July 17, 1934. T. MUNGEN 1,967,192

METHOD AND APPARATUS FOR FORMING OUTSIDE CURLS

Filed June 30, 1930 3 Sheets-Sheet 1

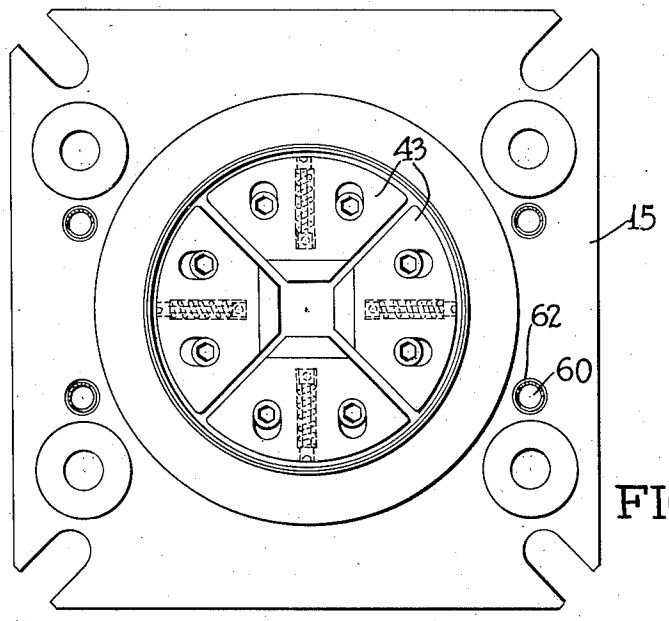


FIG. 1

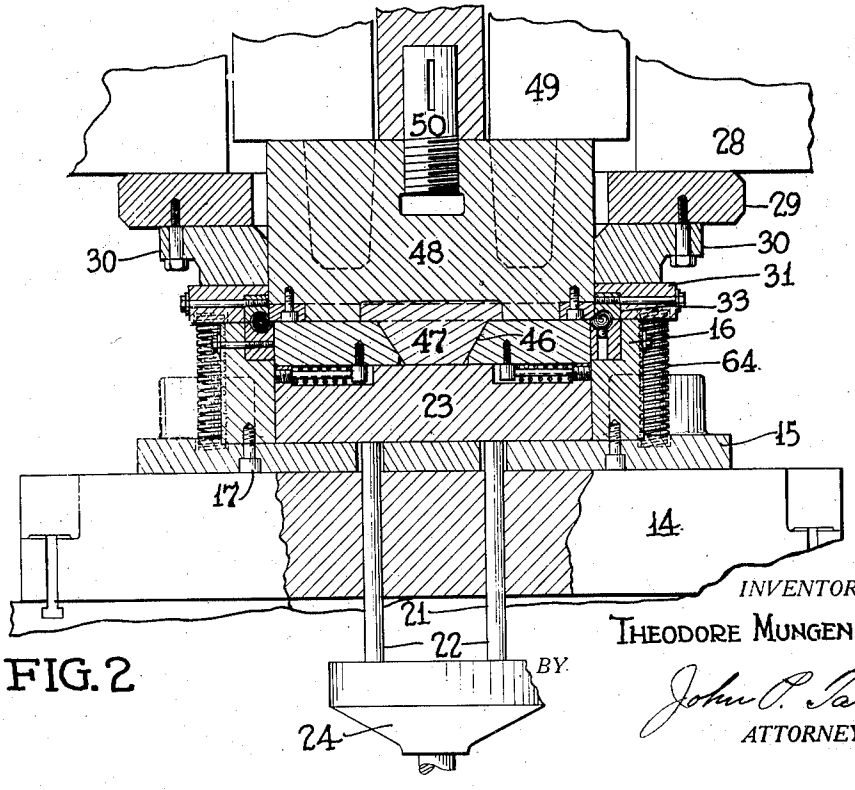


