Jan. 12, 1960 C. J. DE CARO 2,920,563

EXPLOSIVELY ACTUATED DRIVING

Filed Feb. 9, 1953

Fig. 1

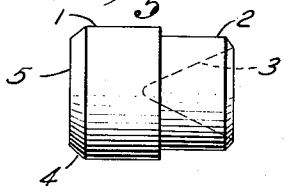


Fig. 2

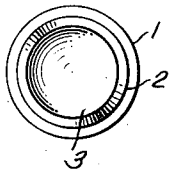


Fig. 3

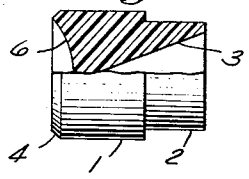


Fig. 4

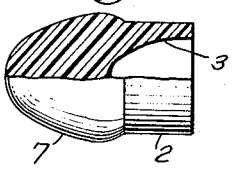


Fig. 5

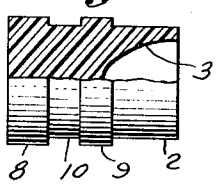


Fig. 6

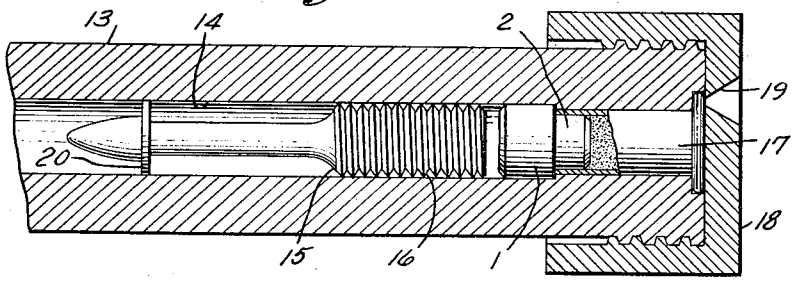


Fig. 7

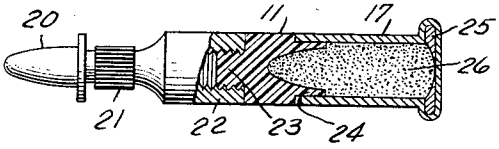
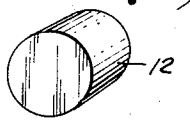


Fig. 8



INVENTOR

Charles J. De Caro

BY

John D. Wilkins

ATTORNEY

United States Patent Office 2,920,563 Patented Jan. 12, 1960

2,920,563

EXPLOSIVELY ACTUATED DRIVING

Charles J. De Caro, Cleveland, Ohio, assignor, by mesne assignments, to Olin Mathieson Chemical Corporation, a corporation of Virginia

Application February 9, 1953, Serial No. 335,925

10 Claims. (Cl. 102—38)

This invention relates to tools and more specifically to the driving of fasteners such as pins and studs into objects of steel, masonry, concrete, wood and the like by use of an explosive actuated tool.

Heretofore, driving and gas obturating means for such projectile types of fasteners have taken various forms and particularly that of a cylinder or piston of metal use of which has not only the disadvantage of interposing a heavy body between the explosive charge and the fastener with attendant diminution of driving power but also the disadvantage of requiring costly precision manufacturing methods to provide the close tolerances and fit needed to insure a minimum of clearance but no binding between the bore of the firing tool and the side wall of the obturator. Such means have also been provided in the form of a cup shaped piece of metal but this, in common with the aforementioned piston, suffers from the disadvantage that the muzzle of the barrel of the tool must have an internal shoulder and the like for capturing the cup, or the piston, which may then be retrieved for reuse. Further, the side walls of the cup bearing forcefully on the bore of the barrel cause even greater barrel wear than the metal piston. To retrieve these pieces has necessitated after each "shot" tedious dissembly of part of the tool which must then be reassembled before the next driving operation is commenced. This tedious procedure also suffers from the disadvantage that workmen using such tools at a considerable height above the ground not infrequently drop the piston or cup parts and on account of the loss of these and other coacting parts the work of driving the fasteners must be halted until replacements can be had.

