

[54] **METHOD OF FORMING MULTIPLE HOLE CONDUIT CLAMPS AND HANGERS**

[72] Inventor: **Frank W. Pepe**, 637 Prospect Drive, Lordship, Conn.

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[58] Field of Search. 72/332, 405; 29/149.5 C, 150, 29/417; 113/116, 116 HH, 116 H, 116 U, 116 BB, 116 AA

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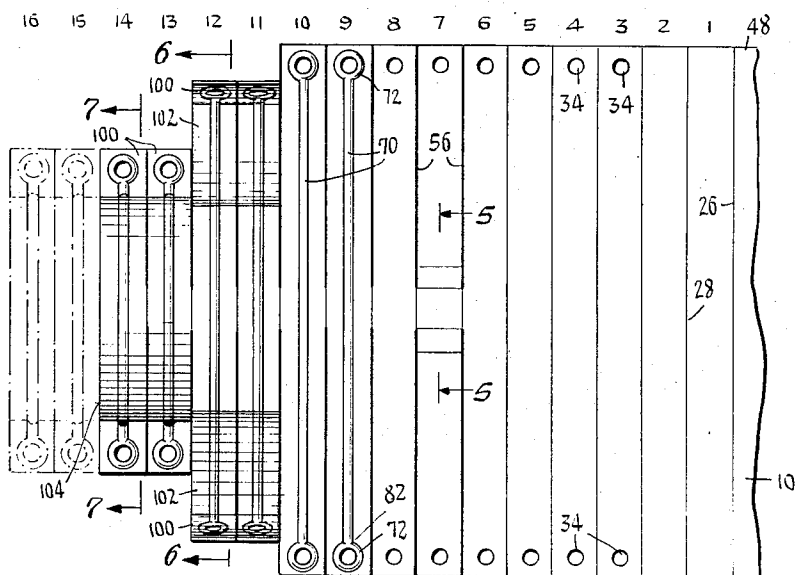
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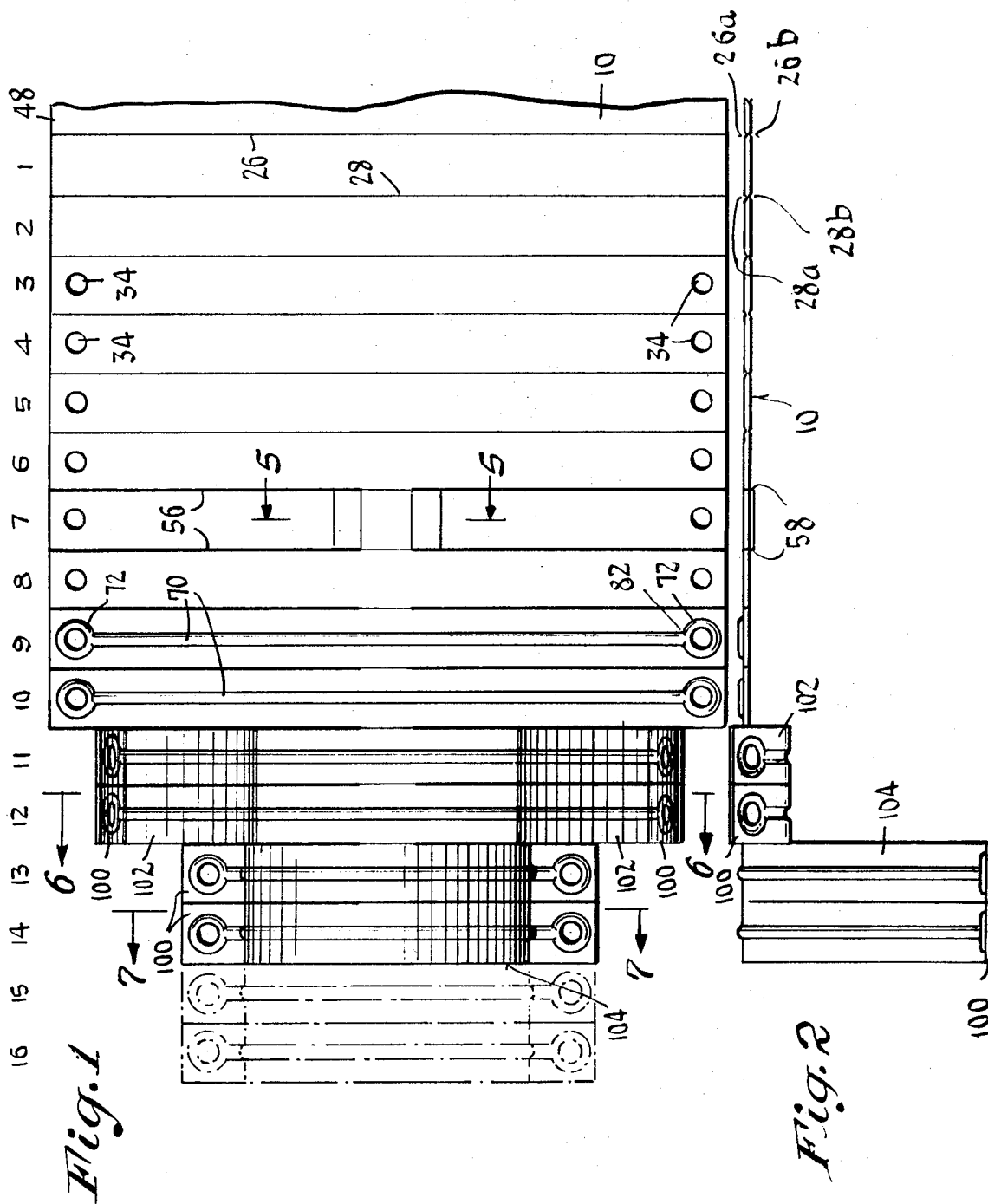
Primary Examiner—Richard J. Herbst
Attorney—Martin D. Wittstein

[57] **ABSTRACT**

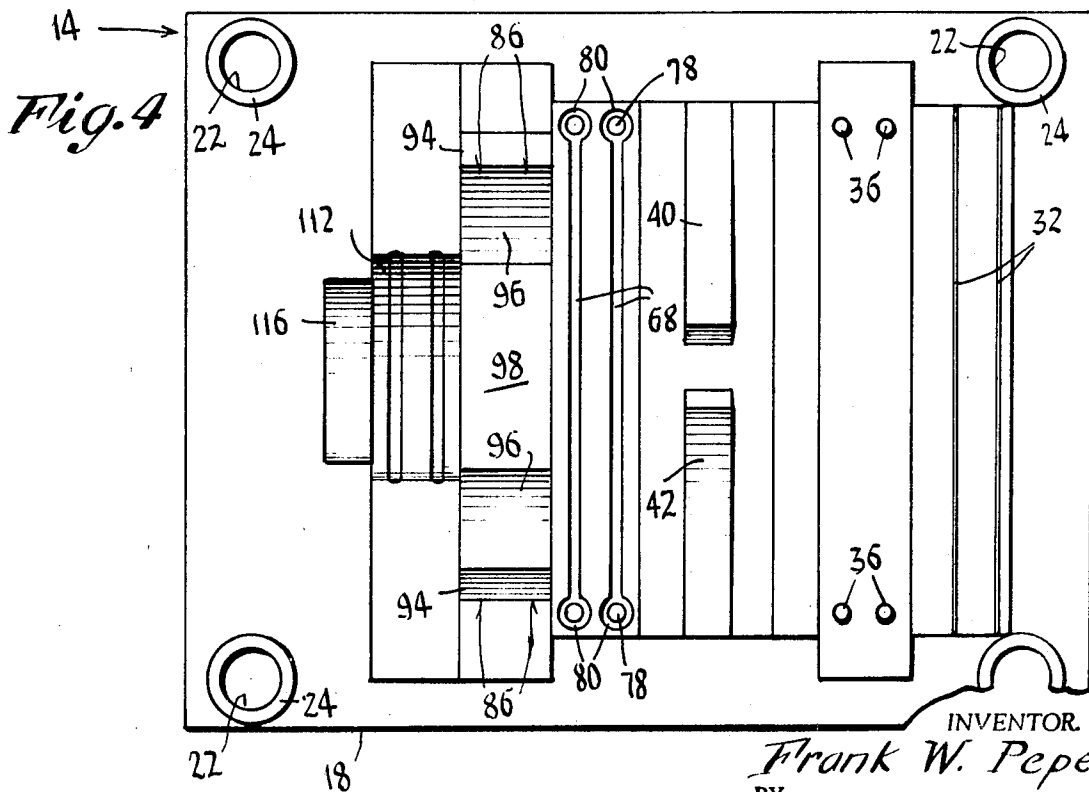
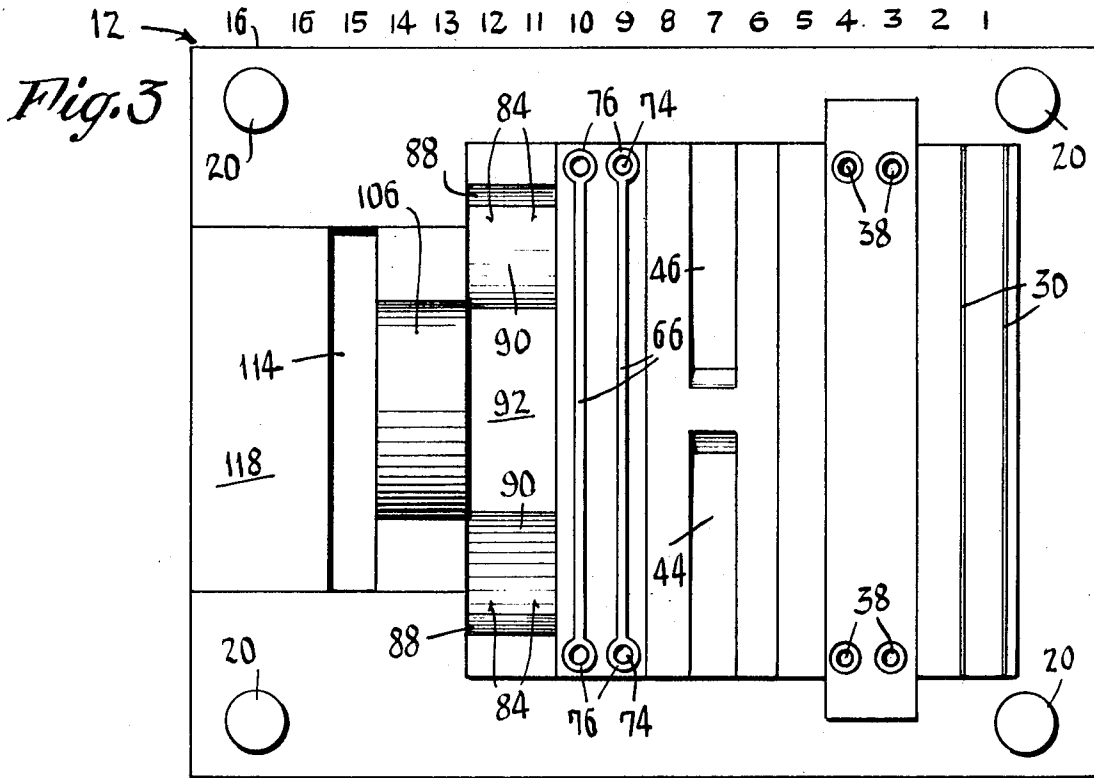
A method of continuously forming multiple hole conduit clamps and hangers from flat strip stock wherein individual clamps or hangers are blanked in side by side relationship longitudinally of the strip but only partially across the width of the strip so as to leave a central unblanked portion, and subsequently formed in even numbered multiples by intermittent feeding of the strip stock through a progressive die punch press. Individual clamps or hangers are partially severed from each other along their ultimate side edges leaving a central carry through portion of the strip within the clamp blank length, then progressively die formed by deformation from the free ends of each clamp or hanger blank toward the center of the strip, and finally severed from the strip in multiples of adjacent pairs of finished clamps or hangers by punching alternate clamps or hangers in opposite directions.

