Oct. 11, 1960 R. E. ROPER ET AL 2,955,556

HYDRAULIC EXPANDER

Filed May 31, 1957 3 Sheets-Sheet 1

FIG. 1

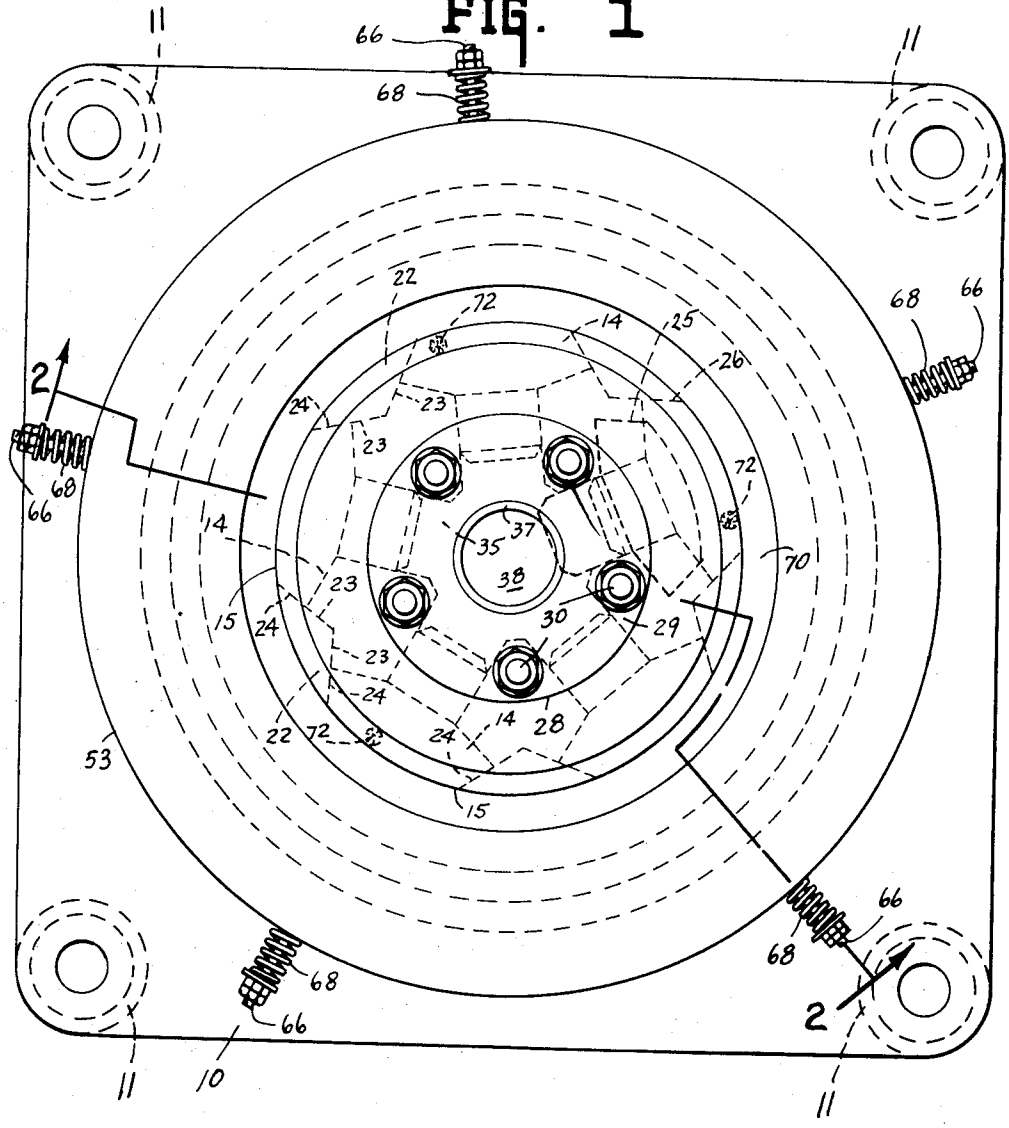

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FIG. 2

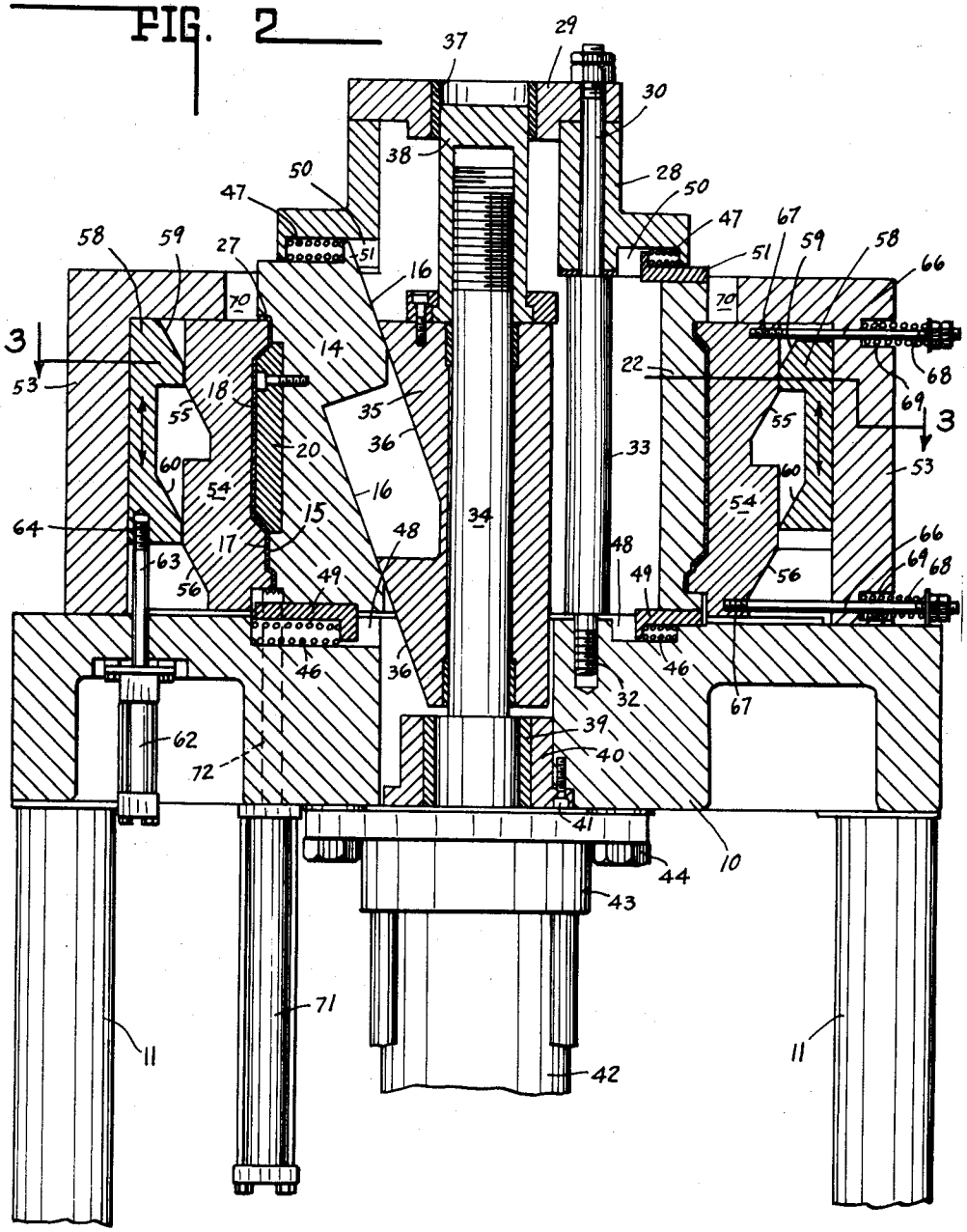

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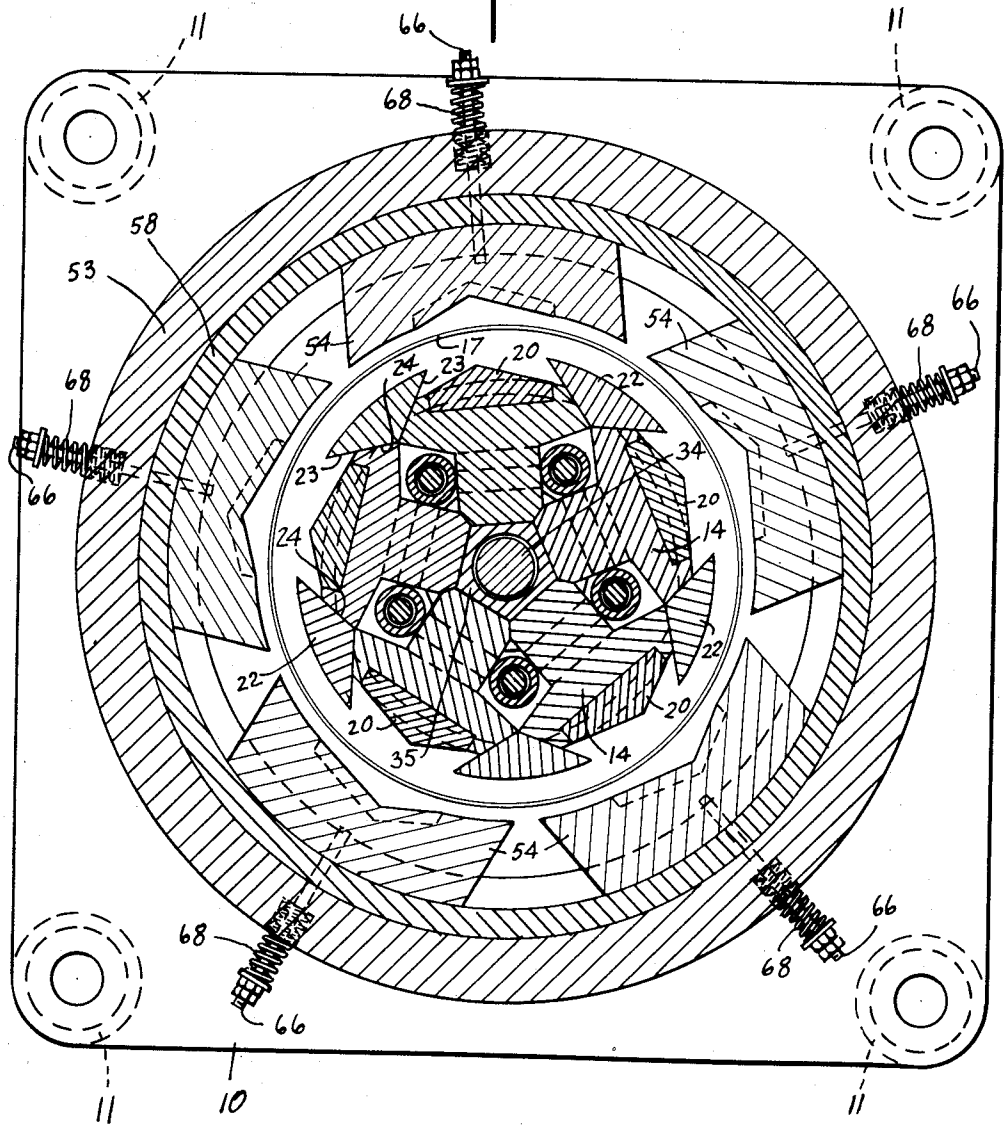
FIG. 3



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HYDRAULIC EXPANDER

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1 Claim. (Cl. 113—48)

This invention relates generally to metal working tools and more particularly it relates to a mechanism especially adapted for forming cylindrical or rectangular metallic shapes from welded metallic cylinders of sheet metal.

