PROCESS OF FORMING JACKETED PROJECTILES

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Fig. 1.

Fig. 2.

Fig. 3.

FORM CORE FROM WIRE

DEBURR CORE TUMBLING BARREL

CLEAN RINSE
PICKLE RINSE
COPPER STRIKE RINSE
BARREL ELECTRO DEPOSIT RINSE
PICKLE RINSE

CORROSION INHIBITOR

DRY

FORM BULLET

Fig. 4.

Fig. 5.

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This invention relates to an improved small arms ammunition projectile and to the process of making the projectile. More specifically, the invention refers to a bullet made by electrodepositing a jacket onto a lead core, thereby eliminating jacket manufacture and tolerances inherent to jacket manufacturing and resulting in a low-cost accurate bullet.

It is an object of this invention to make an inexpensive small arms jacketed projectile whose performance characteristics equals or exceeds conventionally-made jacketed projectiles.

It is another object of this invention to provide an economical electrodepositing method of making a jacketed small arms projectile.

A further object is to make an economical, jacketed, small arms projectile with superior mushrooming characteristics on impact.

Still another object of this invention is to provide a very accurate jacketed bullet with excellent mushrooming qualities by a mass production method.

The need for and use of jacketed bullets is well known and need not be repeated here. Although electroplating of bullets has been considered in the past, these attempts were generally unsuccessful.

The patent to T. F. Werme, 2,336,143, issued on Dec. 7, 1943, describes a discussion on electroplating bullets by stating that this method "... may be fairly regarded as unsatisfactory."

Werme discusses in the above cited patent the conventional method of making jacketed projectiles in the 1941-1943 period and this method is still the conventional way of making jacketed bullets. Thus, a multiplicity of operations are necessary comprising first alternate drawings and annealing of a gilding metal jacket disc until it is formed in the shape of an elongated cup and then subsequently inserting a separately formed slug or core into the prepared jacket. In addition to the multi-operations and expensive equipment needed to make jacketed bullets under this process, the end product has certain undesirable deficiencies.

Thus, there is considerably more variation in the jacket thickness and concentricity with the conventional bullet than is experienced with electroplated jacketed bullets made by the present method.

Moreover, in the conventional jacketed bullets, there is no bonding between the metal cup jacket and the core so that upon impact, although the core may mushroom, the core and the jacket often become separated.

A plated bullet, made by the process explained below, and illustrated in FIGURE 1 has several important advantages over conventionally-made jacketed bullets. First, the lead core is entirely covered with a uniform thickness of copper, or other electrodepositable material. There is no exposed soft lead nose to become damaged in handling or in use in automatic weapons.

By performing a limited amount of forming after the copper jacket is electrodepositing, a high degree of precision in obtaining desired dimensions and shape can be achieved. In this respect, in most instances, it is important that the unplated bullet core should be approximately the same size and shape as the core in the finished plated bullet, otherwise shifting of the core inside the jacket during final forming may fracture the bond between the jacket and the lead core causing loose jackets. In some cases, the profile of the plated lead core can be changed substantially while retaining the bond between the jacket and the core.

A mechanical bond is achieved between the lead core and the copper jacket which is stronger than the lead core. This results in the copper jacket remaining attached to the lead core consistently upon impacting the target, thus providing more shock impact power. The barrel tumbling electrodepositing feature assists in this mechanical bonding and further results in a very uniform and tightly inherent layer of copper being deposited on the lead core, thus, insuring a more stabilized bullet.

As can be seen in FIGURE 4, there is some fingering penetration of the copper in the lead due to the surface discontinuities on the lead core into which the copper has plated. This fingering penetration of the copper in the lead core results in a mechanical bond between the lead core and the copper jacket which is stronger than the lead core. It should be appreciated that the constant tumbling of the bullets in the plating bath will result in the electrodeposit copper being impacted into the surface discontinuities of the lead core thus assisting in producing the strong bond between the core and the jacket.

The electrodeposit copper jackets are generally harder than the gilding metal jackets now in common use. Although there is an optimum desired thickness of copper plating, this thickness varies with the bullet use, the caliber of the bullet and its velocity. A thicker layer is required for mushrooming bullets, for bullets fired at high speeds and for larger caliber bullets. If the electrodeposit jacket is less than the optimum thickness of the particular mushrooming bullet caliber and velocity, the jacket will strip away from the core upon impact of the bullet. Of course, a too-heavy jacket will result in poor mushrooming qualities as well as raise the cost of making the bullet.

Additional advantages of the present barrel electrodepositing method over the conventional method mentioned above are the elimination of the following: (1) scrap loss, (2) scrap handling, (3) blank and cup, (4) washes and annealing, (5) all draws and trims, (6) bullet assembly, (7) all bullet jacket forming tools, and (8) the raw materials used to make bullet jackets. In addition, the present electroplating method reduces inventory and storage of bullet jackets.