10 Claims, 13 Drawing Figures

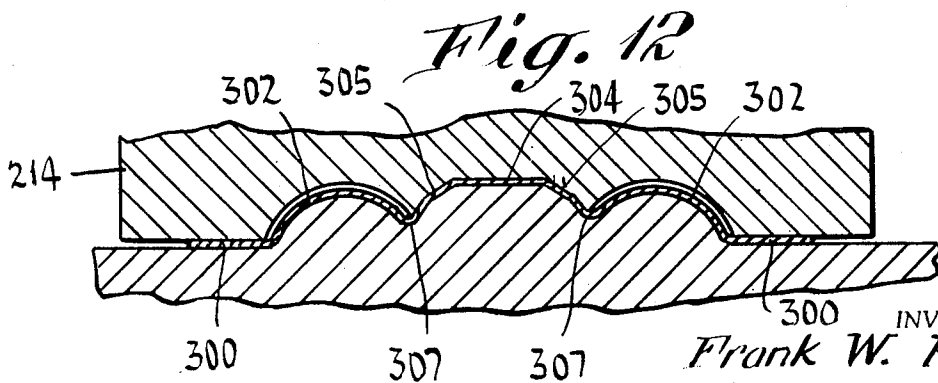
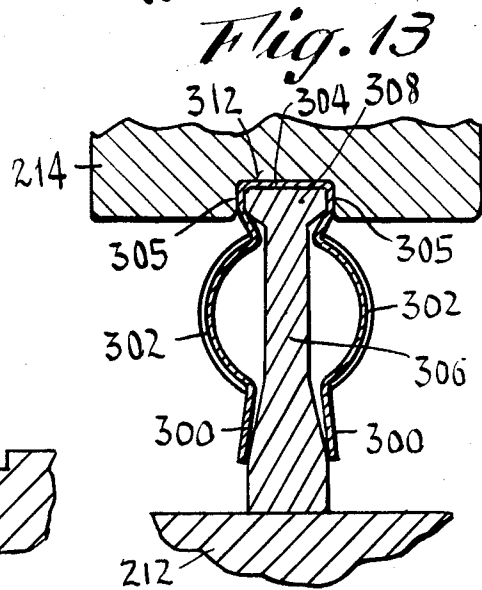
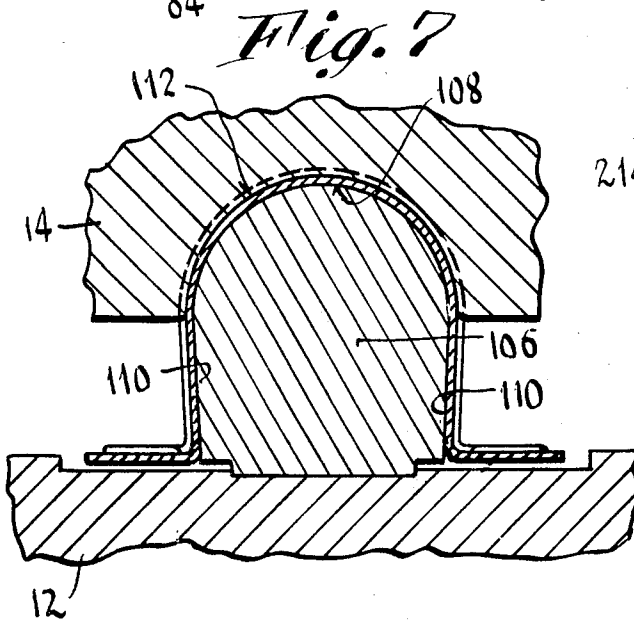
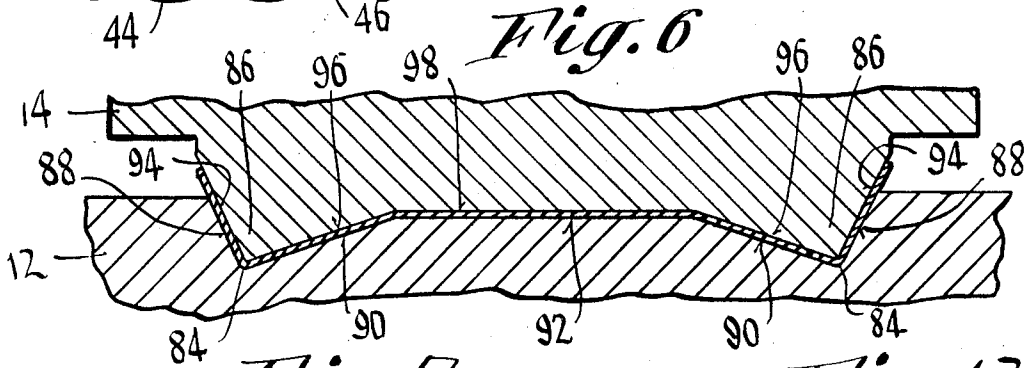
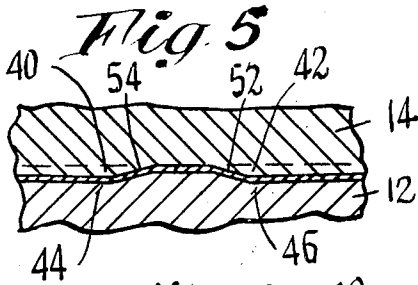




