June 13, 1944. C. L. DEWEY 2,351,020

MACHINE FOR INTURNING TUBE ENDS

Filed Nov. 14, 1942 3 Sheets-Sheet 1

Fig. 1

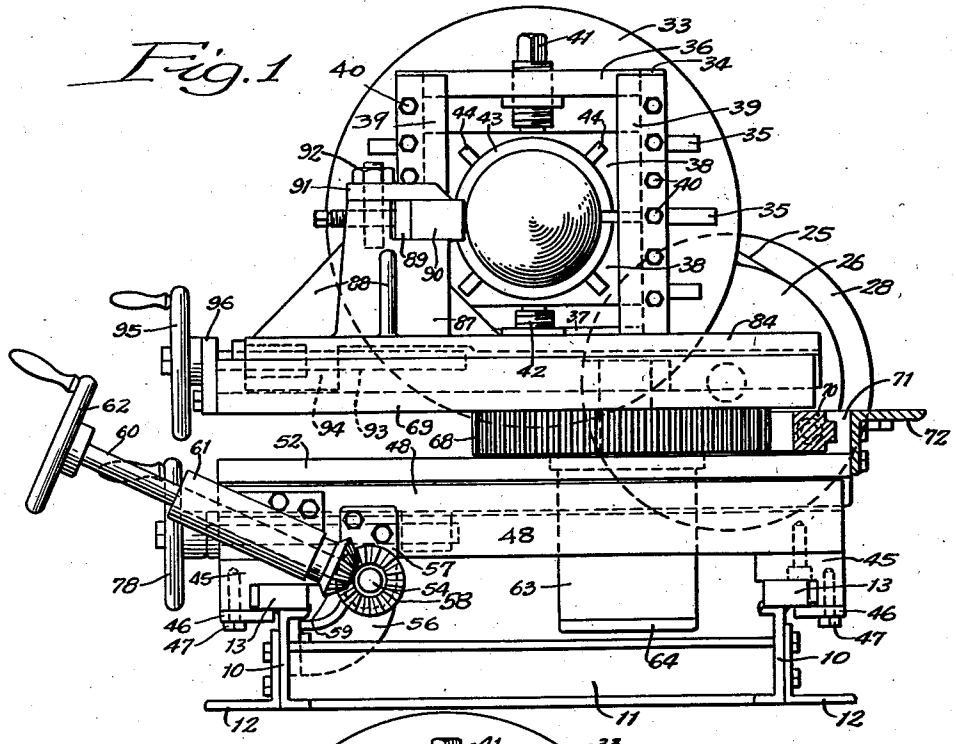
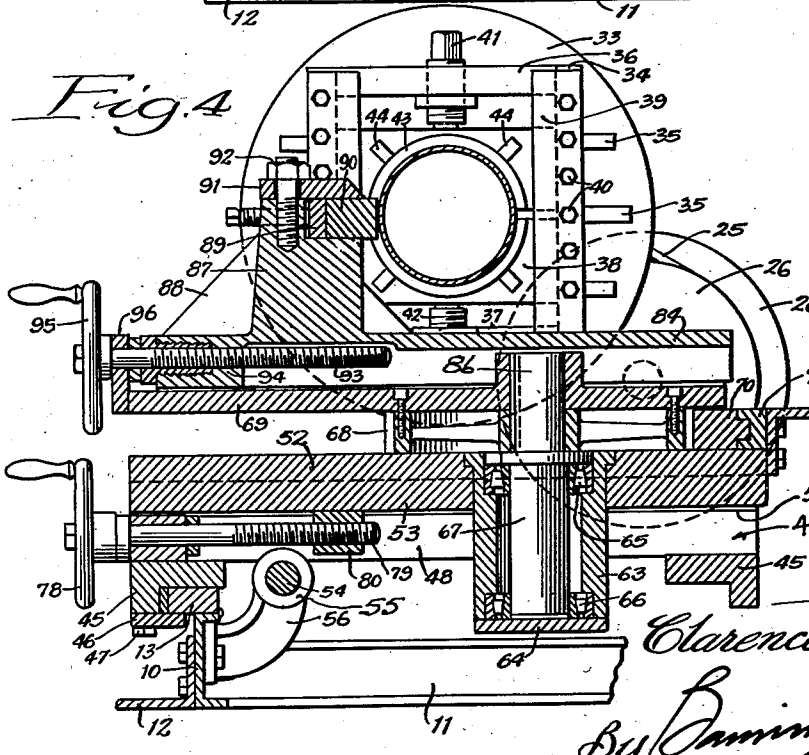


