

Oct. 24, 1961

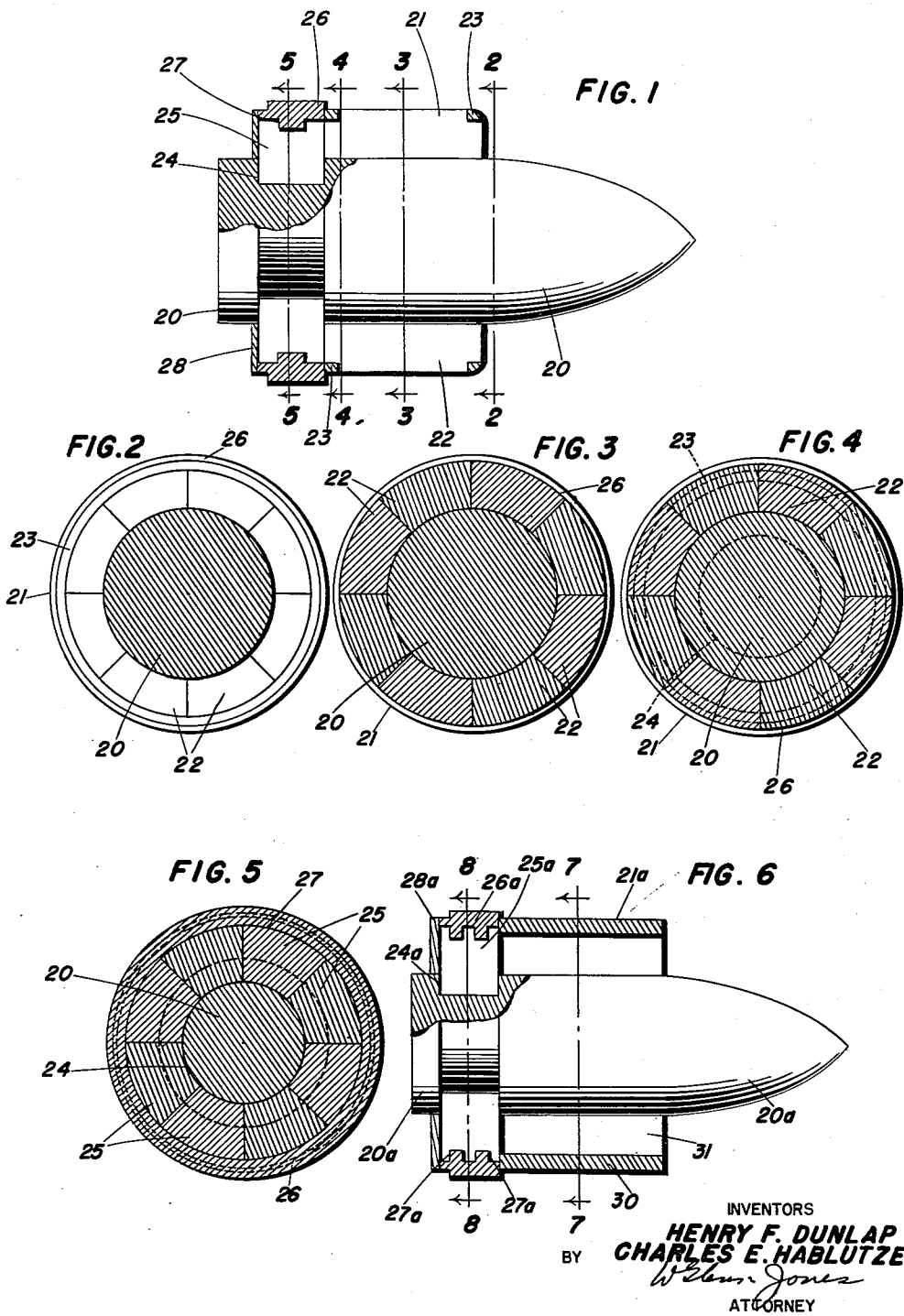
H. F. DUNLAP ET AL

3,005,409

PROJECTILE

Filed June 30, 1944