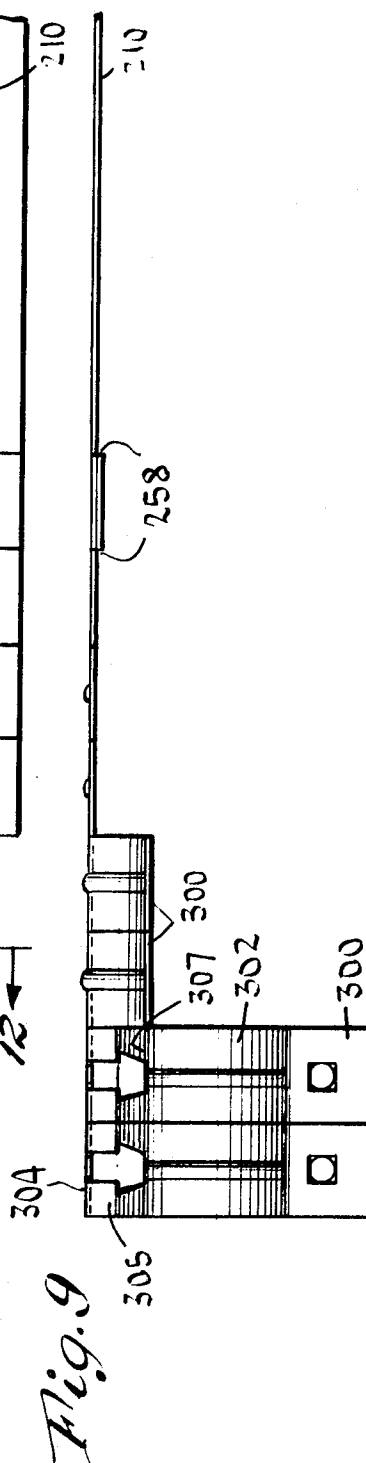
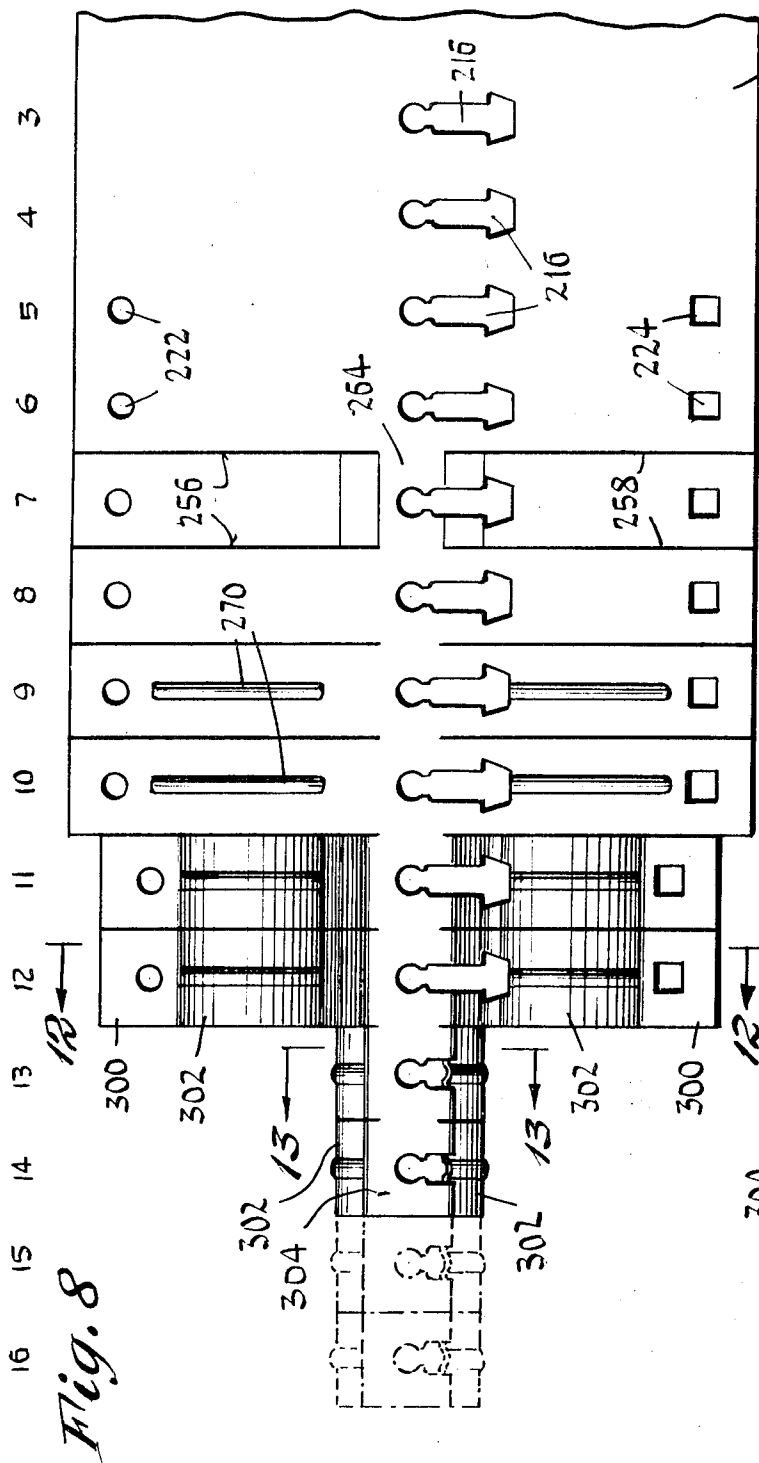
INVENTOR
Frank W. Pepe
 BY *Martin D. Wittstein*
 ATTORNEY



INVENTOR.
Frank W. Pepe
 BY
Martin D. Wittstein
 ATTORNEY



INVENTOR.
Frank W. Pepe
 BY
Martin O. Wittstein
 ATTORNEY



INVENTOR
Frank W. Pepe
 BY
Martin O. Wittstein
 ATTORNEY

Fig. 10

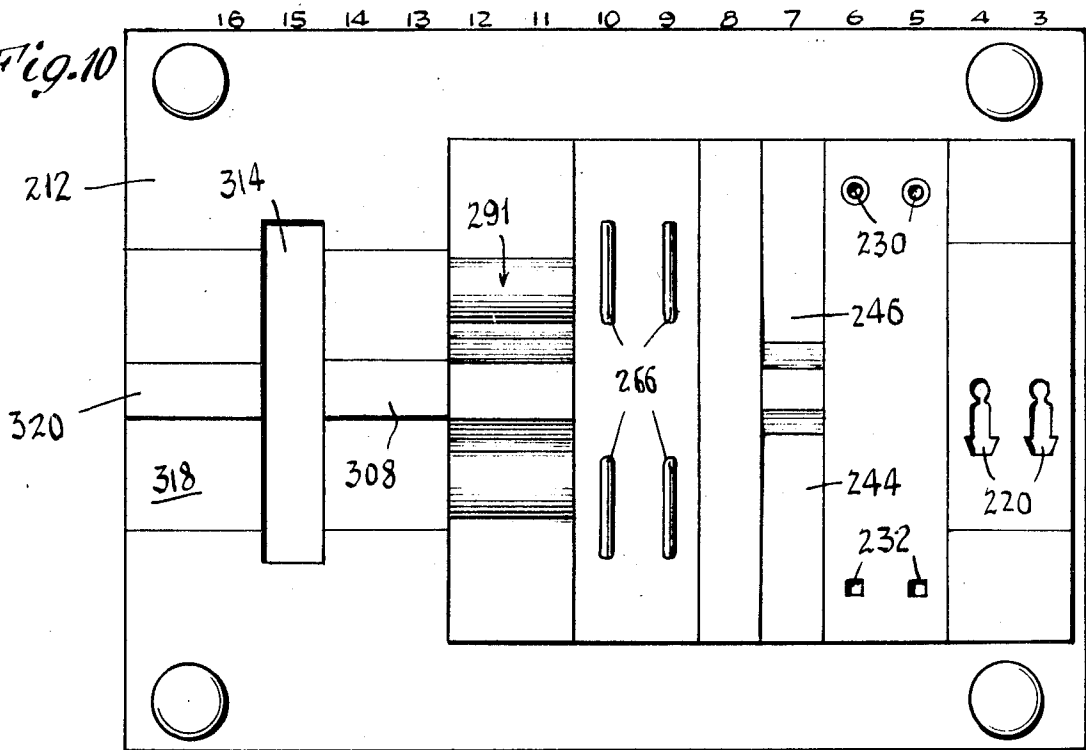
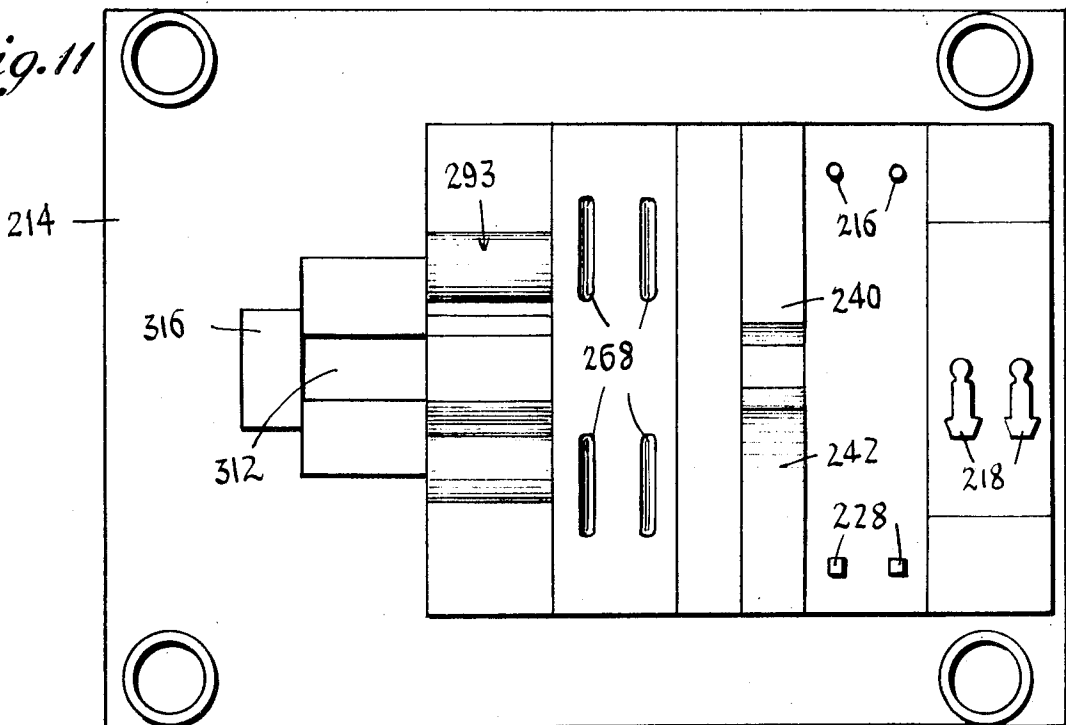


Fig. 11



INVENTOR.
Frank W. Pepe
 BY
Martin D. Wittstein
 ATTORNEY

METHOD OF FORMING MULTIPLE HOLE CONDUIT CLAMPS AND HANGERS

CROSS REFERENCES

This application is a continuation-in-part of my copending application Ser. No. 680,252, filed Nov. 2, 1967, now U.S. Pat. No. 3,461,708, issued Aug. 19, 1969. This application also discloses and claims a novel method of making pipe hangers of the type disclosed and claimed in my copending application Ser. No. 724,970, filed Apr. 24, 1968, now U.S. Pat. No. 3,526,381, issued Sept. 1, 1970.

