Aug. 4, 1931. J. H. TAYLOR 1,817,215

PIPE UPSETTING MACHINE

Original Filed Nov. 25, 1921 3 Sheets-Sheet 1

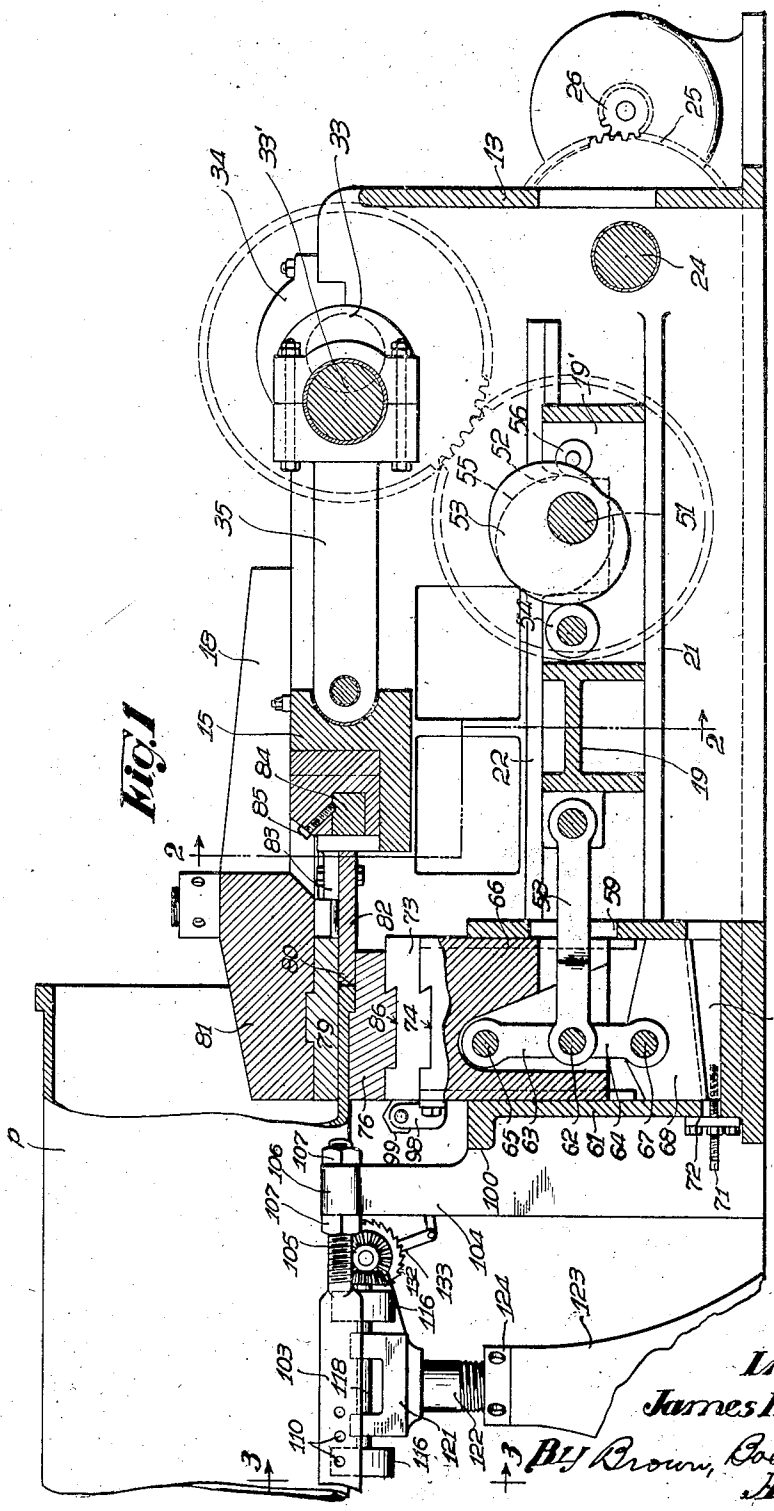


