Dec. 6, 1938. E. LANTO 2,138,867

APPARATUS FOR MAKING HOLLOW PRESSED AXLES

Filed July 18, 1936 2 Sheets-Sheet 1

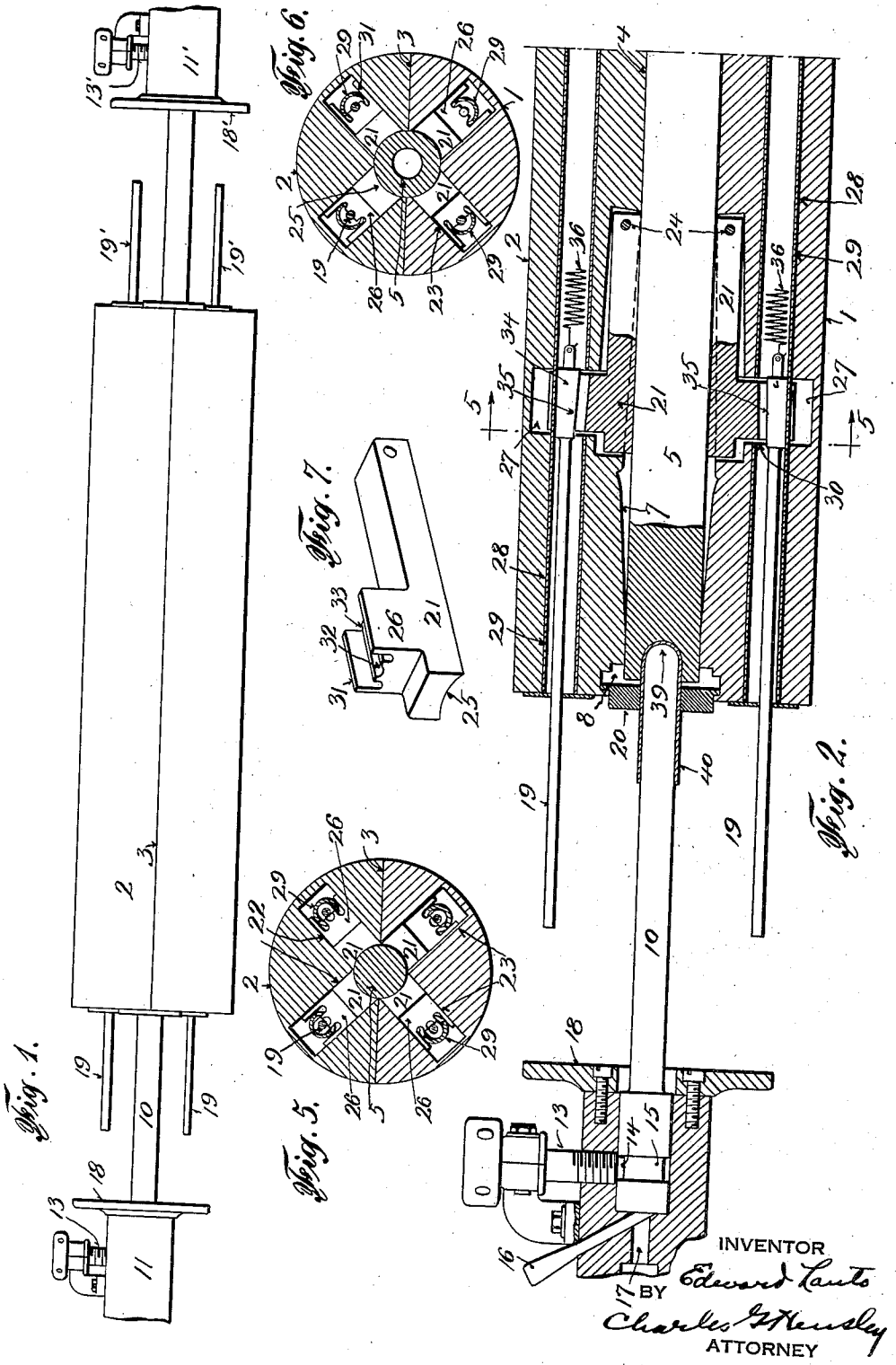

Fig. 1.