BRIEF SUMMARY OF THE INVENTION

This invention relates generally to the metal working art and more particularly to an improved method of making metal conduit clamps and hangers by sequential forming of flat strip stock in a progressive die punch press.

The type of clamp or hanger to which the present invention relates is basically a partial or full U-shaped member, depending on whether it is a clamp or hanger as more fully explained below, which is utilized in vast quantities in commercial and residential structures for securing pipe, conduit, cable, etc. to a flat supporting surface such as a wall or ceiling or to the surfaces of structural members in such buildings, or for suspending pipe or conduit from a ceiling or other overhead structural members.

The above mentioned clamp and pipe hanger have several structural characteristics in common, principal among which is that both have generally similar portions thereof disposed in opposed spaced relationship, and differ mainly in the basic overall configuration of the finished item. The clamp is formed from a flat elongate metal strip and generally comprises a pair of flat end portions each having an aperture therethrough which may be surrounded by a raised annular area for reinforcing purposes. The aperture is adapted to receive a securing member such as a screw or bolt for securing the clamp to the supporting surface. Integrally secured to each flat end portion is a substantially semicircular midportion adapted to fit over a pipe or conduit for which the midportion is appropriately sized, the midportion being joined to the flat end portions at junctures defined by substantially right angles in the metal strip. The clamp is preferably provided with a pair of parallel reinforcing raised ribs which extend over the entire midportion and into the flat end portions and there merge with the raised annular areas surrounding the apertures. The junctures of the flat end portions may be spaced a little closer together than the diameter of the midportion thereby defining a slightly restricted entryway for the pipe or conduit so that the clamp snaps thereover with a resilient snap-over-center fit and is thereby retained in place prior to being secured to a supporting surface.

The above mentioned hanger, of which the method of making is also covered by the present invention, is fully disclosed in the above mentioned copending application Ser. No. 724,970, and comprises very generally a pair of flat end portions integrally connected to a midportion, and being adapted, after the hanger is passed over a pipe, to be disposed in spaced apart parallel relationship. Each flat end portion has an aperture therein to receive a common securing element, such as a screw, therethrough, in order to securely fasten the hanger to a pipe. The end portions are connected to a pair of substantially semicircular inner portions which are adapted to fit around and engage a major portion of the circumference of the pipe for which the hanger is properly sized. A flat midportion is disposed between the semicircular inner portions and is spaced away from the pipe surface, the midportion having an aperture therein through which a bolt or other suitable securing element can be passed in order to secure the hanger to any desired supporting surface. The hanger is also preferably provided with one or more reinforcing ribs as in the case of the clamp, and may also be provided with either reinforcing or locking means adjacent the central aperture to strengthen the hanger and to prevent securing elements from inadvertently

falling out of the aperture prior to securing the hanger to the supporting surface.

Heretofore in the continuous manufacture of clamps or hangers of the type above described, it is customary to make each unit by sequentially carrying out a series of forming operations on a flat strip of metal stock which is intermittently fed through a progressive die punch press. Strip stock is selected which has a width corresponding to the desired width of the finished clamp or hanger. The strip stock is then fed to the punch press a linear distance, for each operation of the press, which is equal to the length of the clamp or hanger blank before any curvature is applied thereto. As the strip stock advances through the several forming stations of the progressive die, the operations required to form the apertures, ribs and other structural characteristics of the clamp or hanger other than curvature are carried out in sequence, after which the still flat clamp or hanger blank is severed from the strip and the curvature portions are then applied to the flat blank which it is in the same location in the die as it was when severed from the strip.

In the above described prior art methods, the final curvature of the curved portions of the clamps or hangers is formed either in a stationary lower die having an upwardly opening cavity into which a punch descends, or on a stationary lower punch over which a die having a downwardly opening cavity descends. In either case, it is necessary to sever the flat blank from the strip before the forming operation takes place, otherwise the strip, with the clamp or hanger blank still attached thereto, cannot be fed to the next working position. This is so for the reasons that, if the strip is fed over a stationary lower die having an upwardly opening cavity, the strip will not feed properly over a pilot pin which projects upwardly from the die in advance of the cavity, the pilot pin being necessary to engage in the aperture in the strip to hold the strip stationary when the punch descends so as to force the metal to flow into the cavity only from the free end of the strip. Also, even if the strip were forced over the pilot pin during feeding until the pilot pin engaged the next aperture, once the curved portion of the clamp or hanger were formed there would be no way of removing the hook portion from the cavity without seriously bending the strip, thereby resulting in very complicated feeding and guiding problems and possible damage to the finished clamp or hanger.

On the other hand, if the strip is fed over a stationary lower punch over which a die having a downwardly facing opening descends, it is apparent that the punch presents a complete barrier to the passage of the strip. And again, even if the strip were forced over the punch, it would be impossible to further feed the strip without seriously bending it to remove the curved portions of the clamp or hanger from the punch.

An additional problem is encountered in the case of the hanger that this element cannot be fully formed in a single forming step due to the severe bends and curvatures inherent in the shape of the hanger. This is so for the reason that the two semicircular inner portions and the raised flat midportion are formed while the hanger blank is essentially flat. Thereafter the final shape of the hanger is formed by bending around another die which imparts the substantial U-shape appearance to the hanger.

It is therefore apparent that it is extremely difficult, if not virtually impossible, to form the clamp or hanger in the prior art process while the blank is still connected to the strip due to the problems encountered in attempting to form the clamp or hanger in the same plane in which the strip is fed. It therefore becomes necessary to first sever the blank from the strip so that it can be shifted from the feeding plane of the strip to a different plane for forming. The severing is usually accomplished by shearing with the movable punch or die member as the case may be. However, it is still necessary to use a pilot pin which is engaged in the aperture of the blank to hold one end of the blank so that all of the metal for the curved portions flows from the free end of the blank, thereby maintaining a fixed area of flat end portion of the blank surrounding the apertures.

A great number of problems arise, and difficulties and disadvantages result, from forming the curved portions of the clamp or hanger after the blank therefor has been severed from the strip, all of which generally result in low production and inferior quality. Firstly, by virtue of the fact that the clamps and hangers are initially blanked out longitudinally of the strip stock, the production rate of a given punch press, when making a given size clamp or hanger, is limited by two factors, namely the cycle time of the press and the cycle time of the stock feeding mechanism to feed the required increment of stock. Since the press can deliver only one finished clamp or hanger for each operating cycle of the press and stock feeding mechanism, maximum production rate is achieved, for the particular clamp or hanger on the particular press, when the above factors have been adjusted for maximum rate of operation.

Secondly, a number of factors contribute to poor quality of clamps formed by the prior art methods, of which a significant one is poor sizing of the clamp or hanger due to variations in setting. This results from the fact that the entire curvature of the curved portions of the clamp or hanger must be formed in a single deep forming operation on the flat blank. The inherent springback in the metal of the strip causes variations in the degree of final curvature or setting of the curved portions of the clamp or hanger with the result that exact uniformity of clamp size is often difficult if not impossible to achieve. Another significant disadvantage of the prior art methods is that there is poor control of the positioning of the clamp or hanger blank over and in the die once the blank has been severed from the strip. The pull on both ends of the blank during deformation of the metal to form the curved portions is so severe that frequently the aperture is stretched into a somewhat elongate shape, with the result that dimensions cannot be maintained and the metal around the aperture may be weakened. Therefore the prior art methods are limited to relatively small size clamps and hangers and the use of relatively soft metals.

Still other problems which arise in the prior art methods are that it is impossible to form sharp deep ribs with small radius edges in the curved portion forming dies due to the flow of metal around the die surface. And it is extremely difficult to form such ribs while the blank is still flat and connected to the strip unless a small area of the strip is notched out where the rib or ribs at one end of the blank contact the other end of the adjacent blank which is not to be ribbed, thereby causing wastage of material. Also, relatively movable clamp or hanger ejecting parts and actuating mechanism therefor are required, thereby increasing the cost of the punch press dies. Still further, the use of very narrow strip stock (equal to the width of the finished clamp or hanger) is considerably more expensive than wider strip stock due to the great amount of slitting which must be done to the relatively wide stock which emerges from the rolling mills as raw material.

All of the foregoing disadvantages and difficulties, as well as others, of the prior art methods are materially reduced or entirely avoided by the practice of the present invention which, in its broader aspects, comprises the steps of intermittently feeding a flat strip stock past a plurality of serially arranged working stations at which a plurality of working operations are simultaneously carried out during the dwell portions of the intermittent feeding of the strip, forming at a first working station at least one pair of elongate side by side adjacent blanks such that each blank of the pair extends from one side edge of the strip stock to the opposite side edge thereof and each blank of the pair is separated from the strip stock along the side edge of each blank over a major portion of its length from the side edges of the strip stock toward the center thereof, but is unseparated from the strip stock over a short length of each blank adjacent the center of the strip stock, deforming at a first subsequent working station each blank of the pair to impart a desired shape thereto which has substantially identical portions on opposite sides of the centerline of the strip stock which are adapted to cooperate with each other but which configuration remains essentially in the elongate shape of the

blanks, then deforming at a second subsequent working station each blank of the pair to bend a substantial portion of each blank on opposite sides of the centerline of the strip stock substantially out of said elongate blank shape to thereby dispose said substantial portions of said blanks in a desired opposed spaced relationship with each other thereby providing at least one pair of finished clamps or hangers still integrally connected to the strip stock, and severing at a terminal working station at least the terminal pair of finished clamps or hangers along the unseparated side edge portion of the terminal pair of finished clamps or hangers whereby at least two individual clamps or hangers are simultaneously separated from the strip stock and from each others.