Fig. 4



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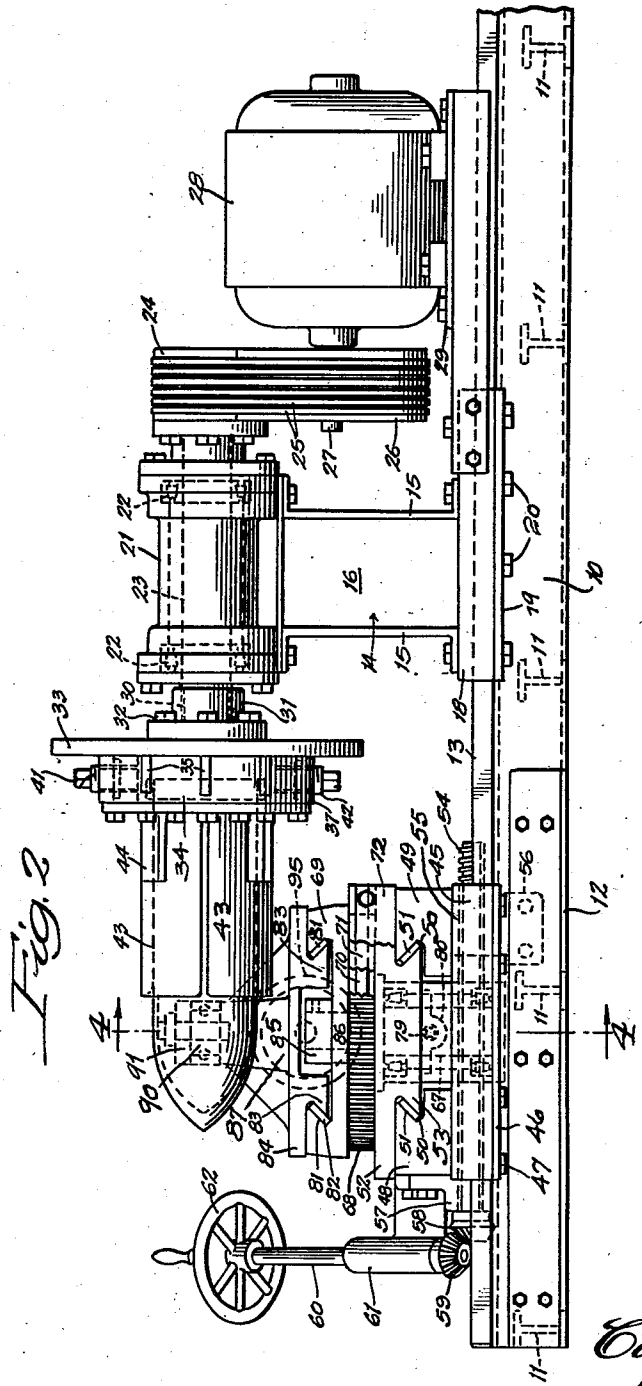


