Jan. 31, 1939. C. T. DRAPER 2,145,587

THREAD SWAGING APPARATUS

Filed Dec. 27, 1937 4 Sheets-Sheet 1

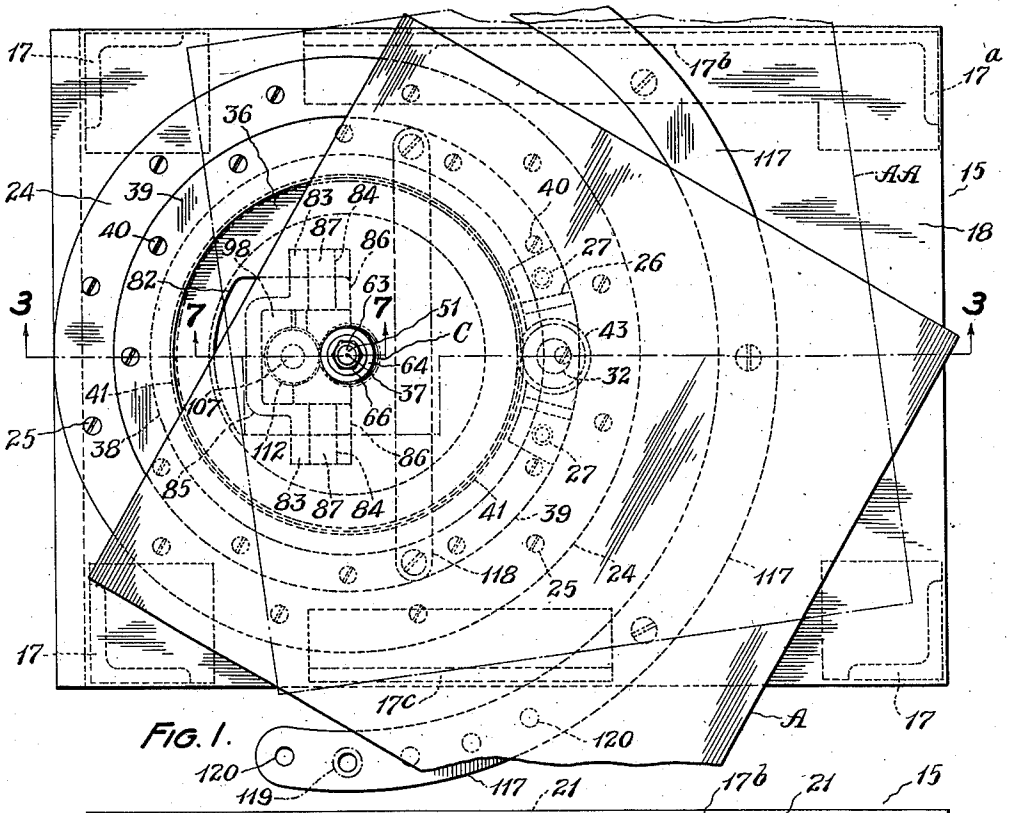


FIG. 1.

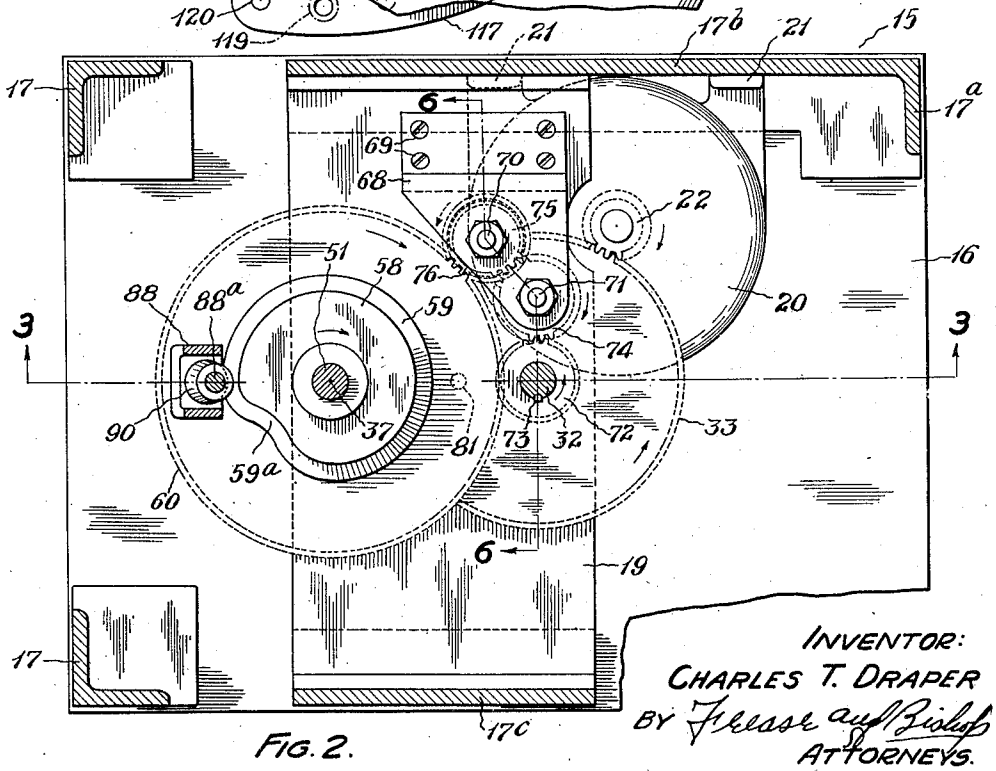


FIG. 2.

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THREAD SWAGING APPARATUS

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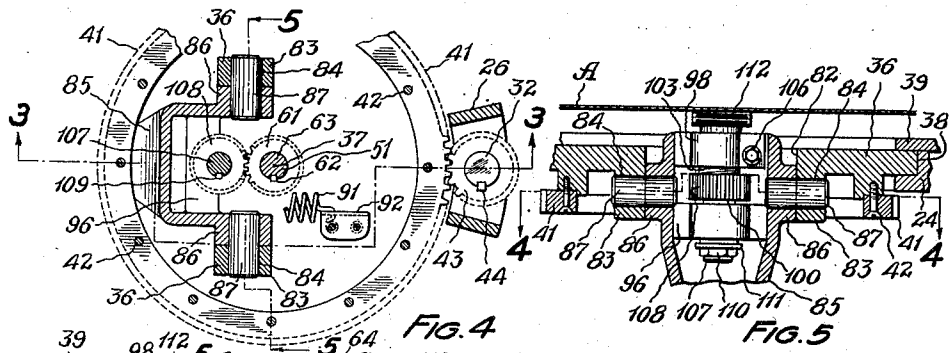


