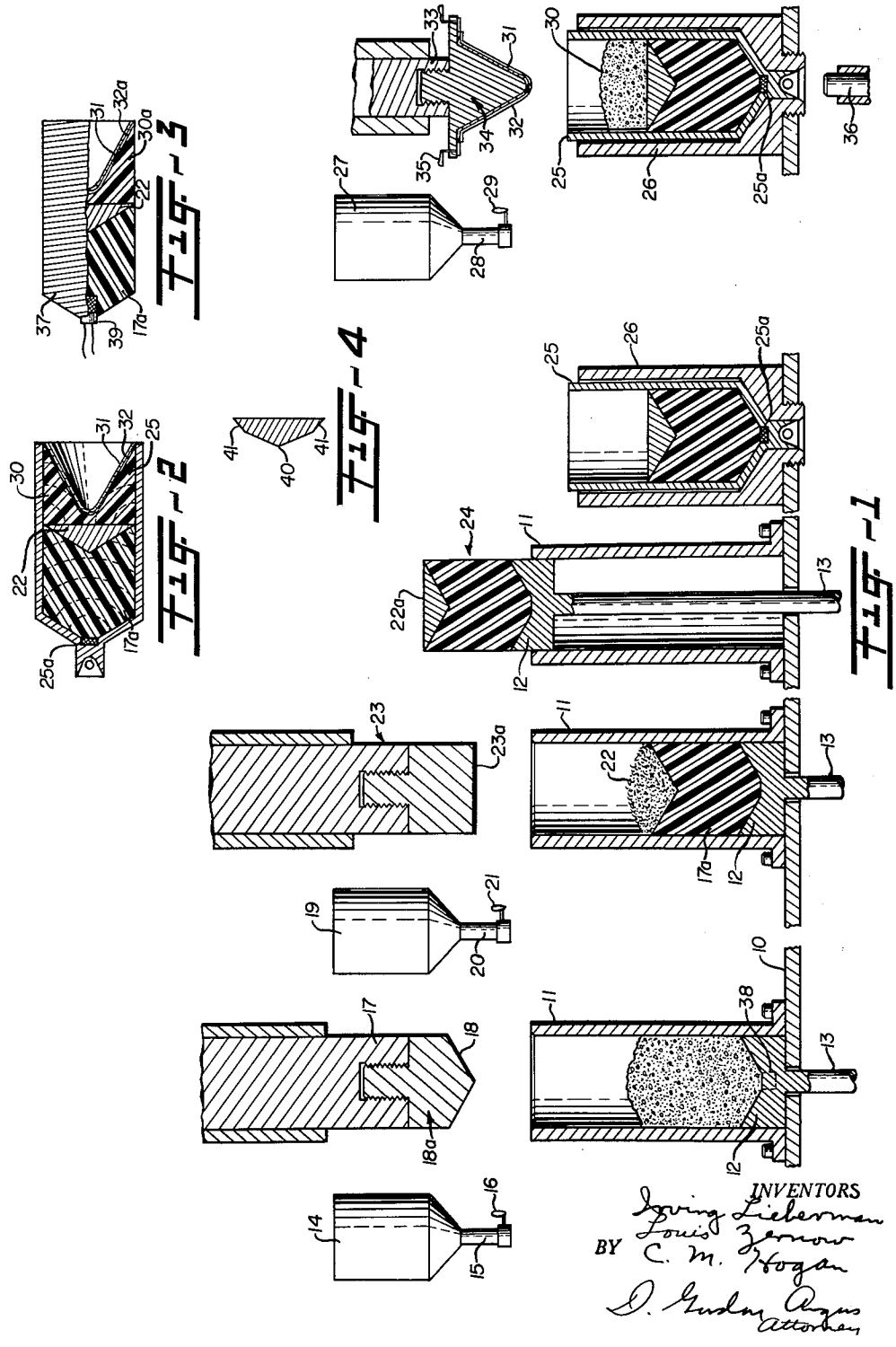
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METHOD FOR PRODUCING A SHAPED CHARGE

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METHOD FOR PRODUCING A SHAPED CHARGE

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This invention relates to the field of high explosives generally and more particularly to a method and means for producing a controlled detonation wave front with cased high explosives operating as shaped charges.

The contemplated major use of the invention is in the preparation of shaped charges and the invention will be specifically described with relation thereto, but it is to be understood that in its wider aspects the invention is not limited to the shaped charge field.

The invention is particularly directed to the use of detonation wave shaping devices in a manner to provide maximum advantage therefrom in the formation of a high velocity jet.

It is obvious that when dealing with high explosives, which are those having speeds of detonation in excess of about 5,000 meters per second, extreme accuracy is required in the form given the components of a charge. To the best of our knowledge, no method or means of securing the required degree of accuracy in a consistent manner permitting uniform reproduction has been hitherto known. It is thus a principal object of the present invention to provide a method of and means for producing high explosive shaped charges, incorporating shaping means for the detonation wave front, which is simple and accurate in operation and produces uniform and satisfactory results.

