May 30, 1933. J. SNEED 1,912,102

METHOD OF MAKING HOLLOW METAL ARTICLES

Original Filed May 21, 1928 2 Sheets-Sheet 1

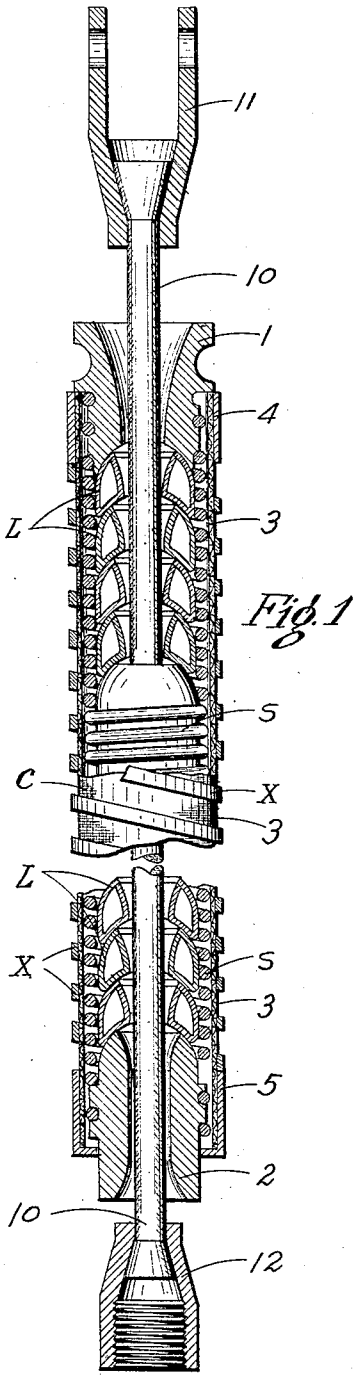


Fig. 1

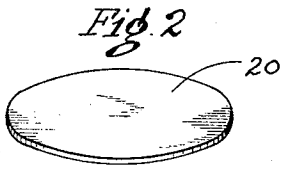


Fig. 2

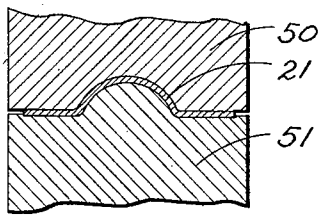


Fig. 3

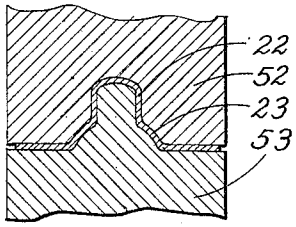


Fig. 4

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May 30, 1933. J. SNEED 1,912,102

METHOD OF MAKING HOLLOW METAL ARTICLES

Original Filed May 21, 1928 2 Sheets-Sheet 2

Fig. 5

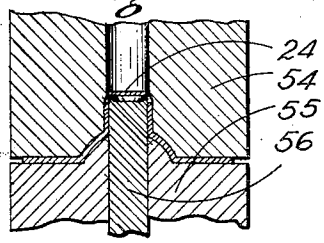


Fig. 6

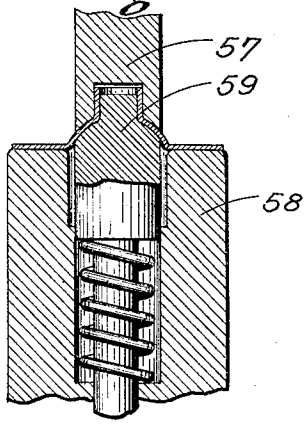


Fig. 8

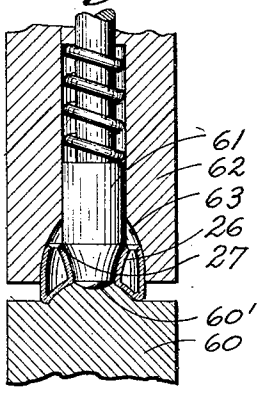


Fig. 7

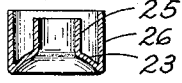


Fig. 10

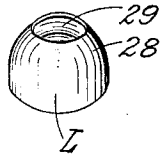
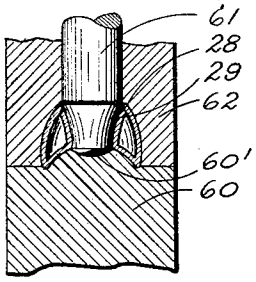


Fig. 9



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UNITED STATES PATENT OFFICE

JOHN SNEED, OF FERNDALE, MICHIGAN, ASSIGNOR TO THE MIDLAND STEEL PRODUCTS COMPANY, OF CLEVELAND, OHIO, A CORPORATION OF OHIO, AS TRUSTEE FOR STEELDRAULIC BRAKE CORPORATION, OF DETROIT, MICHIGAN, A CORPORATION OF MICHIGAN

METHOD OF MAKING HOLLOW METAL ARTICLES

Original application filed May 21, 1928, Serial No. 279,222. Divided and this application filed June 27, 1929. Serial No. 374,255.