Another known type of obturating means takes the form of a convolutely wound strip of paper wrapped around the threaded side of a fastener but this is not only most uneconomical but also rather dangerous since fragmentation of the paper or fiber tube produces flying particles which endanger the eyes of the tool operators and may even cause a violent reaction on the tool, if part of the tube remains as an obstruction in the barrel.

Attempts at use of various other obturators such as the wads commonly employed in cartridges for firearms have not been too satisfactory largely because of the vastly different pressure and temperature conditions encountered in driving fasteners with explosives as compared to projection of bullets or shot in the ammunition art where wads of such material as rubber, cork, paper, sawdust, fiber, hair and straw sometimes admixed with one or more binders such as linseed oil, stearine, pitch, paraffin, or asphalt are well known. There have also been disclosed in the art wads for use in firearms consisting of discs or shallow cups of thin material both metallic and nonmetallic but such forms of gas check fail to perform properly and consistently in powder actuated tools because such a wad tends to tip and misalign itself before seating itself on the rear portion or base of a fastener prepositioned ahead of the wad and at the same time the wad has a tendency to lap over the base of the fastener

and force itself between the tool bore and the fastener and invariably causes fouling of the threads of a threaded fastener particularly where the wad consists of a soft metal such as lead or copper.

The present invention has for one of its objects the provision in connection with explosive driven fasteners of a new and improved member for sealing off the gaseous products of combustion of the propellent powder charge behind the fastener element in order that the available power of the charge may be substantially fully and substantially uniformly utilized while barrel erosion is reduced particularly at high propellent loads.

Another object of the invention is the provision of a novel gas check or obturating means made of a light cohesive plastic material having a lubricating effect in the barrel of the tool from which the fasteners are projected and incapable of decomposition to form corrosive products in the barrel during explosion of the propellant.

Another object of the invention is to provide means for keeping the extremely high pressure, high temperature propellent gases away from the metal fastener so as to prevent injury of the surface of the fastener as by stripping any protective coating or plating therefrom.

A further object is to provide a driving means of novel construction and properties suitable for disposition and improved functioning between the mouth of a propellent powder containing cartridge and the rear end portion of a fastener of the type described and capable of bringing about the desired obturation regardless of variations between the bore diameter of the tool barrel and the "calibre" of the fastener and under a variety of spacing conditions between the fastener and explosive cartridge in the tool barrel.

Another object is to provide a plastic driver and gas check conformable under pressure to the bore of the tool barrel notwithstanding certain variations in the bore and certain differences between the circumferential shape of the bore and the gas check.

A still further object is to provide a new and improved fastener driver and gas check structure made of polyethylene or equivalent material which will overcome the defects of prior art devices.

Other objects and advantages of the present invention will be obvious from the following description of several embodiments and from the accompanying drawing in which:

Figure 1 is a side view of one embodiment of the invention.

Figure 2 is a rear view of the embodiment shown in Figure 1.

Figure 3 is a side view partly in cross section showing another embodiment of the invention.

Figures 4 and 5 are side views also partly in cross section showing two additional embodiments of the invention.

Figure 6 is a fragmentary side view including a fastener, a cartridge partially in cross section and one embodiment of the obturating means of this invention positioned at the breech end of a tool barrel shown in cross section.

Figure 7 is a side view illustrating a still further embodiment of this invention in assembly with a fastener and explosive cartridge.

Figure 8 is a perspective view showing still another embodiment of the invention.

In accordance with the present invention, generally stated, there is provided for disposition between the rear end portion of a projectable or fastener element and a propellent explosive and obturating driving member formed of plastic material having suitable form retaining rigidity together with elastic properties and resistance to rapid deterioration by burning. The gas obturating driving means of this invention is preferably formed of a

synthetic elastomeric organic plastic capable of undergoing elastic deformation under high compression impact force of the burning propellant without fragmenting or cracking over a wide range of ambient temperatures, and characterized by resistance to deterioration from too rapid burning to an inoperable state and freedom from formation of products which would cause corrosion in the bore of the explosive activated tool barrel.

