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2,933,799

METHOD OF PRODUCING CONTROLLED FRAGMENTATION WARHEADS

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FIG. 1.

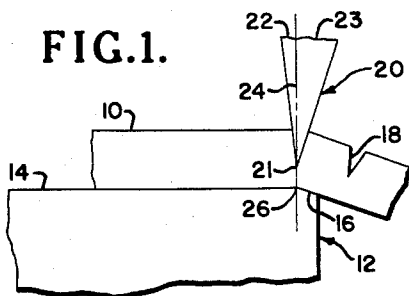


FIG. 2.

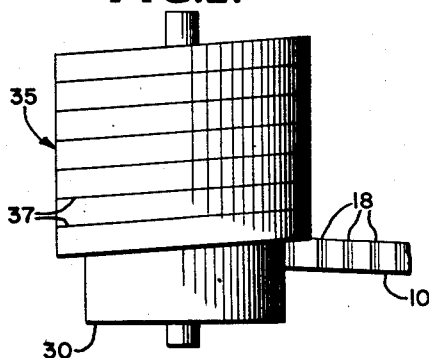


FIG. 3.

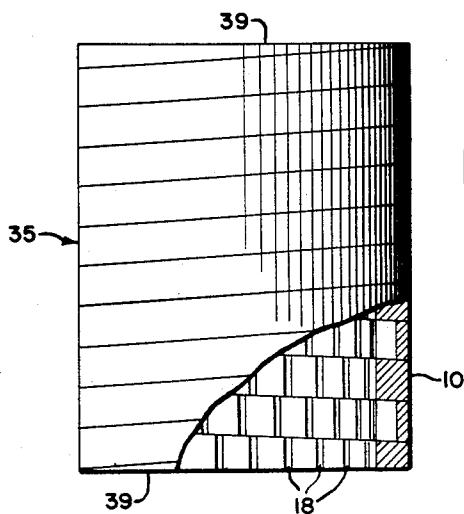


FIG. 4.

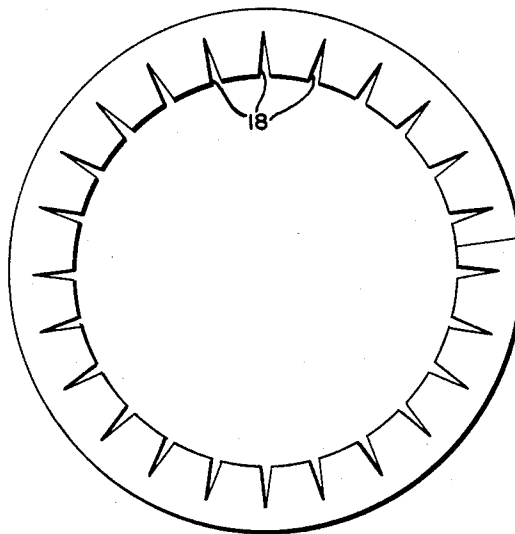
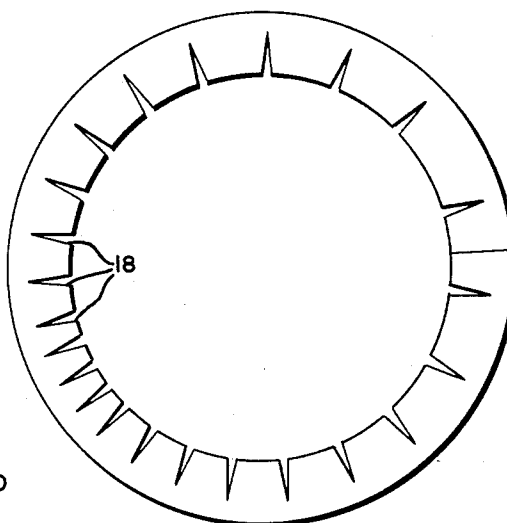


FIG. 5.



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METHOD OF PRODUCING CONTROLLED FRAGMENTATION WARHEADS

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(Granted under Title 35, U.S. Code (1952), sec. 266)

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

The present invention relates generally to a new and improved method of producing controlled fragmentation warheads for projectiles and missiles, and more particularly to a method of mass producing warheads having lines of weakness defined by notches which are formed by a punch-pressing operation.

Warheads, of the controlled fragmentation type, are designed to fragment substantially along the lines of weakness formed thereon, upon detonation of an explosive charge housed therewithin, to produce a multiplicity of destructive fragments. One well known method of fabricating controlled fragmentation warheads is by the process of casting the warheads in a casting form having a grooved pattern. Due to the time intervals involved in the casting operations, this method is impractical for mass production purposes since it requires numerous casting forms in order to compensate for the time loss in each casting form and a prohibitively large manufacturing plant to install the numerous casting forms required. Moreover, experience has shown that cast-produced warheads are unsatisfactory due to erratic fragmentation and due to pulverization into useless chaff of a substantial portion of the warhead.

