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SHAPED CHARGE WITH CYLINDRICAL LINER

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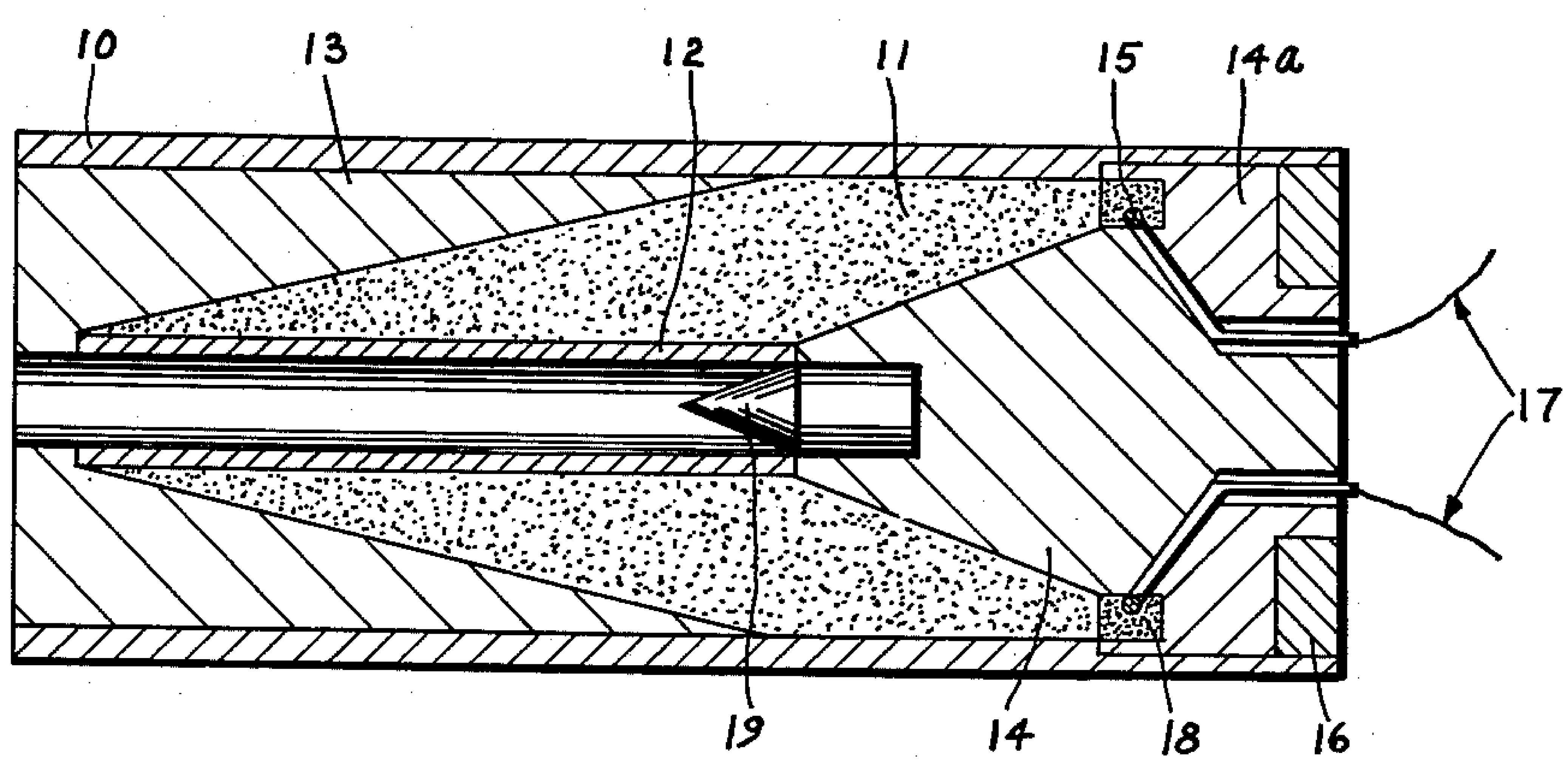

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SHAPED CHARGE WITH CYLINDRICAL LINER

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3 Claims. (Cl. 102—24)

(Granted under Title 35, U.S. Code (1952), sec. 266)

The invention described herein may be manufactured and used by or for the Government for governmental purposes without payment of any royalty thereon.