Fig. 6.

Fig. 7.

Fig. 5.

Fig. 2.

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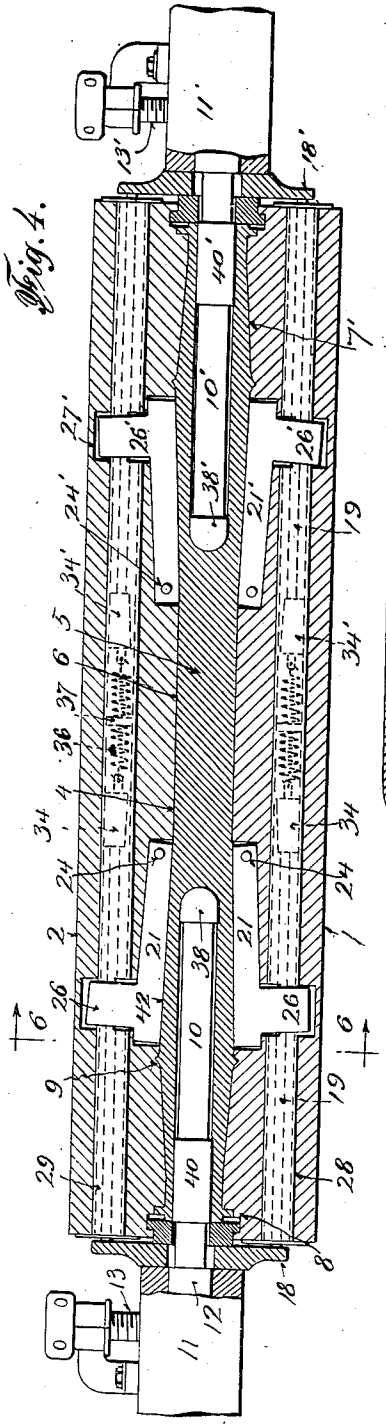

Fig. 4.

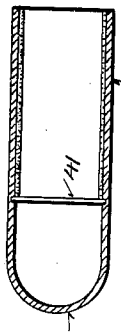

Fig. 8.

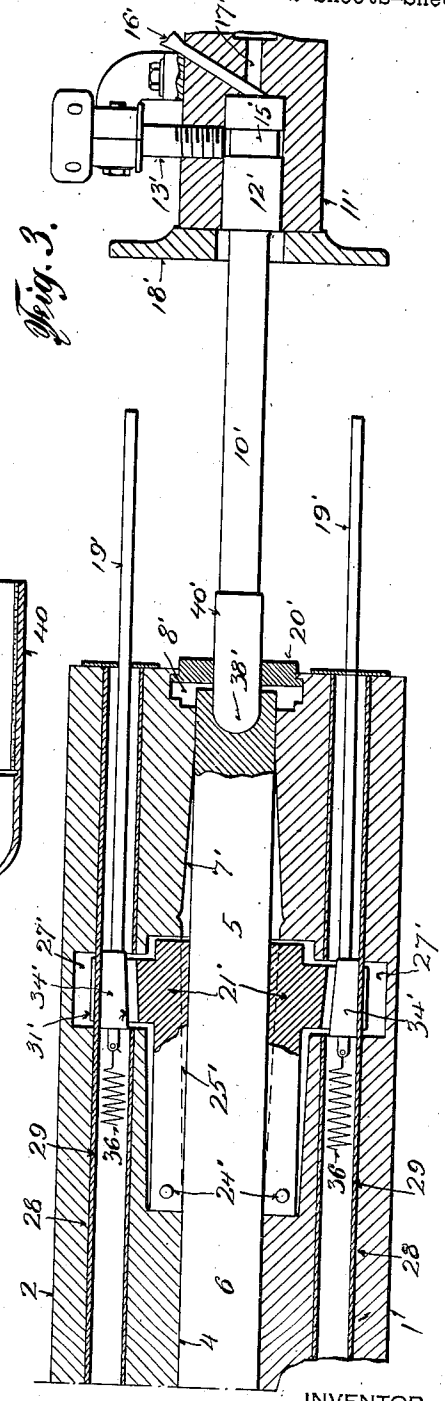

Fig. 3.