Another conventional method of constructing controlled fragmentation warheads consists of sawing notches or grooves in stock bars, forming the bars into rings and welding the ends thereof together, surface grinding the two faces of the rings to make them flat and parallel, supercoincidentally stacking the rings in a suitable jig, and copper brazing, in a hydrogen atmosphere furnace, the side faces of adjacent rings to form a hollow tube for encasing an explosive charge. This method has many disadvantages of which excessive time consumption in the notch-sawing operations and the welded ring-forming operations is predominant. In addition, sawed notches do not approach the desired V-shaped notch. Furthermore, copper-hydrogen brazing facilities are not common and are expensive installations.

The general purpose of this invention is to provide a new and improved method of mass producing controlled fragmentation warheads, which method is fast, inexpensive and capable of being carried out in most manufacturing plants without requiring the installation of expensive equipment. In order to attain these objectives, the method of the present invention contemplates forming spaced notches in a stock bar by a punch-pressing operation, winding the notched bar in a helix, and then welding adjacent turns of the helix with a continuous weld. The welded helix may then be cut in any desired lengths to form warheads of any desirable size.

With the foregoing in mind, it is an object of the present invention to provide a novel and inexpensive method of mass producing fragmentation controlled warheads.

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Another object is to provide a warhead-producing method capable of being practiced in most manufacturing installations.

A primary object is to punch notches in a controlled fragmentation warhead to form the lines of weakness thereof.

A basic object of the invention is to employ the method of forming notches in a metallic stock bar and thereafter winding the bar in a helix to form a controlled fragmentation warhead.

An essential object of the invention is to employ the method of punching notches in a suitable stock bar, winding the bar in a helix to form a cylinder, and thereafter welding along the seams of the helix to thereby inexpensively produce a controlled fragmentation warhead for a projectile or missile.

Other objects and many of the attendant advantages of this invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawing wherein:

Fig. 1 is a fragmentary view illustrating the manner of forming notches in a stock bar in accordance with the preferred concept of the invention;

Fig. 2 illustrates the preferred manner of winding the notched bar in a helix;

Fig. 3 is a side elevation, partly in section, of a warhead constructed in the manner contemplated by the present invention;

Fig. 4 is an end view of a warhead having equi-spaced notches formed in the manner herein disclosed; and

Fig. 5 is an end view of a warhead having decreasingly spaced notches formed in the manner herein taught.

Referring now to Fig. 1 in describing the method of the invention, a stock bar 10, of either circular, square or rectangular cross-section and of any metallic material or alloy suitable for warhead purposes, is passed over an elongated anvil 12 having a planar surface 14 and a tapered end portion 16. The stock bar may be fed from a mechanical feeder [not shown] which firmly grips the stock bar and maintains it in abutment with the planar face 14.

The tip or apex 21 of a wedge-shaped punch 20, which is vertically driven by a press [not shown] such for example as a hydraulic press, strikes the stock bar 10 at a point directly over and in alignment with the junction 26 of the bevelled portion 16 with planar face 14, as indicated by vertical axis 24. The punch 20 is constructed, preferably although not necessarily, so as to have a slightly tapered section 22 on one side of axis 24 and a greater tapered section 23 on the other side of axis 24. The purpose of the larger angle of tapered section 23 is to aid the tapered end portion 16 in such a manner that, upon punch 20 striking bar 10 to form V-shaped notches 18 therein, the portion of bar 10 protruding outwardly from tapered section 16 is permitted to bend away from the punch as it enters the stock bar, thereby resulting in a notched bar having a substantially curvilinear profile. A symmetrical wedge-shaped punch may be used in lieu of the asymmetrical punch illustrated in Fig. 1, the enlarged tapered section 23 merely serving to facilitate the afore-described bending function and not being necessary.

The mechanical feeder and press, which are not shown, may be driven by any suitable motive power means and may be interconnectingly geared and synchronized so that the feeder passes a predetermined incremental part or stock bar under punch 20 and rigidly holds the bar in the aforescribed position until punch 20 strikes the bar, whereupon the feeder again moves the bar the prescribed distance for the subsequent striking by punch 20. The feeder may have any conventional timer-camming apparatus so arranged as to enable the feeder to feed equal

incremental portions of the stock bar under punch 20 to form equi-spaced notches as shown in Fig. 4 or may be so arranged as to feed unequal incremental portions of stock to form vari-spaced notches as shown in Fig. 5.