To carry out the invention the obturating driving member is preferably made of an elastolene such as a normally solid tough polymer of an olefinic hydrocarbon. A solid polymer of ethylene of the type formed at high temperature and pressure as disclosed in U.S. Patent Nos. 2,153,553 and 2,188,465 or 2,342,400 is particularly suited for the purpose. This plastic known specifically as polyethylene was found to be the most suitable material when given the form and structure disclosed herein for the purpose of this invention. The polyethylene may be either oriented or unoriented. Solid polymers having a molecular weight in excess of 10,000 are preferred inasmuch as the higher molecular weight polyethylene remains tough and flexible though hard over a wide range of temperatures and is form stable near the softening temperature which lies in the range from 110° to 200° C. For greatest immunity from cracking of the stress plastic the polymer should have as high as possible a molecular weight. Polyethylene with an average molecular weight of about 18,000 is suitable for the purposes of this invention.

While it is contemplated that the driving and gas check member be made from a plastic composition essentially polyethylene or its equivalent, the plastic may be compounded with one or more of polyisobutylene to some extent to raise the heat softening point and flexibility, some wax, carbon black, various coloring agents generally inorganic pigments such as titanium dioxide and the like, and finely divided calcium carbonate to further raise the softening point and toughness without impairing flexibility as described in U.S. Patent No. 2,466,038. Antioxidants may be incorporated to further improve the resistance to deterioration of the polyethylene on exposure to the heat of the burning propellant.

The form and structure of the obturating driving device of this invention will appear hereinafter more clearly from the description in detail of the various embodiments; but in any event the form and structure should be such as to be capable of filling the space in the bore between the fastener and propellant under the compressive force of the gases when the propellant charge is fired. A generally massive or cylindrical structure characterized by axial thickness or length sufficient for obtainment of obturating lateral distention of the structure under the axially compressive force of the propellant is well adapted for the driving means of this invention. For best operation it is preferred that such structure be additionally provided with a hollow posterior section having a recess facing the rear.

In the embodiment shown in Figures 1 and 2 the gas check or driving member consists of a generally cylindrical molded body of polyethylene. The anterior portion **1** of the body is essentially a solid section of greatest diameter, somewhat less than that of the bore of the tool barrel, and is adapted to provide obturation by lateral or diametral elongation or expansion under the axial compression which portion **1** undergoes between the rear portion of a fastener and the pressure of the gases of the propellant explosive acting axially. As compared to the relatively thin posterior portion **2**, portion **1** is a bulky section suitable for lateral distention under compressive forces. The rearmost portion **2** of this embodiment of the invention is a coaxial section of lesser diameter than part **1** to facilitate inserting the gas check into the open end or mouth portion of an explosive containing cartridge where the polyethylene body also acts as a very effective moisture resistant cartridge closure for retaining the propellant powder thus eliminating the need for a separate "top wad" cartridge closure. Posterior section **2** is a hollow section having a conical concavity or recess **3** beginning at the rear face of the gas check and tapering to convergence at a point short of the front face **5** of the cylindrical body of polyethylene. The periphery of the front face **5** is provided with a chamfer **4** in order that propellant powder cartridges loaded with the plastic gas check of this invention may feed more easily into the breech of the tool barrel especially from an automatic feeding device of the magazine or cartridge clip type.

The embodiment of Figure 3 differs from that of Figures 1 and 2 in the provision of a shallow concavity **6** in the front face of the anterior section **1** while leaving the posterior section **2**, the rear concavity **3** and the front chamfer **4** of the prior embodiment unchanged. Although the embodiment of Figure 3 may be expected to handle with more difficulty in feeding than the embodiment of Figures 1 and 2, the front concavity **6** enhances the elastic lateral expansibility of the anterior compression section **1** provided the thickness of synthetic plastic remaining between the two concavities has not been reduced excessively. Further, the shallow recess **6** of this embodiment may be modified to leave in lieu of chamfer **4** an extremely thin forwardly extending annular flange or collar portion adapted to receive the rear end portion of a fastener such as the fastener **15** shown in Figure 6 and form a connection with the fastener where desired. When such a front connecting flange is provided, its thickness should not greatly exceed the maximum clearance usual between the rear portion of the fastener and the bore of the tool barrel. Otherwise the plastic material of the gas check driver is likely to extrude around the fastener instead of forming a semi-rigid resilient body behind the fastener. With the modification of a front flange together with the coaxial rear portion of reduced diameter, the embodiment of Figure 3 serves as a means of connecting a certain type of fastener and an explosive cartridge as an integral unit which is desirable on certain construction projects employing explosive driven fasteners.