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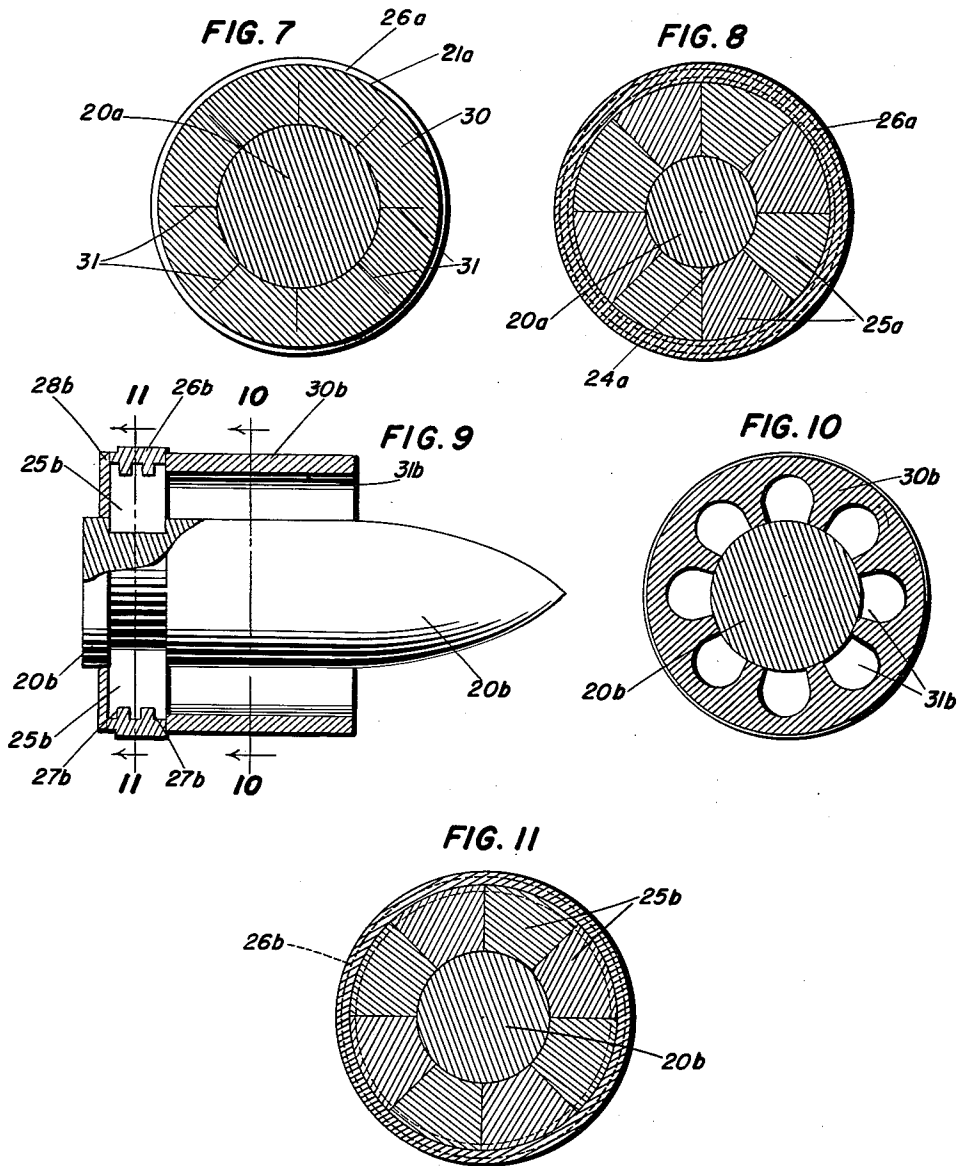
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PROJECTILE