Fig. 1

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Fig. 2

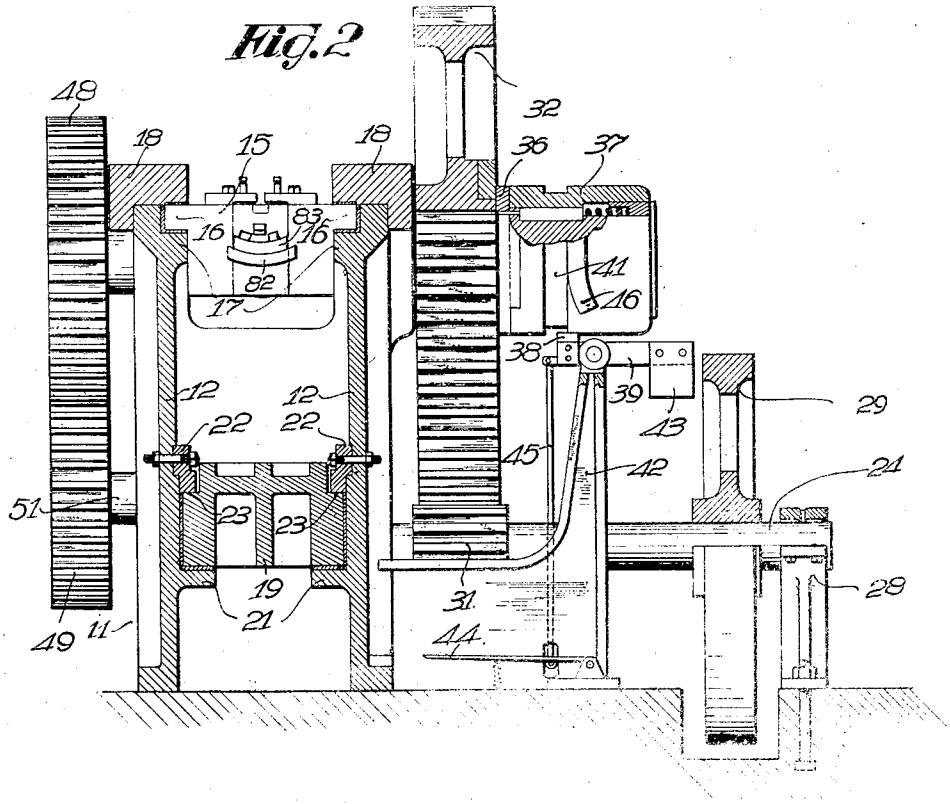
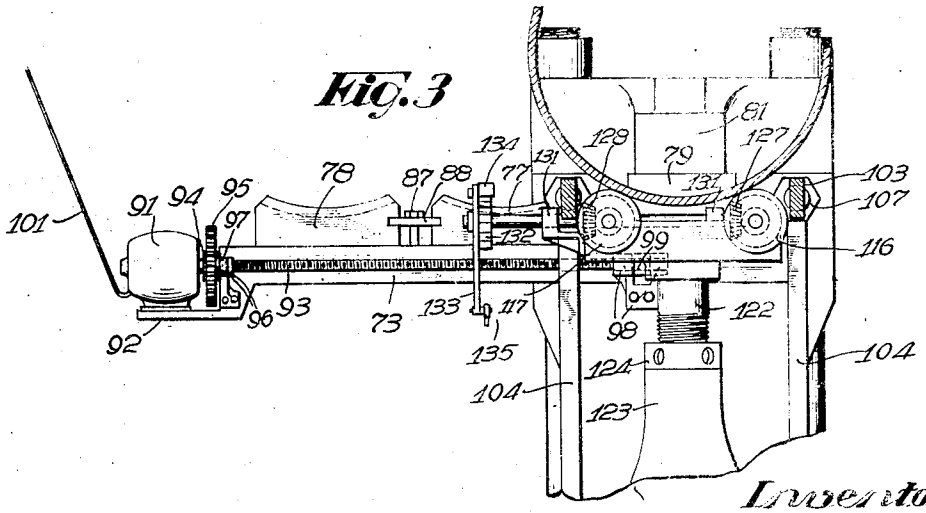


