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CARTRIDGE CASE BASE

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This invention relates to new and useful improvements in the fabrication of cartridge case bases, and particularly to those requiring a substantially thickened central portion, or stud, adapted to receive a primer. One specific example of this type of base is contained in the 105 millimeter "Spiral Wrap" case currently in use.

Heretofore, such bases in common use have been fabricated in one piece by hot forging from W. D. 1035 steel. This method of providing the required contours through the impression of a heated slug results in a finished piece with greatly reduced physical properties. Further improvement in the physical properties would require a heat treatment operation which is expensive, requiring in most cases additional costly facilities, and presenting difficulties in controlling dimensions due to the tendency for warpage. These reduced physical properties, due to the annealed condition of the slug after final forming, have resulted in expansion and distortion within the breech of the firing unit which has caused leakage of the high pressure propellant and in many instances such distortion has resulted in cases which would not eject by normal means and would require the unorthodox procedure of "ramming" to complete ejection. It requires no explanation, therefore, to visualize the disastrous consequences which might arise due to this inherent weakness, particularly if circumstances required the use of this item in combat. In the early stages of development of items of this nature it is customary to specify their use for practice only. The ultimate authorization for use under combat conditions being granted only after exhaustive proof under many climatic and ballistic conditions which might conceivably be encountered. One such climatic test is the so-called "cold firing test" conducted with parts subjected to a temperature of —60 degrees Fahrenheit. Under such tests many bases manufactured by this method show evidence of severe cracking.

An important object of this invention, therefore, is the production of a base which will perform satisfactorily under the rigid requirements of combat and, at the same time, by the method of manufacture herein disclosed, will contribute invaluably towards the conservation of critical material and facilities.

Another important object is the construction of a two-piece undersized base fabricated from less critical material and cold worked to produce the physical properties required therein and at the same time, a base increased in diameter to near a finished size.

Another object of importance is to provide methods of uniting or integrating separate stud material with base plate material whereby there can be a choice in material analysis determined by the physicals required and the degree of cold working received by each part during fabrication.

Another important object is to provide a sequence of cold working operations, or progressive coining, in such a manner that critical facilities such as heavy coining and forging presses will be relieved for more critical requirements.

A further object is the provision of methods of manufacturing the bases which result in smoother and better surface conditions requiring no machining with the consequent retention of the close-grained coined surface affording greater resistance to surface corrosion.

Other objects and advantages of this invention will become apparent during the course of the following description.

In the accompanying drawings forming a part of the description and wherein like numerals are employed to designate like parts throughout the several views,

Fig. 1 is a side elevation of the base end of a cartridge case, with a transverse section taken diametrically through the base thereof,

Fig. 2 is a transverse section of the case taken on the line 2—2 of Fig. 1,

Fig. 3 is a bottom view of one form of base for the cartridge case,

Fig. 4 is a transverse diametrical section thereof taken on the line 4—4 of Fig. 3,

Fig. 5 is a side elevation of the base and stud in relative positions for the assembly,

Fig. 6 is a transverse section of the base and stud assembled in a coining die, which is shown diagrammatically to coin the first face of the base,

Fig. 7 is a similar section showing the coining of the second face and rib of the base,

Fig. 8 is a similar section showing the third and final coining of the rib and flange of the base,

Fig. 9 is a bottom plan view of another form of base for the cartridge case,

Fig. 10 is a transverse diametrical section thereof taken on the line 10—10 of Fig. 9,

Fig. 11 is a transverse section of the base and stud assembly in a coining die, which is shown diagrammatically to coin the face of the base next to the stud,

Fig. 12 is a similar section showing the coining of the second face and rib of the base,

Fig. 13 is a transverse section of the base showing the final coining of the flange and indicating the trim line for the flange performed in a subsequent operation.

From the foregoing it will be observed that in all forms of the invention, a separate stud is united or integrated with a base plate to form substantially and in effect, a one piece base for a cartridge case. This is obviously a great advantage, in that it affords a wide choice of stock for the two parts and a choice of manufacturing operations determined by the physical properties required in all parts of the finished product. This also makes it possible to employ a metal coining operation in the formation of the base which will greatly increase its yield strength. As a representative example, yield points in excess of 58,000 p. s. i. with a Rockwell hardness of 72—80 have been consistently obtained from original yield points averaging 36,000 p. s. i. with the materials subjected to the same degree of cold working. The present invention makes it possible to employ plentiful non-critical plate stock of 1008 to 1015 carbon and 1018 carbon steel or cold drawn B—1118 for the stud stock. These new bases have been found in tests, not to crack, warp or distort, and are ejected perfectly from the breech.

The form of invention which is preferred at present and has shown outstanding results in the tests made thus far, is that which is shown in Figs. 3 to 8 inclusive. From much experimentation, trial and effort, it has been discovered that the base 20 of this form of the invention is best made of an undersized pickled hot rolled 1080 to 1015 carbon steel blank or plate having an average yield point of 36,000 p. s. i. and a hardness of B55 to 60. The stock used for the stud 21 of this form of the invention is cold drawn B—1113 steel stock having a Rockwell hardness of 78 to 80 and is a screw machined part. However, it will
be understood that the invention is not limited to these specifications as the required physical properties can be obtained from other stock by the methods disclosed herein. Dimensions applied to the drawings is used to illustrate representative reductions in degrees of coining.