3,005,409

Filed June 30, 1944

4 Sheets-Sheet 2



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3,005,409

PROJECTILE

Filed June 30, 1944

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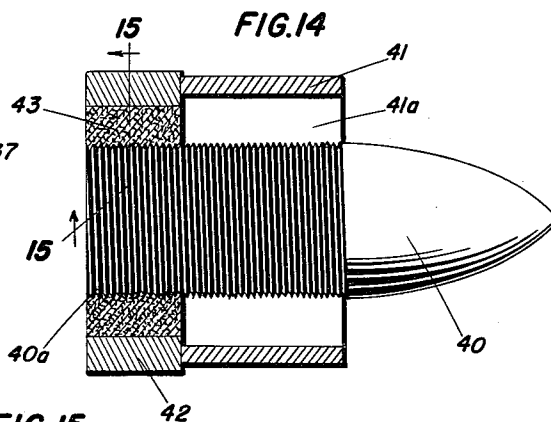
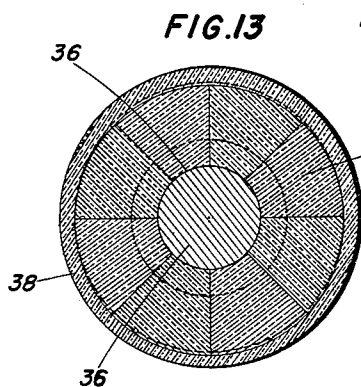
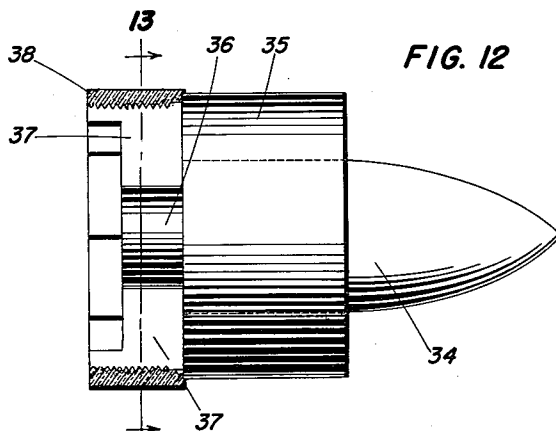
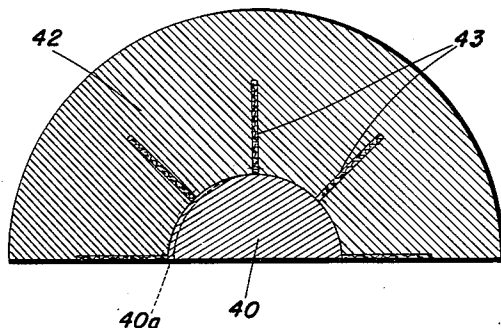


FIG. 15



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PROJECTILE

Filed June 30, 1944

4 Sheets-Sheet 4

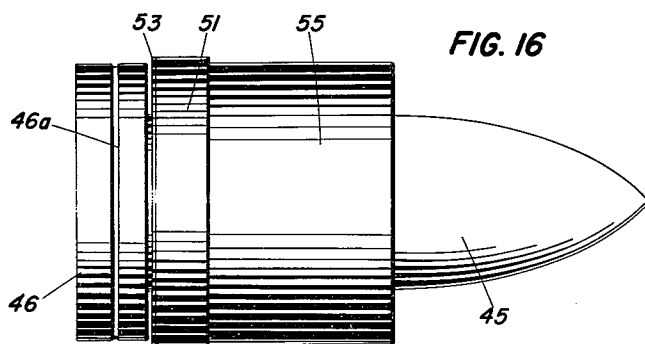


FIG. 16

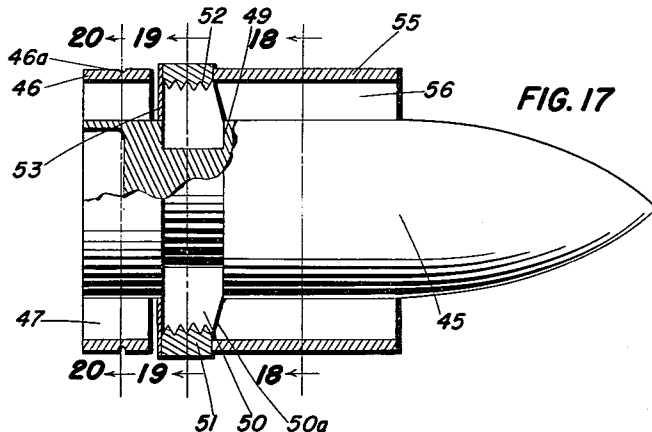


FIG. 17

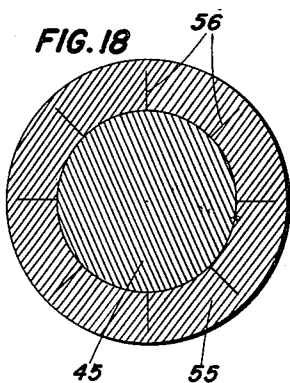


FIG. 18

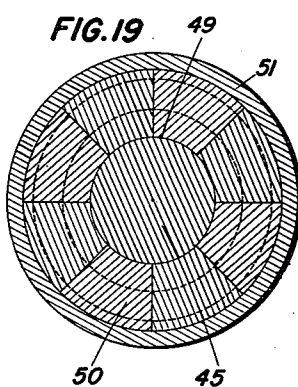


FIG. 19

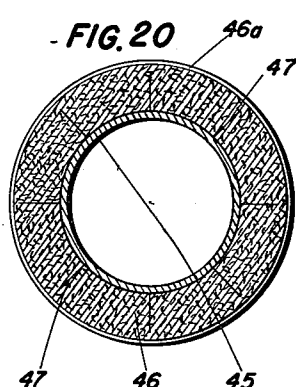


FIG. 20

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3,005,409

PROJECTILE

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Filed June 30, 1944, Ser. No. 543,006

