Sept. 2, 1941. J. A. DOVE 2,254,275

MACHINE OR APPARATUS FOR SHAPING METAL TUBES, CONTAINERS, AND THE LIKE

Filed April 21, 1939 3 Sheets-Sheet 1

Fig. 1.

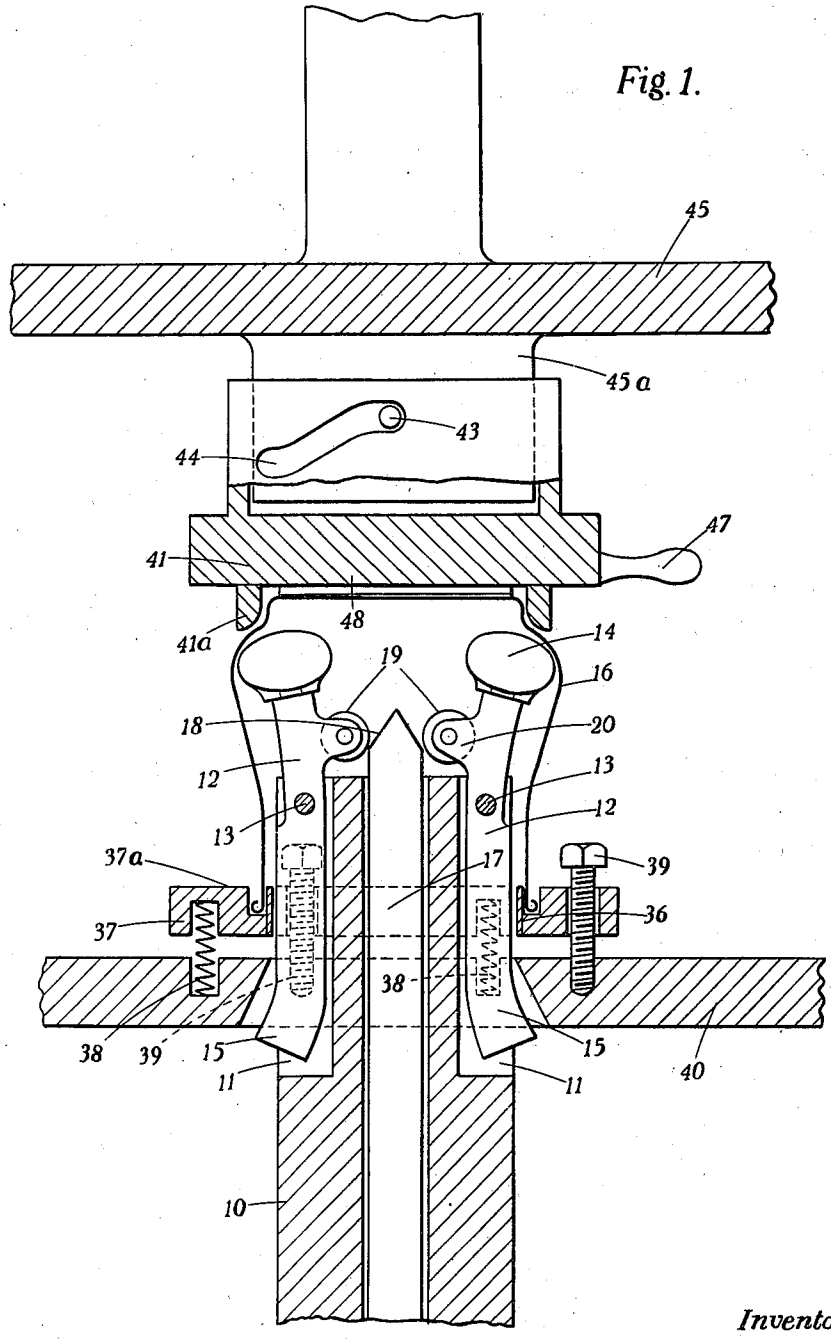

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Fig. 2.

