May 13, 1958 G. A. LYON 2,834,094

COLD NOSING OF THIN WALL SHELLS

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Fig. 1

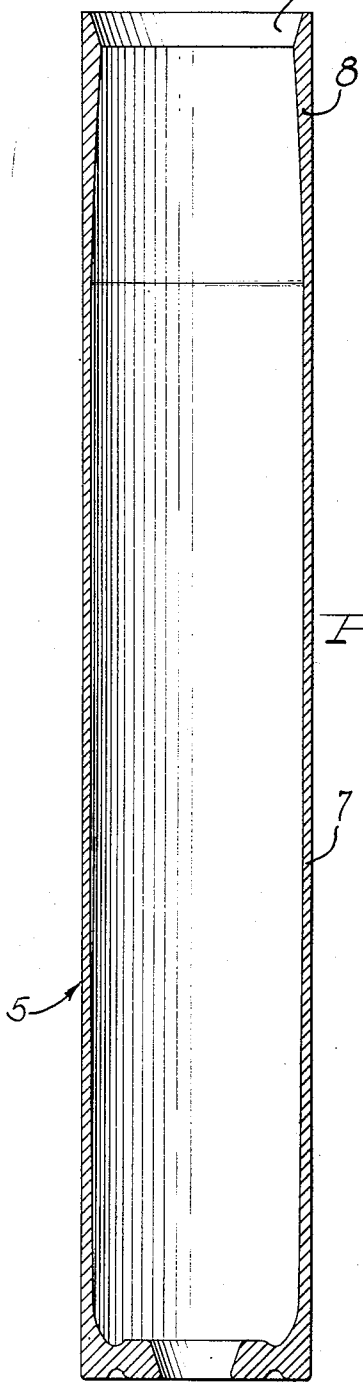


Fig. 2

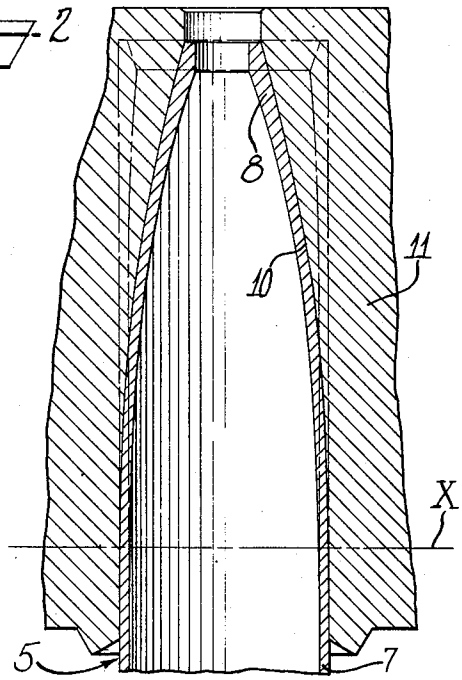
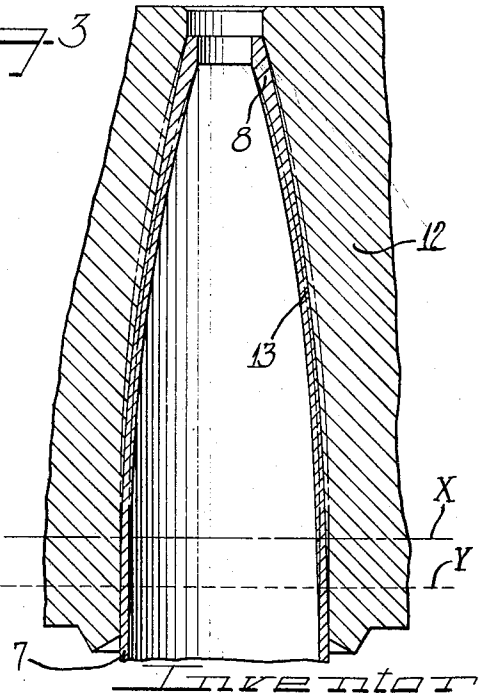


Fig. 3



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COLD NOSING OF THIN WALL SHELLS

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4 Claims. (Cl. 29—1.21)

The present invention relates to improvements in the nosing of thin wall shells and more particularly concerns shells especially useful as components of projectiles.