3 Claims. (Cl. 102-93)

This invention relates to sabot projectiles and has particular reference to a subcaliber sabot-projectile of novel construction in which supporting and centering means for a subcaliber core are automatically released from the core under the action of centrifugal force when the projectile emerges from a gun barrel. The new projectile is simple and compact in construction, has relatively few parts, and is adapted for manufacture at low cost.

One object of the present invention resides in the provision of a sabot-projectile having a subcaliber metal core, a metal sabot mounted on the core and positively secured thereto, and a sleeve-like bourrelet made of relatively light-weight material, such as plastic, mounted on the core in front of the sabot with the rear end of the bourrelet engaged and supported by the sabot, the sabot and bourrelet being releasable from the core by centrifugal force incident to rotation of the projectile as it emerges from the gun barrel.

A further object of the invention is to provide a sabot-projectile having a sabot and a relatively light-weight sleeve-like bourrelet mounted on a subcaliber core and in which the bourrelet is supported laterally by the sabot so that it is unnecessary to provide positive means for locating the bourrelet axially on the core.

Another object of the invention is to provide a sabot-projectile of the character described in which the bourrelet has longitudinal radial cuts or recesses for providing weakened zones in the bourrelet, whereby the bourrelet is adapted to break at the weakened zones under the centrifugal force to facilitate its release from the core.

A further object of the invention is to provide a sabot-projectile of the character described in which the bourrelet and sabot are threaded on the core.

An additional object of the invention resides in the provision of a subcaliber projectile having a segmented metal sabot mounted on a subcaliber core and carrying a turning band made of relatively light-weight material, such as plastic, which acts to hold the sabot segments together on the core, the turning band being breakable under centrifugal force to release the sabot segments when the projectile emerges from the gun barrel.

Still another object of the invention is to provide a projectile having a subcaliber core, a discardable metal sabot intermediate the ends of the core for supporting a turning band, and a pair of light-weight, substantially full caliber rings fitted closely on the core, one in front and one to the rear of the sabot, the rings serving to support and center the core near its ends in the gun barrel and being releasable with the sabot from the core under centrifugal force when the projectile emerges from the gun barrel.

These and other objects of the invention may be better understood by reference to the accompanying drawings, in which:

FIG. 1 is a side elevational view, partly in section, of a sabot-projectile made in accordance with the invention;

FIGS. 2, 3, 4 and 5 are cross sectional views on the lines 2-2, 3-3, 4-4 and 5-5, respectively, in FIG. 1;

FIG. 6 is a side elevational view, partly in section, of a modified form of the new projectile;

FIGS. 7 and 8 are cross sectional views on the lines 7-7 and 8-8, respectively, in FIG. 6;

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FIG. 9 is a view similar to FIG. 6 showing a further modification of the projectile;

FIGS. 10 and 11 are cross sectional views on lines 10-10 and 11-11, respectively, in FIG. 9;

FIG. 12 is a side elevational view, partly in section, showing another form of the projectile;

FIG. 13 is a sectional view on the line 13-13 in FIG. 12;

FIG. 14 is a side elevational view, partly in section, of still another form of the projectile, showing the sabot and bourrelet threaded on the core;

FIG. 15 is an enlarged sectional view on the line 15-15 in FIG. 14;

FIG. 16 is a side elevation of another form of the sabot-projectile;

FIG. 17 is a view similar to FIG. 16 showing parts of the projectile in section, and

FIGS. 18, 19 and 20 are cross sectional views on the lines 18-18, 19-19, and 20-20, respectively, in FIG. 17.

The projectile of the present invention is of the so-called "sabot" type in which a subcaliber core is supported and centered, during its movement through a gun barrel, by means of a generically identified sabot and turning band assembly, and a bourrelet which are discardable automatically under the action of centrifugal force when the projectile emerges from the gun barrel. A projectile of this type is disclosed in a copending application of C. E. Hablutzel, Serial No. 543,005, filed June 30, 1944, and now abandoned. In the projectile there shown, the sabot and bourrelet are relatively narrow, ring-like members positively secured to the core in longitudinally spaced relation, the bourrelet ring being mounted near the nose portion and the sabot ring being mounted near the end of the core. With this construction, it is necessary to provide means for positively securing the bourrelet to the core to prevent it from sliding axially on the core when the projectile is fired. The new projectile is characterized by a sleeve-like bourrelet of relatively light-weight material which is engaged at its rear end by the front face of the projecting portion of the sabot, so that it is unnecessary to provide a positive connection between the bourrelet and the core, other than the sabot.