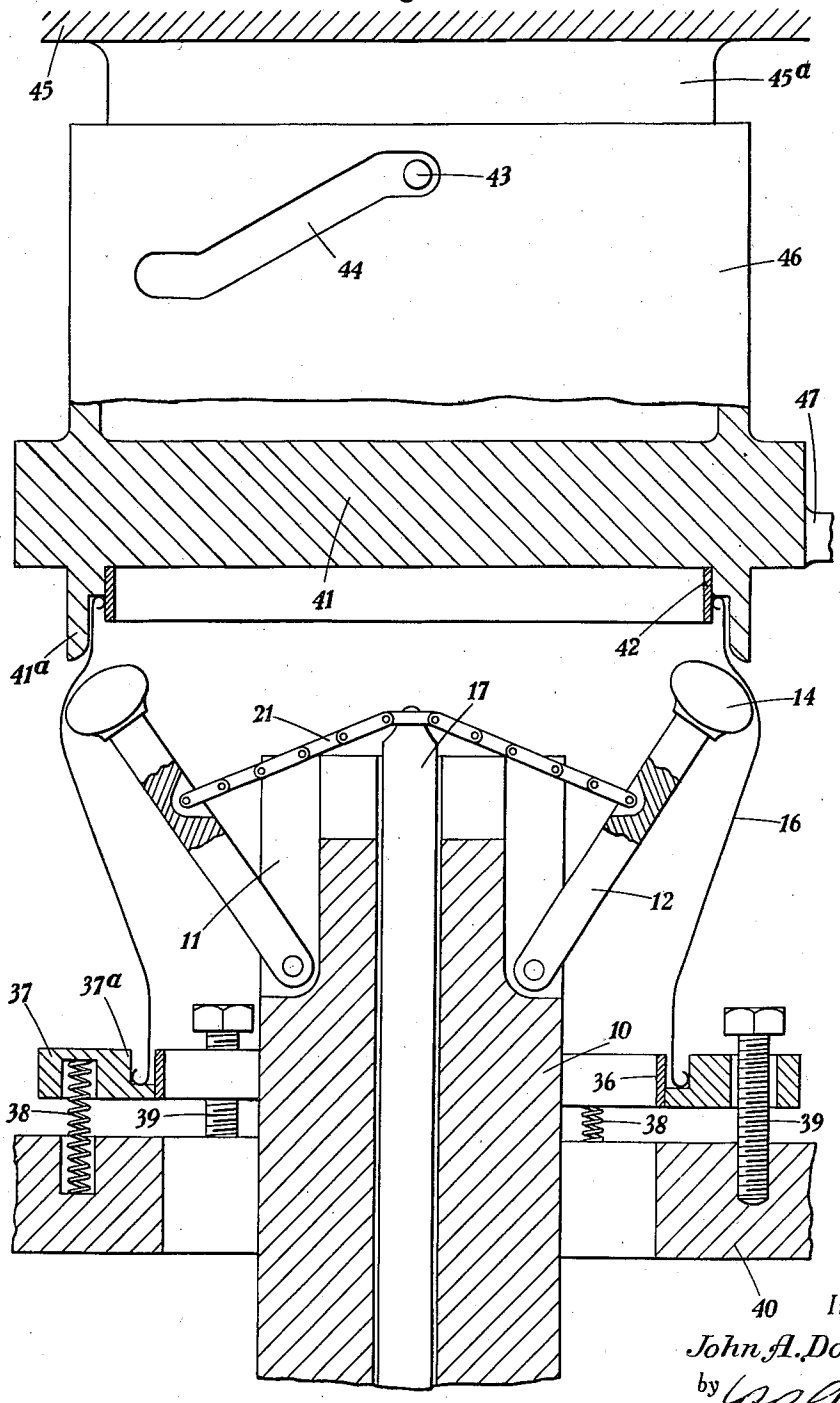

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Fig. 3.

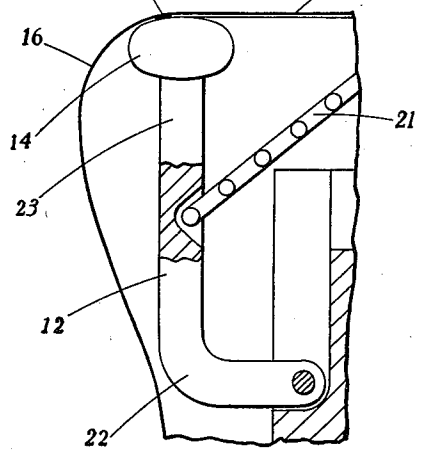


Fig. 4.