Fig. 2

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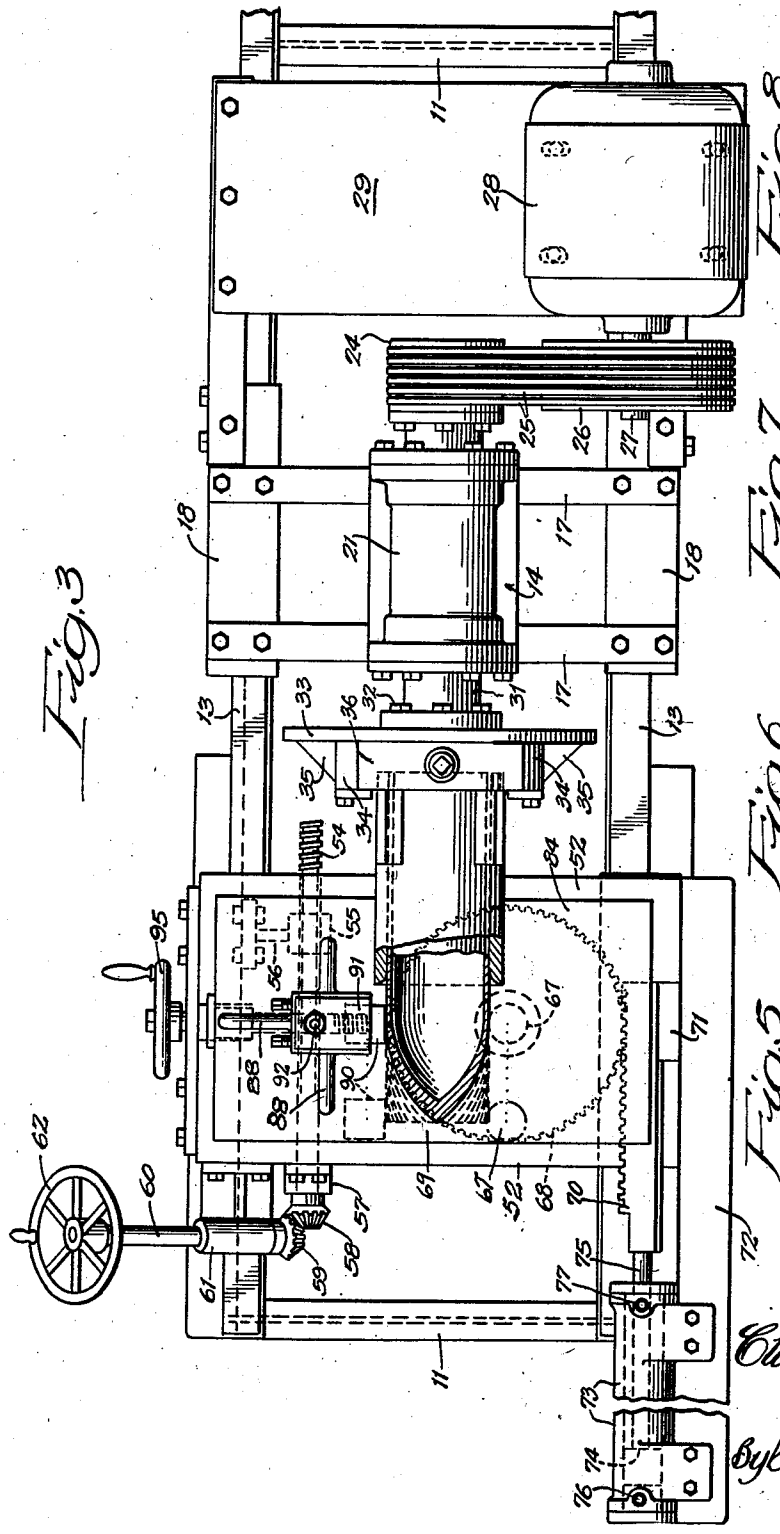


