wall sections, or walls of coal bunkers or like articles, average substantially three-sixteenths of an inch in thickness, more or less, and in this case, should an attempt be made to corrugate plates of this character by forming machines or dies at present used for constructing successive corrugations, the machines would either break or jam. In fact, the forming dies which may be used for corrugating plates will break or jam, particularly where these relatively thick metal plates vary at different points throughout their area. Parts of the machine may break. In other words, when the forming faces come together and contact with the large surfaces, the parts of the machine are put under considerable strain at portions thereof and in other parts, the strain or jamming forces are not present, hence the corrugations are of deformed character and will not serve the purpose to the best advantage.

In the application above mentioned, provision is made for compensating for the varying thickness of the metal plate at various points throughout the area of the plate, thereby permitting the corrugation to be formed with sloping walls or other shaped walls in order that they may uniformly expand or contract and uniformly reinforce or stiffen a structure. The provision made in said application consists of grooves constructed in the faces of the dies, to take up for the varying thicknesses in metal plates.

The present invention includes provision to compensate for the varying thicknesses in metal plates but in an entirely different manner. The present invention consists of the forming dies, a fixed head and a movable follower head, the former carrying a steel knife with planed edges, the latter having a channel to receive the knife freely with considerable clearance around the knife, allowing sufficient space to compensate for the varying thicknesses in the metal plate. Furthermore, the channel may be of sufficient depth to permit corrugations of varying depths to be formed.

Also, in the application above mentioned,

provision is made to permit the plate metal to creep from either of the sides of the fixed and movable heads. In other words, prior to the above mentioned application and the present construction of corrugation forming means, sheet metal forming machines permitted the metal to creep from one side only which necessitated greater pressure to be used to bring the movable follower head toward the fixed head, and to facilitate the creeping of the metal from either of the sides of the fixed and movable heads, provision is made to allow the metal to slide easily as the corrugation is formed in the channel, due to the follower head moving toward the fixed head and receiving the corrugation forming knife.

Another purpose is to provide reversible facing bars removably attached to the walls of the channel of the movable follower head, provided with arcuate edges over which the metal plate may freely creep and feed as the plate is formed with a corrugation.

Still another purpose is to provide longitudinal beads on the corrugation forming knife acting to overcome the different hardnesses of the metal plate, and it is to be noted that the radii of the arcuate edges of the reversible facing bars are to some extent dependent on the position of the beads on opposite sides of the corrugation forming knife.

A further purpose is the provision of abutment beads removably attached to the remote corners of the fixed head so that the action of the beads on the corrugation forming knife and the edges of the facing bars, in conjunction with the abutment beads, will enable the corrugation to take the desired shape.

The depending part of the corrugation forming knife also constitutes a factor in connection with governing the depth and the shape of the corrugation. In fact, it is the combination of these various parts carried by the fixed and movable follower heads that produces and governs any desired form or width or depth of corrugation within the compass of the corrugation forming dies.

A still further purpose is to construct the fixed and movable follower heads in such wise that the inclination of the sloping walls of the channel of the movable follower head may correspond with the inclination or beveled faces of the corrugation forming knife, which beveled surfaces are coextensive with the curved surfaces of the beads on the knife, thereby further governing the formation of the corrugation.

A still further purpose is to position the abutment beads relative to the arcuate edges of the facing bars so that, when the movable follower head elevates into a position to receive the corrugation forming knife at the time of forming the corrugation, the abatment beads will position on opposite remote sides of the edges of the facing bars and thereby govern the positions of the metal plate on opposite sides of the corrugation. In other words, the metal plate on opposite sides of the corrugation may extend in horizontal corresponding planes or at any angle, it depending entirely upon the position of the movable follower head when it is brought to rest.

It is to be understood that the particulars herein given are in no way limitative and that while still keeping within the scope of the invention, any desired modifications of detail and desired proportions may be made in the apparatus according to circumstances.

The invention comprises further features and combinations of parts as will be hereinafter set forth, shown in the drawings and claimed.

In the drawings:

Figure 1 is a view in perspective of an improved corrugation forming die, showing the fixed and movable follower heads in position ready to receive a piece of plate metal to be formed with a corrugation.

Figure 2 is a sectional view through the fixed and movable follower heads, showing a piece of plate metal in position to receive the first stage of forming the corrugation.

Figure 3 is a sectional view showing a second stage.

Figure 4 is a sectional view showing the third stage.

Figure 5 is a sectional view showing the final stage in forming the corrugation.

Figure 6 is a view showing circular fixed and movable follower heads for the purpose of constructing a corrugation of arcuate formation.