In the production of cold drawn shells with as thin walls as practicable wherein it is desirable to have the wall section as thin as practicable for reasons of weight saving while yet attaining large capacity in the shell, a serious problem arises due to the tendency of the tubular shell wall to buckle and collapse incident to compressive forces exerted during longitudinal thrust die nosing of the shell. Such nosing is generally accomplished by driving the shell and a nosing die relatively axially to force the nose portion of the shell into a tapered reduced diameter by contraction and thickening of the nosed portion of the wall within a nosing cavity in the die. To effect contraction within the nosing die, especially by cold working, strong compressive pressures developed in the longitudinal wall of the shell. That portion of the tubular wall of the shell nearest the end portion of the shell undergoing nosing contraction is the most likely to show warpage or wrinkling or buckling.

I have found that as the nosing radius or ogive of the nosing increases there is a proportionately greater tendency toward wrinkling or buckling of the contiguous cylindrical portion of the wall of the shell. As the radius of the ogive is decreased, even though the thrust force remains the same, there is less tendency for the contiguous cylindrical wall portion to warp or buckle.

For purposes of economy, it is highly desirable to accomplish the nosing to at least the final tip diameter with as few nosing passes as possible. However, where the ogive must be on a large radius, that is relatively sharply tapered undue resistance and thus compression forces are generated in the shell wall where severe terminal contraction as well as severe ogiving are simultaneously attempted.

It is therefore an important object of the present invention to effect nosing of thin wall shells in a manner to attain quick contraction to the ultimate terminal diameter without wrinkling or buckling of the thin wall portion of the shell contiquous the nose.

Another object of the invention is to provide an improved method of cold work nosing large size thin wall shells in a minimum of nosing manipulations.

A further object of the invention is to provide an improved method of nosing low carbon steel shells of large size and thin wall while maintaining the thin wall of the shell smooth and symmetrical and free from wrinkling or distortion.

Other objects, features and advantages of the present invention will be readily apparent from the following detailed description of a preferred embodiment thereof taken in conjunction with the accompanying drawing in which:

Figure 1 is a vertical diametrical sectional view through a shell to be nosed according to the present invention;

Figure 2 is a fragmentary vertical sectional view through a nosing die showing how the shell is subjected to a first nosing operation; and

Figure 3 is a fragmentary longitudinal sectional view similar to Figure 2 but showing a second and restrike nosing die wherein the shell nose ogive radius is substantially increased.

By way of example a shell **5** is shown in Fig. 1 of a type adapted for use in producing a low drag bomb head, that is the warhead shell component of a low drag bomb assembly. Such a shell must necessarily be of substantial diameter and length, and it is also an important feature of the shell that it must be of as light weight as practicable consistent with structural strength requisite for the use to which the shell is to be put. The shell **5** may be cold drawn in accordance with the method described in my copending application Serial No. 504,015, filed April 26, 1955. It will be understood, however, that although the shell **5** is disclosed as especially adapted for use as a low drag bomb head, the method of the present invention relating to the nosing of the shell is adaptable for producing nosed shells useful for other purposes such as gas storage cylinders and the like.

A characteristic of the shell **5** is that it has an elongated tubular, preferably cylindrical, thin section wall **7** which terminates in an internally thickened mouth collar portion **8** that extends throughout at least a substantial portion of the length of the mouth end of the shell that is to be nose tapered so as eventually to provide adequate mass of material in the section of the nose terminal to enable machining and threading to receive tip structure such as a fuse or other device. By preference the marginal extremity of the shell mouth is internally tapered as indicated at **9** to facilitate eventual machining after nosing.

According to the present invention, cold work nosing of the shell is carried out in a manner which minimizes compression force reaction in the thin tubular wall **7** of the shell as an incident to nosing thrust pressure. This is accomplished by emphasizing contraction of the tip extremity portion of the shell and tapering a shorter portion of the nose of the shell during contraction of the nose tip than desired in the ultimate or final nose taper. To this end, the mouth end portion **8** of the shell **5** is thrust into a nosing cavity **10** of a nosing die **11** (Fig. 2) wherein the nose portion **8** of the shell is contracted and progressively tapered to an ogive that is of smaller radius and involves a shorter length of the nose portion of the shell than ultimately desired. It will be understood, of course, that the nose portion of the shell will have been appropriately annealed, pickled and lubricated as by phoscoating prior to the nosing.

Although in the die **11** of Fig. 2 the shell **5** is shown as having the nose terminal end thereof reduced in one pass or relative thrust of the die and the shell to the final terminal end diameter, as indicated from the dash outline diameter of the terminal end to the full outline diameter of the terminal end within the die cavity, this can be accomplished with relatively soft material such as SAE 1010 steel, while with harder steels, that is steels with a higher carbon content, two or more progressively diminishing diameter passes may be desirable in as many nosing dies to effect the appropriate reduction in diameter and contraction of the nose.