Fig. 3

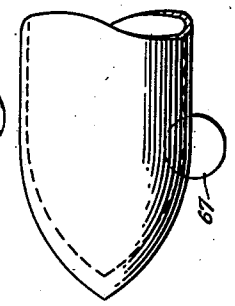


Fig. 8

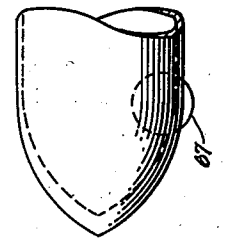


Fig. 7

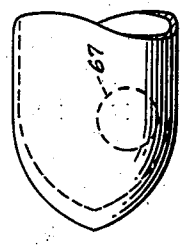


Fig. 6

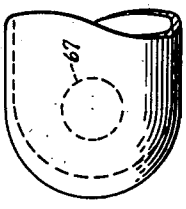


Fig. 5

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Patented June 13, 1944 2,351,020

UNITED STATES PATENT OFFICE

2,351,020

MACHINE FOR INTURNING TUBE ENDS

Clarence L. Dewey, Elkhart, Ind.

Application November 14, 1942, Serial No. 465,628

4 Claims. (Cl. 78—89)

The machine of the present invention is designed to inturn the end of a metal tube in order to close or partially close the end under heat developed by friction so that, particularly in the case of the complete closing of the tube for which the machine is particularly designed, the resultant end formation will be thoroughly welded and of any thickness desired which permits the end to be tapped or otherwise fabricated in the construction of bombs, tanks, or closed receptacles or the like.

The construction of the machine is one which permits the end formation of the tube to be rounded in varying degrees from a truly hemispherical configuration to one approaching a conical formation by suitable adjustments which may be made during the reducing operation to progressively press in the end wall of the tube until a complete closure is effected and until the end wall is thickened to the desired degree, and these adjustments can be varied during the reducing operation to best meet the requirements of various kinds of tubing depending upon the diameter, wall thickness, quality of the metal, and the degree of heat which it is desirable to develop during the reducing operation.

Further objects and details will appear from the description of the invention in conjunction with accompanying drawings, wherein—

Figure 1 is a front end view of a machine embodying the features of the present invention;

Fig. 2 is a side elevation thereof;

Fig. 3 is a plan view of the same;

Fig. 4 is a cross-sectional elevation taken on line 4—4 of Fig. 2 looking in the direction of the arrows; and

Figures 5, 6, 7, and 8 are details showing variations in the range of movements required in imparting varying degrees of curvature to the end closure of sections of tubing.

The machine as a whole is carried by a base comprising spaced side beams 10 and cross beams 11, the side beams being reenforced at their forward ends by angle bars 12. The side beams carry top rails 13 which provide supports for the mechanisms which may be adjustably mounted thereon to accommodate tube sections of varying lengths which will now be described.

The mechanism for mounting and rotating the tube section is carried by a box-like standard 14 having flanged end walls 15 and connecting side walls 16 which end walls are elongated to provide bridge extensions 17, the ends of which are carried by rabbeted slide bars 18 which are adjustably mounted upon the rails 13 and are clamped thereto in properly adjusted position by underlying clamp plates 19 through which are entered bolts 20. The standard 14 carries a journal casing 21 which provides a mounting for front and rear roller bearings 22 through which is journaled a shaft 23 carrying a grooved pulley 24 at its rear end which is driven by belts 25 carried round a driving pulley 26 on the shaft 27 of a motor 28 which is mounted on a bridge plate 29 secured to the slide bars 18.

Th forward end 30 of the shaft 23 is reduced and threaded into a block 31 which is secured by bolts 32 to a chuck plate 33 which has welded to its forward face a pair of spaced side flanges 34, reenforced by ribs 35 which side flanges are connected by top and bottom flanges 36 and 37 giving to the forward face of the chuck plate 33 a box-like configuration.

The chuck plate affords a mounting for a pair of clamping blocks 38 which are adjustably held between the side flanges 34 and are guided by over-lying clamping plates 39 secured by bolts 40. The clamping blocks 38 are forced inwardly by upper and lower set screws 41 and 42, and each is provided on its front face with a half-cylindrical tubular clamping shell 43 having reenforcing ribs 44 which arrangement permits the rear end of a length of tubing to be abutted against the clamping blocks, and thereafter tightly clamped into position in axial alignment with the shaft 23 by the tightening of the set screws 41 and 42.