Referring to the drawings, 1 designates a movable follower head supporting girder which is designed to be operatively mounted in a foundation, the same being operated in any suitable manner and by any convenient means, preferably hydraulic power (not shown). This girder has an upper bed plate 2, the upper surface of which is planed and is adapted to support the movable follower head 3. In fact, the under surface of the follower head is channeled as shown, causing a seat 4 to be formed which includes side shoulders 5. The bottom of the seat is planed, so that when the follower head is placed in position on the movable girder, the two planed surfaces closely engage throughout their entire areas. The shoulders 5 overhang and engage the side edges of the bed plate of the girder, acting to reinforce the connections and relieve any strain that may occur on the securing bolts 6.

The follower head, which may also be termed a bolster, is in the form of a casting, and to lighten it, its sides are cut away causing pockets 7 to be formed, there being in-

tervening ribs 8 which act to reinforce the structure of the follower head or bolster. The securing bolts 6 which fasten the follower head or bolster on the girder pass through the base of the head or bolster and through the side flanges of the bed plate of the girder, their lower ends having suitable nuts to hold the bolts secure and thereby retain the head or bolster on the girder.

At present, in constructing a flue section, plate or wall plate with infrequent corrugations, it is customary to insert plates from six to eight or ten feet in length and width between the fixed and movable follower heads for the purpose of applying corrugations to the plates, though it is obvious that corrugations may be applied to plates of any dimensions. For instance, corrugations may be applied to plates in lengths of ten, twelve to fourteen and sixteen feet and to accommodate plates of these different lengths, it is a purpose of this invention to construct the follower head or bolster in sections so that any number of bolster or follower head sections may be applied to the girder. In this event, the ends of the follower head or bolster sections have suitable openings 9 for the reception of bolts (not shown) which are used to connect the sections of the follower head or bolster together.

The follower head or bolster has a longitudinal central channel 10 which may be any width and depth and any shape, preferably of generally V contour. However, the lower portion of the channel may, in some instances, have parallel opposed walls 11, while the upper parts of the walls of the channel may diverge. The opposed diverging portions of the walls of the channel are grooved or cut to provide seats 12 for the reception of facing bars 13. The flat surfaces of the seats 12 are constructed in the same general plane with the diverging portions of the walls of the channel.

The lower portions of the seats 12 are arcuate, as at 14, and the facing bars 13 are correspondingly arcuate, as at 15. on their opposite longitudinal edges. Obviously, the facing bars are reversible, so that either of the arcuate edges thereof may be used for guiding the plate when creeping from opposite sides of the follower head or bolster during the forming of the corrugation. The arcuate portions of the seats 12 are of the same curvature as the arcuate edges of the facing bars, so that when the facing bars are in their seats, a close fit will be assured.

The facing bars may be made in sections or in lengths to correspond to the full length of the follower head or bolster. Preferably, the facing bars are designed to be constructed in sections corresponding to each section of the bolster or follower head, so that any pair of facing bars may be fitted to a section of the bolster. The facing bars have a plurality of bolt receiving openings 16, the opposite ends of which have beveled countersinks for the purpose of countersinking the heads of bolts 17 which pass through the walls of the channel and through the facing bars, there being nuts 18 on the ends of the bolts and located in the pockets of the follower head or bolster, so that access thereto is easily had.

The facing bars are not only reversible to permit either of their arcuate edges to be located adjacent the upper part of the follower head or bolster, but reversible to enable either of the faces of the bars to oppose each other. This may be accomplished due to the fact that the bolt receiving openings have their opposite ends provided with beveled countersinks. Certain walls of the pockets of the follower head or bolster diverge upwardly corresponding to the diverging walls of the channel 10.

The arcuate edges of the facing bars protrude beyond the upper portion of the bolster and are provided for the purpose of permitting the plate, when being equipped with a corrugation, to ride thereover when creeping toward the channel from opposite sides of the bolster. These arcuate edges of the facing bars may protrude any distance above the upper portion of the bolster. The corrugation, when completed, extends downwardly and, due to the arcuate edges protruding beyond the upper portion of the bolster, the opposite sides of the plate may be forced downwardly to assume partially diverging positions. These diverging positions of the opposite sides of the plate depend entirely upon the distance the opposite edges of the facing bars protrude beyond the upper portion of the bolster.

The opposite sides of the plate, that is, beyond the corrugation which is being formed, may extend in corresponding horizontal planes and not be disposed in downwardly diverging positions while the plate is being formed with a corrugation. However, the opposite sides of the plate beyond the corrugation may be disposed to diverge upwardly, that is, upwardly as long as the plate is resting upon the bolster. The positions of the opposite sides of the plate relative to the corrugation depend entirely upon the location where the follower head may cease to move, that is, with relation to the fixed head 19.