This invention relates to a method of making metallic articles and more particularly to a method of making links or units for flexible conduits and is a division of my copending application Serial No. 279,222, filed May 21st, 1928.

It is among the objects of this invention to produce a flexible conduit formed of interfitting links, of which each link is hollow so that the assembled conduit will be of light weight. Another object is to provide a method of making conduit links which are less expensive than links heretofore known. A further object is to form such links of sheet stock and work and draw the links in a manner consistent with economical and efficient production.

Other objects will appear from the following description of the unit per se and the steps in the method of manufacturing such units, reference being had to the accompanying drawings in which a preferred form of the method and article is disclosed. The essential characteristics are summarized in the claims.

In the drawings, Fig. 1 is a partial broken longitudinal section of a conduit comprising the novel hollow links; Fig. 2 illustrates a blank of sheet stock from which the links may be formed; Fig. 3 illustrates an initial drawing operation and formation of the links; Fig. 4 illustrates a second drawing operation; Fig. 5 illustrates a punching operation in the formation of a link; Fig. 6 illustrates the arrangement of the dies with the one piece in place preparatory to flaring the periphery of the blank into cylindrical form; Fig. 7 is a longitudinal section of the link at the completion of the step illustrated in Fig. 6; Fig. 8 shows the step of flaring the inner walls; Fig. 9 illustrates a continuation of the operation of Fig. 8; that is, forcing inwardly the outer walls; and Fig. 10 is a perspective view of the finished unit.

Referring particularly to Fig. 1, there is shown an assembled conduit. Briefly stated the conduit comprises end members 1 and 2 between which a plurality of links L are held compressed upon each other by an encircling coil spring S. The spring S is secured at its ends to the end members 1 and 2. Surrounding the spring is a suitable dust cover 3 which is secured to the end members by such means as ferrules 4 and 5. The cover 3 may also serve to contain lubricant in the conduit and is supported by a coil spring X. The conduit acts in cooperation with a cable 10; the cable serving as a tension element while the conduit serves as a compression element in a flexible force transmitting device. Suitable yokes or connecting members 11 and 12 are joined to the ends of the cable and may be attached to external devices between which force in tension is transmitted.

Each of the links L may have one concave and one convex spherical end wall of which the spheres defining the end walls have centers lying in the surfaces of adjacent spheres. Each of the links L has a central aperture for the reception of the cable 10. The central aperture has its walls flared toward the convex surface of the unit so that when the conduit is in maximum curvature the cable will be supported along a continuous line in the plane of curvature in the conduit. The intersection of the inner wall of the link L with a longitudinal plane defines a curve whose radius is substantially equal to a maximum radius of curvature of the conduit less the radius of the cable and whose center lies in a line which is the perpendicular bisector of the line which joins the centers of the spheres which define the concave and convex end walls of the unit.

While the foregoing describes the particular unit, those skilled in the art will appreciate that the precepts of this invention are broader than the specific illustration and that the advantages of the method of making hollow links are applicable to other structures.

In forming the link sheet stock, of which a blank 20 is illustrated in Fig. 2 is used, the blank 20 may be placed between dies 50 and 51 for an initial drawing operation in which a central portion of the blank is drawn or cupped as at 21. Referring to Fig. 4, the drawing may be continued between dies 52 and 53 so that a tubular extension 22 is

drawn from the central portion of the blank and a substantially spherical concave end wall 23 is formed.

The next step in the process of forming the link is illustrated in Fig. 5 wherein the link is held between dies 54 and 55 while a punch 56 removes a piece 24 forming a central opening in the blank. The following step in the process has for its object the formation of an outer cylindrical portion and to this end the blank is engaged between dies 57 and 58, see Fig. 6, while the central portion of the blank is supported on a retractable die 59. The die 57 is forced downwardly into the die 58 and the outer parts of the blank are turned upwardly and formed into a cylinder illustrated in Fig. 7. After the blank has passed through the above steps it has been given the shape illustrated in Fig. 7, having a concave end wall 23, an inner cylindrical wall 25 and an outer cylindrical wall 26. There now remains the necessity of flaring the inner wall outwardly to provide the general conically formed aperture and of forcing the outer wall inwardly to become the convex spherical end wall of the link.

To this end the piece shown in Fig. 7 is seated upon a die 60, shown in Fig. 8 and a pair of coaxial dies 61 and 62 are brought toward the die 60. The die 61 enters the inner cylindrical part 25 and flares it outwardly until the die 61 engages the die 60 at the point 60'. Further progress of the dies toward each other forces the upper edges 27 of the outer wall 26 inwardly to conform with the concave cylindrical surface 63 of the descending die 62. In Fig. 9 the dies have come to the limit of their travel and the finished unit is held between them. As the dies are parted the retractable die 61 serves to eject the finished unit. In Fig. 10 the finished link L is illustrated with the convex spherical surface 28 uppermost and overlapping the outwardly flared portions of the central aperture 29, see also Fig. 9.

