Feb. 23, 1965 J. L. MASSINGILL 3,170,236

METHOD OF MAKING A CASING

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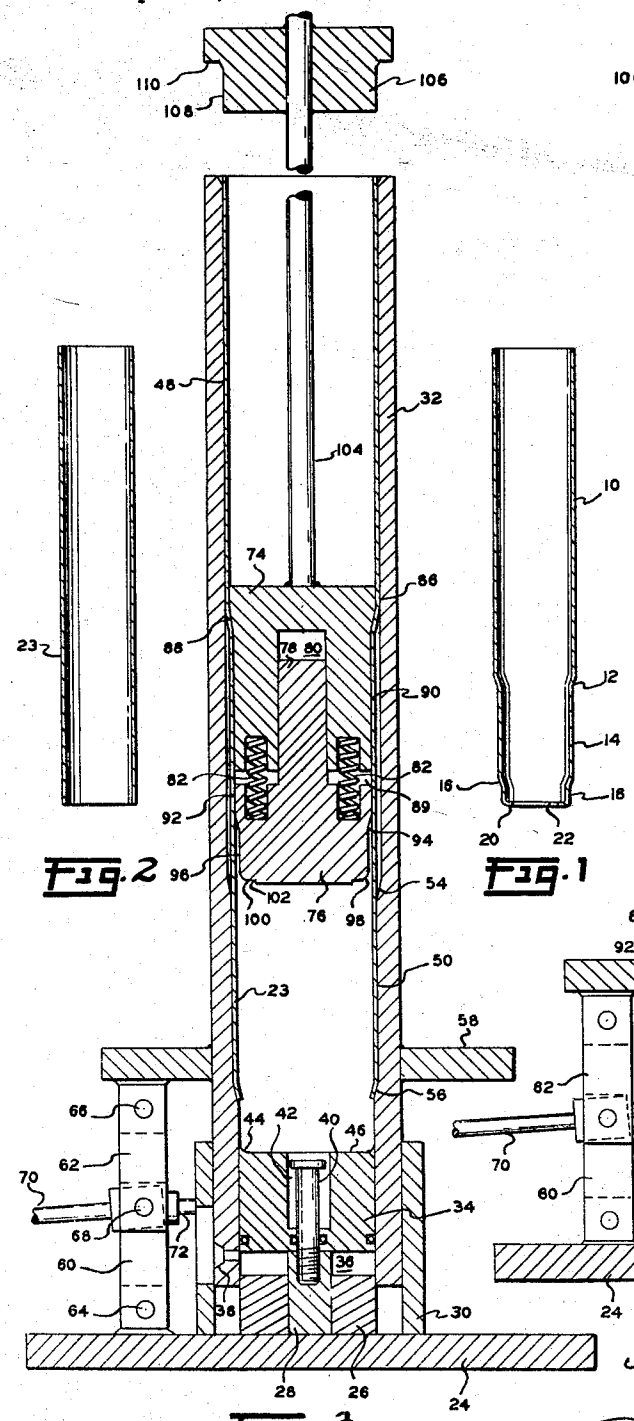


Fig. 2

Fig. 1

Fig. 4

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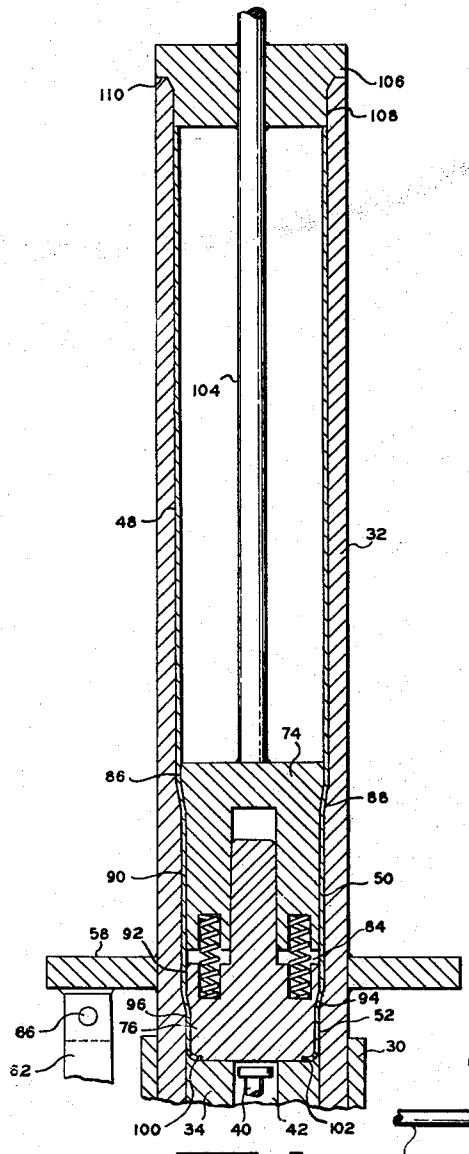