Other objects and advantages of the invention will become apparent from the following description when considered in connection with the accompanying drawings, in which:

FIGURE 1 is a cross-sectional view of a jacketed bullet incorporating the present invention.

FIGURE 2 is a view taken on line 2—2 in FIGURE 1 and shows the front end of a jacketed bullet.

FIGURE 3 is a flow diagram illustrating the various steps in the present process.

FIGURE 4 shows a magnified cross-sectional view illustrating the finger penetration of the copper jacket in the lead core which provides a strong mechanical bond.

FIGURE 5 shows a magnified cross-sectional view of a jacketed bullet which had its lead core cannulated prior to electrodepositing the copper jacket.

FIGURE 6 shows a cross-sectional view taken on line 5—5 of FIGURE 5.

FIGURE 7 shows a side view of a projectile core which is knurled and slitted prior to electrodiposition of the jacket.

FIGURES 8, 8A, 8B, 8C, 8D and 8E show alternate forms of grooves which can be used in place of knurling.

FIGURES 9, 9A and 9B show a modified sequence of
forming a circumferential reinforcing bead on an electro-deposited projectile core.

Bullet jackets can be formed from any material that can be electroplated and any type bullet core can be used provided it can be electroplated.

The initial steps to produce an electro-deposited jacketed bullet is to cut a lead wire into slugs and then swage the slugs, thus, forming profiled lead bullet cores. Obviously, other methods of forming bullet cores can also be used. As mentioned above, the profiled lead cores are the same weight and approximately the same size as the core of the ultimate jacketed bullet. The profiled lead cores are then tumbled and debarred, cleaned, rinsed, pickled, rinsed and then given a copper strike by tumbling the lead cores in a plating bath for a predetermined time until the lead cores are covered by a thin coating of copper over the entire surface of the core. This copper strike is necessary to prevent the main plating bath from becoming contaminated with lead. It has been found that when the main plating bath is contaminated with lead, the electro-deposited copper jackets tend to be brittle. The profiled lead cores entirely covered with a thin coating of copper are then continuously tumbled in the main plating bath until the required thickness of copper or other material is deposited thereon. This type of barrel plating is old and well known and it is not believed to be necessary to illustrate this step. It is, however, an important step in the procedure since it permits the small bullets to be continuously tumbled and plated, thus, providing a uniform layer around the entire periphery of the bullet.

After the necessary thickness of copper is deposited on the bullets, the bullets are rinsed, pickled, rinsed, a corrosion inhibitor is added, and then the bullets dried. The plated bullets are then fed to final forming dies where they are formed to the desired configuration and dimensions and depending on the characteristics required, a front cavity and equally spaced nose cuts provided to assist mushrooming qualities of the bullets. The latter cavity and nose cuts are formed by a knockout pin which knocks the formed bullet out of the final forming dies. A proper cannule can be formed on the plated and formed projectile as desired.

A variation in the process mentioned above may be desirable in order to satisfy certain requirements for specific bullets, etc. In other words, it may be desirable to give a certain bullet, e.g., a 6 mm. bullet, a particular mushrooming effect at a specific distance, e.g., at 100 yards. There are various procedures that can be used in this method to vary the mushrooming qualities of a bullet.

One method which is believed to be novel is to cannule the lead core prior to electrodepositing the copper jacket onto the profiled lead core. This method provides the forming of a controllable groove on the core into which copper deposits, thus, providing a positive locking means by which the copper jacket is held onto the lead core thus aiding in preventing relative movement of the jacket and the core.

Another procedure which can be used to vary the mushrooming qualities of a bullet is to make longitudinally extending grooves on the impact end of a projectile core prior to plating the projectile. Thus, transverse cannules as well as longitudinal grooves can be formed in the lead projectile core prior to plating of the projectile core. The copper is deposited over the entire surface of the core including the grooves in the cores.

After the copper is deposited over the core, a cannule can be provided to the plated core over the cannule previously formed in the core with the result that the deposition of copper in the lead cannule is forced inward to provide a deeper shoulder and a more effective locking action.

The plated projectile core with the longitudinal grooves formed in the core can also be provided with unoriented slits (i.e., with the core slits) to assist in opening up the front end of the projectile upon impact.

FIGURE 1 shows a jacketed bullet 10 made according to the present invention. The bullet core 12 is formed of lead or other deformable metal and the plated jacket 14 made of a second electroplatable metal, preferably copper. A conical indent or cavity 16 and equally spaced nose cuts 18 are formed in the bullet nose to aid in mushrooming. A cannule 20 is shown although this refinement may not be absolutely necessary to satisfactory performance.