FIG. 4

FIG. 5

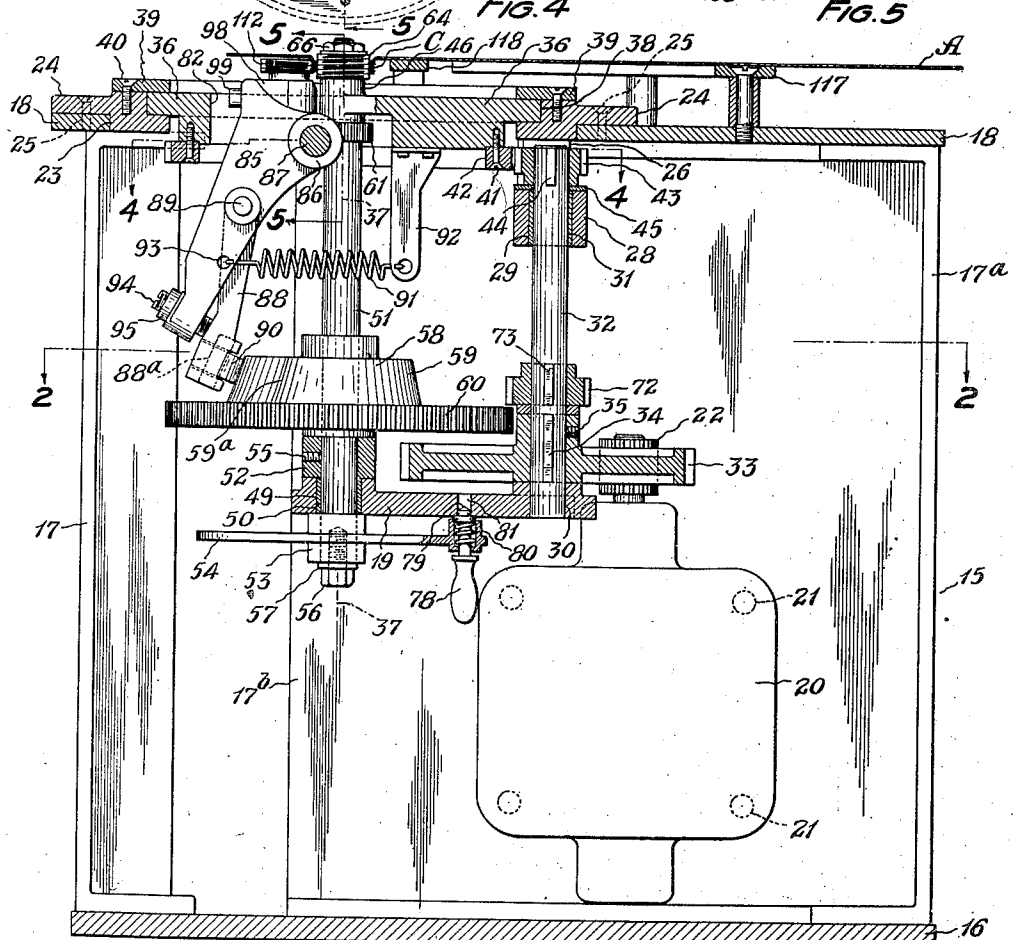


FIG. 3

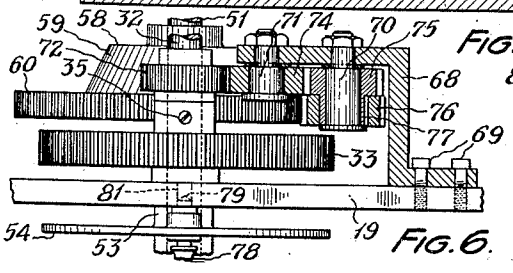


FIG. 6

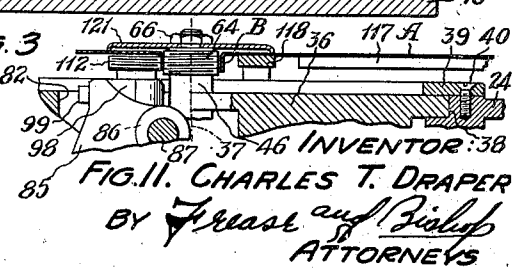


FIG. 11.

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THREAD SWAGING APPARATUS

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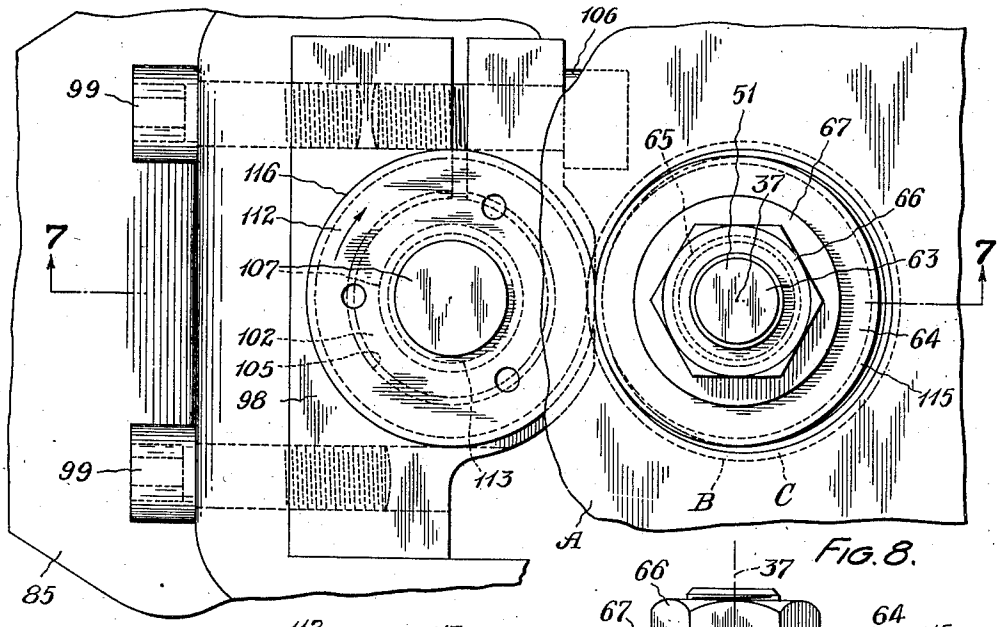


FIG. 8.