FIG. 2

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METHOD AND APPARATUS FOR FORMING OUTSIDE CURLS

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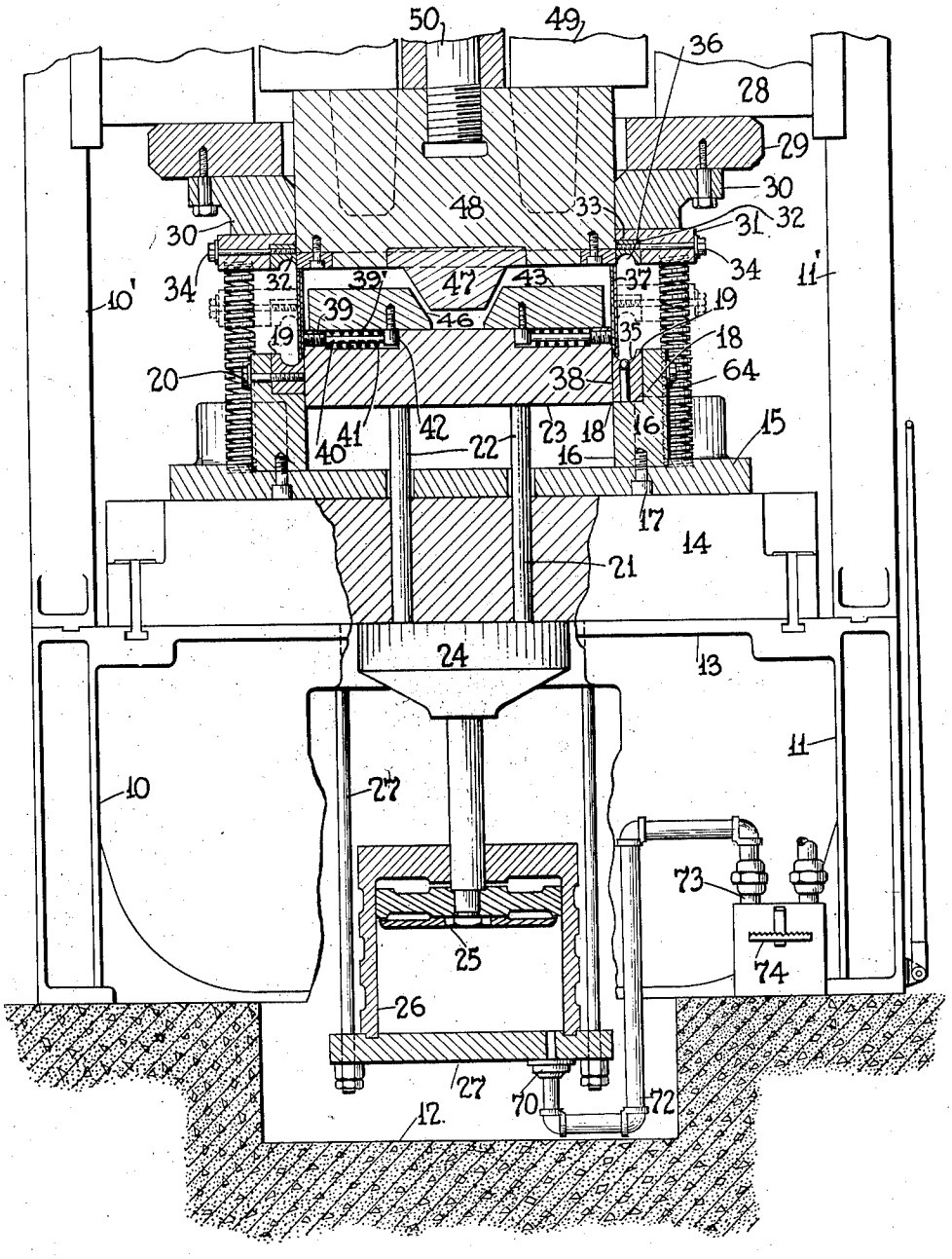


