Oct. 17, 1944. W. G. CALKINS 2,360,473

PROJECTILE DRIVING BAND

Filed March 3, 1938

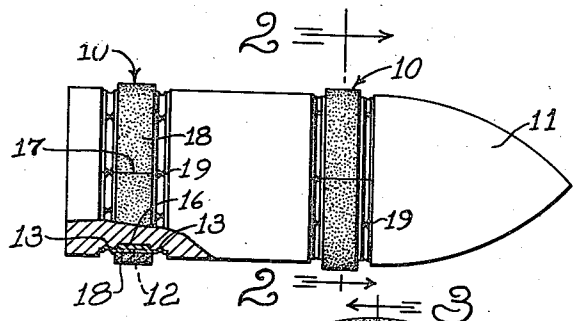


Fig. 1.

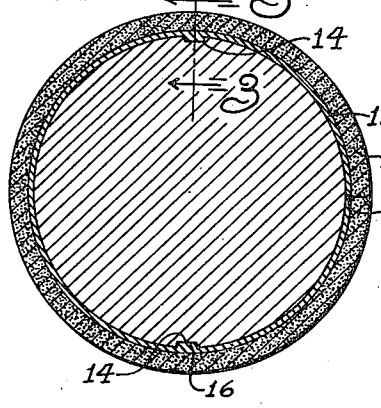


Fig. 2.

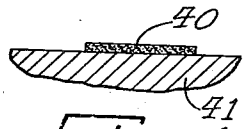


Fig. 6.

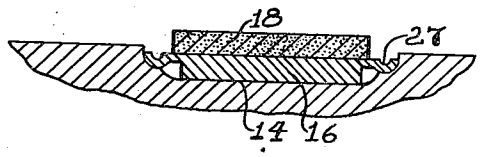


Fig. 3.

Fig. 4.

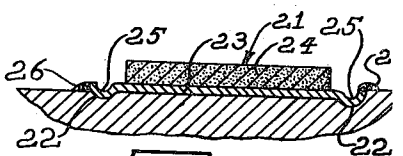


Fig. 5.

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Patented Oct. 17, 1944 2,360,473

UNITED STATES PATENT OFFICE

2,360,473

PROJECTILE DRIVING BAND

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Application March 3, 1938, Serial No. 193,699

4 Claims. (Cl. 102—93)

This invention relates to improved projectile driving bands and method of forming and mounting the same on projectiles.

More particularly, the invention pertains to the provision of projectile driving bands comprising porous metal bearing surfaces and having a substantial absorbed lubricant content.

One of the main objects of the invention is to provide an improved projectile driving band which has a steel back reinforcing portion that is conveniently securable to the body portion of a projectile and an external lubricant impregnated, sintered, porous metal element bonded thereto and having a surface engageable with the barrel of a gun.

Another object of the invention resides in the provision of a method for manufacturing projectile driving bands which have a lubricant impregnated porous metal barrel engaging portion.

Additional objects of the invention are to provide a projectile driving band of this character which lubricates the passage through a gun barrell of the projectile by which it is carried, as well as subsequent projectiles, without depositing harmful quantities of lubricant in the gun; to provide a projectile driving band which carries a charge of liquid lubricant in its interior and which has external surfaces that are substantially free from lubricant wetted areas.

Additional objects of the invention are the provision of a porous metal lubricant containing element as a projectile band which may be produced economically in sheet-like formation and conveniently integrally bonded to an attaching member which is readily securable to a projectile; and to provide a porous metal lubricant containing element of this kind which will withstand stripping by the rifling or by the tapering of a gun barrel during high muzzle velocity discharge of projectiles as well as the severe conditions of temperature and pressure incident to such muzzle velocities.

Other objects and advantages of the invention will be more apparent from the following description taken in connection with the accompanying drawing, in which:

Fig. 1 is a side elevational view, partly in section to disclose the underlying structure, of a projectile embodying the invention.

Fig. 2 is an enlarged vertical sectional view taken as indicated by the line 2—2 of Fig. 1.

Fig. 3 is a vertical sectional view taken approximately as indicated by the line 3—3 of Fig. 2.

Fig. 4 is a side elevational view corresponding to Fig. 1 but illustrating a modified form of the invention.