The stud 21 of the preferred form of invention, has an enlarged head or flange 22 at one end and this flange has a diameter of about 1.875 inches, while the body of the stud 21 has a diameter of about 1.498 inches. The periphery of the stud point upward toward the bottom of the stud at an angle of about 15° and two flats 23 are trimmed from the flange at diametrical points, while a portion 32 of the periphery of the stud tapers down toward the flange 22 at an angle of about 3°. The free end of the stud is of true circular form to be thread through as at 25 as shown in Fig. 1. The primer hole 24 through the stud is bored and counter-bored in the screw machined part and reamed and chamfered as shown in Fig. 4 after it is finally assembled with the base.

The circular undersized base 20 is blanked and pierced from nine-sixteenth of an inch thick and galvanized stock with a hole 26 of a diameter large enough to receive the larger end 27 of the stud with slight clearance, and at the same time is provided with a chamfered enlarged end 28 to receive and seat the flange 22 of the stud when the two parts are assembled and placed in a coining press as shown in Fig. 6. The hole 26 and chamfer 28 may be coined if desired. In this figure the face of the base 20 is shown by the dotted lines 29 and a coining face of the die is indicated by the numeral 30. When sufficient pressure is exerted by the die 30 and the press part 31 upon opposite faces of the base 20, the metal of this base is highly squeezed or compressed and is caused to flow radially inward toward its center and tightly grip about the 3° tapered part 32 of the stud to provide a gas tight seal between the stud and the base 20. As these two parts are cold formed and pressure integrated by the coining of the surface 33 slightly beyond the climatic shoulder 34, the base thickness is reduced about one-sixteenth of an inch in the area defined between the shoulder 34 and the stud, while the area of the entire base blank is increased to a finished size. Thus, the stud is locked within the base with a tight joint furnishing resistance to both movement and leakage.

After this first coining operation, the blank is transferred to another press for a second cold coining operation. This press is provided with a die 35° having a coin ing shoulder 36, and flat and tapered coining surfaces 37 and 38 respectively. The united stud and base are placed in the press and the hole 70 on the hole 35°. The surface 39 of this die under maximum coining pressure of the press, has only a kissing touch with the coin ed surface 33 of the base. The die shoulder 36 provides the base 20 with the coin ed shoulder 34, while the coining surfaces 37 and 38 provide the base with coined surfaces 40 and 41 respectively. This pressure coin the thickness of the base in the area defined by the base surface 40, from .500 down to .428 and causes the area of the base to expand into the space between the die 35° and press part 31 to form the raised lip indicated by surface 41 of the base. The coining die is also provided with a section 42 which restrains lateral movement of the metal and preliminarily starts the formation of the boundary face 43 of the cartridge case supporting boss. The marginal radial outward flow of metal between the die section 42 and press part 31 is indicated by the numeral 50. This second operation will produce a Rockwell hardness of 872 in the base surface 33 and a 878 hardness in the surface 40. In subsequent assembly of the base and case, as shown in Fig. 1, the inturned end 44 of a spirally wound cartridge case 45 is clamped upon the surfaces 40 and 41 adjacent the shoulder 34. A plastic type filler 46 is inserted upon the stud 21 to rest upon the coined surface 33 and overlap the inturned edge of the spirally wound case. A metal washer 47 overlaps this gasket and

c is clamped down upon the same to form a gas-tight seal, by a clamping nut 48 threaded upon the threaded end 25 of the stud 21. After the second coining operation shown in Fig. 7 the outer marginal flange 50 and boss periphery 43 are further coin ed by die section 42 as shown in Fig. 8 to reduce the thickness of the edge or marginal flange 50 to .175. This may be accomplished in a die similar to the shown in Fig. 8 with die section 42 to allow kissing contact with the surfaces 33, 34, 40 and 41 when the final flange 50 is reduced to required thickness. After all three coining operations, shown in Figs. 6, 7 and 8 have been completed, the assembled base and plug are removed as a unit and the flange 50 is trimmed and chamfered as shown in Fig. 9 as a finished joint diameter. The primer hole 24 is then reamed and chamfered after which the stud is threaded.

From the foregoing description it will be observed that the cold working or coining steps begin near the center of the base 20 and move progressively outward in separate steps or operations toward the periphery thereof. The procedure provides for accurate flow of the metal radially inward toward the stud in the initial coining steps until the stud is firmly anchored in and integrated with the base, after which anchoring and in the final coining steps, the flow of metal near the base periphery is radially outward to provide the marginal flange 50 without the necessity of only a minimum of raw material. This cold working of the low carbon steel raises the yield point from an average of 30,000 to an average of 50,000 pounds p. s. i. and raises the Rockwell hardness from an average of 55-60 to an average of 72 to 78.