It will be understood, however, that the formation of the chuck may be otherwise modified where it is necessary to clamp a section of tubing having a reduced end or otherwise specially configured. The chuck arrangement shown is one which serves to tightly grip and reenforce the tubing throughout the major portion of its length allowing the end to project forwardly therefrom the extent required to subject it to the reducing operation now to be described.

Near the forward end of the machine is located a carriage which comprises rabbeted slide bars 45 mounted upon the rails 13 and held in position by under-lying plates 46 secured by bolts 47. The slide bars have mounted thereon spaced front and rear bridge bars 48 and 49 each of which is provided on its inner edge with an undercut V notch 50, the upper wall of which is faced by a bearing plate 51 which plates in unison furnish a slide bearing for a transversely adjustable slide platform 52 having in its undercut face a guide rib 53, the edges of which are undercut to register with the bearing plates 51. The longitudinal movement is imparted to the carriage, and the mechanism supported thereby through the medium of a feed screw 54 which is threaded through a nut 55 carried by a bracket 56 fixedly secured to the rear rail 10. The forward end of the feed screw is journaled within a hanger-bracket 57 secured to the front bridge bar 48 and the feed screw carries a beveled pinion 58 meshing with the beveled pinion 59 on the end of an obliquely disposed spindle 60 entered

through a bracket 61 secured to the bridge bar, the spindle carrying a hand-wheel 62 at its outer end which permits manual adjustment of the feed screw to advance the carriage inwardly toward the tubing as the reducing operation progresses.

The slide platform 52 is movable transversely of the carriage, and has secured thereto and is bored to receive the upper end of a cylindrical journal casing 63 which is closed at its lower end by a head plate 64 and affords a mounting for upper and lower roller bearings 65 and 66 which in conjunction afford a mounting for a vertical shaft 67 which has keyed thereon a large spur-gear 68 which in turn has bolted thereto an oscillating platform 69 which partakes of oscillating movements imparted to the spur-gear.

The spur-gear is in mesh with a rack 70 which is held in position by a guide bar 71 bolted to an angle beam 72 which comprises a portion of a supplemental frame suitably secured to the end of the slide platform, which frame also affords a mounting for a fluid pressure cylinder 73 which operates a piston 74 on the end of a reciprocating piston rod 75 secured to the end of the rack, fluid pressure being alternately admitted through ports 76 and 77.

The slide platform 52 is transversely adjusted by a hand-wheel 78 at the outer end of a feed screw 79 entered through a nut 80 depending from the base of the platform. The oscillating platform 69 is channeled on its upper face to afford over-hanging guide flanges 81 faced by slide bearing plates 82 which furnish a mounting for obliquely faced guide ribs 83 formed on the under-face of a slide plate 84, the guide ribs being spaced to provide clearance for a boss 85 on the oscillating platform through which the reduced upper end of the shaft 67 is entered and locked by a key 86.

Slide plate 84 is provided with a post 87 reenforced by ribs 88 and provided with a shouldered recess 89 adapted to receive a block 90 of extremely hard and refractory material which is held in place by an over-hanging clamping plate 91 secured by a bolt 92. The slide plate 84 is adjusted by means of a feed screw 93 threaded through a lug 94 and rotated by a hand-wheel 95 which bears against a plate 96 on the oscillating platform 69.

The refractory block is the ultimate operating tool which imparts pressure under friction to the end wall of the tube section and progressively advances the same inwardly toward the tube axis and in so doing, develops a very high degree of temperature which may proximate 2200° F. and which results in the compressive welding of the metal and a compacting and building up of the wall thickness as the operation progresses. To meet these conditions, the refractory block must be of material which will be highly resistant to abrasion and to fusing under the high temperatures developed, and for this purpose a material known as alundum has been found to be peculiarly adapted.