However, in any event, the emphasis is upon contracting the tip of the nose to its final reduced diameter, with the ogive of the nosed portion of the shell of relatively small radius and merging with the cylindrical portion of the shell wall **7** well up within the circumscribing die **11** as indicated by the horizontal dash line X across the lower portion of the assembly as depicted in Fig. 2. Thereby, pressures on the thin, cold work hardened shell

wall 7 contiguous the nosed portion of the shell are relieved sufficiently to avoid buckling or warping of such contiguous wall portion.

As the final step in the nosing operation, the appropriately annealed or at least stress relieved small radius ogive nose portion of the shell is subjected to a taper increasing or ogive radius increasing contraction between the tip and the contiguous cylindrical portion of the shell wall 7. This is accomplished in a final nosing and sizing die 12 having a sizing cavity 13 with the desired ogive shape. As an incident to this final nose shaping, the ogive is extended a limited distance beyond the juncture of the smaller diameter ogive with the cylindrical portion of the shell wall 7 up to this point and as represented by the horizontal line X in Figs. 2 and 3. For example, the additional ogiving or extension of the ogive during this operation may be to the extent indicated by the distance between the horizontal line X and a horizontal line Y in Fig. 3.

Since in the final ogiving or sizing of the nose, only relatively thin wall portion of the nose is contracted, with the maximum contraction taking place intermediate the ends of the ogive and diminishing toward each end thereof, that is toward the terminal tip of the nose and the extended juncture Y thereof with the cylindrical portion of the shell wall 7, only moderate nosing thrust pressure is required which is well below the pressure that would have any tendency to buckle or warp the contiguous cylindrical portion of the shell wall 7.

The sizing contraction or ogive radius increasing action of this final sizing step is depicted more or less schematically in Fig. 3 by comparison between the dot dash line position of the shell nose wall, corresponding, of course, to the full line showing in Fig. 2, and the full line showing in Fig. 3 representing the final sharp taper or large radius ogive.

By the present method, therefore it is possible to effect substantially greater reduction in the tip diameter of the nose portion of the shell more rapidly and with less pressure than where the taper or ogive is simultaneously brought to the desired ultimate taper or radius. The final ogive straightening can be accomplished with relatively small power expenditure. Wrinkling or other distortion of the cylindrical shell wall immediately adjacent or contiguous the nose ogive is, by the present invention avoided, even though the nosing is accomplished more rapidly by reason of the greater contraction of the nose tip enabled by the present method.

It will be understood that modifications and variations may be effected without departing from the scope of the novel concepts of the present invention.

I claim as my invention:

1. In a method of nosing a drawn thin wall shell, contracting the tip terminal of the shell to a substantially reduced diameter joined to the thin terminal wall on a relatively small radius ogive and therefore bulging to a larger diameter than desired, and thereafter substantially increasing the radius of the ogive and reducing the bulge diameter thereof to the desired taper while the tip diameter remains substantially unchanged from said contracted reduced diameter.

2. In a method of nosing a thin wall shell to avoid buckling or wrinkling the thin wall adjacent the nosed portion of the shell as an incident to axial nosing thrust into a nosing die cavity, severely contracting the nose tip portion and shaping the nose portion between the tip and the thin wall of the shell to a relatively small radius ogive and therefore bulging to a larger diameter than desired in the finished shell, and thereafter flattening the ogive to a substantially greater radius and extending the ogive into the shell wall a substantial axial distance beyond said small radius ogive.

3. In a method of nosing thin wall shells to avoid wrinkling or buckling of the thin wall adjacent the nose during nosing, contracting the tip portion of the nose end of the shell within a relatively small radius ogive nosing die cavity by relative longitudinal nosing thrust of the shell and the die, and thereafter straightening the ogive between the contracted tip and the shell wall by thrusting the nosed shell into a die cavity wherein the tip diameter is maintained substantially the same as attained in said first die cavity but the ogive between the tip portion of the cavity and the opposite end of the cavity is substantially straightened so as to contract the ogive incident to relative nosing thrust pressure of the shell within the ogive straightening die cavity.

4. In a method of nosing a soft steel shell having a thin work hardened shell wall with a thickened nose portion, contracting the tip of the nose end of the shell in a single nose contracting operation to a final reduced diameter and shaping a substantial length of the shell wall from the reduced diameter nose tip to the full diameter of the shell wall on a small radius ogive which bulges to a larger diameter than desired in the finished shell, and thereafter further contracting the ogive between the tip and the full diameter of the shell wall to a progressively smaller extent from an intermediate portion of the ogive which is reduced in diameter to the greatest extent.

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