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UNITED STATES PATENT OFFICE

2,138,867

APPARATUS FOR MAKING HOLLOW PRESSED AXLES

Edward Lanto, New York, N. Y.

Application July 18, 1936, Serial No. 91,341

14 Claims. (Cl. 78—9)

The object of my invention is to provide an apparatus by means of which hollow pressed axles, suitable for use on railroad rolling stock, may be made. Axles made with my present invention are hollow throughout the major portion of their length.

The apparatus includes a two-part die having a matrix cavity in its two parts, the shape of an axle, and into the die is placed a round rolled blank equal in diameter to the smallest diameter of the finished axle. The blank is gripped by the die members in the middle and at opposite ends. The blank is also gripped for about thirty-two inches of its length by retractive members of the die that are wedge controlled.

Punches are provided which are forced endwise into the blank while the latter is held in the die and as these punches progress into the hot blank for a distance, say, of about eighteen inches, cross heads carried with the punches engage with the wedge-controlled device and gradually release the wedges, permitting the retractive gripping jaws to gradually recede flush into the matrix face and thus permitting the blank to be forced to fill out the size and shape of the matrix face, and thus causing the blank to be shaped when finished, in the shape and proportions of an axle. After the blank has been formed, in the present apparatus, the journal face portion may be finished off on a lathe after the blank is cooled, and if the finished axle is over-length it may also be trimmed off in the lathe.

While this broad object has been sought to be accomplished in the past, certain difficulties arose which previous devices were not capable of overcoming. It is important that the punches center perfectly at all times in relation to the blank and that they have no chance to bend during the pressing operation. The retractive die members referred to herein are adapted to keep the punches straight and to prevent their bending or deflecting.

The punches have a cap on their forward ends or noses, which are rather elongated to provide a sleeve portion behind the nose of the punches. When the present operation starts, the nose cap and the sleeve, which is attached to it, both initially move with the punch until the sleeve portion is within the axle blank and then the sleeve and the cap on the nose become separated, so that the sleeve remains adjacent and within one end of the blank while the cap progresses with the leading end of the punch until the pressing operation is completed. Thus the sleeve which is separated from the cap remains adjacent the entering end of the blank to form a bearing for the punch at this location.

The excessive friction developed as the punch is pressed into the blank causes the separation of the sleeve from the cap and this may be controlled more or less by providing a weakened line where the cap and sleeve join, or by otherwise regulating the thickness of the metal to cause a separation of the sleeve from the cap when sufficient friction has been developed.

The sleeve referred to is lubricated inside with graphite to provide a lubricated face for the punch to slide upon as the sleeve assumes its function as a bearing to keep the punch from bending or distorting. As the punch progresses into the blank some distance from the bearing formed by the sleeve the punch might otherwise tend to be deflected except for the retractive elements which I provide in conjunction with the die and which retract gradually within channels of the die as the blank is expanded by the advance of the punch therein. These retractive members operating at different points around the axis of the blank resist the expansion of the blank under the action of the punch but gradually recede to allow the blank to be expanded into the cavity of the die which determines the size and shape of the exterior of the axle.

By providing these retractive devices operating at different locations around the axis of the punch, the latter is prevented from deflecting or bending and it is therefore maintained in a perfectly straight condition until the pressing operation is completed. The apparatus is so designed that a punch is disposed to enter the blank at each end of the latter and to progress simultaneously into the blank so that a major portion of the finished axle will be hollow but preferably leaving a middle section which is solid and which is slightly less in diameter than the wheel carrying portions of the axle.

The punches and their carriers are preferably alike except that they move in opposite directions and the devices which co-operate to hold the punch in alignment are the same for both punches or, in other words, the construction is duplicated adjacent opposite ends of the die so that both punches perform the same operation on opposite ends of the blank and simultaneously.