FIG.3

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METHOD AND APPARATUS FOR FORMING OUTSIDE CURLS

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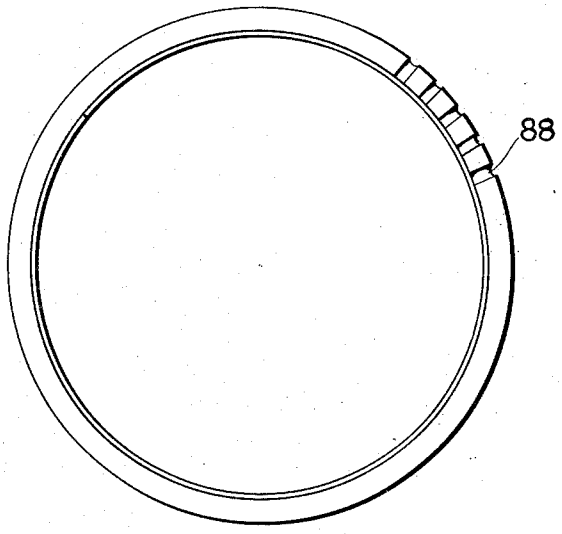


FIG. 4

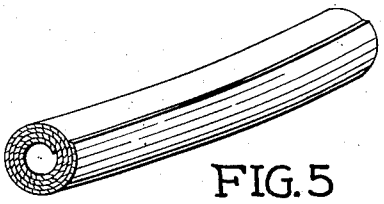


FIG. 5

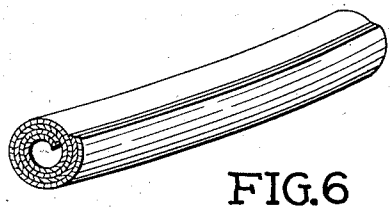


FIG. 6

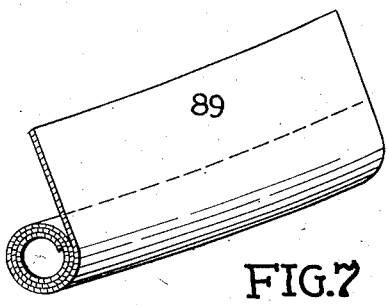
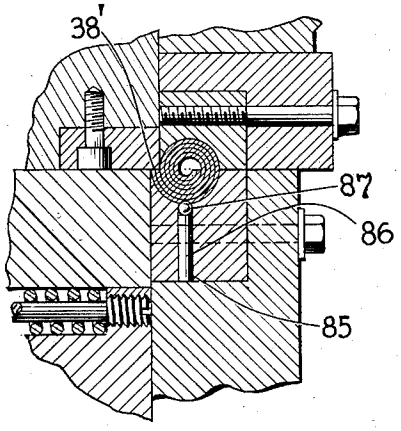


FIG. 7

FIG. 8



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1,967,192

UNITED STATES PATENT OFFICE

1,967,192

METHOD AND APPARATUS FOR FORMING OUTSIDE CURLS

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Application June 30, 1930, Serial No. 464,786

14 Claims. (Cl. 153—48)

This invention relates to a method and an apparatus for forming partial or complete outside curls in sheet metal strips. The invention particularly relates to the formation of outside curls in circular sheet metal bands to form a circular and substantially tubular ring-like construction for use in a great variety of sheet metal constructions. Among the uses that have been found for such circular constructions are the formation of cores for reinforcing vulcanized steering wheels; the formation of chime seams for barrels, circular containers, circular seat bottoms, circular tubing such as smoke stacks and the like, and in fact for the formation of all manner of curvilinear struts, ribs or hoops whether large or small.

Heretofore the general method of forming curls in sheet metal strips has been to wind such strips around a mandrel, with or without the application of heat. Such a method possesses the disadvantage that the curl so formed is not compact and consequently cannot advantageously be used as a strengthening member in certain constructions. Furthermore such a method of forming outside curls is not applicable to curvilinear constructions.