Fig. 5 is a fragmentary sectional view of the portion of the projectile within the circle designated by the numeral 5 in Fig. 4.

Fig. 6 is a fragmentary, sectional view of a projectile having a driving band embodying a further development of the invention.

In the form of the invention illustrated in the drawing, the improved projectile driving band, generally designated by the numeral 10, is illustrated in Figs. 1 to 3 as being non-rotatably secured to a projectile 11. The illustrated projectile is adapted to be fired from a rifled gun barrel and may carry two driving bands, but preferably only one is employed in order that the projectile may be used in barrels having gain-twist rifling. The projectile 11 has a reduced portion 12 in which are formed a pair of spaced, annular grooves 13 having substantially less width than and being located adjacent the extremities of the reduced portion 12.

The driving band includes a steel reinforcing ring 15 having a pair of inwardly extending lugs 16 and is split at 17. The ring 15 is substantially as wide as the reduced portion of the projectile on which it is snugly fitted. The outer edge portions 27 of the ring which overlap the grooves 13 are preferably formed to fit into the latter. The ring 15 has suitably bonded to its outer surface a layer of lubricant impregnated, sintered porous metal bearing material 18. The split ends of the ring 15 are suitably secured together, as by welding.

In mounting driving bands of this character on a projectile, the reinforcing ring and its porous metal layer are drawn around the reduced portion 12 prior to deformation of the marginal edge portions with the lugs 16 disposed in recesses formed in the reduced portion 12 and the split ends of the ring 15 are welded together as illustrated at 19. After the driving band 10 is mounted on the projectile, each of the edge portions of the steel ring 15 is deformed, as by spinning at 27, into one of the grooves 13 so as to assist in preventing relative longitudinal movement between the driving ring 10 and the projectile 11. The deformed marginal portions of the ring 15 may be welded to the projectile at circumferentially spaced locations as indicated at 19.

In the manufacture of sheet porous metal stock for driving bands of this character a powdered metal charge is preferably formed into a continuous, sheet-like briquette by passing it through

rolls in accordance with the disclosure in my copending application Serial Number 77,324, filed May 1, 1936, Patent No. 2,178,529 of Oct. 31, 1939. The briquettes may be cut to a desired length and width or formed directly to the required dimensions by compression of powdered metals in any suitable manner and then placed upon strips of sheet steel. The superimposed layers of porous metal briquettes and sheet steel may then be clamped together and heated in a non-oxidizing, but preferably reducing, atmosphere at from substantially 1500° F. to 1550° F. in order to simultaneously sinter the briquettes and weld the resulting porous metal to the sheet steel. If desired, the briquettes may be sintered in a non-oxidizing or reducing atmosphere and then applied to the steel backing and subsequently bonded thereto by heating under the above described conditions.

It has been found that both sheet briquettes and the finished sheet porous metal formed from the following compositions possess the characteristics desired during the period of manufacturing driving bands and in the finished product. The porous metal has a substantial lubricant absorptive capacity and may be readily impregnated with lubricant by immersion therein while hot or cold or in any suitable manner. The pores of the porous metal ring may be supplied with a charge of lubricant which is normally in either liquid or solid state at atmospheric conditions. The conditions of temperature and pressure existing during firing of projectiles may in many instances be relied upon to force the lubricant to the outer periphery of the bearing ring.

No. 1

	Per cent by weight
Powdered lead	10
Powdered tin	10
Powdered graphite	1½
Powdered boric acid	1½
Powdered copper	77

No. 2

	Per cent by weight
Powdered tin	10
Powdered boric acid	½
Exfoliated mica	1½
Powdered copper	88

No. 3

	Per cent by weight
Powdered copper	20
Powdered graphite	1½
Powdered boric acid	1
Powdered iron	77.5