In briefly considering some of the more specific aspects of the present invention, and particularly in connection with a presently preferred practice of the invention, a suitable metal strip stock is intermittently fed between the punch and die parts of any suitable reciprocating progressive die punch press in which the several clamp or hanger forming operations are simultaneously carried out during the dwell portions of the intermittent feeding. The initial blank forming may, although not necessarily, be accomplished by coining the opposite surfaces of the strip laterally across the strip from side edge to side edge, thereby defining the longitudinal edges of one blank. In the absence of the coining, the first major step in the forming operation is severing or lancing the strip along a major portion of the side edges of each blank from the side edge of the strip toward the centerline thereof, a relatively short length of the side edge of each blank being left unsevered in order to provide an integral carry through portion of the strip which maintains the partially severed blanks together in strip form.

As an incident to the lancing operation, an aperture is punched through each blank adjacent the opposite end thereof, which punching may take place either before or after the lancing operation, but in either event must take place prior to any deformation of the blank out of the plane of the strip stock. Also, in the case of the hanger, a central, specially shaped aperture must be punched in each blank, which operation may accompany the aperture forming operation or it may be carried out separately, although again it must precede any deformation of the blank out of the plane of the strip stock. Finally, particularly in the case of the clamp, one or more elongate reinforcing ribs are formed to extend over a major portion of the length of each blank, and the raised annular reinforcing area surrounding the apertures are simultaneously formed with the elongate ribs. The forming of the ribs, of provided at all, must follow the lancing procedure in order to accommodate the slight amount of flow of metal laterally of the blank during the forming of the ribs.

The next significant step in the practice of the invention is the deformation of each blank out of the plane of the strip stock to form the curved portions and shape of the finished clamp or hanger. This deformation is carried out in at least two forming stages at separate working stations, with the metal of each blank being drawn from the free end edges of the blank toward the central portion of the blank or the center of the strip stock. Thus, in the case of the clamp, the first stage forming consists of bending the end portions of the blank which contain the apertures to an angle relative to the initial plane of the blank such that the end portions will again be coplanar when the mid portion of the blank is deformed to its final semicircular configuration. Also, a flat portion adjacent each end portion is also bent slightly out of the plane of the blank. The strip is then advanced one increment of movement so that the partially formed blanks shift laterally from the partial forming station to the full forming station, where a further deforming operation takes place which imparts the semicircular configuration to the partially formed blank. At this point, remembering that each forming operation is simultaneously carried out on at least two adjacent blanks, a pair of complete clamps is formed although they are still integrally connected to the strip.

In the case of the hanger, substantially the same two-stage forming operation is carried out, the only difference being in the shape of the partially and fully formed article. The partial forming stage imparts the two semicircular spaced apart cooperating portions of the hanger which surround the pipe when the hanger is installed thereon, but the blank is still otherwise essentially flat. The second forming stage bends the two semicircular portions into their cooperating positions with the end portions containing the apertures in spaced parallel relationship. Again, at this point, a pair of finished hangers is provided which are still connected to the strip. In both cases the first stage forming leaves the clamp and hanger blanks essentially in their elongate configuration.

The final step in the process is the severing of the pair of fully formed clamps or hangers from the strip in such a manner that the pair of clamps or hangers is severed from the strip of partially formed clamps or hangers and simultaneously therewith the individual clamps or hangers of the pair are severed from each other, both severing operations being carried out simultaneously by a single movement of the reciprocating member of the punch press. This is accomplished, in the preferred practice of the invention, by severing the next to last clamp or hanger (in the case of forming only a pair with each operation of the punch press) along the unsevered side edge portions of the clamp or hanger by supporting the end clamp or hanger and forcing the next to last clamp or hanger through a suitable opening provided in the stationary die member.

As will be more readily apparent from the detailed description which follows, the two particularly advantageous features achieved by the practice of the present invention are that the clamp and hanger blanks are formed simultaneously in pairs by the lancing operation with the result that very substantial increases in unit production of finished clamps and hanger is achieved, with the minimum increase being double that of conventional methods of making such clamps and hangers. As more fully explained below, any even numbered multiple of clamps or hangers as desired may be formed and severed from the strip with each operating cycle of the punch press since it is possible to feed the strip in increments of any number of pairs of blanks as desired to carry out the several forming operations simultaneously on a corresponding number of pairs of blanks, the only limitation being the practical size of the dies which a particular punch press can handle. Thus, by the unique arrangement of severing punches and dies hereinafter described, it is possible, as a practical matter, to obtain production increases of four to eight times that of prior art methods.

Another highly advantageous feature is that all of the necessary operations for forming a pair of clamps or hangers are performed while the blanks are still integrally connected to the strip which is intermittently moving through the progressive dies laterally in relation to the individual blanks, with the result that very high quality clamps and hangers are produced by this method. Since the deformation forces acting on the blanks are opposed and balanced across the centerline of the strip, excellent positioning of the blanks in the dies can easily be maintained so that the finished clamps and hangers are free from metal working defects. Also, since the curved and other deformed portions of the clamps and hangers can be formed in more than one stage, variations in setting are substantially eliminated thereby achieving more accurate and uniform sizing from one finished article to another.

In addition, other advantages are obtained, which overcome the aforementioned shortcomings of prior art methods, such as more accurate configuration of rib formations, elimination of costly ejecting mechanism from the punch press, reduction or elimination of material waste and reduction in material cost through the use of wider strip stock.

Having now described the general nature of the present invention, it is a principal object thereof to provide an improved method of making double hole conduit clamps and hangers.

It is another object of the present invention to provide a method of making two hole conduit clamps and hangers in which all operations necessary for forming a pair of clamps are carried out while the clamp blanks are still integrally connected to a strip of blanks which is intermittently moving through progressive dies.

It is still another object of the present invention to provide a method of making two hole conduit clamps and hangers in which finished articles are produced in any desired even numbered multiple for each operating cycle of the punch press.

It is yet another object of the present invention to provide a method of making two hole conduit clamps and hangers in which deformation of a portion of the blank is carried out in a plurality of forming stages from flat to final full curvature.

It is a further object of the present invention to provide a method of making two hole conduit clamps and hangers in which a considerably wider strip stock can be used than the width of an individual clamp or hanger.

It is still a further object of the present invention to provide a method of making two hole conduit clamps and hangers which eliminates the need for complex and costly die ejecting parts and actuating mechanism therefor.

It is another object of the present invention to provide a method of making two hole conduit clamps and hangers which is highly efficient, relatively simple, and which produces clamps of uniform high quality.

These and other objects and advantages of the present invention will become more apparent from an understanding of the following detailed description of presently preferred practices of the invention when considered in conjunction with the accompanying drawings in which:

FIG. 1 is a plan view of a strip stock for the two hole clamp formed by the practice of the present invention, showing the successive stages of forming of the clamp blanks from raw material to finished clamps being severed from the strip;

FIG. 2 is a side elevation of the strip stock of FIG. 1;

FIG. 3 is a plan view on a reduced scale of a stationary female die member for carrying out the several metal working operations which are performed on the strip stock shown in FIG. 1 and FIG. 2;

FIG. 4 is a bottom view on a reduced scale of a reciprocating male punch holder adapted to cooperate with the die member shown in FIG. 3;

FIGS. 5-7 are sectional views of an enlarged scale taken on the lines 5-5 to 7-7 of FIG. 1 which show the strip stock in several of the forming stages with corresponding portions of the dies and punches of FIGS. 3 and 4 superimposed under and over the strip stock;

FIG. 8 is a view similar to FIG. 1 showing the method of formation of the pipe hanger;

FIG. 9 is a view similar to FIG. 2 in side elevation of the strip of FIG. 8;

FIGS. 10 and 11 are views, similar to FIGS. 3 and 4, of the die and punch members respectively used in the formation of the hanger; and

FIGS. 12 and 13 are views, similar to FIGS. 5-7, in section showing some of the forming stages for the hanger.

DETAILED DESCRIPTION OF THE INVENTION

Referring now to the drawings and particularly to FIGS. 1 through 4, the method of the present invention for forming two hole clamps begins with a strip of metal 10 which is relatively wide in comparison to its thickness and is of indefinite length. The strip 10 is intermittently fed in predetermined increments between the stationary die member 12 and the reciprocating punch holder 14 of any suitable punch press which operates in conjunction with a suitable strip feed mechanism to cause the die member and punch holder to come together for a metal forming operation during the dwell periods of the intermittent feeding of the strip. Since the details of the strip feed mechanism and the punch press form no part of the present invention, they are not further described or shown herein.

It should be understood that the punch holder 14 as shown in FIG. 4 is mounted over the die member 12 by turning the punch holder upside down so that the forming surfaces of each member are adjacent and the edge 16 of the die member is coincident with the edge 18 of the punch holder. The die is provided with a plurality of upstanding posts 20 over which apertures 22 and heavy guide rings 24 on the punch holder slide in order to maintain proper alignment of the several forming surfaces hereinafter described as the two members engage and disengage with the strip stock therebetween when the punch press reciprocates the punch holder 14.

It should also be understood that in the practices of the invention hereinafter described, the progressive die and punch members are formed to perform each operation simultaneously on at least two clamp blanks, the strip stock being fed an increment of the width of at least two clamp blanks with each feeding operation, so that for each operating cycle of the press, at least two clamp blanks are formed and at least two finished clamps are severed from the strip. Also, for the purpose of more easily comparing the several working stations of the die and punch members 12 and 14 with the corresponding work performed on the strip 10, both the die member shown in FIG. 3 and the strip stock shown in FIG. 1 have been provided with guide numbers 1-16 reading from right to left, these numbers being spaced in accordance with the width of a clamp blank both on the die member and the strip stock.