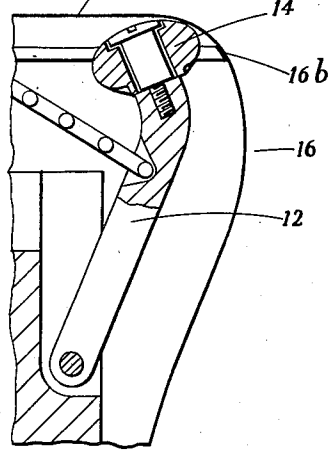


Fig. 5.

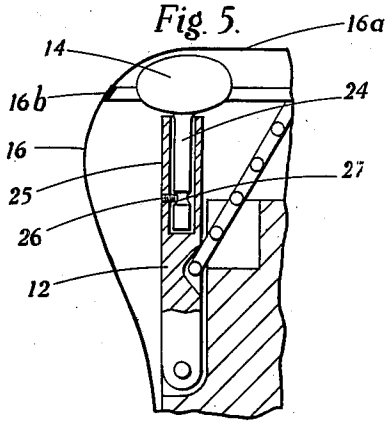


Fig. 6.

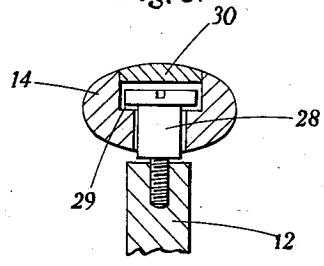


Fig. 7.

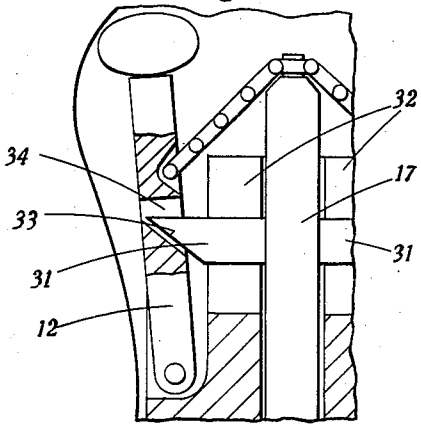
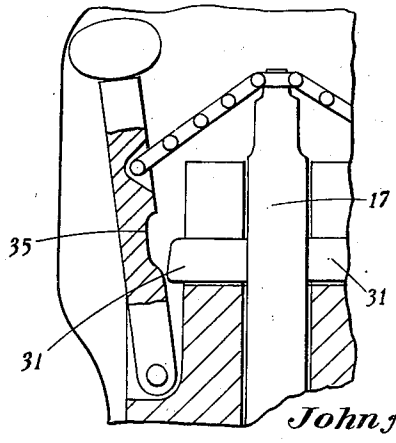


Fig. 8.



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Patented Sept. 2, 1941 2,254,275

UNITED STATES PATENT OFFICE

2,254,275

MACHINE OR APPARATUS FOR SHAPING METAL TUBES, CONTAINERS, AND THE LIKE

John Arthur Dove, Sutton-in-Ashfield, England, assignor to Barringer, Wallis & Manners, Limited, Rock Valley, Mansfield, England

Application April 21, 1939, Serial No. 269,276
In Great Britain April 25, 1938

2 Claims. (Cl. 113—52)

This invention comprises improvements in machines or apparatus for shaping metal tubes, containers and the like, and is primarily concerned with the shaping of thin sheet metal articles by the exercise of pressure thereon at the part or parts to be shaped.

The invention is particularly concerned with machines of the kind wherein shaping of tubular, cylindrical or annular bodies, such for example as sheet metal containers, is effected by a tool operating within the work and embodying a number of radially displaceable pressure members, relative rotation and/or axial or longitudinal movement being effected between the tool and the work and said pressure members being displaced outwards during said movement to bulge or expand the work at the required position or positions and to the required extent.

In the specification of my prior U. S. Patent No. 2,194,385, granted March 19, 1940, a machine is described having means for positively controlling the degree to which the radially displaceable pressure members are moved outwardly during the shaping operation and consequently also the degree to which the article is expanded or bulged; and it is an important object of the present invention to provide in a machine of the kind referred to an improved construction and arrangement of shaping or expanding tool.

According to the present invention a shaping or bulging tool is provided comprising in combination a head, arms pivotally carried by said head and functioning to move radially thereto on their pivots, a roller rotatably mounted at one end of each pivoted arm, said rollers functioning when moved outwards by pivotal displacement of said arms to roll upon and apply pressure to the work to shape same, a member operating in the head between said pivoted arms, and said member functioning to control the degree of pivotal movement of the arms and consequently also the degree to which the work is bulged by the rollers on said arms.