A second method of forming curls in sheet metal constructions, wherein the use of circular dies is involved, is disclosed in the patent to Draper 1,466,643, August 28, 1923. This method is known as the outside curling process and involves a great number of detailed steps including the formation of a circular band by butt welding adjacent edges of a sheet together and the formation of a preliminary initial flared edge before the curling operation takes place. The present invention is designed as an improvement over such a method as is disclosed in the above mentioned patent, and as an improvement in the apparatus employed in forming outside curls in sheet metal constructions.

Accordingly it is an object of the present invention to provide a method and an apparatus for performing the outside curling operation on a sheet of material which will effectively form a closed circular curled member from a strip of sheet material without the necessity of relying on a welding operation for maintaining the finished article closed. It is also an object of the present invention to provide a method and an apparatus for forming such articles which will also eliminate the necessity of mill rolling or otherwise forming an initial bend in the material to insure proper formation of the subsequent die curling operation.

A still further object of the invention is to provide a machine for forming outside curls upon sheet metal in which the curling operation is positive in its action on the sheet of material being formed, means being provided for expanding the material into the form of a true circle prior to its introduction into the die.

Yet another object of the present invention is to provide an apparatus which may successively operate upon different sheets of material to form an outside curl, means being provided whereby each preceding article may easily, with a minimum amount of time involved, be removed from the machine to make room for the succeeding blank to be introduced into the apparatus.

Still another object of the invention is to provide an apparatus which operates upon circular bands of sheet material to form an outside curl and which may, by proper forming of the die, shape the finished article into any desired closed form, and to any desired cross sectional area or which may form the article so as to have a non-uniform cross sectional area.

Another and important object of the invention is to provide an apparatus which may operate not only upon bands that have been pre-formed into circular shape, but which may operate upon bands the tendency of which is to assume a position in a plane, means being provided whereby the inherent characteristic of the apparatus itself will permit the insertion of flat strips of material into the same by coiling them in the machine runway in circular form. This latter feature eliminates the necessity of special apparatus for forming the flat material into ring-shaped form prior to its introduction into the machine.

An additional object of the invention is to provide an apparatus which will form a smooth ring-shaped article if desired and which may also form an article having peripheral striations and a general rough appearance to prevent drifting of the rubber body material and insure close adherence of the same when the article is to be used as a steel core for steering wheels or the like.

Still another object of the invention is to provide an apparatus for forming outside hollow curls from sheet metal which curls are practically fluid tight so that when the article is used as a core in a plastic composition, there will be no seepage of the composition under pressure in the vulcanizing molds into the interior of the curl to deprive an outside region of the article from sufficient material to do justice to proper formation of the article.

Another object of the invention is to provide an apparatus which apart from the introduction into, and the removal from, the machine, of the material to be treated and the finished article respectively, is entirely automatic in its operation and involves a minimum amount of work to be performed by the operator.

Another object of the invention is to provide a machine which is extremely simple in its construction and which employs a minimum number of moving parts. Convenience of arrangement of parts, durability and comparative inexpense of maintenance are further desiderata that have been borne in mind in the production and development of the invention.

A number of exacting tests of cores for steering wheels employing the present improvements have demonstrated that the type of reinforcing ring formed by the present apparatus maintains the inner and outer curl seam effectively intact under conditions that will produce damage and leakage in similar reinforcing rings or ribs manufactured by other well known processes. The material in this method becomes deformed and bends together as a unit instead of separating under great stress as usually occurs with older methods of manufacture. This latter feature arises from the fact that the laps of the curl are, by the outside method of curling, caused to bear against each other with great force so that any subsequent deformation of the ring will not separate or buckle the layers.

Other objects and advantages of the invention, not at this time more particularly enumerated will become more readily apparent as the nature of the invention is better understood, and the same consists in the novel construction, combination and arrangement of parts shown in the accompanying three sheets of drawings in which:

Fig. 1 is a top plan view of the machine assembly with the upper die removed for the purpose of illustrating the invention.

Fig. 2 is a sectional view taken through the machine assembly showing the parts in closed position.

Fig. 3 is a sectional view showing the assembled machine the parts being in open position.

Fig. 4 is a plan view of one of the articles formed by the improved die shaping machine.