Fig. 5

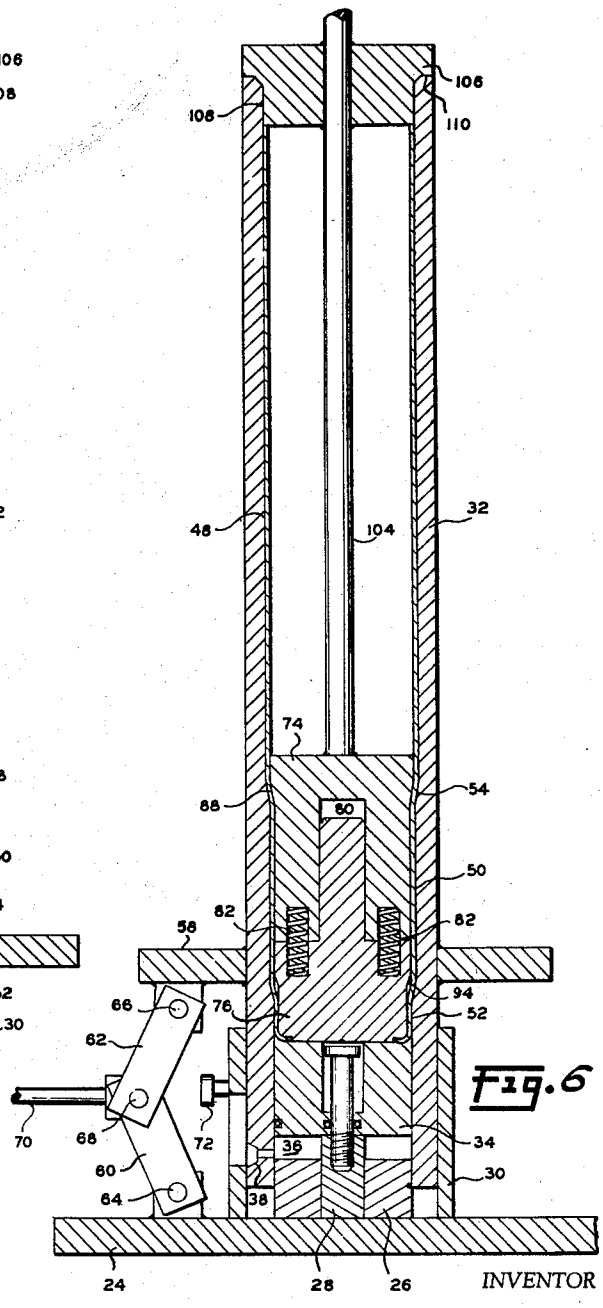


Fig. 6

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METHOD OF MAKING A CASING

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4 Claims. (Cl. 29—534)

The invention relates to a casing member and the method and apparatus of making the same. In particular the casing is of the type used to house submarine detecting radio transmitters which may be dropped into the sea from aircraft.

A casing of generally cylindrical configuration having various sized diameters may be formed from a cylindrical blank by the conventional practice of expanding and necking; however, to form an integral radially extending flange on a casing thus formed is most difficult by known methods. Casings housing aerial dropped submarine detectors are of the above described shape and the normal method of forming the casing is to size the casing diametrically and then rivet or weld a second part to the casing to form the radial flange. Such a method of fabrication is objectionable due to the high cost and it is the purpose of the invention to provide a method of forming a casing of the above configuration from a single blank and in a single forming machine whereby the cost of production is materially lowered and the resultant casing is structurally superior to casings formed by known processes.

It is thus an object of the invention to provide a method of forming a tubular casing of various sized diameters having a radial flange at one end wherein the sizing and flange are produced during a single working stroke of the forming apparatus.

Another object of the invention is to provide a method for forming a tubular casing having a radial end flange wherein the diametrical size of the casing is formed by an internal mandrel moving axially with respect to the casing and the flange is formed by a relatively axial movement between the casing and a die.

A further object of the invention is to provide a method for forming a tubular casing of various size diameters having a radial flange adjacent one end from a cylindrical blank in one operation wherein relatively simple die structure is employed and wherein high production is possible.