By providing the detachable sleeve referred to above, I provide an efficient bearing for the punch at the entering end of the blank and as stated above this bearing may be lubricated to reduce friction on the punch. The retractive members

associated with the die form a bearing for the advancing ends of the punches to prevent deflection or distortion of the punches while the pressing operation is being carried out. This action is the same at both ends of the die. The wedge members which control the retraction of the retractive members are gradually moved in accordance with the movements of the punch heads so that the retractive members move outwardly in proportion to the advance of the punches into the blank, thereby providing controlled resistance to the deflection of the leading ends of the punches.

Other features and advantages of my invention will appear in the following detailed description of the preferred embodiment of my invention.

In the drawings forming part of this application,

Figure 1 is an elevation of the principal parts of an apparatus embodying my invention,

Figure 2 is a vertical sectional view on a larger scale, showing about one-half the length of the apparatus,

Figure 3 is a similar view, and placed end to end with Figure 2 completes a sectional view of the whole apparatus,

Figure 4 is a longitudinal sectional view of the apparatus on a smaller scale than Figures 2 and 3 but showing the parts in the position at the completion of the pressing operation,

Figure 5 is a cross sectional view taken on the line 5—5 of Figure 2,

Figure 6 is a sectional view taken on the line 6—6 of Figure 4 and therefore showing the parts at the time the pressing operation is completed,

Figure 7 is a perspective view of one of the retractive members detached from the die, and

Figure 8 is a longitudinal sectional view of the cap and sleeve.

The apparatus consists primarily of separable die sections and in the drawings I have shown the die as consisting of a lower section 1 which may be mounted in any suitable cradle or base, preferably in a horizontal position, and the upper die section 2 is adapted to rest on the lower die section, the two meeting along the horizontal line 3. The upper die section will be detachable from the lower die section for the purpose of opening the die to discharge the completed axle.

As stated above, the punch mechanism is the same at opposite ends of the apparatus except that they face and move in opposite directions, and a description of the parts at one end of the apparatus will apply to the parts at the opposite end thereof, and corresponding parts are similarly numbered except that those at the right hand end of the apparatus in the drawings will be numbered in prime numbers, whereas the corresponding parts at the other end will be marked in unprimed numbers.

The upper and lower halves of the die are shown as provided with a central bore 4 which is of different diameters at different locations as will be pointed out hereinafter, and the blank 5 from which the axle is to be made is placed into the semi-circular cavity of the lower half of the die while the upper half is removed and then the upper half of the die is placed on the lower half to entirely enclose the blank. The blank is introduced into the die while heated to a high degree so that the material of the blank may be forced into the cavity of the die by the punches. The blank, when introduced into the die, preferably has an exterior diameter equal to the smallest diameter of any portion of the bore 4. Ordinarily, the central portion 6 of the bore of the die which co-operates with the middle portion of the blank will be the portion of smallest diameter of the bore of the die so that the blank will, when introduced into the die, be of sufficient diameter to fill this portion of the bore of the die.

The portions 7, 7' of the bore of the die will generally be slightly tapered with the smaller ends of the tapers near the ends of the axle. At 8 there is a laterally extending pocket into which the metal which is to form the flange at each end of the axle may be forced. At 9 I have shown an annular recess in the two halves of the die into which the metal of the blank may be forced to constitute a flange or shoulder to provide an abutment on one side of the bearing plates for the axle boxes when the axle is assembled in a car truck.

I have shown each punch 10, 10' carried by a head 11, 11' in which the butt or stock 12, 12' of the punch is seated and where it is held by a set screw 13, 13'. The set screw has a reduced end 14, 14' which engages in the peripheral groove 15, 15' of the punch to lock the punch in the head. I have shown a driver 16, 16' arranged in a diagonal aperture in the head 11, 11' which is adapted to engage the rear end of the punch for the purpose of dislodging the punch from the head 11, 11' when the set screw 13, 13' is retracted. This may be desirable because of the expansion of the butt of the punch due to the heat absorbed by the punch. It is desirable that the punch be quickly and easily removable from the head in order to renew the punches whenever necessary.