Fig. 3

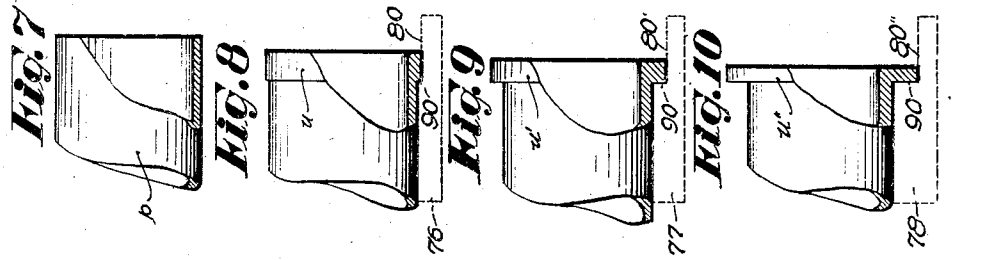


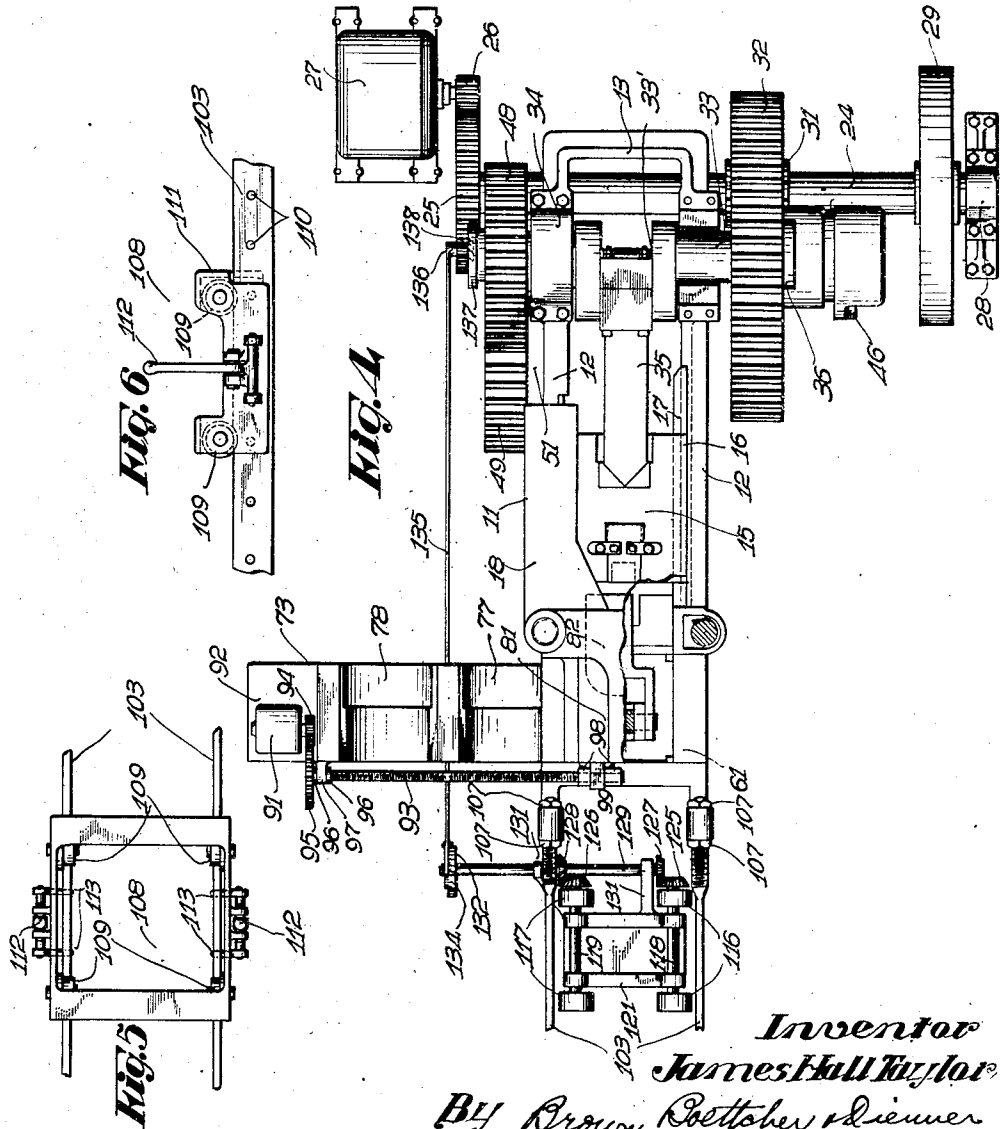
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PIPE UPSETTING MACHINE