Various constructions and arrangements of shaping tool are hereinafter described and included in the claims.

For the purpose of more fully describing the nature of this invention, reference will now be made to the accompanying drawings, wherein:

Figure 1 illustrates in part sectional elevation a tool in accordance with the present invention, in the operative position within a container being shaped, there being also illustrated means for supporting the work during the shaping operation.

Figure 2 is a similar part sectional elevational view illustrating a modified construction of tool in operation.

Figures 3 and 4 are part sectional detail views showing different constructions of pivoted arms carrying pressure-applying rollers.

Figure 5 is a sectional detail view showing one method of mounting a pressure roller within a pivoted arm on the tool.

Figure 6 is a sectional detail showing another method of mounting a pressure roller.

Figure 7 is a part sectional detail view showing one means for positively controlling the pivoted arms when moved out under centrifugal force.

Figure 8 illustrates another method of positively controlling the arms.

In the method of carrying out the invention illustrated in Figure 1, the shaping or expanding tool comprises a solid cylindrical head 10 having diametrically opposed slots 11 open at one end thereof. In each slot 11 is pivotally mounted an arm 12, the pivot 13 being located intermediate the ends of the arm and also at or near the open end of the slot 11, i. e. at or near the end of the tool head. At that end of each pivoted arm 12 which projects beyond the end of the tool head 10 is pivotally mounted a roller 14 which may be of elliptical section, said roller being mounted to rotate upon a small pin fixed to the end of the arm or having fixed thereto a pin which extends down into and is rotatable within a hollowed portion of the arm. Alternatively, the end of the arm itself may be reduced to form an axle for the roller. That part of each pivoted arm 12 located below the pivot 13 is conveniently longer than the part extending above said pivot, or is otherwise formed to constitute a counterweight tending normally to move the rollers 14 towards each other, i. e. towards the axial centre of the tool.

The arrangement is such that as the tool head rotates, the lower or counterweight portions 15 of the arms 12 tend to fly outwards under centrifugal force, thereby as aforesaid moving the rollers 14 towards each other, and when so disposed the tool is entered within the metal box 16 or other work being shaped.

When the tool has been entered within the work, a rod 17 extending axially through the tool head is slidably displaced, and a tapered extremity 18 of said rod co-operates with rollers 19 rotatably mounted between inwardly projecting lugs 20 on the pivoted arms 12 to press outwards the upper ends of said pivoted arms against the action of centrifugal force. This causes the pres-

sure rollers 14 to move outwards and bulge the work 16.

It will be appreciated that the extent to which the work is bulged is variably determined by the degree to which the pressure rollers 14 are pressed outwardly by the tapered end 18 of the rod 17. Opposite sliding movement of the rod 17 permits of the rollers 14 again moving inwardly under the action of the centrifugal force.

Instead of constructing the tool so that the lower portions 15 of the arms 12 fly out under centrifugal force, the outward movement of said arm portions may be effected by suitable springs, against the influence of which the rollers 14 are moved outwards by the rod 17.

In the alternative construction illustrated in Figure 2, the pivoted arms 12 carrying the pressure rollers 14 are pivoted at their lower extremities within the base of opposed slots 11 in the tool head 10; consequently rotation of the tool head results in the arms 12 being caused to fly outwards under the action of centrifugal force and apply the necessary bulging pressure to the work 16 by the rollers 14. In this arrangement the degree to which the rollers 14 move outwards, and consequently also the degree of bulging effected thereby, is variably determined by the slidable displacement of an axially disposed rod 17 suitably connected at its upper end to a chain or other flexible connection 21, the ends of which are connected to the pivoted arms 12 at a suitable position between their ends. It will be appreciated, therefore, that projection of the centre rod 17 from the end of the tool head functions to pull inwardly the pivoted arms 12 and the pressure rollers 14; consequently, the degree to which the rod 17 is moved determines the extent to which the bulging rollers 14 are permitted to fly outwards.

The connection of the centre rod 17 to the chain or the like 21 may be by a pin, screw or the like passing through a centre link of the chain and fixed to the end of the rod.

If desired, there may be more than two radially displaceable pivoted arms 12 in the tool. For example, there may be three such arms.