These and other objects of the invention will be apparent from the following description and accompanying drawings wherein:

FIG. 1 is an elevational sectional view of the final casing configuration after the complete forming operation,

FIG. 2 is an elevational sectional view of the blank used in forming the casing of the invention,

FIG. 3 is a sectional elevational view of a die arrangement which may be used to form the casing of FIG. 1 showing the blank and mandrel relationship during the expanding sequence,

FIG. 4 is an elevational, sectional view similar to FIG. 3 illustrating the mandrel and upper block relation to the die and blank at the end of the expansion sequence and immediately before the necking operation begins,

FIG. 5 is an elevational, sectional view similar to FIG. 3 showing the mandrel, die and upper block relationship at the end of the necking sequence and prior to release of the die holding means, and

FIG. 6 is an elevational, sectional view of the casing, mandrel and die relation after release of the die holding means and completion of the casing flange forming and prior to withdrawal of the mandrel.

The method of forming as set forth below may be used with many tubular configurations and it will be understood that while the invention is described as forming a given shape of casing the practice of the method is not limited to any particular dimension or size relationships.

The casing is best shown in FIG. 1 wherein it will be observed that the casing is of a tubular cylindrical configuration having a maximum diametrical portion **10** which is necked at **12** to form a conical surface which interconnects the portion **10** to an intermediate cylindrical portion **14**. A second conical surface is defined at **16** which interconnects the portion **14** to a cylindrical portion **18** defining the minimum diameter of the casing. At the lower end of the casing the wall thereof is formed radially inward to define a continuous annular flange **20**. The flange **20** is of limited length whereby a circular opening **22** is formed in the end of the casing and a radius exists at the exterior junction of the flange and the casing portion **18**. In the finished casing several holes are punched in the walls thereof for mounting the interior structure and other purposes; however, these holes are performed by a second operation and form no part of the present invention.

The casing of FIG. 1 is formed from a cylindrical blank **23** of uniform diameter as shown in FIG. 2. In practice the blank is of aluminum material; however, the process of the invention may be employed with many types of materials and is not limited to use with aluminum articles.

The forming of the casing takes place in forming die apparatus preferably similar to that shown in FIGS. 3–6. The illustrated die structure is mounted upon a base plate **24** and includes a cylindrical block **26** affixed thereto having an abutment rod **28** within the center of the block and projecting above the upper surface thereof. If desired, the block **26** and rod **28** may be formed integrally. A tubular guide sleeve **30** is affixed to the base plate **24** concentric to the block **26** and is of a greater inner diameter than the outer block diameter so as to form an annular void between the block and sleeve.

The die **32**, which is of an elongated tubular configuration, is slidably received and supported within the annular void between the block **26** and sleeve **30** and is axially positioned with respect to the sleeve by a releasable lock arrangement which is described hereinafter.

A die piston **34** is located within the lower end of die **32** and will move axially with respect to the die upon introduction of pressurized air or fluid into the void **36** through the threaded orifice **38**. The piston **34** normally rests upon the upper end of the abutment rod **28**, and bolt **40**, having an enlarged head, is threaded into the abutment rod to limit vertical movement of the die piston **34**. A concentric recess **42** formed within the die block receives the head end of the bolt **40** and the piston may move upwardly, under the influence of pressured fluid, to the point where the bottom of the recess engages the bolt head. As will be noted in the drawings, the periphery of the die piston adjacent the upper surface **46** is radiused at **44** and this upper surface functions in the formation of the casing flange **20** as will be later apparent.

The die **32** is provided with an inner configuration similar to the outer shape of the casing, e.g., the die is formed with a maximum diameter at **48**, an intermediate diameter at **50**, and a minimum diameter at **52** and shoulders **54** and **56** are formed between the portions **48–50** and **50–52** respectively.

An actuating plate **58** is affixed to the die **32** adjacent the lower end thereof and a link actuated locking means is interposed between the actuating plate **58** and the base plate **24**. The locking means consists of two piv-

otally mounted links 60 and 62, 60 being pivotally affixed to the base plate at 64, 62 being pivoted to the actuating plate at 66 and both links being pivotally interconnected at 68. An actuating rod 70 is affixed to pivot 68 and operated by a hydraulic cylinder (not shown) whereby the links may be pivoted, note FIG. 6, and a stop 72 will determine the position of pivot 68 when rod 70 is moved to the extreme right position as illustrated in FIG. 3.