In the manufacture of sheet metal cabinets, washing machine casings, electrical drier casings and other products of like nature, it has been conventional practice to form the casings of this type one or two sides at a time and then to weld the several sides together to form a complete, relatively rigid, casing. This has been necessary particularly where it is desired to form a casing having decorative or functional, recessed, or expanded surface sections which normally require flow of metal during the forming process.

Heretofore it has been necessary to fabricate a casing of the type described from individual sheets of sheet metal particularly where complex shapes are being formed. Where attempts have been made to form complex shapes from a preformed metallic cylinder, the metal would tear or wrinkle, thereby making it impossible to produce a desired shape in a single forming operation. Also, such shapes would not have a permanent, true, circular or rectangular form.

The principal object of this invention is to provide a metal working machine adapted to expand a welded cylinder of sheet metal into a permanently set, true, rectangular or cylindrical shape having complex projecting or recessed decorative or surface sections.

Another object of this invention is to provide a machine tool adapted to form metallic shapes of the type described in a single cycle of operation.

In accordance with this invention, there is provided a metal working machine comprising an expandable die mechanism adapted to receive thereon a sheet metal cylinder, cam means disposed within said die and operable for expanding it to stretch said cylinder, and an external contracting die including means for contracting it into metal forming contact with said expanding die while the metal of said cylinder is being stretched.