There is also an axial bore 17, 17' in the head 11, 11' to permit a tool to be inserted to drive against the head of the punch for dislodging it from the head. There is carried by each head 11, 11' a cap 18, 18' which surrounds the punch and which is adapted to act on the ends of the rods 19, 19' for the purpose of moving the wedges to be hereinafter described.

There is also provided a centering ring 20 at the outer ends of the die, perfectly to center the punches before they enter the blank. The cap and the sleeve on the point of each punch fits closely into this centering ring, so that at the beginning of the punching process there can be no deviation from true center. But when each punch has advanced until the sleeve has passed this centering ring and the high friction of the hot blank against the sleeve has detached the sleeve from the cap at the head of the punch, thus forming the inner bearing, a space of about one-eighth of an inch remains free between the punch and the centering ring, thus avoiding too great a rigidity in the further course of the travel of the punch.

This centering ring can slide laterally a small distance into the die head, so that when the punches reach the final part of the stroke, the projecting ends of the blank may be upset to fill out the space in the dies to form the collar of the journal.

The retracting members at both ends of the apparatus are the same except that they face in opposite directions and a description of one will apply to both. The retracting members 21 are arranged at different positions around the axis of the axle and I have shown four of these retracting members, two of them fitting in the recesses 22 in the upper die member, and two others lying in the recesses 23 of the lower die member.

Each retracting member is shown pivoted at one end upon a pin 24 anchored in the die members.

The surfaces 25 of these retracting members which face the axis of the axle are curved not only to conform to the circumferential curvature of the axle but as I have shown these retracting members operating on a portion of the axle which is tapered the arcuate surfaces 25 are also tapered in the direction of the length of the retracting members. The retracting members have extensions 26 near one end which travel in lateral recesses 27 in the die members and which prevent lateral displacement of the retracting members and they also serve as means with which the wedges co-operate.

The die members are provided with bores 28 extending the length of the die members, there being as many such bores as there are retracting members around the axis of the axle; and these bores are lined with tubes 29 which have cut-outs 30 in which the outwardly extending members 26 of the retracting members may move. The extensions 26 on the retracting members have outwardly extending plates 31 which straddle the tubes 29. There is also a groove 32 extending lengthwise along the outer surface of the extension 26 of each retracting member to receive therein a portion of the rod 19 which moves the wedge. The surfaces 33 on the extension 26 on either side of the groove 32 are tapered or made slanting in relation to the axis of the axle and these are the surfaces with which the wedges 34 co-operate. Each rod 19 carries a wedge member 34 which is substantially D shape in cross section and the wedge has a slanting surface 35 which is parallel with the slanting surfaces 33 on the retracting members.

I have shown springs 36 arranged in the tubes 29 each having one end abutting against the vertical dividing wall 37 in the tube and having its other end abutting against one end of the wedge 34. The tendency of these springs is to force the wedges 34 in opposite directions or toward the position where they will engage the surfaces 33 and this action causes the rods 19 to follow the head 18 when the punches are retracted.

In Figure 8 I have shown a cap and sleeve which is applied to the end of each punch. This consists of a rounded end portion 38 which fits the rounded end 39 of the punch and this portion of the wall of the member is preferably about one-quarter of an inch thick. From this rounded or nose portion extends the sleeve 40 of tubular form, which fits closely against the outer surface of the punch and the sleeve portion is preferably about one-eighth of an inch in thickness, although I do not wish to limit my invention to any certain measurements. The sleeve portion is preferably weakened as, for instance, by a groove 41 around the interior surface of the sleeve to reduce the metal to about one-tenth of an inch in diameter so that there will be a weakened line circumferentially around the sleeve for the purpose to be described.