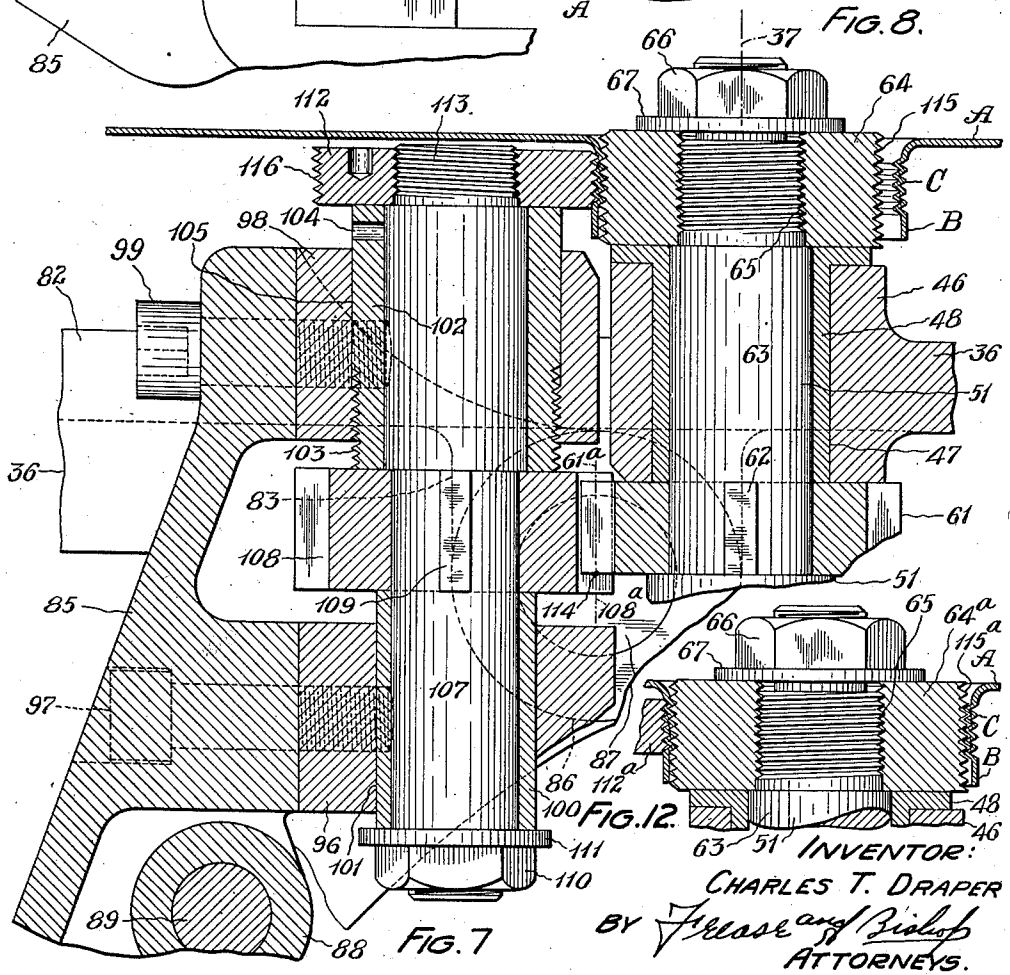


FIG. 12.

FIG. 7

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THREAD SWAGING APPARATUS

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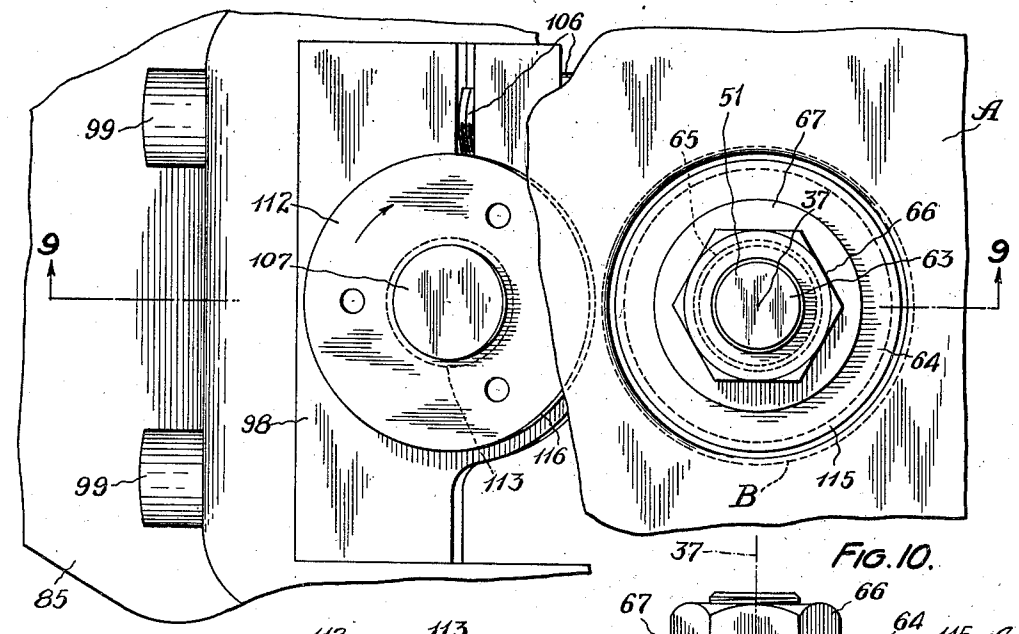


FIG. 10.