Fig. 5 is a fragmentary perspective view showing one of the articles formed from a single sheet of material.

Fig. 6 is a view similar to Figure 5 showing the article formed of a double thickness of sheet material.

Fig. 7 is a fragmentary perspective view showing a different form of article capable of being manufactured by the improved apparatus, and

Fig. 8 is a detailed fragmentary sectional view of the closed assembly.

In all of the above described views, like characters of reference are employed to designate like parts throughout.

The device involves in its general organization a pair of standards, 10 and 11, mounted on a foundation, 12. The standards, 10 and 11, carry therebetween a bed, 13, on which there is mounted a bolster, 14, which is removably secured thereto. Mounted on the bolster, 14, is a lower die base plate, 15. This lower die base plate, 15, carries a lower die holder, 16, which is removably secured thereto by means of bolts, 17, which extend through the lower die base plate. The lower die holder is annular in form and is provided with an internal annular shoulder, 18, on which is mounted the lower die, 19. This lower die is removably secured to the holder, 16, by means of through bolts, 20, extending into the die.

The lower die base plate, 15, and the bolster, 14, are provided with bores, 21, extending therethrough in alignment and through which bores extend a pair of thrust rods, 22, carried on a floater, 23, slidably mounted for vertical movement within the lower die assembly. The thrust rods, 22, have their lower ends connected to a head, 24, carrying a piston, 25, working in a cylinder, 26, suspended by a tie rod assembly, 27, from the bed, 13.

The upper die assembly is slidably carried between the gibs, 10' and 11', and comprises the blank holder of the press, 28, having an annular blank holder plate, 29, to which is secured a spacing member, 30, carrying the upper die blank holder, 31. The upper die, 32, is removably secured in a cut-away portion, 33, in the blank holder, 31, by means of through bolts, 34, extending through the blank holder.

The upper die, 32, and the lower die blank, 19, are adapted to be closed upon each other to cooperate in the machine to perform an outside curling operation upon a narrow ring-shaped band when this sheet is introduced forcibly between the dies. To this end the lower die is in the form of a ring having an annular recess, 35, extending adjacent its inner upper edge around the same. The upper die similar in shape and is provided with a similar recess, 36, extending around its lower surface adjacent the inner edge thereof. The two dies are positioned in the machine in superimposed relation with the upper die spaced from the lower die to permit insertion of a blank, 37, into the machine.

The upper die, 32, is adapted to be closed upon the lower die, 19, to form an annular pocket, substantially circular in cross section, in which pocket the blank is adapted to be forced to perform the outside curling operation upon the die. The inner wall, 38, of the lower die, 19, presents a cylindrical surface which is slightly smaller in diameter than the diameter of the cylindrical surface presented by the inner wall of the upper die, 32. Thus, when the dies are in closed position, a narrow slot, 38' (Fig. 8) leading into the interior of the pocket formed between the two dies, 19 and 32, is formed to permit tangential entry of the blank edgeways.

In order to properly position and hold the blank in the machine preparatory to the performing of the outside curling operation, a floater, 23, is provided within the lower die assembly and is secured to the thrust rods, 22. The floater, 23, is provided with a plurality of radial bores, therein, designated at 39, terminating in slots, 39', and having guide pins, 40, around which are disposed coil springs, 41, the ends of which bear against pins, 42, receivable in holding blocks, 43, radially slidable upon the floater, 23. These blocks are in the form of segments and are preferably four in number, although a greater or lesser number of these blocks may be employed if desired. Each block is provided with a plurality of elongated slots, 44, therein, in which slots there extends a number of fixed pins, 45. The slots, 44, extend radially of the machine and consequently each of the blocks is slidable to contract or expand in unison. The outer sides of the blocks, 43, are accurate in shape, and are of a curvature corresponding to the curvature of the sheet metal blanks.