Operation

While the upper die member 2 is separated from the lower die member 1 and while the heads 11, 11' are moved away from the die, as shown in Figures 2 and 3, the hot blank or rod of steel about the smallest diameter of the bore of the die, and which is heated to a high degree, is placed in the cavity of the lower die and then the upper die 2 is placed on the lower die 1 and secured in any desired manner. The two heads 11, 11' now begin to advance in opposite directions and toward the die so that the punches with the cap shown in Figure 8 fitted over their free or advancing ends, start to move into the center of the blank at each end, as shown in Figures 2 and 3. As the punches are advanced into the blank, the metal of the blank is forced outwardly against the wall of the bore of the die, the punches forming hollow spaces or bores in the opposite ends of the axle blank. In other words, the material of the blank is forced outwardly to fill the portions 7, 7' of the die and as the blank is of lesser diameter than these portions of the die at the beginning of the operation the metal displaced by the punches is forced outwardly to fill the outer portions 7, 7' of the die cavity. When the punches have advanced to approximately the position shown in Figure 4, the friction developed between the sleeve and the inner surface of the axle will have become so great that the forward portion or nose member 38 will be separated from the sleeve portion 40 on the weakened line 41. Thenceforth the sleeve members remain in the axle at about the positions shown in Figure 4 while the nose portions 38 continue to move with the leading ends of the punches. These sleeve members, remaining in the positions shown in Figure 4, serve as bearings for the punches at the outer ends of the axle. As the punches continue to move further into the blank, the nose members 38 displace the metal of the axle laterally.

Just before the leading ends of the punches come into line with the leading ends of the retractable members 21 the members 18 make contact with the rods 19 so that further movement of the heads 11, 11' cause the wedges 34 to be moved in relation to the surfaces 33 thereby permitting the retractable members to gradually spread upon their pivots 24 and to swing radially away from the axis of the axle. These wedges are so designed that the retractable members offer considerable resistance at various points around the axis so that the metal of the blank as the punches advance, forces the retractable members to swing outwardly as permitted by the wedges. When the punches have completely advanced into the blank as shown in Figure 4, the wedges will have completely disengaged from the surfaces 33 and the metal of the axle blank will have been forced out by the punches so that the retractable members are moved to the position shown in Figure 4 where their inner curved surfaces 25 will conform with the taper of the axle at the portion 42.

At the completion of the pressing operation, the heads 11, 11' will be retracted in opposite directions to withdraw the punches from the axle. As the members 18 retract, the rods 19 and with them the wedges are moved in opposite directions by the springs 36 so that by the time the punches have been completely withdrawn from the die the wedges will be moved up to the slanting surfaces 33 of the retractable members but they will not be forced to completely overlap the surfaces 33 until the axle has been removed from the die.

When the punches are withdrawn from the die and from the axle, the nose members 38 will generally remain in the axle because the punches will withdraw from these members as the latter will be held by friction within the axle. Furthermore, the sleeves 40 also remain within the axle and the punches will withdraw endwise from them. Before the present operation starts, the sleeves 40 will be coated interiorly with a coating of graphite in order to lubricate the punches in relation to the sleeves so that while the sleeves act as bearing

members the friction opposing the inward drive of the punches is reduced to a negligible degree.

After the punches have been withdrawn from the die the upper die member 2 will be removed from the lower die member and the axle may be lifted out of the die member 1. As stated above, the axle may be later placed in a lathe and the flanges formed in the pockets 8 may be finished off to the correct width and the ends of the axles may be trimmed off to reduce them to uniform length.

While the punches are advancing into the axle in the above described operation, the retractable members under the control of the wedges offer such resistance to the outward swing of the retractable members by acting on the outer surface of the blank and at various positions around the axis of the blank, that the leading ends of the punches will not be deflected, or in other words, the punches will remain straight while advancing into the blank and as their leading ends progress further from the bearings offered by the sleeves.

Having described my invention, what I claim is:

1. An apparatus for pressing hollow axles, including a two part die of separable sections having a cavity to receive therein a blank from which an axle is to be formed, a punch adapted to be forced axially into the blank held in said die and to force the metal of the blank outwardly to expand it in the die cavity, and retractable members within the die pivoted intermediate their ends to swing outwardly from the die cavity and having cavity portions against which the blank is forced by the punch, conforming with the shape of the exterior of the finished axle, said retractable members co-operating with the blank to control the expansion of a portion thereof while the punch is advancing therein, for the purpose of resisting deflection of the punch.