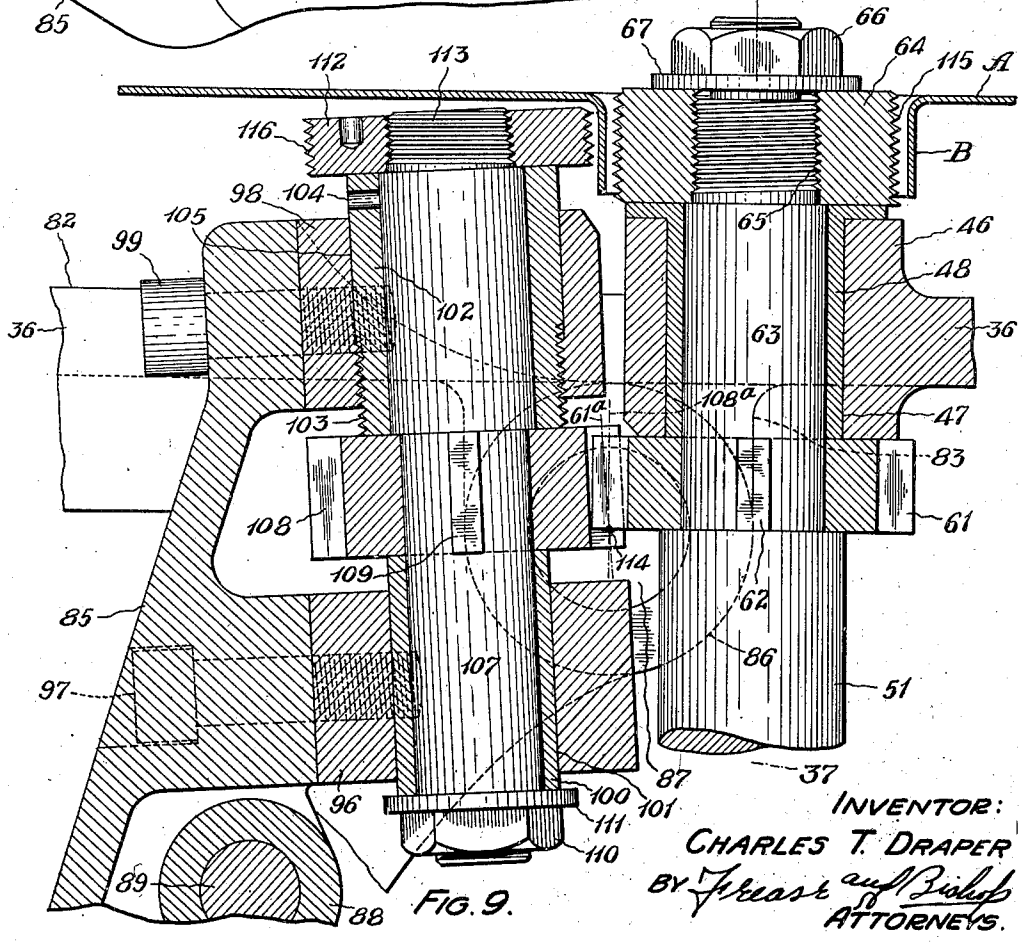


FIG. 9.

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Patented Jan. 31, 1939

2,145,587

UNITED STATES PATENT OFFICE

2,145,587

THREAD SWAGING APPARATUS

Charles T. Draper, Cleveland Heights, Ohio, assignor to The Draper Manufacturing Company, Cleveland, Ohio, a corporation of Ohio

Application December 27, 1937, Serial No. 181,874

13 Claims. (Cl. 80—6)

The invention relates to the manufacture of threaded articles and to the threading of a neck projecting from a sheet metal blank or wall. More particularly, the invention relates to apparatus for threading a neck projecting from a sheet metal blank or wall, and to a new mechanical movement which I have provided in such apparatus.

An opening in a metal wall has been threaded in prior practice by usual thread cutting apparatus and operations; but such cut threads require sufficient metal thickness in the metal wall that the cutting thereof does not unduly weaken the wall.

A cylindrical metal article has been threaded in prior practice by apparatus and operations which require the cylindrical metal article to be rotated.

A need has developed for the provision of standard pipe threads in a neck projecting integrally from a sheet metal wall or blank, or for the provision of threads in a neck projecting eccentrically from a sheet metal wall or blank, without cutting the threads, or without positively rotating the metal wall or blank for forming the threads.

Accordingly, it is an object of the present invention to provide apparatus for forming standard pipe threads in a neck projecting integrally from a sheet metal wall or blank without cutting the threads or without positively rotating the metal wall or blank.

Similarly, it is an object of the present invention to provide apparatus for forming threads in a neck projecting eccentrically from a sheet metal wall or blank without cutting the threads or without positively rotating the metal wall or blank.

Moreover, it is an object of the present invention to provide apparatus for forming from three to six standard pipe threads with a pitch of 14 to 11½ threads per inch in a neck projecting integrally from a sheet metal wall of from 24 to 12 gauge rolled steel, to form a ¾ inch to 2 inch threaded opening; it being understood, however, that such apparatus, by changing the forming dies, may be utilized for forming a different number of threads, having different pitches, in different sized necks, and in metal of other gauges.

It is also an object of the present invention to provide apparatus for forming V-sided threads in a neck projecting integrally from a sheet metal wall or blank without cutting the threads or without positively rotating the metal wall or blank for forming the threads.

Likewise, it is an object of the present invention to provide apparatus for forming V-sided threads with relatively sharp or pointed valleys and rounded crests in a neck projecting integrally from a sheet metal wall or blank without cutting the threads or without positively rotating the metal wall or blank for forming the threads.

Moreover, it is an object of the present invention to provide apparatus for forming threads in a neck projecting integrally from a sheet metal wall or blank closely adjacent to an edge portion of said blank and spaced a relatively greater distance from other edge portions of the blank.

Moreover, it is an object of the present invention to provide apparatus for forming standard pipe threads or V-sided threads in a neck projecting integrally from a sheet metal wall or blank, which apparatus swages the metal and hardens and stiffens the same in providing the thread formation so that the threaded neck is stiff and strong.

Moreover, it is an object of the present invention to provide apparatus for forming threads in a neck projecting integrally from a sheet metal wall or blank without cutting the threads or without positively rotating the metal wall, such threaded neck being adapted for threaded connection with a standard pipe threaded fitting.

Moreover, it is an object of the present invention to provide apparatus for forming standard pipe threads or V-sided threads in a neck projecting integrally from a sheet metal wall or blank without cutting the threads, or without positively rotating the metal wall or blank, the formed threads being located in a region spaced from the outer end of the metal wall forming the neck whereby the outer end of the neck may be turned either inward or outward to form a flange integral with the neck either before or after the threads are formed in the neck.

In certain of the preceding objects, the formation of threads in a neck projecting integrally from a sheet metal wall without positively rotating the metal wall has been stressed; and this point is important in connection with the present invention, because for more than sixty years during which I have had experience in the art of forming and working sheet metal, the only machinery available, to my knowledge, for forming threads in a sheet metal wall without cutting the threads, has involved or required a positive rotation of the article for forming the threads.

With such prior art machinery, it is imprac-

tical if not impossible, to form threads in a neck projecting from a sheet metal blank, because it is obviously impractical, unsafe, if not impossible, to positively rotate a sheet metal blank which may have an area of a few square feet up to dozens of square feet, in the plane of the sheet or blank, and to perform any work upon a relatively small neck projecting integrally from such rotating blank.

The rotation of such a sheet metal blank, for performing work upon an integrally projecting neck therein, becomes all the more impractical, dangerous, if not impossible, when the axis of rotation, passing through the center of the neck, is located eccentrically with respect to the extremities of the blank.

Accordingly, it is a very important object of the present invention to provide apparatus for working the metal in an annular wall of a neck projecting integrally from a sheet metal wall or blank, without positively rotating the metal wall or blank for carrying out the working operation.