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UNITED STATES PATENT OFFICE

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PIPE UPSETTING MACHINE

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The present invention relates to pipe upsetting machines. The invention has particular reference to the art of forming flanges or the like on pipes by performing one or more upsetting operations on the end of the pipe until the desired size of flange is obtained. One of the principal objects is to provide a machine which will perform the upsetting operations in an improved and expeditious manner, and to a certain extent automatically. The invention also embodies an apparently novel method of forming these flanges by the progressive upsetting of the end of the pipe. This progressive upsetting of the pipe is for the purpose of forming a flange of relatively large radial dimension in pipe of average sectional thickness by upsetting a relatively long section of the pipe without incurring the possibility of buckling or otherwise injuring the metal. In this method the end of the pipe is first upset to a certain radial thickness by successively upsetting different portions of the circumference until the entire circumference is upset to a substantially uniform radial thickness. The dies are then substituted and the above operation is repeated by intermittently upsetting the successive portions of the previously upset end to produce an upset portion of greater radial thickness. This upsetting operation is performed one or more times depending upon the desired size of flange and the sectional thickness of the pipe stock.

In the accompanying drawings illustrating a preferred embodiment of the invention:

Figure 1 is a side view, partly in section, of the machine, illustrating the pipe in the process of having a flange formed thereon;

Fig. 2 is a sectional view taken on the plane of the line 2—2 of Figure 1;

Fig. 3 is a sectional view taken substantially on the plane of line 3—3 of Fig. 1 and looking in the direction indicated by the arrows:

Fig. 4 is a fragmentary plan view of the machine;

Fig. 5 is a plan view of the carriage against which the pipe abuts at the other end of the machine;

Fig. 6 is a side view of the same; and

Figs. 7, 8, 9 and 10 are diagrammatic views illustrating the successive steps in the progressive upsetting of the pipe.

Viewed in plan as shown in Fig. 4 the frame 11 of the machine is of U-shaped outline comprising parallel vertical side walls 12 and the end wall 13. A header slide 15 reciprocates horizontally in the upper part of the frame 11, this header slide having projecting flanges 16 resting on guide flanges 17 which project inwardly from the walls of the frame. Longitudinally extending arms 18, constituting part of a die supporting horn which I shall hereinafter describe, are superposed above the flanges 16 and are rigidly secured to the frame, thereby holding the header slide to its guides. Below the header slide 15 a toggle slide 19 reciprocates along horizontal guide flanges 21 projecting inwardly from the walls of the frame. This latter slide is held to these guiding flanges by removable rails or confining members 22 which are bolted to the frame to engage with shoulders 23 adjacent the top of the slide. Both slides are arranged to be reciprocated in certain timed sequence by driving mechanism which I shall now describe.

Motive power is transmitted to a transverse drive shaft 24 through a spur gear 25 and pinion 26 from an electric motor 27 or other suitable source of power. This shaft is supported in suitable bearings 28, and has mounted thereon a fly wheel 29 and a sturdy wide faced pinion 31. This pinion effects a gear reduction with a large spur gear 32 on an upper crank shaft 33. This shaft is supported in suitable bearings 34 on the side members of the frame, and has its crank 33′ connected through the connecting rod 35 with the header slide 15. The large gear 32 is mounted for free rotation on the shaft 33, but is provided with a clutch element 36 on one side of its hub which is adapted for cooperation with a spring pressed clutch element 37 splined on the shaft 33. The clutch element 37 is adapted to be held out of engagement with the clutch element 36 by a roller 38 on a tripping arm 39, which roller is adapted to engage in an annular groove

41 in the clutch element 37. The tripping arm 39 is pivoted on a standard 42 and is weighted at 43 for normally holding the roller 38 in position to engage in the groove 41. The clutch is tripped by a treadle 44 which is pivoted to the frame of the machine and connects through a link 45 with the tripping lever 39. By depressing the treadle 44 the roller 38 is withdrawn from the groove 41, thereby permitting the spring pressed clutch element 37 to shift over and engage the clutch element 36 to drive the shaft 33. A raised cam 46 is formed diagonally on the clutch element 37 to engage the roller 38 and withdraw the clutch element 37 from clutching engagement to permit the roller 38 to reengage in the groove 41. This cam is adapted to effect this automatic unclutching after the shaft has made one complete revolution. By holding the treadle 44 depressed, however, the machine may be operated continuously.