The stock bar 10 may be fed under punch 20 while in either a cold or hot condition. If the stock bar 10 is in the cold condition [room temperature] during the notching operation, it is preferably desired to straighten out the bar after the notching operation is completed, since the notches will not be symmetrically V-shaped due to the curvilinearity of bar 10 caused by enlarged section 23 of punch 20 and by bevelled anvil portion 16. In the event a symmetrical punch is utilized, the stock bar will bend only slightly and the straightening out operation thereon enhances the symmetrical definition of the notches. Straightening of bar 10 acts to constrict the punched notches so as to form symmetrical V-shaped notches. However, the bar straightening operation is optional since the helical winding step, subsequently to be described, is effective to satisfactorily constrict the notches, though not with the symmetrical exactitude of the bar straightening operation.

On the other hand, if the bar has been pre-heated to the forging temperature which is between 2000-2200° F. for steel and fed under the punch while in this condition, the bar is relatively soft and malleable; and upon application of punch 20 to the bar to form a notch, the material of the bar yields longitudinally toward the bevelled end 16 of the anvil and constricts the previously formed notch. In this manner, a succession of substantially symmetrical V-shaped notches is formed without the straightening out operation, as is preferably employed on cold stock bars. With respect to symmetry of the notches, it is to be understood that formation of symmetrical notches is not a critical feature but is desired in order to maintain chaff at a minimum.

After the notch-forming operation with its optional bar straightening step is completed, the stock bar is wound in a helix about any suitable form such, for example, as a mandrel 30, as shown in Fig. 2. The stock bar may be in either a hot or cold condition during the helical winding operation, a hot bar being merely more flexible and more readily yieldable to winding about a form. Although the bar 10 is shown in Fig. 2 with the notches 18 internally arranged, it is to be understood that the bar may be wound with the notches disposed on the exterior face. However, if the bar is wound with the notches on the exterior surface, the hereinabove described bar-straightening operation is preferably, though not necessarily, performed if the bar is press-punched in the cold condition. Moreover, it is readily apparent that, although rod 10 may be of any cross-sectional configuration, it must be of uniform cross-section throughout its length in order to form a hollow cylinder 35. The spacing between notches and the diameter of the mandrel may be predeterminedly selected such that notches 18 are longitudinally aligned throughout the length of cylinder 35 or are staggered, as shown in Fig. 3.

Upon completion of the winding operation, adjacent turns of the helix are bonded together by welding along the seams 37 with a continuous weld. The welding operation can be automatically accomplished by rotatably mounting mandrel 30 on a suitable supporting structure which carries welding apparatus that travels along the seam 37 as the mandrel rotates. Such arrangements are common and well known expedients and do not require illustration or further elaboration. After the welding operation, the hollow cylinder is removed from its form and cut in any desirable lengths with the end faces 39 thereof ground flat and parallel, it being understood of course that mandrel 30 is of sufficient length to accommodate a cylinder which is several times the length of desired warhead sizes.

Fig. 4 illustrates an end view of a warhead having equally spaced notches designed to form a radially uni-

form dispersal pattern upon explosion of the warhead. If an asymmetrical dispersal pattern is desired, the notches are unequally spaced as shown in Fig. 5.

In summary, the method of the present invention basically consists of punching notches in a continuous rod of uniform cross-section, winding the rod in a helix to form a hollow cylinder, and welding along the seams of the helix.

From the foregoing, it is apparent that the invention provides a novel and inexpensive method for mass-producing controlled fragmentation warheads. It is also apparent that the mechanics involved in practicing the method do not require elaborate and expensive installations but may be carried out in most manufacturing plants without additional equipment.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that, within the scope of the teachings herein and the appended claims, the invention may be practiced otherwise than as specifically described.

What is claimed and desired to be secured by Letters Patent of the United States is:

1. The method of producing controlled fragmentation warheads which comprises passing an elongated metallic stock bar of uniform rectangular cross-section over a planar anvil having a flat surface and a bevelled surface contiguous therewith, forming a succession of spaced notches in one side only of the bar by forcibly applying a wedge-shaped punch to the bar at the junction of said flat and planar surfaces whereby forming of a notch causes the precedingly punched portion of the bar to bend away from the punch, and thereafter winding the punched stock bar snugly about a mandrel in a helical manner to define a hollow cylinder.

2. The method of producing controlled fragmentation warheads which comprises passing an elongated metallic stock bar of uniform rectangular cross-section over a planar anvil having a flat surface and a bevelled surface contiguous therewith, punch-pressing a succession of equally spaced notches in one side only of the bar by applying a wedge-shaped punch to the bar at the junction of said flat and planar surfaces whereby forming of a notch causes the precedingly punched portion of the bar to bend away from the punch, and thereafter winding the punched stock bar snugly about a mandrel in a helical manner with the notches facing the mandrel to thereby define a hollow cylinder having internally spaced notches.