2. An apparatus for pressing hollow axles, including a two part die of separable sections having a cavity to receive therein a blank from which an axle is to be formed, a punch adapted to be forced axially into the blank held in said die and to force the metal of the blank outwardly to expand it in the die cavity, and retractable members within the die pivoted intermediate their ends to swing outwardly from the die cavity and arranged concentrically around the blank, having cavity portions against which the blank is forced by the punch, conforming with the shape of the exterior of the finished axle, said retractable members co-operating with the blank to control the expansion of a portion thereof while the punch is advancing therein, for the purpose of resisting deflection of the punch.

3. An apparatus for pressing hollow axles, including a two part die of separable sections having a cavity having a tapered portion, to receive a blank from which an axle is to be formed, a punch adapted to be forced axially into the blank held in said die and to force the metal of the blank outwardly to expand it in the die cavity, and retractable members within the die pivoted intermediate their ends to swing outwardly from the die cavity and having cavity portions against which a tapered portion of the blank is forced by the punch, conforming with the exterior of the tapered portion of the finished axle, said retractable members co-operating with the blank to control the expansion of a portion thereof while the punch is advancing therein, for the purpose of resisting deflection of the punch.

4. An apparatus for pressing hollow axles, including a two part die of separable sections having a cavity to receive therein a blank from which an axle is to be formed, a punch adapted to be forced axially into the blank held in said die and to force the metal of the blank outwardly to expand it in the die cavity, and retractable members within the die pivoted intermediate their ends to swing outwardly from the die cavity, having cavity portions against which the blank is forced by the punch, conforming with the shape of the exterior of the finished axle, said retractable members cooperating with the blank to control the expansion of a portion thereof while the punch is advancing therein, for the purpose of resisting deflection of the punch, and means for automatically controlling the pivotal movement of said retractable members.

5. An apparatus for pressing hollow axles, including a two part die of separable sections, having a cavity having a tapered portion to receive a blank from which an axle is to be formed, a punch adapted to be forced axially into the blank held in said die and to force the metal of the blank outwardly to expand it in the die cavity at the tapered portion thereof, and retractable members pivoted to the die near the smaller end of said tapered portion to swing outwardly from the die cavity, the inner surfaces of said retractable members conforming with the exterior of the tapered portion of the finished axle near the tapered portion thereof, said retractable members co-operating with the blank to control the expansion of a portion thereof while the punch is advancing therein for the purpose of resisting the deflection of the punch.

6. An apparatus for pressing hollow axles, including a two part die of separable sections having a cavity to receive a blank from which an axle is to be formed, a punch adapted to be forced axially into the blank in said die and to force the metal of the blank outwardly to expand it in the die cavity, and retractable members forming a portion of the die cavity and pivoted intermediate their ends to swing outwardly from the die cavity, said retractable members co-operating with the blank to control the expansion thereof while the punch is advancing therein, said retractable members having inner faces conforming with the exterior of a portion of the finished axle, sliding wedges in said dies for controlling the retraction of said retractable members, and means for automatically operating said wedges.

7. An apparatus for pressing hollow axles, including a two part die of separable sections having a cavity to receive a blank from which an axle is to be formed, a punch adapted to be forced axially into the blank held in said die and to force the metal of the blank outwardly to expand it in the die cavity, and retractable members forming a portion of the die cavity and pivoted intermediate their ends to swing outwardly from the die cavity, said retractable members co-operating with the blank to control the expansion of a portion thereof while the punch is advancing therein, sliding wedges in said dies for controlling the outward movement of the retractable members, and automatic means operated in synchronism with the advancing movement of the punch for operating said wedges.

8. An apparatus for pressing hollow axles including a two part die of separable sections having a cavity to receive a blank from which an axle is to be formed, a punch adapted to be forced axially into the blank held in said die and force the metal of the die outwardly to expand it in the die cavity, retractable members in said die pivoted intermediate their ends to swing outwardly

from the die cavity and confined to move radially in relation to the axis of the blank, said retractable members having arcuate surfaces forming a portion of the die cavity, said arcuate surfaces adapted to be engaged by the material of the blank forced outwardly by the punch, the inner surfaces of the retractable members conforming with the shape of a portion of the finished blank, said retractable members co-operating to resist the deflection of the punch while the latter is advancing into the blank.