The full nature of the invention will be understood from the accompanying drawings and the following description and claim:

Fig. 1 is a top plan view of the metal working machine as provided in accordance with this invention;

Fig. 2 is a cross-section taken on line 2—2 of Fig. 1; and

Fig. 3 is a cross-section taken on line 3—3 of Fig. 2 and showing the dies in retracted position.

This invention comprises a metal working machine having a base **10**, which may be supported at floor level by means of stanchions **11** disposed below floor level. An expandable die mechanism is supported on the base **10** and comprises a plurality of driver sections **14** arranged about a common center, each of which is formed to have a generally arcuate external die surface **15**, and a pair of internal inclined cam surfaces **16**. Where it is desired to form in the external surface of a sheet

metal cylinder **17** a protruding surface section such as **18**, one or more of the dies **16** may be provided with a pad **20** which provides the external die surface adapted to form the protruding section **18**.

As shown in Fig. 1, the expanding die mechanism may include five so-called driver die sections spaced apart from one another and operatively engaging the driven die sections **22** disposed between adjacent driver sections. The external surfaces of sections **22** are generally arcuate in form and are so designed as to conform with the arcuate surfaces **15** of the driver sections **14** so that the complete die mechanism presents a continuous cylindrical surface when the mechanism is in its fully expanded position. This feature of the invention is important in that it prevents any marking or deforming of the sheet metal cylinder during its forming operation. Driven sections **22** include inclined cam surfaces **23** which cooperate with inclined cam surfaces **24** of driver sections **14** whereby sections **22** are cammed from their inner positions indicated at **25** (Fig. 1) to their outer positions as indicated at **26** in Fig. 1. Die sections **14** and **22** may be undercut as at **27** to form a rim on cylinder **17**.

The die sections **14** annd **22** rest on and slide on the upper surfaces of the base **10** and are positioned and supported in operative relation with one another by means of an external housing structure comprising in part an upper housing member **28** having a cover **29** clamped in position by means of the bolts **30** threaded into the base **10** at **32** and having enlarged spacer sections **33**. Cooperating with housing **28** and the base **10** is a centrally disposed shaft **34** having fixed thereto a die operating cam **35** having cam surfaces **36** which mate with cam surfaces **16** of driver sections **14**. Shaft **34** is supported at its top end in the bearing and seal **37**, mounted in cover **29**, and includes a cap **38** which extends into bearing and sealing relation with member **37**. The lower end of shaft **34** is supported in a bearing and seal **39** which in turn is supported from the base **10** by means of a collar **40** bolted to base **10** by the stud **41**. Shaft **34** may form the extension of a hydraulic piston (not shown) which operates in hydraulic cylinder **42** extending upwardly to the base **10** and sealed and secured thereto by means of collar member **43** bolted to base **10** by machine screws **44**.

The die members **14** and **22** are confined or restrained into engagement with cam **35** by means of retraction springs **46** and **47**, springs **46** being nested within slots **48** in base **10** and operatively associated with die members **14** and **22** by means of L-shaped guides **49**. Similarly, retraction springs **47** are nested within slots **50** formed in the lower surface of housing **28** and operatively associated with the die members **14** and **22** by means of the L-shaped guides **51**.

From the foregoing description it will be apparent that upward movement of shaft **34** and cam **35** will permit retraction of die members **14** and **22** under the control of the retraction springs **46** and **47**, and downward movement will provide expansion of the die mechanism through the action of the cooperating cam surfaces **16** and **36**.

Outer dies surround the expanding die and are positioned by means of an external housing **53**. The outer dies include 90° arcuate sections **54** having die surfaces which mate with the outer surfaces of inner dies **16** and **22** and cam surfaces **55** and **56** which cooperate with outer cams **58** having cam surfaces **59** and **60**. Outer cams **58** may be in the form of a complete annulus or divided into sections and may be operated by one or more hydraulic rams **62** having shafts **63** threaded into cams **58** as shown at **64**.

For retracting the outer dies **54** there is provided a mechanism consisting of the stud bolts **66** threaded into

die 54 at 67 and compressing springs 68 within bores 69 in housing 53. When cam 58 is operated to move the dies 54 into engagement with the sheet metal cylinder 18, springs 68 are compressed so that they function to draw dies 54 outwardly when cam 58 moves to its lowermost position.