In the embodiment illustrated in Figure 4 the anterior portion **7** takes the form of the ogival portion or nose of a bullet. The posterior section **2** like the foregoing embodiments is of reduced diameter and is provided with a tapering recess **3** which improves the obturation obtainable with the gas check of this invention during the initial stage of each driving shot. This embodiment is virtually a synthetic plastic "bullet" with a hollow heel and has the advantage of permitting handling, loading and feeding on conventional ammunition machinery. This form of gas check is especially advantageous where attachment between the fastener and explosive cartridge is not desired but where easy feeding of the cartridges as from a magazine clip is required.

In the embodiment shown in Figure 5, reference characters **8** and **9** identify annular protrusions or flanges having a diameter somewhat in excess of the bore diameter so as to better hold the plastic gas check in the tool during loading. Flanges **8** and **9** are portions which will provide initial obturation on loading and are adapted to engage with any enlarged bore sections found in certain types of tool barrels. The annular recess **10** in combination with and between the annular protrusions serves to prevent jamming and binding which would make loading difficult and also prevents unnecessarily high obturating forces during firing. To facilitate coupling with a propellent powder cartridge posterior section **2** is of reduced diameter; and to initiate the obturating effect as soon as possible posterior portion **2** is provided with a recess **3**.

In Figure 7 the gas check driving device of this invention is shown in the form of a connector between a

fastener 21 and a cartridge 17. The fastener is of the type having the usual enlarged rear portion 22 adapted to fit the bore of the tool barrel with clearance within the usual commercial tolerances and having an internal thread for connection with other devices as required for the construction work being done. The forepart of the fastener is provided with a cap-like centering and guiding means 20 of the type shown in the drawing. In this instance the gas check driver comprises a relatively bulky or massive mid portion 11 adapted to undergo lateral distension under axial compression, coupling means 23 on the front of part 11 for connection with the fastener head 22, and a posterior section 24 adapted to connect with a rimfire cartridge 17 containing a propellant material 26 and a primer material 25. In this embodiment the gas check serves as an element in a complete fastener-propellent cartridge unit.

In the embodiment of Figure 8 the driver consists of a solid circular cylinder 12 of polyethylene having no concavities but characterized by a somewhat greater length of plastic than the prior embodiments in order that adequate lateral distension may be obtained. With certain types of propellent cartridges, this form, as well as some of the others, may be advantageously secured to the back face of a fastener by interlocking means or an adhesive, for example.

With respect to the several embodiments just described it is to be noted that the provision of a thin walled hollow cup shaped body alone with the recess facing either the fastener or the propellant would be undesirable for lack of form retaining rigidity, difficulty in loading, and inability to provide the degree of obturation obtained by means of my invention under the conditions encountered.

In Figure 6 there is shown a gas check of the type illustrated in Figures 1 and 2 having a nose portion 1 in the bore 14 of tool barrel 13 facing the fastener 15 and rear portion 2 fixed as a closure in the mouth of an explosive cartridge 17 of the rimfire type disposed in the breech of the barrel 13. The stud fastener 15 pre-positioned in the bore 14 and desirably spaced ahead of portion 1 of the gas check to further control the power is provided at the front end with a plastic centering and guiding means or point cap 20 affixed thereto of the aforementioned type which aids in positioning the fastener axially as well as centering it and guiding it in the bore of the tool barrel. The rear end of the stud consists of an externally threaded head 16 having a diameter greater than that of the shank portion of stud 15. Initiation of the driving operation occurs by striking the rim of cartridge 17 with a firing pin projectable through the aperture 19 provided in the breech lock 18 attached at the rear end of barrel 13. Any explosive actuated tool of the type suitable for projection of studs and pin fasteners shown and described may be utilized.