This invention relates to a shaped charge of explosive for use in shells and elsewhere and has for an object to increase the penetrating ability of such a charge.

Investigation has suggested at least two causes for reduced penetrating ability in a shaped charge detonation and each is believed to be due to a lack of precise uniformity in action resulting from a lack of uniformity in structure. One is believed to be due to a lack of exact uniformity in rate of detonation of the high explosive or a lack of uniformity in the initiation and propagation of parts of a detonation wave in the high explosive. A common source of initiation has been a detonating cap, whereby the detonation front travels radially outwardly and then longitudinally from practically a point source. Structural lack of uniformity in the explosive is thought to have been one cause of reduced penetration due to a part of the detonation wave reaching its destination in advance of some other part. Under such a view a very small increment of time would preclude the resulting effect being as strong as it might be were all parts of the detonation wave precisely synchronized angularly.

According to one feature of this invention a detonation wave is initiated from many points simultaneously with the result that the path of travel of the detonation wave is short and the likelihood for any part of such a wave reaching its destination ahead of another part is greatly reduced. Specifically, a ring of wire is exploded setting off the high explosive all around it.

Another cause of some parts of the detonation wave being imperfectly synchronized is believed to have been due to a variation in thickness of the metal liner of only a few thousandths of an inch or more. Attainment of the desired tolerances in the usual conical liner has been more difficult than the possession of the same degree of approach to uniformity in a cylindrical liner. In another way of viewing this invention it may be regarded as finding a preferred angle at which a detonation wave should impinge upon a cylindrical liner to cause it to collapse in a manner similar to the collapse of a conical liner of the desired degree of uniformity in thickness and its subsequent ejection as a finely atomized stream at high velocity to penetrate a target.

According to a second feature of this invention it has been discovered that a detonation wave of travelling flame front and pressure should impinge upon a cylindrical liner from in rear of it at angle of substantially less than 75° and preferably not more than about 44° to the longitudinal axis of the liner. To suppress any rearwardly directed portion of the detonation wave and the collapsed liner material in spray form, a substantial metal barrier for an end of the cylindrical liner has been found desirable. Also a forwardly and inwardly tapered projection from said barrier extending part way into the liner has been found to be desirable for guiding the detonation wave and atomized metal liner.

The single figure of the drawing shows a cylinder embodying the present invention.

A steel casing **10** of a projectile or other device in which a shaped charge is used is provided around the

high explosive **11**. One example of such a high explosive is the mixture known as composition B which comprises TNT, cyclonite and beeswax. A liner **12** of copper about 3" long and 3/32 of an inch thick is placed as illustrated within the high explosive for collapse thereby on ignition. A nose plug **13** supports the front end of the liner tube **12**. A shaping plug **14** supports the rear end of liner **12** and enables the high exposive **11** to be cast in the form illustrated. This plug also constitutes a support for the ring **15**. This fine wire ring of stainless steel of about .003 of an inch in diameter is one embodiment tried. The shaping plug portion **14*a*** to the right and outside the leads **17** to the detonator is preferably preformed separately and independently of the portion of the shaping ring **14** to the left and within the supply leads. The usual closure ring **16** is provided for the shaped charge to minimize the loss of energy rearwardly and the opening in the ring is in practice smaller than illustrated. The insulated supply wires **17** lead to the ring **15**. Surrounding the detonator ring **15** is a type of sensitive high explosive **18** known as PETN, which is an abbreviation for pentaerythrite tetranitrate. A steel plug **19** is tapered as shown to provide the conical point illustrated, such taper being in general prolongation of the tapered surface of the high explosive.