On the other side of the frame the crank shaft 33 carries a spur gear 48 which meshes with a spur gear 49 of equal size on a cam shaft 51 which is journaled in the frame below the crank shaft 33. The toggle slide 19 is adapted to be reciprocated in both directions by the cam shaft 51, and to this end is notched out at 52 to embrace the cam shaft and to provide an end portion 19′ on the other side of the cam shaft. This shaft carries a large cam 53 which is adapted to bear against a roller 54 pivoted on the slide, and a somewhat smaller cam 55 which is adapted to bear against a roller 56 pivoted on the rear portion 19′ of the slide. The forward end of the slide 19 has pivotal connection with a link 58 which extends through an opening 59 in a box guide 61 at the front end of the frame. Within this box guide the link 58 has pivotal connection with the knuckle 62 of two toggle arms 63 and 64. The upper toggle arm 63 has pivotal connection at 65 with a vertically moving slide 66 moving in the box guide 61. This slide supports the series of dies which are employed in the progressive upsetting of the pipe *p*, and is arranged to exert the clamping pressure upon the pipe between the cooperating dies. The lower toggle link 64 has pivotal connection at 67 with a vertically adjustable block 68 which is guided in the box guide 61. The under side of the block 68 is inclined to cooperate with a shiftable wedge block 69, by the shifting adjustment of which the block 68 may be raised or lowered for increasing or decreasing the clamping pressure exerted through the slide 66. An obvious arrangement of adjusting screw 71 and threaded bridge member 72 permits of the convenient adjustment of the wedge block 69.

The vertically moving slide 66 is arranged to carry a table 73 adapted for horizontal motion transversely of the frame 11. The slide is formed with a groove 74 in its upper surface, one side of which groove is dove-tailed, and the lower surface of the table 73 is provided with a correspondingly shaped guide portion engaging in this groove or recess 74. The table 73 is adapted to carry a series of dies 76, 77 and 78 of concave curvature adapted to embrace the outer periphery of the pipe, in cooperation with a convex die 79 which engages the inner periphery of the pipe. The inner die 79 is of smooth cylindrical contour, and is detachably secured to a horn 81 over which the end of the pipe is placed, this horn having the extending arm 18 rigidly braced to the main frame to withstand the clamping pressure exerted through the dies. The horn 81 and die 79 are both in vertical alignment with the header slide 15, so that the header tool 82 will engage the pipe substantially centrally of the inner die 79 and its cooperating outer die 76—77 or 78. The header 82 is bolted or otherwise releasably connected to a mounting bracket 83 which constitutes part of a block 84 removable from the header slide 15. A set screw 85 clamps the block 84 in position. The upper face of the table 73 is provided with a groove 86, similar to the groove 74, in which are clamped the three dies 76, 77 and 78, by bolts 87 passing down through plates 88 engaging with these dies and tapping into the table 73. By this arrangement the dies may be suitably adjusted on the table and may be conveniently removed therefrom for substitution by dies of larger or smaller radius for receiving pipe of greater or lesser diameter. The inner male die 79 is similarly removable from the horn 81 for the substitution of larger or smaller male dies.

The three dies 76, 77 and 78 are adapted to be successively advanced into position under the inner die 79 by the operation of an electric motor 91, mounted at one end of the table 73. This motor is mounted on a shelf 92 depending from one end of the table, and drives a screw 93 extending along one edge of the table, through reduction gearing 94 and 95. The screw 93 is provided with two thrust collars 96 adjacent the large gear 95, which engage at opposite ends of a bearing 97, the bearing 97 being rigidly secured to the table. As shown in Figures 1 and 3, the slide 66 has mounted thereon two upwardly projecting lugs 98—98 which are provided with aligned holes in which the screw 93 can freely slide. Disposed between the lugs 98 is a polygonal nut 99 which is screw threaded to receive the screw 93 and which has one flat face engaging the surface of the table 73 to prevent rotation of the nut. The motor 91 is connected for reversible rotation, whereby the table 73 can be advanced forwardly or backwardly to dispose anyone of the dies 76, 77 or 78 in line under the upper die 79, a swinging flexible conductor 101 permitting this motion of the motor with the table.