It can be seen that the lead core 12 is entirely covered with the copper jacket 14 so that no lead is exposed. Upon impact, the cavity 16 and the nose cuts 18 assist in opening up the front end of the jacketed bullet 10 and exposing the lead core. The front end of the soft lead core 12 will then deform and peel back to form a mushroom type head having a much greater impact area than the original projectile. Since the mechanical bond between the lead core and the copper jacket (see FIGURE 3) is stronger than the lead core, the jacket does not become dislodged from the lead core, thus, keeping the bullet together as a unit.

The mechanical bond between the copper jacket and lead core is best seen in FIGURE 4. This figure shows a lead core 12 and an electro-deposited copper jacket 14. The interface 22 between the lead core and the copper jacket 14 includes a plurality of recesses 24 or surface discontinuities on the outer peripheral surface of the lead core. These recesses 24 become filled with electro-deposited copper and form fingers of copper 26 penetrating into lead, thus, forming a strong bond between the two materials.

FIGURE 5 shows a cross-sectional view of a jacketed projectile made under this invention where the lead core 12 was knurled prior to having the profiled lead core plated. The figure shows an exaggerated groove 28 formed by knurling in which copper was deposited to form an abutment 30 which acts as a lock to hold the copper jacket 14 to the lead core 12.

FIGURE 6 shows a magnified cross-sectional view of the lead core 12 and the copper jacket 14 in the area where the lead core was knurled prior to plating and copper was deposited in the grooves 28 to form abutments 30. These abutments which are integrally formed with the copper jacket aid in preventing longitudinal as well as rotational movement of the jacket relative to the lead core.

FIGURE 7 shows a side view of a projectile core 32 made of lead or other suitable metal which is provided with a transverse knurl 34 and longitudinal grooves 36 prior to electrodeposition of a copper or other suitable metal jacket. After plating, a layer of copper is electro-deposited on the core and increased thicknesses are deposited in the grooves (knurling, grooves, etc.) formed in the lead core.

FIGURES 8, 8A, 8B, 8C, 8D, and 8E show various possible grooves 34a, 34b, 34c, 34d, 34e, and 34f which can be used on projectiles, either on the core or on the finished projectile.

The grooves are important, of course, to hold the electrodeposited jacket of copper onto the lead core, as well as to provide a stop for the metal jacket as it mushroomed back upon impact.

It has been found that the grooves 36 or nose cuts cause cleavage of copper plate at these lines when the jacket is deposited onto the core. These cleavages weaken the jacket at these points and tend to rupture upon impact of the projectile. If the mushrooming characteristics of the projectile are not satisfied by the weakened jacket, additional slits or nose cuts can be made to the outside of the plated projectile. These outer slits need not be oriented with the grooves in the core in order to be effective.

FIGURES 9, 9A, and 9B show a sequence of the initial-
formed lead core 38, the plated lead core 40 and the finished bullet 42. It can be seen from this sequence that the profile of the plated lead core is changed to a greater degree than the other modifications in the forming of the plated core into the finished bullet. In this instance, the forming changed the profile of the front cylindrical portion 44 into a tapered ogival portion 46 with a reinforcing bead 48. This reinforcing bead or fold provides an excellent lock between the core and the jacket and also functions to limit the mushrooming of the projectile to the forward portion of the projectile.

The reinforcing bead 48 is stronger than the groove which would be formed by either grooving the core prior to plating or forming the groove on a tapered plated core. The uniformity of the jacket and the mechanical bond which prevents any relative movement between the lead core and the jacket are factors which result in very substantial improvements in accuracy of the jacketed bullet.

What is claimed is:

1. A jacketed projectile comprising a profiled, deformable, metal core, groove means in desired locations on the peripheral surface of said projectile core, an electrodeposited layer of a second deformable metal which covers the entire periphery of the core including increased metal thickness at said groove means, said increased metal thickness formed at said recess means providing a positive lock between the deformable projectile core and the electrodeposited jacket, said electrodeposited layer being attached to the core by a mechanical bond which has a higher tensile strength than said core.

2. A jacketed projectile as defined in claim 1 wherein said groove means extend in a longitudinal direction at the impact end of the projectile core, said increased thickness of electrodeposited metal formed at said groove means defining weakened portions of said electrodeposited jacket which aids in initiating mushrooming of the projectile upon impact.

3. A jacketed small arms projectile comprising an inner core of lead profiled to its approximate finished dimensions and having an ogive at its front end, a uniform jacket of a deformable metal electrodeposited on the entire periphery of said inner lead core and attached thereto by a mechanical bond which has a higher tensile strength than said inner core, slit means in the electrodeposited jacket adjacent to the tip of the ogive adapted upon impact of the projectile, to open up the front end of the projectile and facilitate further impact expansion of the projectile, said slit means being formed in said jacket after the inner core and jacket have been formed to its accurate and desired final dimensions.

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