Referring to the drawings, particularly FIGS. 1 through 5, the projectile there shown comprises a subcaliber core 20 which may be made of steel, such as that used in armor-piercing projectiles, the core having an ogive. Mounted on the core 20 directly to the rear of the ogive is a substantially full caliber bourrelet 21 comprising a plurality of longitudinal segments 22 disposed in closely adjacent relation on the cylindrical surface of the core. The segments 22 are held together on the core by any suitable means, such as frangible retaining rings 23 disposed in peripheral recesses in the ends of the segments. The rings 23 may be made of metal, and the segments 22 are made of a light-weight material, such as plastic, laminated phenolics, laminated lignins, plywoods bonded and impregnated with phenolics, molded phenolics with a suitable filler, wood, or the like. It will be observed that the bourrelet 21 is generally sleeve-like in form and extends along the core for a substantial part of its length, the bourrelet being adapted to engage the inner wall of the gun barrel to support and center the core 20 therein. While we have shown a bourrelet 21 comprising eight segments 22, any other desired number of segments may be employed. However, for each value of the ratio of core diameter to gun bore diameter, there is a minimum desirable number of segments, usually three or more for practicable designs. If the number of segments is less than this minimum, lateral forces may be exerted against the projectile during centrifugal release of the bourrelet,

as will be described in greater detail presently, which may result in excessive initial yaw of the core.

To the rear of the bourrelet 21, the core 20 has an annular groove 24 which, as shown, is of a length substantially less than that of the bourrelet. Closely fitted in the groove 24 and consequently subannularly of the core is a plurality of sabot segments 25 projecting radially from the core for a substantial distance. The segments 25 are fitted closely together, and the front face of the projecting portion of each segment engages the rear end of the bourrelet 21. A turning band 26, which may be made of annealed copper, is fitted closely around the sabot segments 25 and has a tongue 27 disposed in an annular groove in the sabot. The sabot segments and the turning band are the components of the generically identified assembly. The tongue and groove arrangement between the turning band and sabot in the majority of the modifications disclosed, comprise an interrupted contour which enlarges the area of mutually interfitting contact. The band 26 may be shrunk, press-fitted, or otherwise mounted on the sabot and has an external diameter somewhat greater than that of the bourrelet, whereby the band is adapted to be engraved by the usual rifling in the gun barrel to impart rotation to the projectile when it is fired from the gun. Preferably, a sealing disc 28 is fitted closely around the core 20 to the rear of sabot 25 to provide a seal for preventing leakage of the high-pressure powder gases between the sabot segments.

In operation, the projectile is loaded in the gun breech in the usual manner, and when the gun is fired the pressure from the powder combustion acts upon the relatively large surface comprising the rear end of the core 20 and the sealing disc 28, which is backed by the projecting portion of sabot 25. As the projectile moves through the gun barrel, it is supported and centered by the turning band 26 and sabot 25 and also by the relatively long sleeve-like bourrelet 21. Due to the action of the rifling on the band 26, the projectile is rotated at high speed as it moves through the gun barrel, and the resulting centrifugal force on the parts carried by core 20 causes these parts to release automatically from the core as soon as the projectile emerges from the gun muzzle and is released from confinement by the gun barrel. That is, the centrifugal force on rings 23 and the turning band 26 causes these parts to fracture when the projectile emerges from the gun muzzle, with the result that the bourrelet and sabot segments 22 and 25, respectively, are automatically released from the core 20, so that the latter may continue its flight without the aerodynamic drag which would otherwise be imposed upon it by the sabot and bourrelet. Upon release of the sabot and bourrelet, the sealing ring 28 is moved off the rear end of the core due to the air pressure against the sealing ring.

The bourrelet retaining rings 23 and the turning band 26 are adapted to hold the bourrelet and sabot segments together on the core under the confining pressure of the gun barrel against the rings and band, in spite of the opposing centrifugal force tending to break these members. However, when the projectile emerges from the gun muzzle and the confining force of the gun barrel is released, the strengths of the rings 23 and turning band 26 are substantially exceeded by the centrifugal forces to which they are subjected, due to the outward pressure of the segments against them and to the centrifugal force resulting from their own masses. Accordingly, the sabot and bourrelet are released with an ample margin of certainty when the projectile emerges from the gun muzzle. This release of the parts is effected without substantial energy loss and without appreciable effect upon the flight of the core.