The pipe p is adapted to be swung into position to place its end between the upper die 79 and the lower die on the table 73, with the axis of the pipe aligned substantially with the horn 81. Projecting beyond the end of the pipe are two parallel rails 103 which extend horizontally from standards 104 at the end of the main frame. These rails may receive part of the end thrust which is transmitted to the pipe p by the header 82 during the up-setting operation; and to prevent any lateral stresses being set up in the pipe, these rails 103 are preferably aligned substantially with the lower circumference of the pipe and with the header tool 82. The male and female dies in pressure contact with the pipe receive a large part of the end thrust imposed in the upsetting operation; the male die being braced by the mounting of the horn 81 as before described and the female die being braced by a reenforcing flange or rib 100 on the upper edge of the box guide 61. As shown in Figure 1, the front ends of the rails 103 are reduced and threaded, as indicated at 105, to pass through hubs 106 on the standard 104, and these threaded ends receive nuts 107 on each side of the hubs. By the manipulation of these nuts 107—107 the rails 103 can be moved forwardly or backwardly, whereby a relatively small end-wise adjustment of the pipe p can be readily made, as will be presently described. The outer ends of the rails 103 have support in any suitable supporting frame or member which permits this limited longitudinal motion of the rails. The opposite end of the pipe p is held against the thrust imposed by the up-setting operation by a carriage 108 arranged for rolling motion along the rails 103—103. The carriage 108 has pairs of rollers 109 on each side thereof which track on the rails 103, and the carriage has an abutment stop 111 for abutting the end of the pipe p. To the end of adjustably locking the carriage 108 at different points along the rails 103 for accommodating different lengths of pipe, the rails 103 each have a series of spaced apertures 110 which are aligned transversely between the rails. Each side of the carriage 108 pivotally supports a locking arm 112 which carries two pins 113 at its lower end for reciprocation through holes in the carriage frame and reception in the holes 110 in the rails 103. By rocking the two arms 112 inwardly on each side of the carriage the latter can be shifted to any desired point along the rails and then locked thereto by outward movement of the handles, thereby accommodating any desired length of pipe. The shifting of such carriage provides a relatively coarse adjustment, the close adjustment for minute shifting of the pipe being accomplished through the endwise movement of the rails 103 through the manipulation of the nuts 107—107. This permits convenient and accurate adjustment of the pipe in the dies.

The pipe p is supported principally upon two pairs of rollers 116 and 117 engaging on each side of the bottom of the pipe. The rollers are rigidly mounted upon parallel longitudinally extending shafts 118 and 119 which are journaled in a vertically adjustable frame 121. This frame has a downwardly extending screw 122 having reception in the supporting standard 123 and receiving a nut 124, by which the frame 121 may be raised or lowered to accommodate the rollers 116—117 to pipes of different diameters. These rollers also function to intermittently rotate the pipe p for the purpose of bringing successive portions of the pipe circumference into position between the dies, and accordingly, these rollers are arranged to be automatically advanced through a predetermined angular motion after the completion of each up-setting operation. On the ends of the shafts 118 and 119 are mounted beveled gears 125 and 126 which mesh with cooperating bevel gears 127 and 128 on a transverse shaft 129 journaled in bearings 131 on the frame 121. The shaft 129 projects laterally beyond the side of the main frame and supports at its end a ratchet wheel 132. Cooperating with this ratchet wheel is an advancing lever 133, which is journaled on the shaft 129 and pivotally supports at one end a pawl 134 which normally engages in the teeth of the ratchet wheel 132. The other arm of the advancing lever 133 has connection through a connecting rod 135 with a crank pin 136 projecting from a hub 137 on the end of the crank shaft 33. The pin 136 is adjustably clamped in a dove-tail slot 138 extending radially in the end of the hub 137, whereby the effective throw of the connecting rod 135 may be readily adjusted. Where the pipe is relatively long any suitable supporting carriage or member may be located at the outer end of the pipe, having rollers permitting the free rotation of the pipe.

Assuming that the first female die 76 is in operative position under the male die 79 and the end of the pipe has its inner wall embracing the cylindrical outer curvature of the male die 79, the up-setting operation is begun by depressing the treadle 44. This results in the simultaneous actuation of the crank shaft 33 and cam shaft 51. The cam 53 is timed ahead of the crank 33′ so that the first operation is to straighten out the toggle links 63—64 and raise the table 73 upwardly, thereby forcing the female die 76 firmly against the bottom of the pipe p. The cam 53 has a relatively long circular dwell for maintaining the toggle links 63—64 in their straightened position for maintaining the two dies in pressure contact with the lower portion of the pipe throughout the entire upsetting operation. Immediately after the lower female die is forced up into engagement with the

pipe the header 82 enters the die space between the two dies and upsets that portion of the end of the pipe confined in this die space. The header 82 is of course curved to conform to the curved die space between the dies, and has its corners rounded, as shown in Figure 4 to avoid any shearing of the metal. Figs. 7 and 8 illustrate the two steps occurring in the first up-setting operation, and it will be noted therefrom that the die space is preferably of short radial dimension relative to the sectional thickness of the pipe, in order that the wall of the pipe shall not cold-shut or fold in an injurious manner. The permissible depth of this die space 80 is determined by the length of pipe wall being upset in each operation and the sectional thickness of the wall, different sets of dies being preferably employed on the machine when operating upon pipe of different sectional thicknesses.