Alundum is an artificial aluminum which is made by heating bauxite in an electric furnace, and for present purposes it is desirable to use a block of the material in its crystalline condition, as it comes from the furnace and without further treatment other than to give to its acting face a comparatively smooth surface for contact with the metal wall of the tube.

Operation

With the chuck support adjusted and clamped in position to accommodate tube sections of the desired length, a tube section is clamped into position within the chuck, and the oscillating frame swung into the transverse position shown in Figure 3, and with the carriage advanced to bring the refractory block and the vertical oscillating shaft into the dotted line positions shown in that figure, the machine is properly adjusted to begin the end closing operation.

Fluid pressure is thereupon admitted to the forward end of the cylinder 73 which imparts a rearward thrust to the rack and imparts an inward and forward oscillation to the refractory block. With the slide platform adjusted as in Figure 3, the vertical axis of oscillation will stand laterally outside of the end of the tube so that the radius of the oscillating movement of the refractory block will be greater than twice the radius of the tube itself with the result that the arc of movement will at the beginning only slightly depress the butt end of the tube wall on its forward sweep.

It will be noted that at the beginning of the operation, the axis of the vertical oscillating shaft stands substantially in alignment with the end of the unreduced tube as indicated in dotted lines so that at the beginning the inward or radial component of the oscillating movement will be slight as compared with the longitudinal component of the oscillating movement. Fluid pressure being alternately admitted to opposite ends of the cylinder will cause back and forth swinging or oscillating movement of the refractory block and during these movements, the operator will rotate the hand-wheel 62 which causes a progressive longitudinal retreat of the carriage thereby progressively moving back the center of oscillation through the stages indicated in dotted lines in Figure 3, so that the successive forward oscillations will progressively increase the radial component of each oscillating cycle during which the refractory block is in contact with the metal wall which is meanwhile being rotated at a high rate of speed so that as the operation continues, a progressively greater contact between the refractory block and the tube wall will be maintained thereby increasing the friction and developing a very high fusing temperature as the metal walls approach the axis of the tube with the result that at the final point of closing contact, a fusing temperature will be maintained; and if desired, the operation can thereafter be continued which will serve to additionally increase the thickness of the metal at the tip or nose of the tube.

By rotation of the hand-wheel 78, the vertical axis of oscillation can be adjusted to vary the radius of movement of the refractory block so that where a more gradual reduction in diameter or a more nearly conical formation is desired, the axis can be adjusted to a more distant position from the tube wall or in like manner it can be moved inwardly until its mounting under-lies the tube axis in which latter position a truly dome-shaped or hemispherical closure will result as indicated in Figure 5.

Although for most purposes, a fixed adjustment of the vertical axis of oscillation will be maintained throughout the complete reduction of the tube section, it may be desirable in some circumstances to progressively reduce the radius of oscillation concurrently with the backward travel of the carriage with the result that the initial

inward deflection of the metal will be comparatively gradual and will be increased in abruptness as the metal softens under increasing temperature and until the adjustment required to produce the intended ultimate configuration of the tube closure is attained.

The speed of oscillation of the refractory block can be regulated in proper ratio to the speed of rotation of the tube, but under ordinary conditions a speed of two or three oscillations per second with an r. p. m. of 2000 has been found satisfactory, and in actual use a block of alumina will resist any appreciable abrasion for a long period of time even when subjected to high fusing temperatures so that frequent renewal thereof is not necessary. The adjustment afforded by the hand-wheel 95 permits the refractory block to be brought into proper contact with the surface of the tube at the beginning of the operation so that it will be maintained throughout the operation at a distance equal to the outside radius of the tube, and the range of movement of the piston 74 is so regulated that each oscillation will carry the refractory block inwardly to or beyond the axial center of the tube so that a complete closure of the tube will be effected if the operation be continued throughout; although it will be understood that the machine is equally adapted for use in cases where a partial closure only of the tube is desired and in which the operation will be discontinued after the carriage has been moved inwardly to an extent necessary to effect the desired degree of closure.