In an arrangement such as last described, the pivoted arms may be of substantially bell crank formation, as illustrated in Figure 3, the lower part 22 of each arm being normally substantially horizontal or radial and the remaining part 23 being normally substantially vertical or parallel to the axis of the head, the linking of the arms to the central axially slidable rod 17 being effected as aforesaid by a chain or chains 21.

By cranking the arms 12, the axes of rotation of the pressure rollers 14 are normally parallel or approximately parallel with the axis of the tool, and it will be appreciated that by so disposing the axes of rotation of the pressure rollers 14 the latter can operate to effect bulging of the box or container 16 right up to or substantially near to a base or end wall 16*a* which has been previously fixed, by seaming or otherwise as at 16*b*, to said box without any fear of damaging the seam or other joint between the peripheral wall and the end wall of the box. This operation is clearly illustrated in Figure 3.

The disposition of the pressure rollers 14 to permit of same operating right up to or approximately up to the end closure or wall 16*a* may, however, be accomplished by cranking the pivoted arms 12 at their upper or outer ends as shown in Figure 4 and pivotally mounting the rollers at said cranked ends, and with such an arrangement the pressure rollers may, if desired, be brought into engagement with and operate upon the fixed base or end wall 16*a* itself, so as to provide a certain degree of curvature to said end wall at or near to its peripheral edge, as shown in Figure 4. By this means the capacity of the box can be increased.

Another method whereby a box or the like 16 can be shaped or bulged at its closed end 16*a* beyond the seam 16*b* thereof, is by so forming the pressure rollers 14 that the entire exposed peripheral face of each roller is adapted to rotate solid. Where such roller is provided it is not necessary that the pivoted arms 12 be cranked, and it will be appreciated by reference to Figure 5 that the rollers can be brought into engagement with the inner face of the end closure 16*a* while the axes of said rollers are approximately vertical; and by virtue of the fact that the entire surface of the exposed part of the roller rotates relatively to the arm 12, same will exert a bulging effort on the closure 16*a* without fear of damaging said closure.

To this end the roller 14 may, as shown in Figure 5, be a solid member provided with a downwardly projecting pin 24 rotatably accommodated within a socketed end portion 25 of the pivoted arm 12 and retained from axial displacement by a small grub screw or the like 26 coacting with a circular groove 27 in the pin 24. Alternatively, a headed screw 28 inserted within a shouldered recess 29 in the roller 14 may be screwed into the end of the arm 12, and a disc 30 may be inserted within the shouldered recess 29 above the head of the screw 28 so as to complete the exposed face of the roller 14 and make same solid (see Figure 6).

In some instances it is desirable that the pressure rollers 14 be so mounted that at all times during the operation thereof on the interior of the work 16, the axis of rotation of each roller is disposed so that as the rollers travel round in contact with the work same have a slight rubbing or slurring action on the work, and any more markings or imperfections on the face of a roller or rollers engaging the work are not imprinted on the surface of said work.

In other words, the rollers may be so mounted that the general plane of rotation of each roller is at an angle out of perpendicular to the axial centre of the tool, as illustrated in Figure 4.

It may, however, be desirable to produce certain markings on the face of the work during shaping, such for example as hammered effects, in which case the surface of the rollers may be prepared or treated for producing these effects, and the rollers in such case will be mounted to rotate on axes parallel or approximately parallel with the axis of the tool head.

In order to obviate or minimise the possibility of spiral markings, rings or other undesirable lines being produced on the work, due to unsteady or inconsistent application of pressure or to vibration of the pivoted arms and pressure rollers, the invention provides means whereby positive outward pressure is applied to the pivoted arms carrying the pressure rollers during the shaping operation.

In one method of accomplishing this, a bar or equivalent member is fixed to the central rod 17 so as to provide radiating arms 31 extending through slots 32 in the tool head and having their outer ends inclined or bevelled on their under side as at 33. Each of said bevelled ends 33 coacts with a slot 34, having a correspondingly bevelled base cut in each pivoted arm 12

(see Figure 7). As the head revolves and the arms 12 tend to swing out, the central rod 17 is moved downwardly, carrying with same the radiating arms 31, and the bevelled ends 33 of said arms coact with the inclined bases of the slots 34 so as to exert outward pressure on said arms and prevent same from "kicking" or vibrating in the event of their being met with varying resistance by the metal being shaped.