It is a further object of this invention to provide a method of and means for producing shaped charges incorporating wave shaping means by which a particular type of hole and depth of penetration in the target or strata to be perforated may be selectively obtained with minor adjustment of the means for producing the charges.

With the above and further objects and features of the invention which will appear from the following specification and accompanying illustrative drawings in view, the invention relates to a method of producing a shaped charge provided with a wave shaping device comprising the steps of molding a quantity of a high explosive in deformable condition to the configuration of the rear portion of the charge and to shape the forward face of said rear portion to receive a wave shaping device, positioning a wave shaping device against the forward face of said rear portion when hard, molding over said wave shaping device a forward portion of the high explosive charge in plastic condition having the same diameter as the rearward portion of the high explosive charge, positioning a liner element in the forward end of said forward portion of the high explosive while in plastic condition, and providing said shaped charge with an outer covering effective to provide a rigid structure, together with means to detonate said shaped charge.

In the drawings:

FIG. 1 is a diagrammatic layout of suitable equipment to produce shaped charges including wave forming devices according to this invention.

FIG. 2 is a longitudinal section of a shaped charge produced by the elements shown in FIG. 1.

FIG. 3 is a longitudinal section of an uncased shaped charge containing a wave shaping device produced by an alternate technique, differing from that by which the shaped charge shown in FIG. 2 is produced.

FIG. 4 is a central section through a modified form of wave shaping device.

Referring now to FIG. 1 the numeral 10 indicates a

table upon which a hollow cylindrical die 11 is mounted. The die 11 is open at its upper end and of the same interior diameter as that of a charge case in which the charge is to be mounted if a cased shaped charge is to be produced.

The bottom 12 of the die is provided by the head of a plunger 13 vertically moved by any suitable means in a later stage of the cycle to eject the contents of the die.

The head of the plunger is formed to exactly produce the rear of the charge to a contour which will exactly fit the bottom of the charge case.

A supply vessel 14 is positioned as the first of the succession of mechanisms carrying out the production of the shaped charge of the invention. For simplicity of illustration the high explosives are shown as in the form of powders compacted by pressure in the die, but it is to be understood that the supply vessels might equally well be used to dispense melted high explosive which when cooled to a jelled condition can be formed in the same way as when in powdered form.

The supply vessel 14 is provided with a delivery spout 15 controlled by valve 16. A predetermined amount of the powdered explosive is discharged into the die 11 which is then brought under a ram 17. The ram is forced downwardly by any suitable means as is well known in the art, under pressure which compacts the explosive to a dense mass as indicated at 17*a* in the next forming stage of the shaped charge.

In order to be capable of forming a forward contour of the forward face of the first high explosive charge of any required form, it is preferable to provide the operative face 18 of ram 17 as a detachable fitting 18*a*.

The ram 17 is then withdrawn and the table moved to carry the die 11 under a second supply vessel 19 fitted with delivery spout 20 controlled by valve 21 which contains granular material from which the wave shaping device is to be formed.

The wave shaping device is required to prevent the detonation wave arising from the detonation of the rear explosive charge from impinging as a uniform spherical, nearly planar wave front against the liner, but rather to cause the wave front to conform more nearly to the shape of the liner. For the conical liner shown, the wave shaper is given the form of a cone.

It will be noted that the operative face of the ram 17 was of conical form. If the granular material 22 delivered into the die is compacted into the conical recess in the forward face of the rear charge of explosive by a flat operative surface on another ram, the required conical shape of the wave-shaping device will be secured, the amount of the material being such that the edge of the wave shaping device is thin.

The material from which the wave shaping device is formed is advantageously a material such as powdered lead which has a specific gravity of about 9 but various materials may be used, the heavier metals being preferable in order to conserve space.

The table 10 is moved to bring the die 11 under a second ram 23 which is furnished with an exchangeable operative face 23*a* and the ram forced under pressure produced by any suitable means into the die. The amount of the material 22 is adjusted to be only sufficient under the pressure exerted to fill the cavity in the rear charge of explosive, thus providing a thin edge to the wave shaping device as shown at 22*a*. Preferably, although not necessarily, the wave shaping device is made with a diameter the same as that of the charges of high explosive of the shaped charge.

Alternatively the wave shaping device 22*a* may be separately and accurately formed and then placed in the recess provided therefor when the plunger 23 is raised, for instance by a cam or lever, not shown, to enable the

shaped rear charge of high explosive to be raised clear of the die as shown at 24.

The wave shaping device may be given various forms for which reason the operative face 23*a* of the ram 23 is formed on a detachable fitting so that different forms from that shown may be produced.