From the foregoing it will appear that there is provided a method of forming a hollow conduit unit which can be cheaply made and which will have all the strength necessary for any desired use. In describing the process of forming the units those skilled in the art will appreciate that certain of the steps may be varied or combined with equivalent steps to get like results, and while there is described a preferred method, it is not desired that the patent be limited other than by the claims appended hereto.

I claim:—

1. The method of forming a unit for flexible conduits of substantially concavo convex external contour from a metallic disc comprising forming a centrally located cup shaped portion having an open ended cylindrical portion extending concentrically outward from the bottom of said cup shaped portion, turning back the remaining portion of said disc to form an outer wall portion, flaring said open ended cylindrical portion and swaging inwardly said outer wall portion until the edges of said open ended portion and said outer wall portion are contiguous.

2. The method of forming a unit for flexible conduit formed of sheet stock which consists in drawing a central generally cylindrical part, cupping back the periphery of the blank to form an outer cylindrical part and flaring the outer cylindrical part inwardly to form an annular closed hollow member.

3. The method of forming a unit for flexible conduit of sheet stock which consists in drawing a central generally cylindrical part, punching out the end of the drawn cylindrical part, cupping back the periphery of the blank to form an outer cylindrical part and flaring the outer cylindrical part inwardly and the inner cylindrical part outwardly to form an annular closed hollow member.

4. The method of forming a conduit unit from sheet stock from a disc shaped blank which consists in drawing the midportion of the disc to form a substantially hemi-spherical cup shaped part with a cylindrical extension, punching out the end of the cylindrical extension, turning back the periphery of the disc to form a cylindrical wall coaxial with the said cylindrical extension and swedging in the end of the cylindrical wall to form a curved end wall and flaring out the end of the said cylindrical extension to meet and support the said curved end wall.

5. The method of forming a conduit unit from sheet stock from a disc shaped blank which consists in drawing the midportion of the disc to form a substantially hemispherical concave cup shaped part with a cylindrical extension, punching out the end of the cylindrical extension, turning back the periphery of the disc to form a cylindrical wall coaxial with the said cylindrical extension, swedging in the ends of the cylindrical wall to form a convex curved end wall with a central opening and flaring out the end of the said cylindrical extension to meet and support the said convex curved end wall adjacent the opening therein.

6. The method of forming a link for flexible conduit from a disc like blank of sheet stock which consists in drawing from the center portion of the disc a concave substantially hemispherical end wall with a cylindrical extension for the inner wall of a passageway through the link, punching out the end of the drawn part, turning back the periphery of the blank to form an outer cylindrical wall coaxial with the said passageway along the edge of the said substantially hemispherical concave end wall, flaring the end of the inner wall outwardly remote from the end said concave wall, and swedging the end of the outer wall inwardly to form a convex

spherical surface of a radius similar to the radius of the said concave spherical surface.

7. The method of forming a link for flexible conduit from a disc like blank of sheet stock which consists in drawing from the center portion of the disc a concave substantially hemispherical end wall with a cylindrical extension for the inner wall of a passageway through the link, punching out the end of the drawn part, turning back the periphery of the blank to form an outer cylindrical wall coaxial with the said passageway along the edge of the said substantially hemispherical end wall, flaring the end of the inner wall outwardly remote from the said concave wall, and swedging the end of the outer wall inwardly to form a convex spherical surface of a radius similar to the radius of the concave spherical surface over the outwardly flared ends of the inner wall, whereby the inner wall supports and spaces apart the inner portions of the said end walls.

8. The method of forming a unit for flexible conduits from a metallic disc comprising forming a centrally located cup shaped portion having an open ended cylindrical portion extending concentrically outward from the bottom of said cup shaped portion, turning back the remaining portion of said disc to form an outer wall portion while holding an intermediate portion, flaring said open ended cylindrical portion without distoring said cup shaped portion and swaging inwardly said outer wall portion until the edges of said open ended portion and said outer wall portion are contiguous.

9. The method of forming a unit for flexible conduits from a metallic disc comprising forming a centrally located cup-shaped portion having an open ended cylindrical portion extending concentrically outward from the bottom of the cup-shaped portion, providing an outer part surrounding the cup-shaped portion, and flaring said open ended cylindrical portion to cause its end to abut the end of the outer part.

10. The method of forming a unit for flexible conduits from a metallic disc, comprising forming a centrally located cup-shaped portion having an open ended cylindrical portion extending concentrically outward from the bottom of the cup-shaped portion, providing an outer part surrounding the cup-shaped portion, and then flaring outwardly the end of the cup-shaped portion while simultaneously flaring inwardly the outer part to cause its end to abut the flared end of the inner part.

11. The method of forming a hollow double walled article consisting of forming a cup-shaped portion having an open ended cylindrical portion extending concentrically outward from the bottom of the cup-shaped portion, providing an outer part surrounding the cylindrical and cup-shaped portions, and expanding said open ended cylindrical portion to cause its end to abut the end of the outer part.

In testimony whereof, I hereunto affix my signature.

JOHN SNEED.