The minimum axial thickness of plastic needed to insure the lateral distention to accomplish obturation will vary with the molecular weight of the polymer, with the type and amounts of the aforementioned additives and coloring agents or fillers, and with other factors.

Polyethylene (or any equivalent resilient synthetic organic plastic) is admirably suited for the purpose of this invention. In the first place, it is elastically deformable under compression very much like rubber and will compress longitudinally under the axial impact force of the propellant with concomitant lateral distention to provide desired obturation between fastener and propellant. But unlike rubber and certain other plastics, it was found that polyethylene does not have the tackiness and relatively high coefficient of friction of these materials with respect to a smooth metal surface such as the bore of the tool barrel but on the contrary has self-lubricating properties even at the high temperatures of powder combustion due to its wax-like surface. Since an obturator coacts with the wall of the bore of the tool barrel as well as with the fastener and propellant, the cleansing and lubricating

action of the polyethylene driver is important to insure that excessive wear and fouling of the tool barrel is prevented though extraneous lubricant is not used. Furthermore, it was found that the polyethylene gas check does not form corrosive products of combustion under the extreme temperature and pressure conditions which occur in the tool barrel upon firing of the fastener. On the contrary, a thin protective film of polyethylene is believed to be left on the surface of the bore of the barrel. Since the polyethylene plastic gas checking driver is tough and coherent and not brittle, it was found that it will not disintegrate like fiber or other plastics to leave a residue in the barrel and flying fragments at the muzzle adjacent the work with attendant loss of obturation and danger and inconvenience to the tool operator.

In its massive form especially, it was found that the gas check is especially resistant to deterioration under the heat of the burning powder since polyethylene has a slow burning rate at least to the extent that such burning as does occur, does not impair gas sealing. Moreover, the consumed polyethylene of the thinner posterior section of the gas check is believed to add to the driving power of the powder charge of the cartridge since at the high temperatures attained during explosion of the propellant powder particularly under sustained operation of the tool part of the polyethylene may decompose explosively which may account in part for the disappearance of the thin sections of the polyethylene wad. Further, it was found that in the massive sections found in the gas check structure of this invention polyethylene is sufficiently rigid to hold its shape and resist excessive shearing past the fastener and extrusion into the usual clearance space between the barrel bore and the rear end of a fastener even at high propellant powder loads without total loss of elasticity however (polyethylene may be classed as semi-rigid becasue in stiffness it lies between the conventional categories of rigid and non-rigid plastics). Such extrusion of the driving member would cause jamming, loss of obturation and driving power and fouling of any threads on the fastener. Still further, although massive in form, the plastic gas check here described is characterized by desired lightness and resulting low loss of driving power since polyethylene is one of the lightest of all plastics having a specific gravity of 0.92. The high differential in weight between the steel fastener and the polyethylene check accentuates the static inertia of the fastener to promote obturating deformation of the gas check.

As compared to polyethylene other resilient plastic materials do not have the combination of properties and characteristics needed for the purpose of this invention. Elastomeric plastics such as rubber, butyrates and vinyl resins and various plastics containing halogen atoms or sulfur leave acidic products of decomposition which in the presence of moisture formed in the barrel after each firing of the tool corrode the barrel. Still other plastics, such as ethyl cellulose for example, simply lack flexibility unless plasticisers are incorporated which render these materials less stable because of the tendency of the plasticiser to evaporate or separate out and also reduce the softening tempeature. Because of the absence of plasticisers, the polyethylene gas check suffers no change in desirable properties on account of aging.

The plastic gas checking driver of this invention is preferably made by either an injection or a compression molding process but fabrication by working such as machining of extruded stock is also feasible particularly for an embodiment like Figure 8.