The shaped rear charge of high explosive is then positioned in the shaped charge case 25 which has been previously provided with a booster charge 25*a* positioned in a recess at the rear of the case. The case 25 may be positioned in a supporting fitting 26 and the table 10 moved to bring the case 25 under a third supply vessel 27 provided with a delivery spout 28 and control valve 29 therefor.

The supply vessel 27 contains a supply of high explosive in melted form, a measured quantity of which is delivered into the case 25 as indicated at 30.

A liner member 31 shown as in the form of a thin metal cone is then pushed into the forward high explosive charge before it solidifies. The outer surface of the liner member 31 is coated with a coating of tacky material 32 such as an asphalt or similar paint compatible with the high explosive which serves to hold the liner 31 securely to the forward charge of explosive and to the shaped charge case.

Although the positioning of the liner may be effected manually, it may advantageously be effected by moving the table 10 to position below a plunger 33 fitted with a changeable head 34 contoured to the shape of the liner which is detachably held on the head 34 by clamps 35 which may be swung out of way just prior to the liner being fully inserted in the forward body of high explosive.

The cased shaped charge may be removed when completed from the fitting 26 by an ejector plunger indicated at 36.

It is to be understood that the various mechanisms illustrated are well known, as are means for operating them and are shown by way of illustrating suitable mechanism for producing shaped charges by a continuously operated method or process which may be either wholly or partly carried out mechanically.

For instance, the mechanisms may be carried by a rotated table indexed automatically from station to station.

When an uncased shaped charge is to be produced, the case 25 and supporting fitting 26 would not be required, all steps being carried out in molds 11 and the completed shaped charge bound into a rigid unit with a binding of adhesive tape 37, FIG. 3, such as "Mylar" or other plastic waterproof material treated with adhesive. When producing an uncased shaped charge, the upper face 12 of the plunger 13 would be furnished with an upstanding plug, not shown, which could be screwed into a threaded socket 38, FIG. 1, thus forming a recess into which a detonator 39 and booster charge held in a tubular case could be inserted. An uncased shaped charge is shown in FIG. 3, the component parts being indicated by the same numerals as in FIG. 2 with the addition of the subscript *a*.

Numerous high explosives processed to withstand pressing into molds are known, such as densitized RDX, and particulars of such explosives suitable for use under various conditions may be found in the technical literature of the art.

The wave shaping devices may be given various forms as for instance that shown in FIG. 4 in which the wave shaper 40 is shown as relatively thick except at its edges 41. In all cases the function of the wave shaper is to restrict the passage of the detonation wave from the rearward body of explosive to the forward body of explosive to definite zones. In the forms of wave-shaper shown

the propagation of the detonation wave will be forwardly through the thin circumferential edge of the wave shaper as indicated by the curved lines in FIG. 2.

By the combination of a particular form of wave-shaper and liner a wide control is afforded over the type of hole to be made by the shaped charge and increased penetration of the target by the jet is obtained.

Preferred embodiments of the invention have been specifically described herein by way of example but not as limitative of the invention since various modifications may be made therein by those skilled in the art without departing from the scope of the invention as defined by the appended claims.

We claim:

1. A method for producing a shaped charge provided with a wave shaping device comprising: molding a predetermined quantity of high explosive to form a rearward charge in a hollow cylindrical die having the exact configuration of the rear surface of the charge by a ram under pressure and sliding exactly into said die and having its operative face shaped to the exact contour of the rear surface of a predetermined shape of a wave-shaping device; withdrawing said ram; depositing a quantity of powdered metal on the rearward charge of high explosive, compacting the powdered metal into a compact mass to form a wave shaping device, depositing a predetermined second quantity of high explosive in deformable condition in said die on the front face of said wave shaping device; pressing into said second quantity of high explosive a liner element coated on its outer face with an adhesive holding it in place in said second quantity of high explosive; ejecting the moulded charge from said die; securing the shaped charge into a cohesive unit; and securing a detonating element in contact with the rear of said rearward charge of high explosive in a location on the axis of said shaped charge.

2. A method for producing a shaped charge for insertion into a cylindrical shaped charge case containing a booster charge in a rear recess opening into said case comprising: molding a predetermined quantity of a first charge of high explosive in a cylindrical die having the same diameter as said case and a bottom configuration conforming exactly to the configuration of the bottom of said case by using a plunger under pressure and sliding exactly into said die and having its operative face shaped to the exact contour of the rear surface of a predetermined shape of a wave-shaping device, withdrawing said plunger, depositing a quantity of powdered metal into the die, compacting the powdered metal into a compact mass to form a wave shaping device, withdrawing said plunger and ejecting the molded first charge and wave shaping device in position thereon, and depositing it in the shaped charge case; depositing a predetermined second quantity of high explosive in plastic condition in said case on the front face of said wave shaping element; and pressing into said plastic second quantity of high explosive a liner element coated on its outer face with an adhesive holding it in place in said second quantity of high explosive and in said case.

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