The fixed head 19 is also in the form of a casting which may be any proportions and any suitable shape, and it has adjacent its under face a longitudinal groove constituting a seat 20 for the reception of a corrugation forming knife 21. The fixed head may be of a length suitable to the maximum length of the bolster or follower head and will, therefore, accommodate bolsters or follower heads of less lengths.

Adjacent the opposite sides of the fixed head there are longitudinal recesses angular in cross section constituting seats 22 for the reception of the abutment beads 23. These abutment beads extend the full length of the fixed head and are secured in position in the seats by means of screw bolts 24. The fixed head may be any width according to the width of the widest portion between the facing bars, so as to permit the abutment beads 23 to position upon remote sides of the arcuate edges of the facing bars, that is, when the bolster or follower head ceases in its movement upwardly. If the widest portion between the facing bars is increased, then the distance between the abutment beads is increased.

The abutment beads protrude downwardly below the under face of the fixed head, so as to straddle the arcuate edges of the facing bars for the purpose of controlling the positions of the opposite sides of the plate as it is being formed with its corrugation. The remote sides of the abutment beads are curved on their edges, as at 25, to permit the plate as it is being bent to feed thereover and to easily creep from opposite sides of the head as the bolster moves upwardly with the girder.

The corrugation forming knife protrudes downwardly from the under face of the fixed head and is provided with opposite beveled faces 26 which diverge in the same general direction as the diverging walls of the channel 10. The greater portion of the corrugation forming knife has its opposite faces parallel and between where the lower portions of the parallel faces terminate merging into the diverging faces 26, side bars constituting beads 27 are fastened to the knife. These beads or side bars 27 may be removably fastened to the knife or welded thereto, and they protrude laterally sufficiently so that their curved faces may be co-extensive with the diverging faces 26, acting to govern the divergent directions of the walls of the corrugation formed in the plate and to enable an arcuate corrugation to be constructed.

The side bars or beads 27 and the abutment beads 23 are to be arranged to suit different thicknesses of plate. The side bars or beads 27 may be either bolted or welded to the knife and are necessary to overcome the different hardnesses of plate. It has been found through experience that if cold metal plates to be formed with corrugations were of equal hardness, the function of the beads or bars 27 would be dispensed with, but as it has been found through the same experience that the angle of the sides of the corrugation formed by the knife 26 will differ with the variation in the hardness or stiffness of the plates, it has been found necessary to provide some means to insure a reasonable similarity in form, that is, similarity in the form of the corrugations of the various plates. Experiences along this line show that the tendency of soft plates is to cling toward the knife as the knife is in the act of forming the corrugation, hence some such means as the beads or bars 27 must be used to regulate the uniformity of the angle of the corrugation.

As previously stated, after considerable experimenting, the use of beads or bars 27 has been found most practical. The beads or bars 27 come into play almost at the end of the downward stroke of the knife, pushing the sides of the corrugation apart to a fairly uniform distance. This distance is not absolutely uniform in every instance due to the variation in the hardness of the plates. For instance, it has been found that soft plates stay where they are pushed while those of increased hardness have a tendency to spring back slightly and in order to prevent the springing back of the sides of the corrugation, the beads or bars 27 are employed. When the sides of the corrugation spring back, they do contact with the beads, hence it will be seen how the beads or bars 27 act to cooperate with the plates according to the different hardnesses thereof. The radii of the arcuate edges of the facing bars are dependent upon the position of the side bars or beads 27. Their action, in combination with the abutment beads 23, gives the plate the desired shape of corrugation or indentation.

The lower projecting part of the corrugation forming knife also constitutes an essential factor in constructing the corrugation. In fact, due to the projecting part of the corrugation forming knife being thin enough and due to having parallel opposed faces with the side bars or beads attached thereto, the corners adjacent these parts are permitted to receive the varying inequalities in the plate. In fact, it is the combination of these various features and formation of the follower head and the fixed head, the channel 10 and the corrugation forming knife that causes the production of any desired form or width or depth of indentation or corrugation within the compass of the die. The diverging faces 26 extend in the same general direction as the diverging portions of the opposite walls of the channel 10 which also insures the proper forming of the corrugation.

The invention having been set forth, what is claimed is:

1. As an article of manufacture, a fixed head provided with a corrugation forming knife, and a removable bolster or head, the latter having a channel to receive the corrugation when formed by the knife, said channel having opposed reversible facing bars

with their edges projecting beyond the upper portion of the bolster and over which a plate creeps during the forming of the corrugation, the fixed head having means to straddle the facing bars and acting to depress the opposite sides of the plate the required distance.