With the new construction, the bourrelet 21 is located axially on the core by engagement of the bourrelet with the front face of the projecting portion of sabot 25. Therefore, it is unnecessary to provide separate means for positively securing the bourrelet to the core. Since

the bourrelet is completely segmented, except for the retaining rings 23, it may be easily manufactured by molding or otherwise fabricating the separate segments 22. If desired, the bourrelet segments 22 may be held together on the core by means of a thin sleeve, made of plastic, or the like, pressed over the assembled segments in place of the rings 23.

As described in the copending application of C. E. Hablutzel, Serial No. 543,005, filed June 30, 1944, aforementioned the sabot segments 25 act substantially as cantilever beams anchored in the annular groove 24, and the propelling pressure of the powder gases exerts a turning moment on these segments tending to move the outer ends forwardly relative to the core. This turning moment is opposed by the flat walls of the groove 24 and by the confining pressure of the gun barrel on the turning band 26. Also, with the new construction, the turning moment on the sabot segments 25 is opposed by engagement of the bourrelet 21 with the front faces of the sabot segments. More particularly, the force of setback on the bourrelet 21 when the gun is fired acts to increase the pressure between the rear end of the bourrelet and the adjacent faces of the sabot segments, thereby setting up turning moments on the sabot segments opposing the turning moments imposed by the pressure of the powder gases. In this connection, the setback force on the bourrelet 21, which opposes the turning moment on the sabot segments due to the powder gases, is proportional to the acceleration of the projectile and therefore to the pressure of the powder gases producing the turning moment.

The torque due to rotation of the turning band 26 by the gun barrel rifling is transmitted to the core 20 through the sabot segments 25 and also through the bourrelet 21. The turning moment on the sabot segments due to the powder pressure tends to cause a wedging action of the sabot segments in the annular groove 24 so as to increase the resistance to relative rotation between the sabot segments and the core in the transmission of the torque. Also, the increased pressure between the bourrelet and the sabot due to setback increases the capacity of the bourrelet for transmitting torque to the core from the sabot.

The projectile shown in FIGS. 6, 7 and 8 is somewhat similar to that shown in FIGS. 1 through 4, and similar parts are indicated by corresponding reference numerals with the subscript "a" added. However, in the projectile shown in FIGS. 6, 7 and 8, the retaining rings 23 are omitted and the bourrelet 21a is made of a single sleeve-like member 30 closely fitted on the cylindrical portion of the core 20a, as by means of a press fit. The member 30, which is made of a light-weight material such as plastic, fiber, or the like, is partially segmented by a plurality of longitudinal cuts 31 radiating from the inner diameter of the member and terminating short of its outer diameter. The radial dimension of the cuts 31 is dependent upon the strength of the material from which the bourrelet sleeve 30 is made, it being understood that the cuts are so dimensioned that the bourrelet will release automatically from the core by centrifugal force when the projectile emerges from the gun barrel, due to fracturing of the bourrelet at the weakened portions adjacent the cuts 31. The bourrelet 21a is engaged at its rear end by the front faces of sabot segments 25a, which carry a turning band 26a having a pair of tongues 27a disposed in annular grooves in the sabot. The operation of the projectile shown in FIGS. 6, 7 and 8 is similar to that of the projectile previously described, except that the bourrelet 21a is released from the core by breaking of the bourrelet sleeve 30 at its outer weakened portions adjacent the cuts 31, under centrifugal force, when the projectile emerges from the gun barrel.

The projectile shown in FIGS. 9, 10 and 11 is generally similar to that shown in FIGS. 6, 7 and 8, and similar parts are indicated by corresponding reference

numbers with the subscript "b" added. In the projectile illustrated in FIGS. 9, 10 and 11, however, the bourrelet sleeve 30b is provided with configured holes or openings 31b extending longitudinally through the bourrelet, in place of the cuts 31. As shown, the recesses 31b are generally circular in shape, although any other desired configuration may be employed. The longitudinal openings 31b have the function of materially decreasing the mass of the bourrelet, in addition to their function of weakening the bourrelet for centrifugal release. The openings 31b may extend from either the inside or outside surface of the bourrelet to points approaching complete severance of the bourrelet wall. As in the preceding forms of the projectile, the bourrelet 21b is backed by engagement of its rear end with the projecting portions of the sabot segments 25b.