The expansion of the blank and final sizing and forming of the casing conical necks and flange are performed by an internal mandrel or plunger consisting of an upper part 74 and a lower part 76. The lower part 76 is formed with a shank 78 which is slidably received in a recess 80 within the upper mandrel part 74 and compression springs 82, of which there are six, are interposed between the upper and lower parts biasing the lower part 76 away from the upper part 74. Lost motion pins (not shown) connecting the mandrel parts limit the gap 84 between the mandrel parts without interfering with movement of the lower part 76 toward the upper mandrel part 74.

The upper mandrel portion is formed with a maximum diameter 86, a conical shoulder 88 and an intermediate diameter 90 which correspond to the inner configuration and dimensions of the casing portions 10, 12 and 14 respectively. The lower mandrel portion is provided with the intermediate diameter 92, which is equal to diameter 90, a conical shouder 94, and a minimum diameter 96 which correspond to the inner casing dimensions at 14, 16 and 18 respectively. The lower end of the mandrel part 76 is radiused at 98 and annularly recessed adjacent the radius at 100 to form the casing flange 20. A circular shoulder 102 is defined on the end of the lower mandrel by the recess 100.

The mandrel 74–76 is axially reciprocated within the die 32 by means of a piston rod 104 operatively connected to a hydraulic cylinder (not shown) and an actuating block 106 is affixed to the rod 104 at a given distance from the mandrel for a purpose which will be later apparent. The block 106 is of circular transverse cross section and is formed with a diameter 108 which is slightly smaller than the casing diameter 48 and a shoulder 110 is defined on the block for abutment with the upper end of the casing, as will be described.

The operation of the apparatus and formation of the casing is as follows:

At the beginning of the operation the die apparatus will be as in FIG. 3, e.g., the rod 70 will be in the rightmost position whereby the stop 72 will position the links such that the center of pivot 68 is slightly past center in regard to the line connecting pivots 64 and 66 and the die piston 34 rests upon the top of the abutment rod 28. At this time the mandrel 74–76 is completely withdrawn from the die 32 whereby the blank 23 may be dropped into the top of the die. The blank 23 is of a diameter equal to that of portion 14 of the finished casing and hence will fall within the die 32 until the lower edge of the blank engages the conical shoulder 56.

The hydraulic cylinder actuating piston rod 104 is now energized to move the mandrel 74–76 downwardly into the blank 23 and as the mandrel travels axially through the blank the conical shoulder 88 will circumferentially expand the blank to the diameter 10 of the finished casing. During this phase, FIG. 3, the downward axial force exerted on the blank will cause the lower end thereof to partially neck down due to the engagement with the shoulder 56.

Downward movement of the mandrel 74–76 continues to form the casing portion 10 until the lower edge of the block 106 engages the upper end of the blank 23 as shown in FIG. 4. At this time the shoulder 88 is above the shoulder 54 and the lower end of the lower mandrel part 76 will be approximately on a level with the lower end of the blank. It will be observed that no compression

of the springs 82 has taken place and that the blank now consists of two different diameters. At the position illustrated in FIG. 4 the casing portion 10 has been completely formed.

Further downward movement of the mandrel 74–76 and block 106 results in an equal axial movement of the blank with respect to die 32 due to the engagement of the block 106 with the end of the blank and as the blank is moved toward the die piston 34 that portion thereof passing over the shoulder 56 will be "necked" inwardly to form the diameter 18 of the casing. During this necking operation the lower end of the mandrel part 76 will maintain approximately the same relationship to the lower end of the blank as that illustrated in FIG. 4 whereby the end of the mandrel part 76 will engage the surface 46 at the termination of the necking phase.

The relative positions of the blank, die and mandrel at the end of the necking formation of surface 18 is shown in FIG. 5. At this time the shoulder 110 of block 106 will engage the upper end of the die 32, the lower mandrel 76 engages the surface 46 of the die piston, the lower end of the blank has been necked down and the shoulders 88 and 94 are separated from the shoulders 54 and 56, respectively, by the thickness of the blank wall whereby the casing portions 12 and 16 are accurately sized between the mandrel and die. At the position of FIG. 5 it will be noted that the axial length of the necked down blank portion is greater than the axial length of the casing portion 18. This is due to the fact that the flange 20 is formed from this material and, at this point, the lower end of the blank 23 is only engaging the radius 44 and has not yet been turned under to form the flange.