2. The combination with a fixed die head provided with a corrugation forming means, of a movable bolster or head associated in opposed position to the fixed head and having a channel to receive the corrugation formed by the knife, said knife having opposed beads positioned to overcome the different hardnesses of plate during the forming of the corrugation.

3. The combination with a fixed die head provided with a corrugation forming knife, the lower portion of which is provided with opposed diverging faces, of a movable bolster or head associated in opposed position to the fixed die head and provided with a channel to receive the corrugation when formed by the knife, the channel having opposed diverging walls, said diverging walls at their lower portions merging into parallel opposed walls forming an extended bottom to the channel to permit of additional movement for the knife, whereby the corrugation may be formed with increased depth, said walls also terminating at their upper portions in arcuate edges protruding beyond the upper portion of the bolster and over which a plate may creep from opposite sides of the bolster.

4. The combination with a fixed die head provided with a corrugation forming knife, the lower portion of which is provided with opposed diverging faces, of a movable bolster or head associated in opposed position to the fixed die head and provided with a channel to receive the corrugation when formed by the knife, the channel having opposed diverging walls terminating at their upper portions in arcuate edges protruding beyond the upper portion of the bolster and over which a plate may creep from opposite sides of the bolster, and opposed beads fixed to the opposite faces of the knife constituting means to overcome the different hardnesses of plate, the fixed die head having abutment beads to straddle the arcuate edges of the diverging walls of the channel.

5. The combination with a fixed die head provided with a corrugation forming knife, of a movable bolster head having a channel with diverging walls to receive the corrugation formed by the knife, the diverging walls having longitudinal seats, and reversible elongated facing bars mounted in the seats.

6. The combination with a fixed die head provided with a corrugation forming knife, of a movable bolster head having a channel with diverging walls to receive the corrugation formed by the knife, the diverging walls having longitudinal seats, and reversible elongated facing bars mounted in the seats, said facing bars having opposite longitudinal arcuate edges to protrude beyond the upper portion of the bolster and over which a plate may creep from opposite sides of the bolster.

7. The combination with a fixed die head provided with a corrugation forming knife, of a movable bolster head having a channel with diverging walls to receive the corrugation formed by the knife, the diverging walls having seats, reversible facing bars mounted in the seats, said facing bars having opposite longitudinal arcuate edges to protrude beyond the upper portion of the bolster and over which a plate may creep from opposite sides of the bolster, and abutment beads detachably carried by the remote edges of the fixed head and adapted to straddle the arcuate edges of the facing bars for governing the positions of the opposite sides of the plate.

8. The combination with a fixed die head provided with a corrugation forming knife, of a movable bolster head having a channel with diverging walls to receive the corrugation formed by the knife, the diverging walls having seats, reversible facing bars mounted in the seats, said facing bars having opposite longitudinal arcuate edges to protrude beyond the upper portion of the bolster and over which a plate may creep from opposite sides of the bolster, and abutment beads detachably carried by the remote edges of the fixed head and adapted to straddle the arcuate edges of the facing bars for governing the positions of the opposite edges of the plate, the lower portion of the corrugation forming knife having diverging faces, the remaining portions of the faces of the knife being parallel and provided with beads constituting means to overcome the different hardnesses of plate.

9. The combination with a fixed die head provided with a corrugation forming knife, of a movable bolster head having a channel with diverging walls to receive the corrugation formed by the knife, the diverging walls having seats, reversible facing bars mounted in the seats, said facing bars having opposite longitudinal arcuate edges to protrude beyond the upper portion of the bolster and over which a plate may creep from opposite sides of the bolster, and abutment beads detachably carried by the remote edges of the fixed head and adapted to straddle the arcuate edges of the facing bars for governing the positions of the opposite sides of the plate, the lower portion of the corrugation forming knife having diverging faces, the remaining portions of the faces of the knife being parallel and provided with beads constituting means to overcome the different hardnesses of plate, the association

of the knife with the channel of the bolster, together with their relative proportions, permitting of the reception of the varying inequalities of the plate and causing the plate to creep or feed from opposite sides of the bolster.

10. The combination with a fixed die head provided with a corrugation forming knife, the lower portion of which is provided with opposed diverging faces, of a movable bolster or head associated in opposed position to the fixed die head and provided with a channel to receive the corrugation when formed by the knife, the channel having opposed diverging walls, said diverging walls at their lower portions merging into parallel opposed walls forming an extended bottom to the channel to permit of additional movement of the forming knife, whereby the corrugation may be formed with an increased depth, as a plate creeps from opposite sides of the bolster.

In witness whereof, in the presence of two witnesses, the inventor's signature is hereunto affixed.

WILLIAM M. CONNERY.

Witnesses:
W. E. WESCOTT,
R. A. BOSWELL.