In the projectile shown in FIGS. 12 and 13, a sub-caliber core 34 is fitted closely into a substantially full caliber bourrelet 35 which is preferably made of a light-weight material, as previously described. The bourrelet 35 is press fitted or otherwise mounted on the cylindrical portion of the core directly to the rear of the ogive and is made up of a single sleeve-like member. The member 35 is not segmented, as in the previous forms of the projectile, but is made of material having inherently a tensile strength sufficiently small so that the bourrelet will burst under centrifugal force in the absence of weakening cuts, when the projectile emerges from the gun muzzle and is thereby released from the confining effect of the gun barrel.

To the rear of the bourrelet 35, the core 34 is provided with a reduced portion 36 on which a plurality of sabot segments 37 are mounted. The segments 37 project radially from the core 34 for a substantial distance and support a turning band 38 threaded on the sabot. The band 38 is made of a light-weight material, such as a plastic, and is somewhat larger in external diameter than the bourrelet 35, so that the band is adapted to be engraved by the usual rifling in the gun barrel to impart rotation to the projectile. The sabot segments 37 may be made of a light-weight material, such as macerated fabric, and are held together on the reduced portion 36 by the plastic turning band 38, which has lateral support on the bourrelet 35.

When the projectile is fired from a gun, the bourrelet 35, the turning band 38 and the sabot segments 37 are held together on the core by the confining influence of the gun barrel as the projectile moves through the barrel, against the centrifugal force due to rotation of the projectile by action of the rifling on band 38. However, when the projectile emerges from the gun muzzle and is thereby released from the confining influence of the gun barrel, the bourrelet 35 and turning band 38 break under the centrifugal force, whereby the bourrelet, sabot and band are released from the core.

By employing a bourrelet, a sabot and a turning band made of a plastic or other light-weight material, as described, the ratio of the mass of these parts to that of the core 34 is maintained relatively low, which is a desirable feature in projectiles of this type. While we have shown the plastic turning band 38 threaded on the plastic sabot segments 37, it will be understood that the band may be made integral with the sabot. That is, the sabot and the turning band may be made of plastic or other light-weight material in a single piece which may be weakened by radial cuts partially segmenting the piece for centrifugal release. Alternatively, the light-weight material from which the sabot and turning band unit is made may have a tensile strength sufficiently small so that the unit will burst under centrifugal force in the absence of weakening cuts, when the projectile emerges from the gun muzzle. Also, the bourrelet 35, sabot 37 and turning band 38 may be made in a single integral piece and may be made of a plastic filled with laminated material so that it has a sufficiently low tensile strength across certain planes to

cause it to burst under centrifugal force in the absence of weakening cuts, when the projectile emerges from the gun barrel.

The projectile shown in FIGS. 14 and 15 comprises a subcaliber core 40 made of steel and having its cylindrical portion externally threaded, as shown at 40a. A substantially full caliber bourrelet 41, made of a plastic or other light-weight material, is threaded on the cylindrical portion 40a of the core and is disposed directly to the rear of the ogive portion of the core. The bourrelet 41 is provided with longitudinal cuts 41a radiating from its internal diameter and terminating short of its external diameter so that the bourrelet has weakened outer portions adapted to fracture under centrifugal force and thereby facilitate release of the bourrelet. A light-weight sabot 42, which may be made of macerated fabric, is threaded on the rear end portion of the core and tightened against the rear end of bourrelet 41. The sabot 42 is provided with longitudinal cuts radiating from its inner diameter so as to partially segment the sabot, the cuts being filled with a fiber filling 43. The filling 43 is packed tightly in the radial cuts so as to seal the sabot against leakage of gas from the powder combustion, and also to stiffen and strengthen the sabot and prevent distortion of the sabot upon transmission of torque. The sabot 42 has an external diameter somewhat greater than that of bourrelet 41, and the peripheral portion of the sabot comprises a turning band which is adapted to be engraved by the rifling in the gun barrel to impart rotation to the projectile. The threads 40a are in such a direction that the rotation imparted to the sabot by the gun rifling acts to tighten the sabot against the bourrelet 41.

It will be apparent that when the projectile is fired from a gun, the centrifugal force incident to the rotation of the projectile causes the sabot 42 and the bourrelet 41 to break apart adjacent the radial cuts 43 and 41a, respectively, when the projectile emerges from the gun barrel, so that the core 40 continues its flight without the sabot and bourrelet.