Although I have shown a construction in which the carriage which supports the oscillating mechanism is progressively moveable longitudinally and in which the rotating tube is held against longitudinal movement, it will be understood that like results may be accomplished by a construction in which the tube is advanced or a construction in which the tube is held stationary, and the refractory block is revolved around the tube and either the block or the tube moved longitudinally with relation to the other and, unless otherwise indicated in the claims, it will be understood that relative rather than absolute movement is referred to in securing the necessary co-action between the tube wall and the reducing block; and it will also be understood that in cases where excessively high frictional temperatures are not encountered, a reducing block or other similar agency which lacks the refractory properties previously referred to may be employed although in cases where a complete closure of the tube end is desired, the frictional development of high welding temperature may be found most desirable.

I claim:

1. In a machine of the class described, the combination of a chuck member adapted to engage the rear end of a tube section and present its forward end in position to be acted upon, a carriage located in laterally spaced adjacent relation to the forward end of the tube section, means for imparting relative longitudinal and rotational movements between the carriage and the chuck, an oscillating member carried by the carriage and mounted to swing on an axis extending transversely to the axis of the tube section, adjusting means connecting the oscillating member and carriage and operable to impart relative transverse movement therebetween for laterally adjusting the position of the axis of the oscillating member with respect to the axis of the tube section, and a forming tool carried by the oscillating member and positioned to engage the more distant end edge wall of the tube section.

2. In a machine of the class described, the combination of a base frame affording a trackway, a chuck for engaging the rear end of a tube section and a carriage mounted on the frame, means for imparting relative longitudinal movement between the chuck and the carriage, means for imparting rotation to the chuck, a slide frame mounted for transverse adjusting movements on the carriage, an oscillating platform carried by the slide frame and mounted to swing on an axis extending transversely to the axis of the tube section carried by the chuck, adjusting means for adjusting the slide frame on the carriage to vary the lateral spacing between the axis of the oscillating member and the axis of the tube section, a forming tool carried by the oscillating platform and positioned to engage the more distant end edge wall of the tube section and swing inwardly toward the tube axis during each oscillation, and power means carried by the slide frame for oscillating the platform.

3. In a machine of the class described, the combination of a base frame affording a trackway, a chuck for engaging the rear end of a tube section and a carriage mounted on the frame, means for moving the carriage longitudinally toward the chuck, means for imparting rotation to the chuck, a slide frame mounted for transverse adjusting movements on the carriage, an oscillating platform carried by the slide frame and mounted to swing on an axis extending transversely to the axis of the tube section carried by the chuck, adjusting means for imparting adjusting movements to the slide frame to vary the lateral spacing between the axis of oscillation and the axis of the tube section, a forming tool carried by the oscillating platform and positioned to engage the more distant end edge wall of the tube section and swing inwardly toward the tube axis during each oscillation, and a piston operated rack and gear carried by the slide frame for oscillating the platform.

4. In a machine of the class described, the combination of a frame, a chuck member rotatably mounted on the frame and adapted to engage the rear end of a tube section and present its forward end in position to be acted upon, a carriage located in laterally spaced adjacent relation to the forward end of the tube section, means for imparting relative longitudinal and rotational movements between the carriage and chuck, an oscillating member carried by the frame for sliding movements both longitudinally and transversely thereof, said oscillating member being also pivotally mounted to swing on an axis extending transversely to the axis of the tube section and chuck member, screw means associated with the oscillating member for holding said member against movements relative to the frame, and for adjusting the position of the pivotal axis thereof both laterally and longitudinally with respect to the axis of the tube section, a tube deforming tool slidably carried by the oscillating member, and means operably associated with said tool for imparting reciprocatory adjusting movements thereto.

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