Referring again to the cycle of operation of the machine, the forward motion of the header 82 upsets a limited circumferential portion of the pipe end substantially equal to the width of the header, and then retracts upon the return throw of the crank 33′. Concurrently with the return motion of the header the cam 53 recedes from the roller 54 and the cam 55 engages the roller 56 and thrusts the toggle slide 19 to the right, as viewed in Fig. 1. This breaks the toggle knuckle and lowers the female die 76, thereby relieving the pipe p of the pressure between the dies. As soon as this pressure is relieved the pipe p is free to be rotated to present the next successive circumferential portion between the dies. This is accomplished by the crank pin 136 imparting operative movement at this time to the shaft 129 through the ratchet 134 and ratchet wheel 132. The angular motion of the shaft 129 operates through the bevel gears 125—128 to rotate the rollers 117 and 116, thereby revolving the pipe p through a predetermined angular motion. As soon as this next successive portion of the pipe circumference is in position between the two dies, the continued motion of the cam 53 raises the lower die into pressure contact with the new portion of the pipe circumference, and the subsequent inward thrust of the header between the dies upsets this next succeeding portion of the pipe circumference, as before described. This is assuming that the treadle 44 has been held depressed, otherwise the clutch 36—37 will have been tripped out after the completion of the first upsetting operation. The operation may be continuous, or step by step by the intermittent tripping of the treadle 44, as desired. In either event, the pipe p is automatically advanced to progressively advance the successive portions of the pipe end between the male and female dies for the upsetting operation above described.

After the entire end of the pipe has been upset to the radial thickness illustrated in Figure 8, the rotation of the shafts 33 and 51 is interrupted, and the electric motor 91 is energized, with the table 73 in its lower position, to advance the second female die 77 into cooperative alignment under the upper male die 79. The large gear reduction between the motor 91 and the screw 93 permits minute adjustment of the die 77 for accurate alignment of the dies by backward or forward rotation of the motor 91. As shown in Fig. 9, the die space 80′ of this second die is of greater radial dimension than in the preceding die. For upsetting the end of the pipe into this wider die space a header 82 of greater thickness is substituted to fill this die space. The headers may be quickly substituted by virtue of their detachable mounting on the bracket 83, and it will be noted that this mounting always disposes the upper edge of the header in substantial alignment with the under surface of the male die 79 irrespective of the thickness of the header. The foregoing operation of progressively upsetting successive portions of the pipe circumference is then repeated with this combination of dies. The radial dimension of the die space 80′ of this second female die 77 bears a certain relation to the radial dimension of the upset portion performed on the end of the pipe in the previous upsetting cycle. That is to say, this latter die space is of such depth or radial dimension that in the upsetting of the previously upset portion u there will be no possibility of a coldshut or fold occuring in the metal. After the end of the pipe has been upset throughout its entire circumference to the radial dimension corresponding to the die space 80′, the third female die 78 is shifted into operative alignment with the male die 76 and the pipe end upset to the greater radial dimension corresponding to the die space 80″ formed in this last mentioned die 78.

The progressive upsetting of the metal in the end of the pipe resulting from the use of the plurality of dies having different depths of die spaces enables a flange of relatively wide radial dimension to be formed by the upsetting of a long section of pipe wall of average sectional thickness without folding, straining or otherwise injuring the metal in the flange or at the juncture of the flange and pipe stock. The several female dies are preferably so aligned and constructed that as these dies are successively advanced into operative position under the male die, the die shoulders 90 of each of these female dies will assume substantially the same position relative to the pipe p and the upper male die. Thus in the first upsetting cycle the end of the pipe is successively upset, portion by portion, throughout the entire circumference, to displace the metal whereby it flows against

the shoulder 90 and against the horizontal face of the female die 76. The next die 77 disposes its shoulder 90 substantially in contact with the back of the upset portion u, and in this next upsetting operation the metal is upset or expanded outwardly across the face of this die shoulder to form the upset portion u' of greater radial dimension. Similarly, the third die 78 disposes its shoulder 90 in back of this upset portion u', whereby the subsequent upsetting operation displaces the metal outwardly across this shoulder to produce the upset portion u'' of greater radial dimension and shorter longitudinal dimension. The number of these progressive operations is determined by the sectional thickness of the pipe and the size of the desired flange or upset portion, it being understood that two progressive upsetting operations may suffice in some instances, and in other instances it is possible that even more than three progressive upsetting operations would be required.