The projectile shown in FIGS. 16 to 20, inclusive, comprises a subcaliber core 45 carrying on its rear end portion a ring 46 which is made of light weight material, such as fiber. The ring 46 may be cemented or otherwise secured on the core and is adapted to fit tightly into a suitable cartridge case (not shown) for containing the propellant powder, the ring having a circumferential groove 46a in its peripheral portion into which part of the case may be crimped. A plurality of longitudinal saw cuts 47 radiate from the inner surface of the ring and partially segment the ring to provide weakened zones.

In front of the ring 46, the core is provided with an annular groove 49 into which a plurality of steel segments 50 are closely fitted to form a sabot projecting radially from the cylindrical surface of the core. The sabot segments 50 are held closely together in the groove 49 by a frangible turning band 51 made of copper, or the like, and secured on the peripheral portion of the sabot as shown at 52. The front face of the sabot 50 is inclined rearwardly from the leading edge of the groove 49. A sealing disc 53 engages the rear face of the projecting portion of sabot 50 in spaced relation to the ring 46.

A substantially full caliber bourrelet 55 made of fiber or other lightweight material is fitted closely on the cylindrical portion of the core in front of the sabot 50, the rear end of the bourrelet being formed to fit closely against the inclined sabot surface 50a and the turning band 51. The bourrelet 55 is sleeve-like in form and has longitudinal saw cuts 56 radiating from its inner surface but terminating short of its outer surface to provide weakened zones.

The turning band 51 has an external diameter somewhat greater than that of the bourrelet 55 and the ring 46 and is engraved by the rifling in the gun barrel to impart rotation to the projectile when the latter is fired from the gun.

When the projectile emerges from the gun muzzle, the centrifugal force due to rotation of the projectile causes the turning band 51, ring 46 and bourrelet 55 to break apart so that these members and the sabot 50 are released from the core. The sealing disc 53 is then moved off the rear end of the core by the air pressure on the disc, and the core continues its flight without the drag which would normally be imposed by the parts mounted on it.

It will be apparent that in the several illustrated embodiments of the new projectile, the bourrelet is of a sleeve-like form held in place by its close fit on the core and by engagement of its rear end with the front face of the sabot which is positively secured to the core. Because of the form and support of the bourrelet, the latter may be made of relatively weak and light-weight material, whereby the ratio of the mass of the sabot and bourrelet to the mass of the core may be maintained relatively low. Also, with the new construction the bourrelet may be easily manufactured and mounted on the core, without the use of positive securing means other than the sabot. By reason of the interengagement of the radially projecting portions of the sabot and bourrelet, these members provide mutual lateral support.

While we have given several examples of light-weight material which may be used in the manufacture of the discardable parts mounted on the core, it is to be understood that other light-weight materials may be used, and in the following claims the term "plastic" is intended to include other equivalent light-weight materials of a density substantially less than that of the core material.

We claim:

1. In a subcaliber sabot-projectile having a metal subcaliber core, a sabot mounted on the core and positively secured thereto, the sabot projecting radially from the core a substantial distance for supporting and centering the core in a gun barrel, a turning band on the sabot, a substantially full caliber plastic bourrelet fitted closely on the core in front of the sabot and engaged at its rear end with the front face of the projecting portion of the sabot, the bourrelet extending forwardly from the sabot for a

distance substantially in excess of the sabot width, and a substantially full caliber plastic sleeve mounted on the core to the rear of the sabot and having an annular groove for receiving part of a shell case, said sleeve, bourrelet, sabot and band being releasable from the core by centrifugal force incident to rotation of the projectile when it emerges from the gun barrel.

2. A subcaliber projectile comprising a subcaliber core having a base, a segmented sabot mounted on the core adjacent to the base, a turning band surrounding the sabot to confine the segments, the contacting surfaces of the sabot and turning band being of interrupted contour to provide a mutual interfitting, and a bourrelet firmly mounted on the core ahead of the sabot, abutting both the sabot and the turning band throughout the entire radial distance of the sabot and at least part of the turning band.

3. A subcaliber projectile comprising a cylindrical subcaliber core having a reduced portion, a segmental sabot on the reduced portion, said sabot extending beyond the annulus of the core and having interruptions along its peripheral surface, a turning band fitted on the sabot, having complemental interruptions tightly interfitting those on the periphery of the sabot to bind the segments together, and a bourrelet firmly mounted on the annulus of the core, abutting the adjoining surface of the sabot and overlapping the dividing line of the interruptions to abut at least part of the turning band.

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