Moreover, it is an object of the present invention to provide a new mechanical movement for transmitting rotary movement to an annular die, the axis of which is revolving about a stationary annular die, while at the same time transmitting relative radial movement to the rotating and stationary dies.

And finally, it is an object of the present invention to provide a metal working apparatus in which one or more of the aforesaid desiderata is incorporated and which constitutes a radical departure in structure and operation from metal working apparatus in analogous arts, and which is safe, efficient, and inexpensive to operate.

These and other objects may be obtained by the elements, parts, combinations, sub-combinations, mechanical movements and constructions constituting the present invention, a preferred embodiment of which is shown in the accompanying drawings and is hereinafter claimed and described in detail, which may be stated in general terms as including in thread swaging or metal working apparatus, a frame, power means, a rotary head journaled in the frame, a normally stationary annular die journaled in the rotary head on the axis thereof, a rotary die, rotary die holder means pivotally mounted on the head for moving the rotary die radially toward and away from the normally stationary die, means driven by said drive means for rotating the rotary die about its axis, the axis of said rotary die revolving about the axis of the normally stationary die as the rotary head rotates, means for oscillating the rotary die holder means, means for driving said oscillating means from said drive means, adjusting means for the rotary die, adjusting means for the rotary die holder means, means for normally holding said stationary die stationary, means for selectively rotating said normally stationary die, work holder means, preferably work clamping means, and preferably releasable work stop means.

An embodiment of the improved thread swaging apparatus is shown in the accompanying drawings in which

Figure 1 is a plan view of the thread swaging apparatus, certain parts being broken away, showing the apparatus in the process of swaging threads in a neck projecting eccentrically integrally from a sheet metal blank;

Fig. 2 is a plan sectional view through the apparatus shown in Fig. 1, taken on the line 2—2, Fig. 3; and showing the drive gearing for transmitting rotating movement to a rotary die, for revolving said rotary die about a stationary die, and for transmitting relative radial movement to the rotary and stationary dies;

Fig. 3 is a vertical section through the apparatus shown in Figs. 1 and 2, taken on the line 3—3, Figs. 1, 2 and 4, showing the drive gearing, the thread swaging roller dies, and the mounting means for said roller dies;

Fig. 4 is a fragmentary plan sectional view, taken on the line 4—4, Figs. 3 and 5, showing the head drive and the drive for the revolving rotary die;

Fig. 5 is a fragmentary vertical sectional view through certain of the parts shown in Figs. 1, 2, 3 and 4, taken on the line 5—5, Figs. 3 and 4;

Fig. 6 is a fragmentary vertical elevation, with certain parts in section, showing the reduction gearing for the drive gearing taken on the line 6—6, Fig. 2;

Fig. 7 is an enlarged fragmentary vertical sectional view, taken on the line 7—7, Figs. 1 and 8, illustrating the details of the thread swaging mechanism and its mounting, the parts being shown in the relative positions assumed while a thread swaging operation is being carried out;

Fig. 8 is a plan view of the mechanism shown in Fig. 7;

Fig. 9 is a view similar to Fig. 7, taken on the line 9—9, Fig. 10, showing the thread swaging mechanism with the parts thereof in their relative positions when a thread swaging operation has been completed and a new work piece has just been fed to the mechanism prior to having a thread swaging operation performed thereon;

Fig. 10 is a plan view of the mechanism shown in Fig. 9;

Fig. 11 is a view similar to certain parts of Fig. 3, but illustrating additional work holding means which may be used in some cases; and

Fig. 12 is a view similar to certain parts of Fig. 7, but showing a slightly different sized stationary swaging die.

Similar numerals refer to similar parts throughout the various figures of the drawings.

Referring more particularly to Figs. 1 to 6, inclusive, the improved thread swaging apparatus may include a frame structure or housing generally indicated at 15 preferably comprising a base plate 16, corner or leg members 17 and 17a and a top or bed plate 18. The corner member 17a may have one elongated leg portion 17b extending toward another corner member 17; and on the opposite side of the apparatus (Fig. 2) an upright side member 17c may be provided.

The members 17, 17a, 17b and 17c may be connected or joined to the base plate 16 by any suitable means as by welding, and may be connected or otherwise joined to the top or bed plate 18 by any suitable means as by welding. A cross frame member 19 may be located intermediate the base and top plates 16 and 18, extending between members 17b and 17c, and may be connected or otherwise joined to the members 17b and 17c, as by welding.

A main drive motor 20 is provided for driving the thread swaging apparatus, and the motor 20 may be mounted in any suitable or usual manner on the member 17b as indicated at 21 in Fig. 2. The motor 20 has a drive pinion 22 on one end of the motor shaft thereof.

The top plate 18 is provided with a large opening 23 in and around which is mounted a bed ring 24; and the bed ring 24 may be secured to

the top plate 18 in any suitable manner, as by screws 25. A U-shaped bracket 26 (Fig. 4) may be secured to the underside of the bed ring 24 by bolts 27 (Fig. 1) and a bearing box 28 is provided on the underside of the bracket 26. A central bore 29 may be provided in the bearing box 28 in vertical axial alignment with a bore or aperture 30 provided in the cross frame member 19; and the bore 29 may be lined with a bushing 31.

A main drive shaft 32 is journaled in bushing 31 and in bore 30. A main drive gear 33 is keyed to shaft 32 at 34 and the gear meshes with the drive pinion 22. The gear 33 may also be provided with a set screw 35 engaging shaft 32 for preventing endwise movement of shaft 32. A rotary head plate 36, rotatable about an axis 37, is peripherally journaled at 38 in bed ring 24 and is secured against axial movement by top ring 39, which may be bolted at 40 to bed ring 24.

A ring gear 41 is secured preferably by bolts 42 to the underside of rotary head 36; and the ring gear 41 meshes with pinion 43, keyed at 44, to the upper end of the main drive shaft 32. A thrust washer 45 is preferably interposed between the lower end of pinion 43 and the upper end of bearing boss 28.

The rotary head 36 is provided with a central boss 46 (Fig. 7) having a bore 47 provided with a bearing bushing 48; and cross frame member 19 is also provided with a bore 49 having a bushing 50 therein. Bores 47 and 49 are in vertical axial alignment on axis or center line 37.

A die spindle and cam centering spindle shaft 51 is journaled in bushings 48 and 50 and is secured against axial movement by collar 52 and hub 53 of back off disk 54. Members 52 and 53 are mounted on opposite sides of cross frame member 19. Collar 52 may be secured to shaft 51 by set screw 55; and hub 53 may be secured to shaft 51 by screw 56 and washer 57. A cam 58 having a tapered warped cam surface 59 is journaled on shaft 51 and cam gear 60 is secured to cam 58, preferably immediately above collar 52.