While the cylinder activating piston rod 104 maintains a downward pressure on the mandrel 74–76 and die 32, through block 106, the cylinder operating the actuating rod 70 is energized to pull the rod 70 to the left and pivot the links 60 and 62 away from the sleeve 30 as shown in FIG. 6. Movement of the links in this manner permits the die 32 to move downwardly and this motion likewise permits the mandrel part 74, blank 23 and block 106 to move with the die. Bearing in mind that as the lower mandrel part 76 cannot move downward due to engagement with the stationary die piston 34 it will be appreciated that the "dropping" of the die 32 drops the end of the blank onto the radius 44 and surface 46 which folds the end of the blank inwardly into the recess 100 to form the flange 20. As the lower mandrel part 76 and die piston relationship does not change during the formation of the flange the die cavity formed by recess 100, radii 44 and 98, surface 46 and shoulder 102 exists before the flange is formed and hence will accurately direct the formation of the casing flange 20. The shoulder 102 insuring that the opening 22 is circular and smooth edged.

It will be noted in FIG. 6 that after die 32 drops, the springs 82 are compressed and that the gap 84 has completely closed whereby the upper mandrel part 74 is bearing directly on the lower part 76. Thus, the force of the cylinder actuating piston rod 104 is also imposed on the lower mandrel part and any creases or wrinkles occurring in the casing flange area will be ironed out.

The casing formation is now complete and the rod 104 is reversed to withdraw the block 106 and the mandrel 74–76 from the die 32. Pressurized fluid or air is then introduced into void 36 via a suitable conduit affixed to orifice 38 and the die piston 34 is lifted from engagement with the abutment rod 28 and as the die piston raises the casing will likewise be lifted and freed from die 32 such that the operator may manually lift the finished casing from the die. The rod 70 is then moved to the right to lift the die 32 to the position of FIG. 3 and the cycle may be repeated.

It will be appreciated that the entire casing formation is effected by a single working stroke of the piston rod

104 and in actual operation the entire sequence of operation takes approximately 5 seconds. The sequence of operation of the cylinders operating rods 70 and 104 and the introduction of pressurized fluid into void 36 may be controlled by electric switches actuated by the various components and the operation can be made almost completely automatic by using switching principles that are well known in the art. Thus, the invention discloses a high production method of expanding, reducing and flanging a tubular blank with relatively simple die structure and apparatus and the invention is not intended to be limited to the described embodiment but is to be defined only by the scope of the following claims.

I claim:

1. The method of forming a tubular casing having axial portions of various dimensions and a radially extending flange comprising the steps of inserting a tubular blank into a die having an inner configuration similar to that of the casing, interiorly expanding the circumference of a first axial portion of the blank while said blank is relatively sationary with respect to the die, axially translating the entire blank with respect to the die through a reduced portion formed on the die to exteriorly reduce a second axial portion of the blank and forcing the end of the reduced axial portion against a second die while fixing said blank with respect to the first die to form an inwardly projecting flange from the end of said reduced portion.

2. A method of forming a tubular casing having axial portions of various dimensions and a radially extending flange in a single unidirectional working stroke comprising the sequential steps of interiorly circumferentially expanding a first axial portion of a tubular blank by an expanding tool within said blank being axially translated through said blank while said blank is stationary, exteriorly reducing a second axial portion of said blank through a shoulder defined on a first die encompassing said blank by axially translating the entire blank with respect to the shoulder and engaging the end of said reduced portion with a second die during axial movement of said blank and first die toward said second die after reducing said reduced portion to deflect the end of the blank inwardly to form the radial flange.

3. A method of forming a tubular casing having axial portions of various diameters and a radially extending flange comprising the sequential steps of placing a cylindrical tubular blank within a hollow die having a configuration similar to the casing, passing an expanding tool partially through said blank while said blank is stationary within said die to form an enlarged first axial portion, axially translating said blank through a reduced shoulder in said die to form a second axial portion of reduced dimension and translating said die, expanding tool and blank toward a second die wherein the end of the reduced blank portion engages said second die and is radially deflected inwardly to define an annular flange.

4. A method of forming a tubular casing having spaced axial portions greater and lesser than the diameter of a tubular cylindrical blank and a radially extending flange defined on one end of the casing by means of a hollow die, an expanding tool and a flange forming die comprising the sequential steps of circumferentially expanding an axial portion of said blank while within the hollow die by the expanding tool while said blank is relatively stationary to the hollow die, axially translating said blank within the hollow die past a reduced shoulder defined therein upon completion of said expanding to circumferentially reduce an axial portion of said blank adjacent one end of the blank, maintaining said blank stationary relative to the hollow die and axially translating the hollow die and blank toward the flange forming die upon completion of said blank reduction whereby the end of said blank reduced portion engages the flange forming die and forms a flange and confining the blank portion defining said flange during the formation of said flange.

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