The method of assembly includes the insertion of the steel nose **13** within the casing **10**. A supporting mandrel not shown is provided to axially align the copper tube **12** in position as illustrated. The portion of the shaping plug **14** within and to the left of the supply leads together with the plug **19** is placed in position, temporary spacing means **14*a*** being preferably provided to align this shaping plug yet allow the pouring of the high explosive **11** around this plug and into position contiguous to the copper tube **12** as illustrated. The detonating ring **15**, its leads and the explosive charge **18** are then placed in position after which the preformed portion **14*a*** of the shaping plug is placed in position. Finally the closure ring **16** is secured in place by means well known in the art.

In operation a high energy supply heats the wire **15** causing it practically to explode and ignite the high explosive throughout 360° of its extent. The higher the energy of initiation for the detonation wave the higher is believed to be its velocity. The right end of the copper tube **12** is believed to collapse first because the detonation wave reaches this end portion of the tube in advance of it reaching the other end due to the right having closer proximity to the point of initiation of the detonation. When the copper tube collapses the plug **19** precludes any component of the tube having a direction rearwardly and the conical point of the plug **19** assists in guiding all portions of the collapsed metal spray in a forward direction, especially since all portions of the tube are believed to collapse almost simultaneously inasmuch as there is less opportunity in the present invention for any part of the detonation wave to become advanced ahead of any angularly displaced other portion of the wave. In practice the electrical energy for firing the wire **15** was the discharge of a one microfarad condenser under pressure of about 3000. volts. In practice a still finer wire than the 3 thousandths of an inch stainless steel wire used here is contemplated inasmuch as a lower voltage is contemplated.

Among the advantages of the present invention may be mentioned the provision of a detonation wave in high explosive from a ring source whereby there is less opportunity for any part of the detonation wave to become advanced over any other part angularly displaced therefrom, as might occur were a point source of initiation used. Another advantage of the present invention is the simplification in manufacture of a liner within the tolerances allowed inasmuch as the production of a cylindrical liner substantially uniformly thick is easier than is the production of a conical liner after the manner of the prior art. The shaping rings **14** and **14a** are primarily for the purpose of providing a wall for the molding of the high explosive material. Under this invention the detonation wave through the high explosive impinges upon the copper tube at an angle of substantially less than 75° to the longitudinal axis of the tube. In fact it is preferred that the detonation wave impinge upon the cylindrical tube at an angle less than about 45° with the cylinder axis. A steel plug **19** prevents any rearward component of the collapsed metal. Its conical point assists in guiding the collapsed metal particles forwardly.

We claim:

1. A shaped charge of high explosive comprising a steel cylindrical casing surrounding said charge, a central hollow cylindrical liner having substantially uniform wall thickness, a conical shaping plug extending from adjacent a rear end of said liner rearwardly and radially outwardly to adjacent said casing, a conical surface of said shaping plug making an angle of less than about 45° to an axis of said liner, and a shaped charge extending radially between said liner and casing with a rear inclined surface contiguous said conical shaping plug, a nose plug within said casing around said liner and shaped charge, a forward face of said shaped charge and a rear face of said nose plug being contiguous and forming an angle of less than about 45° to an axis of said liner, and a hot wire initiator ring coaxial with said liner within said casing and around a base portion of said shaping plug for firing said shaped charge substantially simultaneously throughout 360° around a rear and radially outer end portion of said charge whereby all portions of a detonation wave from said shaped charge are better synchronized to enhance the penetrating ability of said charge.

2. A shaped charge according to claim 1 in which a steel plug is provided projecting from said shaping plug with a forward end portion of said steel plug being conical and projecting into said liner with at least a portion of its conical surface in prolongation of the contiguous faces of said shaping plug and shaped charge.

3. A shaped charge according to claim 2 in which a sensitive high explosive known as pentaerythrite tetranitrate surrounds said initiator ring.

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