The first general step performed on the strip stock 10 is the forming of flat clamp blanks in side by side relationship along the longitudinal dimension of the strip stock with each blank extending from one side edge of the strip stock to the other side edge thereof. As previously indicated above, this may optionally be accomplished by means of coining one or both surfaces of the strip stock by means of V-shaped coining punches mounted on one or both of the die and punch members 12 and 14, and arranged to form a V-shaped notch in the surface or surfaces of the strip stock to define the boundaries of the clamp blanks thereon.

Thus, this initial forming stage may be accomplished by coining the strip stock 10 at two spaced apart locations 26 and 28, as seen in FIG. 1, by means of coining punches 30 and 32, seen in FIGS. 3 and 4, on the die and punch members respectively. As seen in FIGS. 1 and 3, this coining would take place over the area occupied by the clamp blanks indicated by guide numbers 1 and 2. The coining punches would impress a V-shaped notch into the opposed surfaces of the strip stock 10 indicated by the lines 26 and 28 on the surface shown in FIG. 1 and as actually shown in FIG. 2 and indicated by the numerals 26a-26b and 28a-28b respectively.

The next operation takes place in the clamp blank areas indicated by the guide numbers 3 and 4 where apertures 34 are punched through the strip stock 10 closely adjacent the longitudinal side edge of the strip. The apertures 34 are formed by means of punches 36 carried by the punch holder 14 which mate with apertures 38 formed in the die member 12. The apertures 34 serve to receive nails or other securing members used to secure the finished clamp to a flat supporting surface.

It should be recognized that the step of forming the apertures 34 is carried out at the locations indicated by guide numbers 3 and 4 only as a matter of convenience, and that these apertures can be formed at any prior or subsequent stage in the formation of the finished clamps so long as it is done while the clamp blanks are still flat and before any out of plane deformation takes place.

The clamp blank areas indicated by the guide numbers 5 and 6 are non-working positions on the die member and punch holder due to the practical necessity of providing sufficient space between working stations on the die and punch members to convert from one type of working operation to another without interference therebetween. It will be understood that additional non-working stations on the punch and die members have been omitted for the sake of eliminating unnecessary detail from the drawings.

The next important operation to take place, which may be the first important operation if the optional coining step is

omitted and the holes 34 are formed at a later stage, occurs between the clamp blank areas indicated by the guide numbers 6, 7 and 8 and consists of separating, preferably by lancing, the longitudinal side edges of each clamp blank from the strip stock only along a major portion of the length of each clamp blank from the side edges of the strip stock 10 toward the center thereof, while leaving an unseparated portion of the side edge of the clamp blank over a short length thereof which crosses the longitudinal centerline of the strip 10. The lancing is done in such a way that at least two clamp blanks are severed with each drop of the press after the first or setup cycle has taken place.

Thus, a pair of substantially rectangular punches 40 and 42 carried by the punch member 14 in the area indicated by the guide number 7 are adapted to engage with a pair of rectangular recesses 44 and 46 formed in the die member 12, a portion of the punches 40 and 42 and recesses 44 and 46 being shown in FIG. 5. The punches 40 and 42 and the recesses 44 and 46 extend from the opposite side edges 48 and 50 of the strip 10 toward the centerline thereof, but the punches and recesses terminate short of the strip centerline at the outwardly tapered portions 52 and 54 of the punches as seen in FIG. 5. Thus, the clamp blanks located at the positions indicated by the guide numbers 7 and 8 are lanced along the lines 56 and 58 from the side edge of the strip to the points indicated as 60 and 62 adjacent the centerline of the strip 10, thereby leaving a short length of the clamp blanks unseparated from the strip stock so as to provide a central carry through portion 64 for each clamp blank which serves to maintain the individual blanks integrally connected with the strip stock throughout the remainder of the forming operations.

Since the downstream or left hand edge of the clamp blank indicated by the guide number 8 has been severed in a previous operation of the press, the present operation serves to sever the other side edge of the clamp blank at the number 8 position, which is common to the left hand side edge of the clamp blank at the number 7 position, as well as the right hand edge of the clamp blank at the number 7 position. It will be understood, therefore, that two laterally adjacent clamp blanks have now been formed in which each clamp blank extends from one side edge of the strip stock to the other side edge thereof, but is separated from the strip stock along only a major portion of the length of each blank from the opposite side edges of the strip toward, but not reaching, the centerline of the strip.

The next forming operation to be carried out, still on the flat clamp blanks, is the ribbing and aperture reinforcing which takes place in the clamp blank areas indicated by the guide numbers 9 and 10. Referring to FIGS. 3 and 4, the die member 12 is provided with a pair of elongate parallel recesses 66 into which the strip stock 10 is forced by a corresponding pair of elongate parallel punches 68 carried by the punch holder 14. The recesses 66 and punches 68 form an elongate reinforcing rib 70 on each adjacent clamp blank of the pair being formed which extends from a point adjacent one aperture 34 along the entire length of the clamp blank to a point adjacent the opposite aperture.

At the same time that the longitudinal reinforcing ribs 70 are being formed and at the same working location, an annular reinforcing rib 72 is formed on each clamp blank surrounding each aperture 34. These ribs are formed by a plurality of posts 74 carried by the die member 12 which have a diameter larger than the diameter of the apertures 34, each post being surrounded by an annular recesses 76 having the desired configuration of the rib 70. The punch holder 14 is provided with a plurality of bores 78 which are positioned to receive the posts 74, and each bore 78 is surrounded by an annular punch 80 which matches the recess 76 in the die member 12. As best seen in FIG. 1, the several mating posts, bores, punches and recesses above described, both for the longitudinal ribs 70 and the annular ribs 72, are preferably formed so that the longitudinal ribs terminate at, and merge with, the annular ribs at the location indicated by the reference numeral 82, thereby

producing a continuity of the reinforcing ribs along substantially the full length of the clamp blanks as well as completely around the apertures 34.

It will also be noticed that, as a result of the formation of the annular rib 72, the aperture 34 is now larger than in the previous working positions, and it is immediately surrounded and defined by an annular ring or extrusion which provides a flat seating surface around the aperture to help prevent collapse of the annular rib when the clamp is being secured to a supporting surface.

It will be appreciated from the foregoing that any desired configuration of ribbing, indenting or other shaping may be performed on the flat clamp blanks at this stage in the progressive forming of the finished clamps. Also, since the clamp blanks are separated from each other over most of their length, yet integrally connected to the strip stock, very exact positioning of the individual clamp blanks between the die member and punch holder is easily achieved with the result that sharp deep ribs with very small connecting radii can be formed having greatly superior accuracy over that possible with prior art methods.

It will now be understood that two complete flat clamp blanks have been formed which possess all the configurations of the finished clamp with the exception of the semicircular midportion. As will be more fully explained below, some of the foregoing steps may be rearranged in their order of sequence, or they may be omitted entirely.

The next significant step in the practice of the invention is the deforming of the flat clamp blanks over a major portion of the length of the clamp blanks to provide the desired shape thereto which has substantially identical portions on opposite sides of the centerline of the strip stock which are adapted to cooperate with each other to thereby provide at least two finished clamps still integrally connected to each other and to the strip stock. This step is carried out in at least two forming stages at separate working stations in order to achieve an accurate curvature and uniform configuration from one clamp to another. By virtue of the fact that the metal of each clamp blank is drawn from the free ends of each blank toward the central portion thereof or the center of the strip stock, as more clearly explained below, the full deformation may be carried out over as many steps as desired depending on the extent of deformation necessary and the strength and elasticity of the metal of the strip stock.

Referring again to FIGS. 1-4 and also to FIGS. 6 and 7, it will be seen that the die member 12 is provided, at the clamp blank areas indicated by the guide numbers 11 and 12, with a plurality of cavities 84 into which the flat clamp blanks are forced by punches 86 carried by the punch holder 14. As best seen in FIG. 6, each cavity 84 is provided with a first outwardly disposed, upwardly and outwardly sloping surface 88 and a second inwardly disposed, upwardly and inwardly sloping surface 90, the two surfaces 90 being separated by a flat horizontal portion 92. As is readily apparent from FIG. 6, the punches 86 have correspondingly shaped mating surfaces 94, 96 and 98 respectively. The mating surfaces 88 and 94 meet with the mating surfaces 90 and 96 on both sides of the clamp blank at an angle of approximately 90°, the surfaces 88 and 94 being intended to clamp the flat end portions 100 of the clamp blank which contains the securing aperture 34 and which is adapted to lie flat on a supporting surface when the finished clamp is placed over a piece of pipe and secured to the supporting surface. The mating surfaces 90 and 96 are intended to clamp flat portions 102 which lie intermediate the flat end portions 100 and an area 104 which ultimately will form the semicircular part of the midportion of the finished clamp.

Thus it will be seen by reference to FIGS. 1, 2 and 6 that the first deforming operation which takes place at the clamp blank areas 11 and 12 essentially defines the major areas of the finished clamp only by flat or planar deformation of the clamp blank out of the plane of the strip stock 10 and provides the right angle bend between the flat end portions 100 and the adjacent flat areas 102 of the midportion of the finished clamp.