The inner sides of the blocks, 43, are tapered in-

wardly to provide cam surfaces, 46, and these cam surfaces are adapted to be engaged by a spreader, 47, mounted centrally on a punch, 48, secured to a plunger, 49, which plunger is adapted to be reciprocated by means of thrust member, 50. The blocks, 43, are normally urged inwardly by means of the coil springs, 41, bearing upon the pins, 40, in the slots 39'. The blank, 37, when inserted into the machine is caused to assume an annular form of a diameter sufficient just to permit its insertion around the floater, 23, and inside the upper die holder, 31, and spacing member, 30.

When the blank has been inserted in the machine, these latter parts, namely, the upper die holder, 31, and spacer, 30, are caused to move in unison downwardly past the blank as indicated in dotted lines in Fig. 3, so that the blank is positioned against the inside walls of these elements, and firmly held thereagainst by means of the blocks, 43, when the punch descends. The recess, 35, and the recess, 36, in the lower and upper dies respectively, are upon descending of the upper die, brought into opposed adjacent relation ship to form a closed curling die, into which the material of the blank may be slid outwardly. When the punch descends upon the block, the spreader member 47 engages the cam surfaces 46 to spread the blocks 43 outwardly to engage the blank 37, and maintains same properly positioned about the slot 38 for the subsequent outside curling operation.

The punch 48 is of a diameter equal to the outside diameter of the blank to be curled so that upon the descending of the punch the extreme outer edge of the same will engage the upper edge of the sheet material of the blank and force the same downwardly into the closed dies. In its uppermost position, the punch is sufficiently raised to permit the insertion of the sheet metal blank, and after such insertion the punch may assume the intermediate position shown in Figure 3.

During the movements of the various parts outlined in the preceding paragraph, the upper die assembly, including the upper die blank, holder, spacer and blank holder plate, are guided upon suitable pilot rods, 60, Fig. 1, mounted in the lower die base plate, 15, and extended through bores, 62, in these latter members. The upper die assembly is normally held in a raised position by means of a four point suspension spring arrangement, comprising a plurality of coil springs, 64, interposed between the upper die holder, 31, and the lower die base plate, 15. Upon descending of the upper die assembly, these coil springs are adapted to be compressed to permit the two dies to come into contact with each other.

In the coil forming process, after the upper die assembly is in its lower or closed position, the punch descends forcing the blank, 37, downwardly and causing the same to slide into the recess formed between the two dies. As the metal of the blank is slid into the space between the dies, its edge turns outward, and the material curls up within the die, as clearly shown in Figure 8. At the same time that this curling action is taking place, the punch maintains the blocks, 43, extended against the blank and the floater member is forced downwardly by the punch, thereby depressing the head, 24, thrust rods, 22 and piston, 25. The floater member descends until the blocks, 43, have substantially cleared the blank and the blank is completely curled within the dies.

At such a time, the upper die assembly may be released to be forced upwardly by the action of the springs, 64, and the floater member is held in a lowered position by the action of the piston, 25, in the cylinder, 26. The ring thus formed may then be removed manually. This piston, 25, is held in its depressed position, as clearly shown in Figure 3, to maintain the floater in its lowered position, and an inlet is provided at 70. This inlet is suitably connected by a connection, 72, to a valve, 73, normally closed, but operable by a depression of a foot lever, 74, to be opened to admit compressed air, steam or other liquid into the casing, 26, to again raise the floater member to permit insertion there-around of a new blank in a second operation.

The blank is shown in Figures 2, 3, 6 and 8 as being formed of two thicknesses of sheet metal. However, in certain instances it is preferable that the blank be formed of a single thickness of sheet metal, and in this latter instance it is necessary that the blank be pre-formed into an annular band and its ends welded together. Where double thicknesses of metal are employed, the welding operation may be completely eliminated, for the sheets of metal may be so positioned with respect to each other that the adjacent ends of one sheet terminate at a point remote from the ends of the other sheet of material so that each sheet serves as a binder to maintain the ends of the other sheet together.