Referring now to Figs. 4 and 5 wherein is illustrated a somewhat slightly modified embodiment of the invention, it will be understood that this modified arrangement is intended to be substituted for the corresponding parts previously described and shown in Figs. 1 to 3. It will be noted that the projectile **20** has but one driving band, generally indicated by the numeral **21**, this projectile being adapted to be fired from a gain-twist gun barrel. This projectile **20** is provided with a reduced trailing end portion **20'** and a pair of spaced annular grooves **22**, one located at the forward extremity of the reduced end portion and the other between this location and the trailing end of the projectile. The driving band includes a steel reinforcing ring **23** adapted to closely surround the reduced portion **20'** and of sufficient width to extend into both grooves **22** and slightly beyond the rear groove. The ring **23** has suitably bonded thereto a lubricant impregnated, sintered, porous metal bearing ring **24**. The respective parts of the driving band shown in Figs. 4 and 5 may be formed and bonded together in accordance with the procedure herein set forth or in any suitable manner and after applying the band to the projectile in the position illustrated the end portions **25** of the reinforcing ring are preferably swedged or spun into the grooves **22** and the extremities of this ring may be welded, as indicated at **26**, to the body portion of the projectile. The outer periphery of the porous metal rings **24** and **18** of each form of the invention respectively extends outwardly, sufficiently beyond the outer surface of the projectile to engage the barrel surface during firing.

The projectile **41**, shown in Fig. 6 of the drawing, is provided with a driving band **40**, comprising the foregoing type of porous bearing metal and it also has a substantial, self-contained lubricant content. The band **40** may be applied to a suitable cylindrical portion of the projectile **41** by wrapping a sheet-like strip of porous bearing metal around the projectile and bonding it directly to the outer surface, or through the medium of a suitable bonding metal, during a heat treatment of substantially the same character as that recommended for bonding such material to a reinforcing backing. This direct bonding of the band to the projectile may take place before or after sintering the compressed powdered metals of which the porous bearing metal is formed and if bonded prior to the sintering operation the latter operation and the bonding will be accomplished simultaneously. The band may then be charged with lubricant in any suitable manner, as for example, by heating the projectile and band slightly and immersing them in oil.

Various modifications and changes may be effected in the illustrated applications without departing from the spirit of the invention or the scope of the appended claims.

What I claim is:

1. A driving band for projectiles having a reduced annular portion provided with a pair of spaced relatively deeper annular grooves, comprising a sheet metal reinforcing ring adapted to fit closely around said reduced projectile portion and having end portions extending over said grooves, and a layer of porous metal bearing material comprising mainly a uniformly foraminous mass of unfused particles of metal fixed together by fused bonds having a lower melting point than that of said metal particles, said layer being bonded by the metal thereof directly to the outer surface of said ring between said end portions thereof and having an exposed contacting surface and a substantial lubricant content, said end portions of said ring being crimped into said grooves.

2. A driving band for projectiles having a reduced annular portion provided with a pair of spaced relatively deeper annular grooves, comprising a sheet metal reinforcing ring adapted to fit closely around said reduced projectile portion and having end portions extending over said grooves, a layer of porous metal bearing material comprising a bonded together compressed uniformly foraminous mass of unfused particles of metal bonded by the metal thereof directly to the outer surface of said ring between said end portions thereof and having an exposed contacting surface and a substantial lubricant

content, said end portions of said ring being crimped into said grooves, and means including a lug on said ring seated in a slot in said projectile for holding said driving band against rotation relative to said projectile.

3. In the manufacture of a projectile; the method of providing thereon a driving band which includes forming spaced annular grooves in a cylindrical portion of the body of said projectile, surface bonding to all but the opposite marginal portions of a strip of sheet solid metal, a layer of porous bearing metal comprising a compressed mass of unfused powdered metal particles fixed together by bonds comprising metal of a lower melting point and provided with a substantially absorbed liquid lubricant content, disposing said strip and said layer around said body with an entire side surface of said strip adjacent said body and with edge portions thereof disposed over said grooves, and pressing said edge portions into said grooves.

4. A driving band for a projectile having spaced circumferential grooves in its main body portion said band including a cylindrical sleeve comprising deformable solid metal, and a layer of porous metal bearing material comprising a compressed and sintered uniformly foraminous mass of powdered metal particles fixed to the external surface of said sleeve by direct bonds between the latter and said particles and extending axially of said sleeve over all but the end marginal portions thereof, the end marginal portions of said sleeve being disposed over said grooves and crimped into the latter for retaining said driving band in place.

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