The next stage of the deforming operation takes place at the clamp blank areas indicated by the guide numbers 13 and 14 where the curvature or semicircular configuration is imparted to the previously flat area 104 of each clamp blank to provide essentially the finished shape to the clamp. Thus, referring to FIGS. 1-4 and FIG. 7, the die member 12 is provided with a protuberance or punch portion 106 which has a semicircular portion 108 and flat side portions 110, the semicircular portion 108 of which is adapted to mate with a semicircular depression 112 formed in the punch holder 14. As the die member 12 and punch holder 14 are forced together, the mating configuration of the protuberance 106 and depression 112 deform the flat portion 104 of the clamp blank into the shape shown in FIG. 7 without disturbing or altering the angular relationship between the flat end portions 100 and the flat portions 104 of the overall intermediate portion of the finished clamp.

It will now be understood that a significant advantage of the present invention over prior art methods is based on the forming of a pair of clamp blanks which extend over the width of the strip stock and are separated therefrom over a major portion of their length from the outer edges of the strip prior to carrying out any forming operation which would alter the length of a flat clamp blank. By thus initially laying out the clamp blanks on the strip, it is possible to form the curvature and other deformation therein from the side edges of the strip stock, which after lancing, correspond to the free ends of each of the clamp blanks.

As will be readily understood from FIGS. 6 and 7, as the various punches and cavities made, the metal of each clamp blank flows into the cavities from the opposite edges of the strip with the result that the tremendous tensile force exerted on the central portions of the strip 10 is equalized in both directions across the strip centerline. By achieving this balance of forces on the strip it is relatively easy to maintain proper positioning of the strip in the die cavities and produce more accurate and uniform sizing of the deformed portions of the clamp. In addition, since the clamp blanks are separated from each other over at least the length thereof that is to be deformed, and the metal flows from the free end of each clamp blank, the actual deformation can be formed in a succession of stages rather than in one forming stage as required by prior art methods, thereby assuring a more accurate set to the deformed portion of the clamps.

It should also be noted that since the individual clamp blanks are moving through the progressive stages of the die member and punch holder in a direction normal to the longitudinal axes of the clamp blanks, the strip as a whole can readily move from one working station to another without the aid of any complex ejecting mechanism since the individual forming cavities are open along their lateral edges.

The final significant step in the practice of the present invention is the severing of the finished clamps from the strip, the severing being carried out in the same multiple arrangement as the previous forming steps so that as many finished clamps are simultaneously severed from the strip and from each other as the number of clamp blanks formed in the previous working operations. It has been found that the most desirable way to sever the clamps is to sever the next to last clamp from the strip as by shearing along the unseparated portions of the side edges of the adjacent clamps.

Referring again to FIGS. 1-4, it will be seen that the severing operation takes place in the clamp blank areas indicated by the guide number 14 and 15. As best seen in FIGS. 3 and 4, the die member 12 is provided with an aperture 114 located at the clamp blank area indicated by the guide number 15, and the punch holder 14 is provided with a raised punch 116 located at the same clamp blank area. The aperture 114 extends laterally of the die member 12 for a distance at least a little more than the length of the finished clamp so that the latter, when severed, can fall through the aperture and into a suitable receptacle positioned beneath the aperture 114. The punch 116 is considerably shorter than the aperture 114 and

need be only long enough to bear down on the top of the unsevered portion of the clamp.

Adjacent the aperture 114 on the die member 12 is a clamp supporting surface 118 which is adapted to support the last clamp of the strip and prevent downward movement thereof during the severing operation. Also, although the exact configuration of the parts for severing are not shown since they are not significant to the invention, it will be understood that any desirable form or shape may be imparted to these parts, such as a protuberance corresponding to the protuberance 106 on the opposite side of the aperture being added to the supporting surface 118 of the punch 116 being shaped to conform to the curvature of the clamp, in order to prevent any undesirable deformation of the end pair of clamps when the next to last clamp is actually being severed by the punch 116 from the strip stock and from the last clamp.

Assuming that at least one previous severing operation has taken place so that the last clamp on the strip is located at the clamp blank area indicated as 14, when the strip stock 10 is advanced the next increment of movement, which is two clamp blank spaces, the clamp at clamp blank area 14 will move to clamp blank area 16 and the clamp at clamp blank area 13 will move to clamp blank area 15 and be positioned over the aperture 114 in the die member 12. When the punch holder 14 descends, the punch 116 will sever the next to last clamp at clamp blank area 15 along the unsevered side edge portions thereof from the strip 10 and simultaneously from the last clamp at clamp blank area 16, since the latter clamp is supported by the flat or shaped supporting surface 118 and cannot move. The next to last clamp thus falls through the aperture 114 while the last clamp remains on the supporting surface 118.

Thus it will be understood that as the strip advances in increments of two clamp blanks, two finished clamps are provided for each operating cycle of the progressive die punch. It should also be understood that the strip stock may be fed through the progressive die punch in any desired increment, including one although this is not particularly desirable, the only requirement being that additional working clamp blank areas must be provided at each working station to provide for the number of clamp blanks being simultaneously formed. This is merely a matter of duplication for all working steps prior to severing, and at the severing station is means providing alternate apertures and supporting surfaces so that alternate clamps can be severed. In general, the smaller the clamp being formed and the softer the metal of the strip stock, the more clamps can be formed with each operation of the punch press.

As briefly indicated above, certain of the above described steps may be rearranged in sequence or may be entirely omitted without departing from the scope of the invention or from the basic procedure of the present form of practice of the invention. For example, the coining step may be omitted, thereby relying on the lancing step to initially form the individual clamp blanks. The advantage of coining before lancing is to provide clean and smooth edges on the clamps which are as free of burrs as possible. In addition, the aperture forming step may be combined with the coining step or it may be combined with the lancing step. It could also be combined with either the ribbing step or the deformation steps, although it is preferable to have an initial aperture before the annular rib around the aperture is formed. The longitudinal ribbing can be carried out at any stage prior to forming the initial deformation of the clamp blank, but again, it is preferable to do the longitudinal ribbing after the clamp blanks have been separated by lancing.

It is thus seen that the practice of the present invention is quite flexible in regard to a number of the preferred steps described above. The critical steps which must be followed in a particular sequence are the initial forming of the adjacent partially separated clamp blanks, the deformation of the clamp blanks from the opposite free ends of the pair toward the center of the strip, and the severing of the clamps from the

strip in numbers corresponding to the number of clamp blanks simultaneously formed in the previous working stations.

Having thus set forth in detail the method of forming the conduit clamps described in the introductory portion of this specification, it remains now to describe the method of forming the pipe hangers which were also briefly described in the introductory portion of the specification. Since the pipe hangers are formed by a method which is quite similar to that described above in connection with the clamps, the essential differences being only in the configuration of the forming parts, the following description will be considerably briefer and less detailed than the previous portion and will be explicit only in the actual differences between the two methods, although the drawings contain comparable views for both methods.

Thus, referring now to FIGS. 8-13, it will be seen that a strip stock 210 is fed between the die member 212 and punch holder 214 of a progressive die punch press in the same manner as in the method of forming the clamps. The initial coining step in forming flat hanger blanks has been omitted, for the sake of brevity, from the description and drawings relative to forming the pipe hangers, but it may optionally be included and would be performed at the same location and by the same form of punching dies as described above for coining the strip 10 as part of forming the pipe clamps. For this reason the clamp blank areas indicated by the guide numbers 1 and 2 in FIGS. 1-4 have been omitted from FIGS. 8-11.

The next step in forming the flat hanger blanks is carried out at the locations indicated by the guide numbers 3 and 4 where a central aperture 216 is formed which has the shape shown in the drawings. This aperture is formed by mating punches 218 carried by the punch holder 214 which mate with correspondingly shaped recesses 220 formed in the die member 212. The particular shape of the aperture 216 is to form a slot extending across one half of the top portion of the pipe hanger, the slot having an enlarged opening in the side wall of the hanger and a centrally located hole in the top portion so that a headed suspending member, such as a screw or lag bolt, can be inserted into the pipe hanger after the hanger has been securely fastened around the pipe. The details of construction of the pipe hanger are fully disclosed and claimed in my copending application Ser. No. 724,970, filed Apr. 29, 1968, entitled Pipe Hanger.

The next step disclosed, which takes place at the blank areas indicated by the guide numbers 5 and 6, is the forming of end apertures 222 which are preferably round and apertures 224 which are preferably square. These apertures receive a headed screw having a square portion of shank which, together with a nut, draws the free ends of the pipe hanger around the pipe and secures the pipe therein. The apertures 222 and 224 are formed respectively by round and square punches 226 and 228 carried by the punch holder 214 which mate with round and square apertures 230 and 232 respectively formed in the die member 212.

The next step in forming the flat hanger blanks is carried out between the blank areas indicated by the guide numbers 6, 7 and 8 where the lancing takes place in the same manner and configuration as that described above in connection with the lancing of the flat clamp blanks. Thus, as seen in FIGS. 10 and 11, a pair of rectangular punches 240 and 242 are carried by the punch holder 214 which mate with cavities or recesses 244 and 246 respectively formed in the die member 212. These punches and recesses lance the side edges of the hanger blanks located at blank areas 6 and 7 in the same manner as described above, these cuts being indicated by reference numerals 256 and 258 in FIGS. 8 and 9, leaving an unlanced portion 264 which bridges the centerline of the strip 210 and maintains the hanger blanks integral with the strip throughout the remainder of the forming operations as in the manner of the previously described method. Since the lancing step is carried out in the same manner as is the lancing of the strip 10 in forming the clamps, it is not deemed necessary to further explain this step in the formation of the hangers.