9. An apparatus for pressing hollow axles, including a two part die of separable sections, having a cavity to receive therein a blank from which an axle is to be formed, punches adapted to be forced axially and simultaneously into the opposite ends of the blank held in said die to force the metal of the blank outwardly to expand it in the die cavity, and retractable members pivoted intermediate their ends to swing outwardly from the die cavity and having inner surfaces shaped to conform to portions of the exterior of the finished blank and forming portions of the die cavity adjacent the paths of both of said punches, said retractable members co-operating with the blank to prevent the deflection of the punches moving in said blank.

10. An apparatus for pressing hollow axles, including a two part die of separable sections having a cavity to receive a blank from which an axle is to be formed, a punch adapted to be forced axially into the blank held in said die and to force the metal of the blank outwardly to expand it in the die cavity, a cap on the advancing end of said punch having a cylindrical sleeve extending partly along the punch, said sleeve so formed as to be adapted to be detached from said cap near the end of the blank by friction developed between the punch and the blank whereby said sleeve will remain in the blank adjacent the end thereof while the punch advances therein, to form a bearing for the punch while the latter is completing its stroke in the blank.

11. An apparatus for pressing hollow axles, including a two part die of relatively movable sections, having a cavity to receive therein a blank from which an axle is to be formed, a punch having a rounded end adapted to be forced axially into the blank held in said die, and to force the metal of the blank outwardly to expand it in the die cavity, a member including a rounded cap on the advancing end of said punch and having a cylindrical sleeve extending partly along the punch from said cap, said sleeve portion of said member so formed as to be adapted to be detached from the cap portion by friction developed between the punch and the blank whereby said sleeve will remain in the blank adjacent the end thereof while the punch advances, to form a bearing for the punch while the latter is completing its stroke in the blank.

12. An apparatus for pressing hollow axles, including a two part die of relatively movable sections having a cavity to receive therein a blank from which an axle is to be formed, a punch adapted to be forced axially into the blank held in said die and to force the metal of the blank outwardly and to expand it in the die cavity, a member comprising a cap on the advancing end of the punch and having a cylindrical sleeve portion extending along the punch, said member having a circumferentially weakened portion whereby said sleeve will become detached from the cap to remain in the blank near the end thereof by friction developed between the punch and the blank whereby said sleeve will remain adjacent the entrance end of the blank while the punch is completing its stroke in the blank, to form a bearing for the punch.

13. An apparatus for pressing hollow axles, including a two part die of relatively movable sections having a cavity to receive therein a blank from which an axle is to be formed, a punch adapted to be forced axially into the blank held in said die and to force the metal of the blank outwardly to expand it in the die cavity, a cap on the advancing end of said punch having a cylindrical sleeve extending along the punch, said sleeve so formed as to be adapted to be detached from said cap adjacent the end of the blank by friction developed between the punch and the blank, whereby the sleeve will remain in the blank adjacent the end thereof to form a bearing for the punch while the latter is completing its stroke in the blank and a coating of lubricating material applied to the interior of said sleeve.

14. An apparatus for pressing hollow axles, including a two part die of relatively movable sections having a cavity to receive therein a blank from which an axle is to be formed, a punch adapted to be forced axially into the blank held in said die and to force the metal of the blank outwardly to expand it in the die cavity, a cap on the advancing end of said punch having a cylindrical sleeve extending partly along the punch, said sleeve so formed as to be adapted to be detached from said cap within the blank and adjacent the end thereof by friction developed between the punch and the blank, whereby said sleeve will remain adjacent the entrance end of the blank and form a bearing for the punch, and a bearing member in which said sleeve primarily engages during the first part of the stroke of the punch, whereby said bearing member will form a bearing for said sleeve and said punch prior to the passage of said sleeve into the blank.

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