In Figs. 9 to 13 inclusive there is illustrated another manner of connecting a stud 60 with a base 61. In this case the base may be of 1012 carbon steel and the stud may be of S. A. E. 1018 with some variation in the carbon content of the stock one way or the other. The stud 60 in this instance is made of cold rolled rod stock which is cut off to length, upset to form a head or flange 62 after which the flash is trimmed therefrom. This head has its periphery chamfered at 63 and is of polygonal shape provided with diametrically disposed flats 64 as shown in Fig. 9.

The base 61 is provided by compound blanking and piercing to provide it with a central hole 65 and chamfered recess 66 in the bottom surface of the base to receive the stud and its head as shown in Fig. 10. Prior to insertion of the stud, the recess 66 is coined and the inside and outside diameters of the base are then formed in the die 35°. The stud is then inserted in the hole 65 with the head 62 engaged with the walls of recess 66 and the assembly is placed in a coining press to upset the stud to the extent shown by the dotted lines 67 in Fig. 10. This operation shortens the stud and increases its diameter to have a pressure fit in the hole 65 and forms a head of the dimensions shown by the dotted lines 67 which includes a diameter greater than the hole 65.

Next the assembly is subjected to pressure in a coining press as in the preceding form of invention to coin the surface 33 as shown in Fig. 11 and as is performed in the preceding embodiment. This operation may if desired be combined with the previous operation of upsetting the stud. The cold coining of this surface 33 reduces the thickness of the base thereunder by about one sixteenth of an inch and causes the metal of the base to flow radially inward toward the stud and form a gas tight union therewith as in the preceding form of invention. Next, the surfaces 34, 40 and 41 are cold coined as indicated in Fig. 12 in the same manner as the correspondingly numbered portions in the preceding form of invention were coined. After this operation, the flange 50 is coined, sized, formed and trimmed and given a coined edge chamfer. These faces 33, 34, 40, 41 and 43 correspond with the same numbered parts in Figs. 4 to 8 and are cold worked in the same manner.
The operations performed on the forms of invention illustrated in Figs. 9 to 13 control the elastic limits and Rockwell hardness of the various parts to approximately the same degrees as described for the invention of Figs. 1 to 8 inclusive. These controls may be varied by selection of the physicals possessed by the kind of stock employed and the degree of coining pressures selected to coin the various surfaces, as will be obvious. Generally it may be said that the control of the elastic limit covers a range better than 20,000 pounds per square inch and the Rockwell hardness of around a 14 point range. This, however, is based on the economical selection of stock thickness and degree of coining to produce the specified physicals.

In all of the forms of invention illustrated, the stud is provided with a shoulder effect such as around the stud 21 under the head 22 in Fig. 6, and around the stud 60 under the head 62 in Fig. 10. In assembly of the studs with the bases, a shoulder of each stud is disposed within the hole in the base to form means for preventing displacement of the stud in one direction. Displacement of the stud from the hole in an opposite direction is precluded by the coining of the surfaces 33 in all forms of the invention and also by the upsetting of the stud to form the enlarged head 67 in Fig. 10. Thus in all forms, there is a contraction of the walls of the hole in the base around the stud and/or an expansion of the stud diameter to cause a substantial inter-molecular union between the walls of the hole and the stud to form an integrated strong unit sealed against the escape of gases through the base. This integration of the base and stud provides substantially a one-piece base for the cartridge case, as well as to increase its elastic limit and hardness to degrees well beyond ordnance requirements. A superior smooth surface finish is also derived from these operations, and all from plentiful non-critical stock. To additionally secure against torsional forces resulting from tightening the nut 48 on the threaded portion 25 of the stud 21, diametrically disposed flat surfaces 23 and 64 are provided on the stud head to engage with the similarly coined contour provided in the base.

It is to be understood that variations in the construction of the device and in the sequence of steps of the herein disclosed methods of manufacture may be resorted to without departing from the spirit of the invention and the scope of the appended claims. Also it will be apparent that this invention is not limited to a spirally wound cartridge case as other types may be used with the base with equally superior results.

We claim:

1. A base for cartridge cases comprising a stud having an enlarged head at one end and a cylindrical opposite end, said stud having a reduced portion extending from said cylindrical end to a smaller diameter adjacent said head, a base plate having a central hole with an enlarged recess at one end thereof, said stud being positioned in said hole with said head disposed in said recess, and said plate having metal in the area immediately surrounding said stud worked into engagement with the reduced portion of said stud to interlock it with said base plate.

2. A base for cartridge cases comprising a stud having an enlarged head at one end and a cylindrical opposite end, said stud having a portion tapering from said cylindrical end into a smaller diameter adjacent said head, a base plate having a central hole of larger diameter than said cylindrical end of said stud and provided with an enlarged recess at one end thereof, said stud being positioned in said hole with said head disposed in said recess, and said plate having metal in an area immediately surrounding said stud cold worked into engagement with the tapered portion of said stud to interlock it therewith and to increase the elastic limit and hardness of said plate.

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