In performing the outside curling operation in accordance with the principles of the present invention, it is evident that as the edge of the metal travels outwardly in the die, it must be stretched or made circumferentially longer. This, in some cases, is sufficient to crack the metal radially at numerous points there-around, and in order to guard against this cracking the diameter of the dies must not be too large in proportion to the diameter of the ring to be formed. The behavior of the metal in this regard also depends upon the thickness and toughness of the same. If the curl itself is too large in relation to the thickness of the metal, the edge of the metal will not go properly into the die.

In accordance with the principle stated in the preceding paragraph of this specification, that the edge of the metal going into the die must be increased circumferentially, it may safely be assumed that there is, during the curling operation, a tendency for the metal to resist this outward movement. Furthermore, when the metal has once been set into a curve, and when the formation of the incipient curl, already commenced, is continued there is no action tending to again straighten out the curl. Consequently, and it has been proven in practice, the metal will normally tend to go into the spiral regardless of the presence or absence of the upper die assembly. The upper die assembly has been provided in the present instance to assist in forming a compact curl that will be entirely fluid tight when formed so that the same may be employed as a core for vulcanizing material.

However, where the device is employed to form outside coils for use in other connections, as for example in forming metal chimes for containers, the upper die assembly may entirely be dispensed with and the outside coil may be formed directly into the open die.

Referring now to Figure 8, the lower die is shown as being provided with a bore, 85, extending therethrough and connecting with the recess, 35, in the same. Mounted within this bore is a

plug, 86, serving to support a steel ball, 87, a portion of which extends upwardly within the recess. A number of these steel balls may be so positioned around the recess as to cause a number of circular corrugations, 88, to be formed around the finished ring which corrugations serve, when the ring is to be employed as a steel core for vulcanized rings, to prevent spreading of the rubber in the moulds.

It is obvious that other projections may be positioned or formed in the mould to cause any desired irregular cross-sectional deformations of the finished article. Furthermore, the entire inner surface of the mould may purposely be roughened to leave a number of minute striations on the interior surface of the finished article to further prevent migration of the rubber on the same when in the mould.

In Figure 7, the article is shown as being formed with flange, 89, left thereon. Such a flange may be formed on the article by limiting the stroke of the punch, 48. The stroke of the punch may be lengthened or shortened at will to decrease or increase respectively the length of this flange. This flange is admirably adapted for attachment by riveting, welding or the like to the article to which the device is to be applied.

In the accompanying drawings, an apparatus has been disclosed for performing outside curls upon sheet metal construction, yet it is contemplated by the reversal of certain of the parts, especially the dies in this device, to form inside curls of sheet metal bands. With the internal curling, the circumferential stresses in the edge of the metal as it travels inwardly, are tensile instead of compressive, and where very light sheet metal is employed this latter method of curling is contemplated in accordance with the principles of the present invention.

The invention is not to be limited to the exact arrangement of the parts shown in the accompanying three sheets of drawings, or described in the present specification, as many changes in the construction of the various parts (as for example the use of inside instead of outside curling dies) is contemplated. Only in so far as the invention is particularly pointed out in the accompanying claims is the same to be limited.

What I claim is:

1. The method forming a closed ring-shaped curl which comprises providing a retaining means for holding a flat strip of sheet material in the form of a cylinder, placing a sheet of material in said retaining means, placing a second sheet of material in said retaining means with the edges of one sheet of material coming into proximity with each other at a point remote from the point where the edges of the other sheet of material come into proximity, and rolling the edges of said sheets simultaneously to form a single curl of double thickness.

2. The method of forming a ring-shaped curl which comprises bending a plurality of sheets of material into the form of bands, placing said bands within each other with adjacent longitudinal edges of each band remote from the adjacent edges of each other band, and rolling the cylindrical edge of said bands simultaneously into a curl.

3. The method of forming a closed ring-like structure which comprises forming a pair of strips of sheet material into the form of bands, placing one band within the other with adjacent longitudinal edges of each band at points remote from each other, and rolling adjacent cylindrical edges of the bands simultaneously.

4. A machine for forming curls in sheet material comprising a lower die having an arcuate recess formed therein, an upper die having an arcuate recess therein, means for bringing said dies into position adjacent each other with the recesses opposing each other to form a recess of circular cross section, having a peripheral opening therein, and means for forcing a sheet of material into the peripheral opening thus formed between the dies to cause the same to follow the inside curvature of the recess and form a curl.