As an illustrative specific example of an embodiment of the invention such as the type shown in Figures 1 and 2 found suitable for use in an explosive actuated fastener driving tool there was molded a gas check of a polyethylene known as "Alathon No. 1" made by E. I. du Pont de Nemours & Company having an average molecular weight of 18,000. For a tool having a barrel

with a nominal bore diameter of 0.250 of an inch or not less than 0.2505 of an inch but not more than 0.2510 of an inch, the anterior portion 1 was easily molded with a diameter within the narrow range from 0.247 of an inch to 0.249 of an inch and a length in the axial direction of about 5/16 of an inch. The posterior or heel portion 2 protruding coaxially rearwardly from portion 1 by about 1/8 of an inch was provided with a recess of generally conical shape beginning with a diameter of about 11/64 of an inch at the rear face of portion 2 and extending forwardly into the body of the gas check to an apex forming an angle of about 45°. While thinner sections of portion 2 were found to have disappeared after the fastener was "shot" the major portion of the gas check was intact and was ejected from the muzzle of the barrel of the tool with a pop by the residual gases showing the check was still in good condition to provide a gas seal though it has been subjected to the high temperature and high pressure impact of the burning propellant powder. The ability to retain a gas sealing form immediately after a shot facilitates trouble free ejection of the expendable plastic gas check of this invention; but, if pressure is gone, the wad drops out easily.

Since the tool barrels of the type described are commonly provided with a circular bore, only a circular cylindrical shape of obturator has been referred to herein, but other cross sectional shapes can be employed with a given barrel provided the shape selected is capable of distending to seal the bore. While the gas check of this invention has been described with particular reference to explosive driven fasteners, it is obvious that the polyethylene gas check device may have utility and advantages in the ammunition and fire arms art.

As hereinbefore mentioned the present gas sealing members are intended for use with metal pins, studs and the like fastener elements. The pins are generally provided at the base—looking at such pins as a projectile—with a work holding head portion having a diameter approaching the diameter of the bore of the barrel of the tool. The studs similarly are provided at the base or rear end portion with an externally or internally threaded head portion of a diameter nearly that of the bore of the barrel. When used in connection with the gas sealing means of this invention the external diameters of the holding head or threaded portions of such fasteners, typical ones of which are shown in Figures 6 and 7, may vary from the internal diameter of the tool barrel by at least the usual interchangeable fit tolerances and need not be held to the extremely small tolerances that are so costly to maintain to avoid excessive gas bleed around the fastener element particularly at higher propellant loads. A clearance on one side between barrel and fastener head portion as high as about 0.005 of an inch is permissible with the gas check of this invention.

From the foregoing description, it is evident that various advantages are obtained with the present invention. Use of the plastic driving member will allow manufacture of fasteners having the greater and more variable commercial tolerances rather than the heretofore close tolerances needed to prevent excessive blow-by. Further, use of the gas check of this invention makes possible more efficient use of the available energy in any given unit of powder load. Another advantage secured is the reduction of barrel erosion and prevention of deterioration of the surface or surface coating of the fastener by the hot propellant gases. Still another advantage is that the obturating and driving device of this invention provides desired constancy and uniformity of driving power and resultant accurate and dependable uniformity of penetration depth of the fastener independently of the variable sealing effect between the rigid fastener, having transverse dimensions varying within relatively wide tolerances, and the barrel diameter, which varies within manufacturing tolerances and with wear and temperature changes occurring during operation. Furthermore, a cleaner work surface is obtained after firing. Still other advantages are that the plastic gas check serves in the dual capacity of a powder closure for the explosive cartridge and as means of identifying the magnitude of the powder load in the cartridge when the gas check is colored in conformity with a color code.

While various specific embodiments of the invention have been shown and described herein, it will be understood by those skilled in the art that changes and modifications may be made without departing from the spirit and scope of the invention and that the invention is not to be limited thereby except insofar as set forth in the appended claims.

What is claimed is:

1. An overpowder gas check member adapted for use in the bore of the barrel of an explosive operated device between a projectable member and the explosive propellent powder comprising a body of a solid polyethylenic polymer or the like olefinic plastic substance having a self-lubricating surface and elasticity together with substantial resistance to rapid deterioration and excessive plastic deformation all in the presence of the flame and pressure of the reaction products of said powder, said substance having properties, including the aforesaid, generally similar to those of polyethylene of a molecular weight of at least 10,000.