For ejecting cylinder 17 after it has been formed by the dies, there is provided an ejector consisting of one or more hydraulic rams 71 attached in any suitable manner to the lower surface of the base 10 and including a shaft 72 projecting upwardly in alignment with the space between inner dies 14, 22 and outer dies 54. The ram 71 may be used both for lowering cylinder 17 into position for forming, and elevating cylinder 17 after it is formed to a position where it may be removed from the machine either manually or by means of a hoist.

In operation it may be assumed that shaft 34 and cam 35 are in their uppermost positions and the die sections 14 and 22 are in their retracted positions. Similarly, cam 58 is in its lowermost position whereby die sections 54 are retracted to their outermost positions. This leaves a space at 70 between the inner and outer die sections into which a welded cylinder 17 of sheet metal may be dropped.

In order to form cylinder 17 into a relatively rigid cylindrical casing, the piston in cylinder 42 may be controlled to draw the shaft 34 downwardly whereby cam 35 drives the driver die sections 14 in an outward direction. As shown in Fig. 3, the driven die sections 22 project outwardly beyond driver sections 14. It will be apparent from the geometrical relationship between die sections 14 and 22 that the outer surfaces of driven die sections 22 project outwardly of the outer surfaces of driver sections 14 until driver sections 14 reach their outermost radial positions to form a continuous cylindrical surface.

Before die sections 14 reach their outermost positions, the driven die sections 22 will engage portions of and stretch the cylinder 17, and the undercut portion 27 of sections 14 and the similar undercut portion of section 22 will begin forming sections of a rim on cylinder 17. As all of the die sections move outwardly, the metal of cylinder 17 is stretched and can flow to prevent tearing or fracture. During the stretching process, the die sections 22 form sections of a rim on cylinder 17 and then sections 14 will have begun to form intermediate sections of the rim while all the metal is still stretching and in this manner a continuous, smooth and unwrinkled or unbroken rim may be formed on cylinder 17.

The operation of the rams 62 may be timed with relation to the operation of cam 35 to be moved upwardly and move outer die sections 54 into contact with cylinder 17 while it is being stretched by inner die sections 14 and 22. This has the effect of laying the metal of the cylinder 17 on to the protruding parts of dies 14 and 22 while the metal is being stretched by dies 14 and 22 At the same time outer dies 54 flow the metal of cylinder 17 into any depressions in the die sections 14 and 22 As a result of the cooperative stretching of cylinder 17 by the inner die sections and the laying of metal on the protruding parts of the die sections, no tearing or wrinkling of cylinder 17 occurs and a rigid casing member is formed in one continuous operation

After the forming operation is completed, the machine

may be controlled to permit the outer dies to assume their outermost positions and to permit the inner dies to assume their innermost positions, thereby freeing the finished cylinder 17. The ejector rams 71 may then be operated to elevate the cylinder 17 to a position where it may be lifted free of the machine

From the foregoing description, it will be readily apparent that this invention provides a mechanism adapted to form cylindrical metallic shapes from welded metallic cylinders of sheet metal. The forming process eliminates a series of separate operations on separate pieces of metal and is effective in a single cycle of operation to form a casing member which is relatively rigid and holds its shape.

While the invention has been disclosed and described in some detail in the drawings and foregoing description, they are to be considered as illustrative and not restrictive in character, as other modifications may readily suggest themselves to persons skilled in this art and within the broad scope of the invention, reference being had to the appended claim.

The invention claimed is:

A metal forming device for forming a cylindrical metallic shape comprising a base, a plurality of radially disposed, spaced, driver die sections slidably mounted at their lower ends on said base and each having a die surface in the form of a vertical section of a cylinder, driven die sections disposed between said driver die sections and each having a die surface in the form of a vertical section of a cylinder complementing the adjacent die surfaces of said driver sections to form a complete cylindrical die surface, a cam slidably mounted centrally of said driver die sections and having radially extending cam surfaces engaging each driver section, independent drive means for said cam, said driver and driven die sections having mutually cooperating cam surfaces whereby movement of said centrally disposed cam moves all of said die sections outwardly to form a continuous cylindrical die surface, said mutually cooperating cam surfaces being formed so that said driven die sections reach metal forming position prior to said driver die sections, a cover slidably engaging the upper ends of said die sections, spring means engaging the upper and lower ends of said die sections and said base and cover for retracting said die sections, outer die sections surrounding said cam-operated die sections each having die surfaces mating with the die surfaces of said cam-operated die sections, an outer casing surrounding said outer die sections, cam means operatively associated with said casing and said outer die sections for moving said outer die sections into metal forming relation with said cam operated die sections, and independent drive means for said cam means.

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