5. An apparatus for forming curls in sheet material which comprises a bed having a lower die mounted thereon, an upper die holder movable with respect to said bed, a die mounted on said die holder for movement therewith, said dies having opening recesses therein, and a floater slidably mounted within said lower die and adapted to receive a sheet of material therearound, said floater member forming with an edge of said upper dies a guide for a band of sheet material, means for closing said upper die and said lower die, and a punch for engaging the upper edge of said sheet material, and forcing the same endwise into the recesses between said dies.

6. An apparatus for forming curls in sheet material which comprises a lower die assembly and an upper die assembly, including upper and lower dies respectively, means for moving one of said dies into close proximity with the other of said dies, said dies each having a recess therein adapted when said dies are in close proximity to form a tubular restriction, a floater member forming with an edge of one of said dies a guide for a strip of sheet material, means upon said floater member for forcing a strip of said material inserted within the guide firmly against one of the dies to position the same for curling, and means for sliding the sheet of material into the recesses in said dies to form a curl.

7. An apparatus for forming outside curls in sheet material which comprises a lower die assembly and an upper die assembly including upper and lower dies respectively, means for causing said upper die assembly to move with respect to said lower die assembly to bring said dies in close proximity, said dies being ring-shaped in form, and having recesses therebetween when closed upon each other, a floater mounted within said dies and adapted to form with said upper die a guide therebetween for a band of sheet material, and means for engaging the upper edge of a band of sheet material within said guide for forcing said sheet material endwise into the recess between said dies.

8. An apparatus for forming outside curls in sheet material which comprises a lower die assembly and an upper die assembly including upper and lower dies respectively, means for causing said upper die assembly to move with respect to said lower die assembly to bring said dies in close proximity, said dies being ring-shaped in form, and having recesses therebetween when closed upon each other, a floater mounted within said dies and adapted to form with said upper die a guide therebetween for a band of sheet material, and means for engaging the upper edge of a band of sheet material within said guide for forcing said sheet material endwise into the recess between said dies, and means associated with said last mentioned means for forcing the sheet material radially outwardly to accurately shape

the same for introduction into the recess between the dies.

9. A die for forming curls comprising a curling die member having a recess therein adapted to receive the metal to be curled and to form a ring of curled metal, said recess having a protuberance therein for forming grooves in the material in the direction of the curl throughout the convolutions of the curled metal.

10. A die for forming curls in sheet metal which comprises a curling die member having a recess therein adapted to receive the metal to curl the same and to form a ring of curled metal, and a steel ball imbedded in the metal of the recess for deforming the metal to be curled throughout the convolutions of the curled metal.

11. A die for forming curls in sheet material which comprises a curling die member having an arcuate recess therein in which the sheet metal is slid for curling and for forming a ring of curled metal, and a plurality of smooth projections extending upwardly from the bottom of the recess for deforming the material to be curled throughout the convolutions of the curled metal.

12. The method of forming a ring-shaped curl from sheet metal which comprises providing means for holding a flat strip of sheet material in the form of a band and forcing the entire material of said band endwise tangentially into a ring-shaped curved cross section mold, closed except for a constricted opening to receive the band, whereby said band of sheet metal will initially follow the curvature of said mold and be curled up by the mold into a unitary compacted ring of curled metal.

13. The method of forming a closed ring-like structure which comprises forming a pair of strips of sheet material into the form of bands, placing one band within the other on a cylindrical surface with adjacent ends of each band at points remote from each other, and outwardly rolling adjacent cylindrical edges of the bands simultaneously.

14. A machine for forming a ring-shaped curl from sheet material comprising a ring-shaped die having a substantially arcuate recess having a peripheral opening therein of a width equal substantially to the thickness of the material, and means for forcing a ring-shaped sheet of material edgewise completely into the peripheral opening to cause the material to follow the curvature of the recess and form a compact curl.

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