2. A driving member for use in the bore of the barrel of an explosive operated device comprising the sole overpowder member between a projectable member and the explosive propellent powder with direct exposure to said powder, there being clearance space between said projectable member and said bore within maximum commercial tolerance, comprising an elastically deformable plastic body free from plasticizer and of cylindrical configuration at least one portion of which is a disk-shaped solid characterized by a diameter substantially equal to that of the said bore and an axial thickness sufficient to permit axial compression with concomitant obturating lateral expansion of said portion under the impact force of the products of combustion of the explosive propellent powder, said body formed essentially of a self-lubricating grade of solid polyethylene having a molecular weight of at least about 10,000 and sufficient to impart substantial resistance against any tendency of said body to extrude excessively through said space along said projectable member during driving.

3. A propellent device for use in the bore of the barrel of an explosive operated tool for driving studs having clearance space between at least the rear end of said stud and said bore within maximum commercial tolerance, said device comprising a cartridge case open at one end and having an explosive powder charge therein, an elastically deformable cylindrical overpowder closure in the open end of said case, said closure having at least one portion a disk-shaped solid being adapted to snugly engage the open end of the case and having an axial thickness sufficient to permit axial compression with concomitant radial expansion under the impact force of the products of combustion of said charge, said closure consisting essentially of a self-lubricating grade of solid polyethylene free from plasticizer and extraneous lubricant and having a molecular weight not less than about 10,000 and averaging about 18,000 sufficient to impart substantial resistance against the tendency of said body to extrude excessively through said space during driving.

4. An overpowder plastic gas check wad comprising a polyethylene cup adapted to elastically distend laterally and constituting the sole means of maintaining obturation behind a projectable element in the bore of the barrel of an explosive propellent operated device under the force of the propellent powder in the direct presence of the combustion products of said propellant, there being clearance space between said element and said bore within maximum commercial tolerance, said polyethylene being solid and of a self-lubricating grade having a molecular

weight not less than about 10,000 and averaging about 18,000 sufficient to impart substantial resistance against the tendency of said wad to extrude excessively through said space during driving, said cup having a massive solid anterior portion of a diameter that of said bore and a hollow posterior forming a recess opening to the rear adjacent said powder, said anterior portion having a chamfered front end and being of a length forward of said hollow portion sufficient to be axially compressible to provide obturating expansion.

5. A plastic gas check member according to claim 1 comprising an axially compressible laterally expandable solid cylindrical portion having both an anterior recess and a posterior recess, said member being formed of polyethylene of a molecular weight of at least 10,000.

6. The driving member of claim 2 wherein the cylindrical body has a shallow concavity in its front face and a relatively deep concavity in its rear face and wherein the axial length of polyethylene between said concavities provides the disk-shaped solid portions having an axial thickness of polyethylene sufficient for axial compression with concomitant obturating lateral expansion of said portion.

7. The driving member of claim 6 wherein the cylindrical body has a reduced diameter at the rear to permit affixing the member into the mouth of a propellent containing cartridge case.

8. The driving member of claim 2 wherein the cylindrical body has a bulky solid anterior portion and a hollow posterior portion, said anterior portion having at least one integral annular protrusion connected to an

adjacent portion of lesser diameter, and said hollow posterior portion having a reduced diameter at the rear to permit affixing the member into the mouth of an explosive propellent cartridge case.

9. The wad of claim 4, wherein the chamfered front end forms an ogival anterior portion having at least a portion of its diameter substantially that of the bore.

10. The wad of claim 9 wherein the hollow posterior portion has a reduced diameter at the rear to permit affixing the wad into the mouth of a propellent containing cartridge case.

References Cited in the file of this patent

UNITED STATES PATENTS

157,793	Cochran	Dec. 15, 1874
997,566	Leach	July 11, 1911
2,153,553	Fawcett et al.	Apr. 11, 1939
2,188,465	Perrin et al.	Jan. 30, 1940
2,342,400	Hopff et al.	Feb. 22, 1944
2,518,395	Sopris	Aug. 8, 1950
2,559,275	Brown et al.	July 3, 1951
2,663,259	Catlin et al.	Dec. 22, 1953

FOREIGN PATENTS

531,477	France	Oct. 24, 1921
765,268	France	Mar. 19, 1934
108,354	Australia	Sept. 7, 1939

OTHER REFERENCES

Scientific American, July 1934, page 42.