The combination of the stationary mounting of the inner die and the movable mounting of the outer die has particular cooperation in the present machine, as by such arrangement the lowering of the outer die permits of the quick substitution of the dies. The stationary mounting of the inner die on the horn 81 permits the adaptation of the present machine to pipe of smaller diameter than would be the case if the inner die had motion. The mounting of the plurality of female dies on the transversely moving table 73 speeds up the output of the machine, as by such arrangement the female dies can be brought into operative position in the shortest possible time. Such arrangement also permits convenient selection of these dies either in sequence or otherwise.

It will be apparent that numerous modifications can be made in the apparatus and process hereinbefore described without departing from the essence of the invention, and it is intended that such deviations and modifications shall come within the spirit and scope of the appended claims.

I claim:

1. In combination, an inner die, a slide, a table supported by said slide and movable relative thereto, a plurality of outer dies supported on said table, said table being movable to dispose any one of said dies in operative alignment with said inner die, and means for moving said slide for moving the selected outer die into engagement with the pipe.

2. In combination, an inner die, a plurality of outer dies, a slide, a table supported by said slide and movable relative thereto, said outer dies being supported on said table, means for moving said table relative to said slide for selectively disposing any one of said outer dies in operative alignment with said inner die, and power means actuating said slide for moving said selected outer die into engagement with the pipe.

3. In combination, die mechanism engageable with the pipe, upsetting mechanism for upsetting the pipe in said die mechanism, a plurality of supporting rollers for the pipe, a shaft for rotating certain of said rollers, and means operating automatically to advance said shaft for rotating successive portions of the pipe into operative position relative to said die mechanism.

4. In combination, an inner die, an outer die, upsetting mechanism for upsetting the end of the pipe between said dies, a plurality of supporting rollers for the pipe, a shaft for actuating said rollers, a ratchet wheel on said shaft, and a ratchet operable after each upsetting operation to advance said ratchet wheel and rotate a succeeding portion of the pipe between said dies.

5. In combination, die mechanism, upsetting mechanism cooperating therewith, a supporting rail, a carriage movable along said rail, said carriage operating as an abutment engageable with the end of the pipe, means for locking said carriage to said rail at a plurality of predetermined points, and screw means for shifting said rail to minutely adjust the position of said pipe in said die mechanism.

6. In combination, a vertically movable supporting member, a horizontally moving supporting member carried by said first supporting member, said horizontally movable supporting member being adapted for supporting a plurality of dies, pipe supporting means, power means for moving said horizontally movable supporting member to dispose any selected die in association with the pipe, and means operable to move said vertically movable supporting member to carry said selected die into engagement with the pipe.

7. In combination, a vertically movable slide, a horizontally movable table carried by said slide, said table being adapted to support a plurality of dies thereon, work supporting means, power means comprising an electric motor and screw for shifting said table horizontally of said slide, and power means for raising said slide to bring any one of said dies into engagement with the work.

8. In an upsetting machine, two dies cooperating to clamp between them a pipe end to be upset and defining a space for reception of a header, one of the dies being movable toward and away from the other die, a header operating in said space, a drive shaft, means supporting the pipe for turning movement about its axis when the dies are open, positive operating connections between the movable die and the header and the shaft, said connections operating the movable die and the header in timed relation, and means positively driven from the

drive shaft for turning the pipe a predetermined distance upon each successive opening of the dies.

9. In an upsetting machine, two dies cooperating to clamp between them a pipe end to be upset and defining a space for reception of a header, one of the dies being movable toward and away from the other die, a header operating in said space, a drive shaft, means supporting the pipe for turning movement on its axis when the dies are open, positive operating connections between the movable die and the header and the shaft, said connections operating the movable die and the header in timed relation, and automatic means operated in synchronism with the movable die and the header for turning the pipe a predetermined distance upon each successive opening of the dies.

In witness whereof, I hereunto subscribe my name this 17th day of November, 1921.

JAMES HALL TAYLOR.