3. The method of producing controlled fragmentation warheads which comprises passing an elongated metallic stock bar of uniform rectangular cross-section over a planar anvil having a flat surface and a bevelled surface contiguous therewith, punch-pressing a succession of equally spaced notches in one side only of the bar by applying a wedge-shaped punch to the bar at the junction of said flat and planar surfaces whereby forming of a notch causes the precedingly punched portion of the bar to bend away from the punch, winding the punched stock bar snugly about a mandrel in a helical manner to define a hollow cylinder, and welding adjacent turns of the helix with a continuous weld.

4. The method of producing controlled fragmentation warheads which comprises passing a metallic stock bar of uniform rectangular cross-section over a planar anvil having a flat surface and a bevelled surface contiguous therewith, forming a succession of spaced notches in one side only of the bar by applying a pointed punch to the bar at the junction of said flat and bevelled surfaces whereby forming of a notch causes the precedingly punched portion of the bar to bend away from the punch, and thereafter snugly winding the punched stock bar in a helix to define a hollow cylinder.

5. The method of producing controlled fragmentation warheads which comprises passing an elongated metallic

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stock bar of uniform rectangular cross-section over a planar anvil having a flat surface and a bevelled surface contiguous therewith, punch-pressing a succession of spaced notches in one side only of the bar by applying a wedge-shaped punch to the bar at the junction of said flat and planar surfaces whereby forming of a notch causes the precedingly punched portion of the bar to bend away from the punch, winding the punched stock bar about a mandrel snugly in a helical manner with the notches facing the mandrel to thereby define a hollow cylinder having internally spaced notches, and welding adjacent turns of the helix with a continuous weld.

6. The method of producing controlled fragmentation warheads which comprises passing an elongated steel stock bar of rectangular cross-sectional configuration over a planar anvil having a flat surface and a bevelled surface contiguous therewith, punch-pressing a succession of spaced notches throughout the length of the bar by applying a wedge-shaped punch to one side only of the bar at the junction of said flat and planar surfaces whereby forming of a notch causes the precedingly punched portion of the bar to bend away from the punch, heating the bar to a temperature of about 2000 degrees Fahrenheit, winding the punched stock bar while hot snugly about a mandrel in a helical manner to define a hollow cylinder, and welding adjacent turns of the helix with a continuous weld.

7. The method of producing controlled fragmentation warheads which comprises heating an elongated metallic stock bar of uniform rectangular cross-section to the forging temperature thereof, passing the bar while hot over a planar anvil having a flat surface and a bevelled surface contiguous therewith, punch-pressing a succession of spaced notches in one side only of the bar while hot by applying a wedge-shaped punch to the bar at the junction of said flat and planar surfaces whereby forming of a notch causes the precedingly punched portion of the bar to bend away from the punch, winding the punched stock bar snugly about a mandrel in a helical fashion with the notches facing the mandrel to thereby define a hollow cylinder having internally spaced notches, and welding adjacent turns of the helix with a continuous weld.

8. The method of producing controlled fragmentation

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warheads which comprises passing a metallic stock bar of rectangular cross-sectional configuration over a planar anvil having a flat surface and a bevelled surface contiguous therewith, forming a succession of spaced notches in one side only of the bar by respectively applying a pointed punch to the bar at the junction of said flat and planar surfaces whereby forming of a notch causes the precedingly punched portion of the bar to bend away from the punch, winding the punched stock bar snugly about a mandrel in a helical manner with the notches facing the mandrel to thereby define a hollow cylinder having internally spaced notches, and welding adjacent turns of the helix with a continuous weld.

9. The method of producing controlled fragmentation warheads which comprises heating an elongated metallic stock bar of uniform rectangular cross-section to the forging temperature thereof, passing the bar while hot over a planar anvil having a flat surface and a bevelled surface contiguous therewith, punch-pressing a succession of spaced notches in one side only of the bar while hot by applying a wedge-shaped punch to the bar at the junction of said flat and planar surfaces whereby forming of a notch causes the precedingly punched portion of the bar to bend away from the punch, winding the punched stock bar snugly about a mandrel in a helical manner with the notches facing the mandrel to thereby define a hollow cylinder having internally spaced notches rotating the mandrel about its longitudinal axis, welding adjacent turns of the helix with a continuous weld as the mandrel rotates, removing the cylinder from the mandrel, and cutting the cylinder transverse to its longitudinal axis to a predetermined length.

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