The next step, which is carried out at the hanger blank areas indicated by the guide numbers 9 and 10, is the formation of the longitudinal ribs 270 which extend along the length of the hanger blank substantially from the round apertures 222 to the square apertures 224, these ribs being formed by rib punches 268 carried by the punch block 214 which mate with rib recesses 266 formed in the die member 212. Again, these ribs are formed in the same manner as the corresponding ribs in the clamp blanks and further description thereof is not believed necessary.

At this point, a pair of complete flat hanger blanks has been formed to the same extent that the flat clamp blanks have been formed at the blank areas indicated by the guide numbers 9 and 10 in FIG. 1, the hanger blanks having all of the characteristics of the finished hangers except that the blanks are still in the plane of the strip stock 210.

The next step in the formation of the hangers, which is the second significant step in the method, is the deformation of the hanger blanks out of the plane of the strip stock in a plurality of forming stages to form the finished hangers. Thus, referring to FIGS. 8-13, it will be seen that the first deforming stage takes place at the hanger blank areas indicated by the guide numbers 11 and 12 and consists of forming a series of curved and angled surfaces according to the configuration as seen in FIG. 12. Thus, the die member 212 and punch holder 214 are each provided with protuberances and depressions which mate according to the configuration shown in cross section in FIG. 12 to provide on each clamp blank a pair of flat end portions 300 which join at an angle with a pair of partially semicircular portions 302 which in turn are separated by a flat midportion 304 having downwardly slanted side portions 305 and adjacent downwardly extending depressions 307. The function of each of these configurations will become more apparent in the description of the next forming stage. Without further explanation of the die member 212 and punch holder 214, it will be evident that these members, in the hanger blank areas 11 and 12, having mating depressions, generally indicated by the reference numeral 291, and protuberances, generally indicated by the reference numeral 293, which form the shape shown in FIG. 12.

The next deforming stage takes place at the hanger blank areas indicated by the guide numbers 13 and 14 and provides the deformation necessary to completely form the finished clamps. Thus, as best seen in FIGS. 10, 11 and 13, the die member 212 is provided with an elongate upstanding protuberance 306 having a widened top 308 which conforms generally to the finished shape of the midportion of the pipe hanger. The punch holder 214 in this situation has a shallow depression 312 of rectangular cross section which mates with the top portion 308 of the protuberance 306. It will readily be appreciated that when the die member 212 and punch holder 214 having protuberance 306 and cavity 312 respectively come together on the hanger blank as shaped in FIG. 12, all side portions of the hanger commencing with the side portions 305 are bent toward one another until the hanger blank having the configuration shown in FIG. 12 assumes the configuration of a finished hanger as seen in FIG. 13. In this configuration the midportion 304 is the top of the hanger, the side portions 305 provide a clearance between the pipe and the top of the hanger for the head of a suspending member, the curved side portions 302 encircle the pipe, and the end portions 300 receive a screw and nut assembly for drawing the curved portions 302 tightly against the pipe. At this point two complete pipe hangers have been formed which are still integrally connected to the strip and to each other along the originally unsevered side edge portions adjacent the centerline of the strip.

The final step in the formation of the pipe hangers, the severing of the finished hangers simultaneously from each other and from the strip in multiples, takes place at the hanger blank areas indicated by the guide numbers 15 and 16. The procedure for severing the hangers is identical to that described above in connection with severing the clamps, and further description thereof is not deemed necessary except to

note that the die member 212 is provided with an aperture 314 through which the next to last hanger is punched by a punch element 316 carried by the punch holder 214. The last hanger on the strip is supported by a supporting surface 318. In this case there is also shown an upstanding supporting member 320 which is shaped similar to the protuberance 306 so as to support the upper portion of the hanger during the severing operation to prevent any deformation of the last hanger on the strip when the punch 316 descends on the next to last hanger.

It is now apparent from the foregoing that there is provided a method of forming pipe clamps and hangers which achieves the foregoing objects and advantages set forth and which avoids the disadvantages of prior art methods.

What I claim and desire to secure by Letters Patent is:

1. A method of continuously forming conduit clamps and hangers from flat strip stock of indefinite length, said clamps and hangers having generally similar portions thereof disposed in opposed spaced relationship with each other, said method comprising the steps of:

- A. intermittently feeding a flat strip stock past a plurality of serially arranged working stations at which a plurality of working operations are simultaneously carried out during the dwell portions of the intermittent feeding of the strip,
- B. forming at a first working station at least one pair of elongate, side by side adjacent blanks such that each blank of the pair extends from one side edge of the strip stock to the opposite side edge thereof, and each blank of the pair is separated from the strip stock along the side edge of each blank over a major portion of the length of each blank from said side edges of the strip stock toward the center thereof, but is unseparated from the strip stock over a short length of each blank adjacent the center of the strip stock,
- C. deforming at a first subsequent working station each blank of the pair to provide a desired configuration therein over the length of each blank, which configuration has substantially identical portions on opposite sides of the centerline of the strip stock, but which configuration remains essentially in the elongate shape of said blanks,
- D. deforming at a second subsequent working station each blank of the pair to bend a substantial portion of each blank on opposite sides of the centerline of the strip stock substantially out of said elongate blank shape to thereby dispose said substantial portions of said blanks in a desired opposed spaced relationship with each other, thereby providing at least one pair of finished clamps or hangers still integrally connected to each other and to the strip stock, and
- E. severing at a terminal working station at least the terminal pair of finished clamps or hangers simultaneously from each other and from the strip stock along the unseparated side edge portion of said terminal pair of finished clamps or hangers whereby at least two individual clamps or hangers are simultaneously separated from the strip stock and from each other.

2. A method as set forth in claim 1 wherein said forming of said pair of blanks comprises the steps of

- A. coining at a first working station the opposite surfaces of said strip stock only laterally thereof at spaced intervals to define the side edges of said pair of side by side adjacent blanks, and
- B. lancing at a second working station said side edges of each blank of the pair along said major portion of the length of each blank from said opposite side edges of the strip stock toward the center thereof.

3. A method as set forth in claim 1 wherein said deforming of each blank of said pair at said first subsequent working station is carried out by simultaneously forcing each blank into a die member having spaced apart depressions and protuberances therein which define the configuration to be provided to each blank by means of a punch holder having mating protuberances and depressions respectively such that the

metal of each blank flows in said depressions from the free end edge of each blank toward the center thereof and the tensile forces from the deformation of each blank are balanced across the unseparated central portion of each blank.

4. A method as set forth in claim 1 wherein said severing of the terminal pair of finished clamps or hangers is carried out by punching the next to last clamp or hanger out of the plane of the strip stock while simultaneously supporting the last clamp or hanger in the plane of the strip stock whereby said terminal pair of clamps or hangers are simultaneously separated from the strip stock and from each other.

5. A method as set forth in claim 4 wherein said punching of said next to last clamp or hanger is accomplished by placing said next to last clamp or hanger over an aperture formed in a die member and forcing said next to last clamp or hanger through said aperture by means of a descending punch element while simultaneously supporting the last clamp or hanger on said die member.

6. A method as set forth in claim 1 wherein, in the forming of said clamps, said deforming of each blank at both said first and second subsequent working stations is carried out over the entire length of each blank in at least two stages in the first of which oppositely disposed portions of the separated portions of each blank are forced into a die member having depressions and protuberances by means of a punch holder having mating protuberances and depressions respectively which define flat end portions and adjacent flat portions disposed at substantially a 90° angle with said flat end portions of each side of each blank, with a remaining central flat portion connecting said second mentioned flat portions, and in a second stage the thus partially deformed blanks are forced into a substantially semicircular depressions carried by the punch holder by means of a substantially semicircular mating protuberance formed in the die member whereby a semicircular configuration is imparted to said remaining central flat portion to thereby form a finished clamp from each blank still integrally connected to the strip stock.

7. A method as set forth in claim 6 wherein said severing of the terminal pair of finished clamps is carried out by placing the next to last clamp over an elongate aperture formed in said die member and forcing said next to last clamp through said aperture by means of a descending punch element while simultaneously supporting the last clamp on a substantially

semicircular support member carried by said die member thereby preventing deformation of said last clamp while severing said next to last clamp.

8. A method as set forth in claim 1 wherein, in the forming of said hangers, said deforming of each blank at both said first and second subsequent working stations is carried out in at least two stages in the first of which said separated portions of each blank on the opposite side of the unseparated central portion are forced into a die member having depressions and protuberances by means of a punch holder having mating protuberances and depressions respectively which define flat end portions, adjacent substantially semicircular portions and further adjacent flat portions disposed at an angle to the plane of the strip stock with a remaining central flat portion connecting said second mentioned flat portions, and in a second stage the thus partially deformed blanks are forced into a substantially rectangular depression carried by the punch holder which is of approximately the same dimensions as said remaining central flat portion by means of an elongate upstanding substantially rectangular mating protuberance formed in the die member whereby a semicircular configuration is imparted to the inner portions of each blank adjacent said flat end portions and are disposed generally perpendicular to said remaining central flat portion to thereby form a finished hanger from each blank still integrally connected to the strip stock.

9. A method as set forth in claim 8 wherein said severing of the terminal pair of finished hangers is carried out by placing the next to last hanger over an elongate aperture formed in said die member and forcing said next to last hanger through said aperture by means of a descending punch element while simultaneously supporting the last clamp on an elongate upstanding substantially rectangular protuberance corresponding in shape to the configuration of the central portion of the finished hanger as a support member carried by said die member thereby preventing deformation of said last hanger while severing the next to last hanger.

10. A method as set forth in claim 1 wherein said deforming at said second subsequent working station comprises the step of bending said substantial portions of each blank at approximately a 90° angle to the plane of the strip stock to thereby dispose said substantial portions in said opposed spaced relationship.

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