Another gear 61 is keyed at 62 to the reduced upper end 63 of shaft 51, below boss 46; and a swaging die 64, to be described later in detail, is secured to the upper spindle end of shaft 51 above boss 46, preferably by interengaging threads 65, nut 66 and washer 67.

The cam 58 is also driven from the main drive shaft 32 by a reduction gearing best shown in Figs. 2 and 6. A bracket 68 is mounted at 69 on cross frame member 19, and stub shafts 70 and 71 are carried by bracket 68. A gear 72 is keyed at 73 to main drive shaft 32 and meshes with gear 74 journaled on stub shaft 71. Gear 74 meshes with gear 75 journaled on stub shaft 70. Gear 76 is keyed at 77 to gear 75 and gear 76 meshes with cam gear 60.

Back off disk 54 is preferably provided with an operating handle 78 having a detent 79 spring pressed at 80 to hold detent 79 in aperture 81 in cross frame member 18, whereby the die spindle and cam shaft 51 and die 64 are normally held stationary. Any other suitable means may, however, be provided for normally holding cam shaft 51 stationary for a purpose to be later described.

The rotary head 36 is provided with an aperture 82 adjacent to and extending from one side of the central boss 46; and ears 83 provided with bores 84 extend downward from the rotary head 36 at each side of aperture 82 to form means for mounting a rotary swaging die and rotary swaging die holder on the rotary head 36.

The rotary swaging die holder preferably includes a U-shaped main lever 85 provided adjacent to its upper end with bosses 86 carrying pins 87 which are rotatably journaled in the bores 84 of ears 83, whereby main lever 85 pivots about pins 87.

An auxiliary lever 88 is pivotally mounted at 89 on main lever 85 and the lower end of lever 88 is provided with a pin 88a on which tapered roller 90 is journaled. Roller 90 rides on cam surface 59 of cam 58.

A spring 91, secured at one end to a depending arm 92 fixed to the lower side of rotary head 36, is secured to lever 85 adjacent to the lower end thereof at 93, to normally urge lever 85 in a counter-clockwise direction viewing Fig. 3. An adjusting screw 94, held by a lock nut 95 to the lower end of lever 85, abuts against the lower end of lever 88 to press roller 90 in engagement with cam 58.

Referring more particularly to Figs. 7, 8, 9 and 10, a bearing block 96 is secured by screws 97 to U-shaped lever 85 near the upper end thereof; and another split ring bearing block 98, spaced above bearing block 96, is secured to the upper end of U-shaped lever 85 by screws 99. A bushing 100 is located in bore 101 provided in bearing block 96. A bushing sleeve 102, the lower end of which is threaded at 103 and the upper end of which is provided with one or more apertures 104 for the reception of a spanner wrench, is threaded into the partially threaded bore 105 of split ring bearing block 98.

Bushing sleeve 102 may be clamped in any adjusted position by clamping screw 106 provided in split ring bushing block 98 (Fig. 8). A shaft 107 is journaled in bushing sleeves 100 and 102; and gear 108 is keyed at 109 to shaft 107 between bearing blocks 96 and 98.

Gear 108 meshes with gear 61; and shaft 107 is maintained in assembled position by nut 110 and washer 111 at the lower end thereof and rotary swaging die 112 screwed onto the upper end of shaft 107 at 113.

The axis 114 upon which rotary die holder lever 85 pivots, passes through the pitch lines 61a and 108a, respectively, of gears 61 and 108, and preferably through the lower face of the teeth of gear 61, as best shown in Figs. 7 and 9; whereby gears 61 and 108 are in mesh irrespective of the position of lever 85.

Swaging die 64, being fixed to shaft 51, which is normally stationary, is likewise normally maintained in a stationary position. The outer annular surface of die 64 is provided with right hand thread formations 115, preferably V-sided thread formations, when right hand threads are desired to be formed in the work piece. If a left hand thread is to be formed in the work piece, then the thread formation 115 will be left hand rather than right hand. If thread formation 115 is a right hand thread, then threads 65 are also right hand threads.

Rotary swaging die 112 is likewise provided with outer annular thread formations 116 which are left handed if the thread formations 115 are right handed. If thread formations 116 are left handed, then threads 113 are also left handed.

Swaging dies 64 and 112 are herein and in the claims termed "annular dies" meaning dies having annular forming surfaces. The term "annular" is not limited to a ring shaped die as the swaging dies might be formed as a part of their respective shafts.

The operation of the apparatus is as follows:—

Assume that it is desired to provide a thread formation, preferably a V-sided thread formation or a standard pipe thread, in a neck projecting integrally from a sheet metal wall. Assume further that the neck may be located eccentrically with respect to the edge portions of the metal blank, although the neck may be in the center of the blank, and that the metal blank may have considerable area.

Such a metal blank is indicated at A in the drawings and an integral neck indicated at B in Fig. 9 may have been provided eccentrically therein by the usual drawing operations. Blank A with the neck B extending downwardly therefrom, is superimposed on the apparatus, resting on the work holder or supporting means 117 and 118, so that neck B is telescoped around stationary swaging die 64. Referring to Fig. 1, the initial position of the blank A when superimposed upon the apparatus is indicated by dot-dash lines at AA.

The motor 20 is then started, which rotates rotary head 36 through members 22, 33, 34, 32, 44, 43, 41 and 42. Meanwhile, shaft 51 and swaging die 64 fixed thereon, are held stationary by members 53, 78 and 79 cooperating with aperture 81 in frame member 19. As rotary head 36 is rotated, die holder 85 is rotated therewith about axis 37, which revolves the axis of swaging die 112 about axis 37. In so revolving, swaging die 112 is rotated about its own axis because it is fixed on shaft 107, to which gear 108 is keyed at 109, and gear 108 meshes with gear 61 which is keyed at 62 to stationary shaft 51.

Meanwhile, cam 58 is also rotated by members 60, 76, 77, 75, 74, 72 and 73 from drive shaft 32. The gearing is so designed, that for one cycle of the operation of the apparatus, presently to be defined, the cam rotates one revolution more or less than the number of revolutions made by the rotating head. During such a cycle of operation, the cam 58 thus makes one revolution relative to the rotating head 36.