Where a parallel bulge is being produced (Figure 8) the aforesaid radiating arms 31 may be formed with approximately right-angle ends adapted to move into and out of engagement with approximately square cut slots or recesses 35 in the pivoted arms; the arrangement being such that as the arms 12 swing outwardly and the central rod is moved downwardly, the radiating arms 31 leave the slots 35 and become wedged between the arms so as to lock same against inward movement until the central control rod 17 is again moved in an opposite direction.

The movement of the centre rod 17 may be controlled from one or more cams in a manner similar to that described in the specification of my aforesaid patent. Advantageously a rotatable cam device is employed for this purpose; and where axial or longitudinal movement is imparted between the tool and the work, the rotation of the cam may be effected automatically and simultaneously with said axial or longitudinal movement. The operation may be such that during reciprocation of the work the cam is rotated in one direction or the other and the radial displacement of the pressure members of the tool thereby variably controlled. The employment of a rotatable cam enables a comparatively abrupt bulge to be produced in the work from a comparatively less abrupt rise or inclination of the cam.

During the shaping operation the work is carried between end supports, one of which may have associated therewith spring or resilient media for exerting a resilient or yielding pressure on the work and thereby allowing for any elongation or contraction of the work due to the bulging. The resilient pressure on the work also minimises the possibility of said work being damaged, such as by bursting or collapsing a seam or seams therein.

The spring or resilient end support for the work may comprise a plate 37 influenced by a plurality of spaced springs 38 and capable of a limited axial movement on headed screws or pins 39 fixed to a relatively stationary part 40. This resiliently supported plate 37 may be located at the open end of the container being shaped, there being provided an annular spigot or flange 36 on said plate 37, around which spigot the open end of the container is located. This spigot functions as an internal support for the open end of the container and obviates or minimises the possibility of inward collapse of said container during shaping, or inward collapse of a seam in the wall of the container. The opposite end of the work is supported by an end plate 41 carrying a second internal spigot 42; or where the container being operated upon has a closed end, this internal spigot 42 is dispensed with. The plate 41 is also provided with an outer or external spigot 41a which encircles the end of the work. A similar outer spigot 37a may be provided on the plate 37 at the opposite end of the work.

The end supporting plate 41 is adapted to be moved axially from and towards the work for permitting insertion of the work in a machine. This movement may be effected by connecting the plate 41 to a sleeve 46 mounted to rotate upon a boss or the like 45a extending from a plate or bracket 45, there being a pin 43 on the boss co-operating with a cam or inclined slot 44 in the sleeve, so that by rotation of the sleeve by a hand lever 47 or other means, the plate 41 is moved towards or away from the work. The movement of the end plate 41 to and from the work may be effected automatically.

Where the shaping operation is being effected upon a container having a closed end, the end plate 41 may be provided with a rubber or other pad or similar cushion 48, adapted to have a pressing engagement with said closed end of the work.

If desired, the container or the like being shaped may, during the shaping operation, be assembled within an outer or female die having an internal contour conforming exactly to the outer shape of the finished article. This outer die may with advantage be formed of two diametrically hinged halves adapted to be opened for insertion of the work and closed for retaining same in position while being shaped.

When the article being shaped is provided with one or more seams in its peripheral wall, said seam or seams may be suitably locked for minimising the possibility of collapse during the shaping operation. For instance, if a container is being shaped having a base or end fixed prior to shaping, the side seam or each of a plurality of such seams may at one or more positions remote from the base, e. g. at the open end of the container, be formed with interlocking elements which function to resist a force tending to collapse the seam inwardly.

I claim:

1. A tool for shaping or bulging thin-walled tubular bodies such as thin sheet metal containers, comprising a head rotatable at relatively high speed; an arm pivotally carried by said head and responsive to centrifugal force produced by said rotation to move radially outward from the axis of rotation; an ellipsoidal roller journaled on said arm for engagement with the inner surface of an outwardly unsupported portion of the work; means for controlling the outward movements of said arm and roller in opposition to said centrifugal force, comprising a rod slidable axially within the head and a flexible connection between said rod and arm; and means carried by said rod and engageable with said arm for applying positive outward pressure on the arm during a shaping operation to minimize vibration of the arm and roller.

2. The combination stated in claim 1, wherein the arm is provided with a camming surface, and the means carried by the rod for applying positive pressure to the arm has a complemental portion engageable with said camming surface.

JOHN ARTHUR DOVE.