At the start of the operation, the die parts are in the position shown in Fig. 9 when roller 90 is in the cam valley 59*a* (Fig. 2). As the operation of one cycle progresses, and the cam 58 makes one revolution relative to the rotary head, the roller 90 rides along cam surface 59, moving, through levers 88 and 85, the rotating and revolving swaging die 112 radially toward stationary swaging die 64 whereby the cooperating right and left hand thread formations 115 and 116 on dies 64 and 112 roll, swage, deform and work the metal in neck B to form the V-sided thread formation C therein.

For the purposes of description, it may be said that the head 36 may rotate nineteen times while the cam 58 rotates twenty times, so that the rotary die 112 repeatedly and successively annularly works the metal to form the thread formation C in neck B as it moves radially inward toward die 64, as die 112 rotates about its own axis, and as die 112 revolves about the axis 37 of stationary die 64.

After one cycle of the operation has been completed, (which may be defined as operation of the appartus until the cam 58 has made one revolution relative to the rotary head 36) the motor 20 is stopped and roller 90 again rides in cam valley 59*a*, whereby the parts are again in the position shown in Fig. 9.

If the neck B originally was of the size shown in Fig. 9, after the threads C have been formed therein, the blank A may be lifted off, because there is sufficient clearance, as shown in Fig. 7, between the threads C and thread formation on die 64.

The operation of the apparatus may then be repeated in connection with successive new blanks.

Under certain circumstances, it may be desired that the original size of the neck B be of substantially the same size as or only slightly larger than the outer periphery of the die 64, as indicated in Fig. 12, wherein the die 64*a* is slightly larger in diameter than the die 64. Under such circumstances, upon completion of the threading operation, the neck B with threads C therein cannot be withdrawn axially of die 64*a*. The function of back off disk 54 therefore becomes apparent. Thus, the detent 79 may be released from aperture 81 and disk 54 rotated by handle 78, to rotate the normally stationary shaft 51, thereby unscrewing the loose threaded engagement between threads C and die 64*a* to permit removal of the blank A. After completion of the back off operation, the detent 79 is again engaged in aperture 81 to hold shaft 51 and die 64*a* stationary.

Such back off means is provided because it is obviously not practical, due to the size of the blank A, to rotate the blank for unscrewing it off of die 64*a*.

In carrying out the back off operation, the blank may have a tendency to turn as the shaft 51 is rotated; and for the purpose of stopping rotation of the blank A, a removable pin shown in dot-dash lines at 119 in Fig. 1 may be inserted in any one of apertures 120 provided in work support means 117. Thus, the pin 119 will engage an edge of blank A and stop rotation thereof.

Referring more particularly to Fig. 11, it is desirable to maintain the blank A level, at least in the region of the neck B, while performing the threading operation; and with certain gauges of metal it may be necessary to utilize a clamping or holding die such as the flanged disk 121 held by die clamping nut 66.

Referring to Figs. 1 and 9, due to the fact that neck B has a larger internal diameter than the outside diameter of the die 64, it is clear that each time that the die 116 revolves about die 64 in performing the swaging operation, neck B will (due to its larger internal circumference) creep about die 64 so that when one cycle has been completed, the blank assumes a position somewhat as shown in full lines in Fig. 1.

Thus, there has been a slight rotation of the blank during the swaging operation and such slight rotation, (which is diminished as the internal diameter of the neck B approaches the external diameter of the die 64 as in Fig. 12) or creep, is to be distinguished from a positive continued rotation of the metal blank required in the prior practice of annularly working a cylindrical article as by spinning.

Clearly, the operation of the machine is not limited to the particular type and size of threads shown, for any meshing annular dies may be utilized to provide a desired formation in a neck projecting from a sheet blank. Moreover, the location of the die 16 may be adjusted by the adjusting means 102, 98, 106 for meshing dies 112 and 64 or for changing the relative location of the zone in neck B that is to be worked.

Likewise, the adjustment 94, 95 enables the limit of radial travel of the die 112 toward the

die 64 to be changed to accommodate different thicknesses of metal and the swaging pressure exerted between the dies.

Although the motor 20 has been described as being started and stopped by hand, it is clear that any usual type of limit switch construction may be provided, operated by the rotation of any one of the parts in the driving mechanism, for stopping motor 20 automatically after a predetermined number of revolutions of such part coincident with one revolution of the cam 58 relative to rotary head 36.

Obviously, for smooth and efficient operation of the apparatus, certain of the rotary parts should be balanced in a usual and well known manner not necessary to be described herein.

Accordingly, the present invention provides apparatus for forming an integral threaded neck almost anywhere in a wall of a sheet metal container such as for instance the particular threaded neck shown but not claimed herein, which is claimed in my copending application, Serial No. 181,875, filed of even date herewith. The method of making a threaded bung opening neck in a sheet metal wall disclosed but not claimed herein, is claimed in my copending application Serial No. 246,119, filed December 16, 1938.

Moreover, the present apparatus provides for the annular working of metal in a neck integral with a sheet metal wall, such as the formation of standard pipe threads or V-sided threads in such a neck, without cutting the metal or without positively rotating the article to be worked.

Having now described the features of the invention, and the construction and operation of a preferred form of the same, and the advantages and results obtained by the improved apparatus; the new and useful parts, elements, combinations, sub-combinations, constructions, devices and mechanical movements, and reasonable mechanical equivalents thereof obvious to those skilled in the art, are set forth in the appended claims.

I claim:—

1. In metal working apparatus, a frame, a normally stationary shaft mounted in the frame, a head mounted for rotation about said shaft, a plurality of annular dies, means fixedly mounting one of said dies on said shaft, lever means pivotally mounted on said head, shaft means journaled on said lever means rotatably mounting another die on said lever means, means for rotating the head, a gear fixed to said stationary shaft, a second gear meshing with said first named gear fixed to said shaft means, the axis of said lever means pivot passing through the pitch lines of said gears in one face of one of said gears, and means for moving said lever means about said pivot to move the die carried thereby radially of the stationary die.

2. Apparatus for swaging threads in a neck projecting integrally from a sheet metal blank, including a frame, a normally stationary shaft mounted in the frame, a head mounted for rotation about said shaft, power means, an annular die having thread formations thereon mounted on said shaft, a rotary die having complementary thread formations thereon, rotary die holder means pivotally mounted on the head, means driven by said power means for rotating the rotary die about its axis, means driven by said power means for rotating the rotary head to revolve the axis of the rotary die about the axis of the stationary die, means for oscillating the rotary die holder means to move the rotary die radially toward and away from the stationary die, means for driving said oscillating means from said power means, means for adjusting the longitudinal axial position of the rotatable die on said die holder, means for adjusting one limit of radial movement of the rotatable die, means for normally holding said shaft and the die mounted thereon stationary, independent means for selectively rotating said normally stationary die, work holder means, work clamping means, and releasable means for stopping rotation of the work when said normally stationary die is rotated.

3. Apparatus for roller swaging V-sided pipe threads in a neck projecting integrally from a sheet metal blank, including a plurality of roller dies having complementary V-sided pipe thread formations thereon, one of said dies being normally stationary and another being rotatable, drive means for rotating the rotatable die, means for revolving the axis of the rotatable die about the axis of the stationary die, means for moving the rotatable die radially of the stationary die as the rotatable die revolves about the stationary die, and independent means for rotating the normally stationary die.

4. Apparatus for roller swaging V-sided pipe threads in a neck projecting integrally from a sheet metal blank, including a plurality of roller dies having complementary V-sided pipe thread formations thereon, one of said dies being stationary and another being rotatable, means for rotating the rotatable die, means for revolving the axis of the rotatable die about the axis of the stationary die, means for moving the rotatable die radially of the stationary die as the rotatable die revolves about the stationary die, and means for supporting a sheet metal blank having an integral neck with said neck telescoped over the stationary die whereby internal and external V-sided pipe threads are swaged in the neck as the revolving rotating die moves radially toward the stationary die.

5. Apparatus for roller swaging V-sided pipe threads in a neck projecting integrally from a sheet metal blank, including a frame, a rotary head plate journaled in the frame having a central bearing, a normally stationary shaft mounted in the frame and journaled in said bearing, lever means pivotally mounted on the head plate adjacent to said bearing, a plurality of roller dies having complementary V-sided pipe thread formations thereon, one of said dies being fixed to said shaft and another being rotatably mounted on said lever means, means for rotating the head plate, means for rotating the rotatable die, and means for moving the lever means to move the rotatable die radially of the stationary die.

6. Apparatus for roller swaging V-sided pipe threads in a neck projecting integrally from a sheet metal blank, including a frame, a rotary head plate journaled in the frame having a central bearing, a normally stationary shaft mounted in the frame and journaled in said bearing, lever means pivotally mounted on the head plate adjacent to said bearing, a plurality of roller dies having complementary V-sided pipe thread formations thereon, one of said dies being fixed to said shaft and another being rotatably mounted on said lever means, means for rotating the head, means for moving the rotatable die radially of the stationary die, and the mounting of the rotatable die on the lever means including a member in engagement with another member

fixed to said shaft at a point adjacent to said lever means pivot for rotating the rotatable die as the head rotates.

7. Apparatus for roller swaging V-sided pipe threads in a neck projecting integrally from a sheet metal blank, including a frame, a rotary head plate, means journaling the periphery of said plate in said frame, a normally stationary shaft extending axially through said plate, a plurality of roller dies having complementary V-sided pipe thread formations thereon, one of said dies being fixed to said shaft and another of said dies being rotatably mounted on said head, means for rotating the head, means for rotating the rotatable die, and means for moving the rotatable die radially of the stationary die.

8. Apparatus for roller swaging V-sided pipe threads in a neck projecting integrally from a sheet metal blank, including a frame, a rotary head plate, means journaling the periphery of said plate in said frame, a normally stationary shaft extending axially through said plate, a plurality of roller dies having complementary V-sided pipe thread formations thereon, means fixedly mounting one of said dies on said shaft, die holder means pivotally mounted on said head plate for movement radially of said fixed die, another of said dies being rotatably mounted in said die holder means, means for rotating the head, means for rotating the rotatable die, and means for moving the rotatable die radially of the fixed die.

9. Apparatus for roller swaging V-sided pipe threads in a neck projecting integrally from a sheet metal blank, including a frame, a rotary head plate journaled in the frame, a normally stationary shaft extending axially through said plate, a plurality of roller dies having complementary V-sided pipe thread formations thereon, means fixedly mounting one of said dies on said shaft, lever means pivotally mounted intermediate its ends on said plate, means rotatably journaling another of said dies on said lever means adjacent to said lever means pivot, means for rotating the head thereby revolving the die mounted on said lever means about the fixed die, interengaging means carried by said shaft and lever means for rotating the rotatable die as the head rotates, and means for moving the lever means to move the rotatable die radially of the stationary die.

10. Apparatus for roller swaging V-sided pipe threads in a neck projecting integrally from a sheet metal blank, including a frame, a rotary head plate journaled in the frame, a normally stationary shaft extending axially through said plate, a plurality of roller dies having complementary V-sided pipe thread formations thereon, one of said dies being fixed to said shaft and another being rotatably mounted on said head, means for rotating the head, means for rotating the rotatable die; and means for moving the rotatable die radially toward and away from the stationary die, including a cam journaled on said shaft for rotation on the axis of said shaft, driving connections between said cam and the means for rotating the head, and lever means pivotally mounted on the head and mounting said rotatable die thereon and engaging said cam.

11. Apparatus for roller swaging V-sided pipe threads in a neck projecting integrally from a sheet metal blank, including a frame, a rotary head plate journaled in the frame, a normally stationary shaft extending axially through said plate, lever means pivotally mounted intermediate its ends on the plate, a plurality of roller dies having complementary V-sided pipe thread formations thereon, one of said dies being fixed to said shaft and another being rotatably mounted on one end of said lever means, means for rotating the head, means for rotating the rotatable die; and means for moving the rotatable die radially of the stationary die, including a cam journaled on said shaft engaging the other end of said lever means, and driving connections between said cam and said head rotating means for rotating the cam, whereby the cam is rotated relatively to the rotating head.

12. Apparatus for roller swaging V-sided pipe threads in a neck projecting integrally from a sheet metal blank, including a plurality of roller dies having complementary V-sided pipe thread formations thereon, one of said dies being rotatable, means for rotating the rotatable die, means for revolving the axis of the rotatable die about the axis of a second of said roller dies, means for moving the rotatable die radially of the second die as the rotatable die revolves about the second die, means for supporting a sheet metal blank having an integral neck in a position with said neck telescoped over the second die, and means for holding the blank in said supported position whereby internal and external V-sided pipe threads are swaged in the neck as the revolving rotating die moves radially toward the second die.

13. Apparatus for roller swaging V-sided pipe threads in a neck projecting integrally from a sheet metal blank, including a frame, a rotary head plate, means journaling the periphery of said plate in said frame, a rotatably fixed shaft extending through said plate within the periphery of said plate, a plurality of roller dies having complementary V-sided pipe thread formations thereon, one of said dies being fixed to said shaft and another of said dies being rotatably mounted on said head, means for rotating the head, means for rotating the rotatable die, and means for moving the rotatable die radially of the rotatably fixed die.

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