July 27, 1965 G. FRANCIS ETAL 3,196,791

METHOD OF RUPTURING WALLS

Filed June 6, 1962

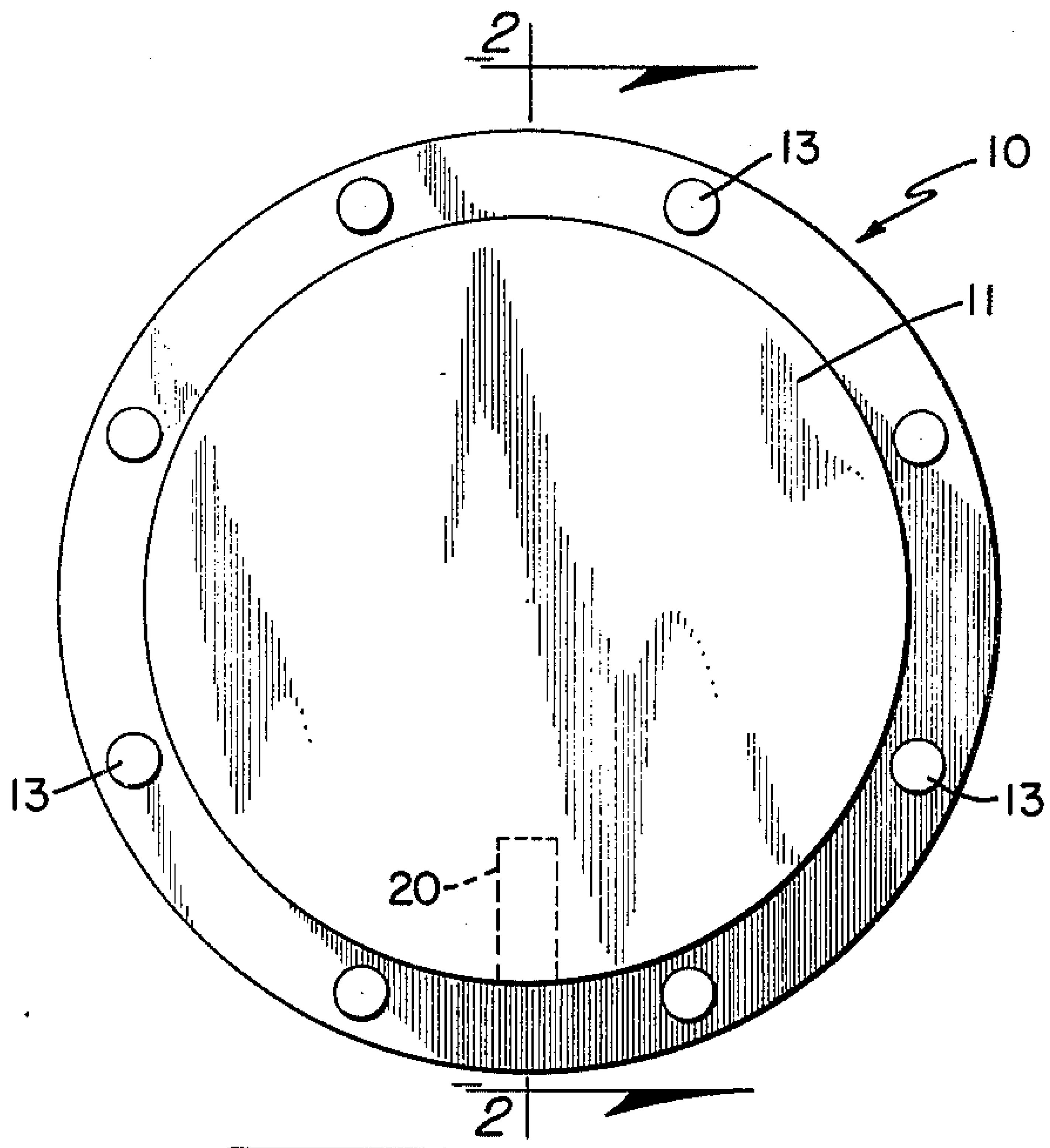

FIG. 1

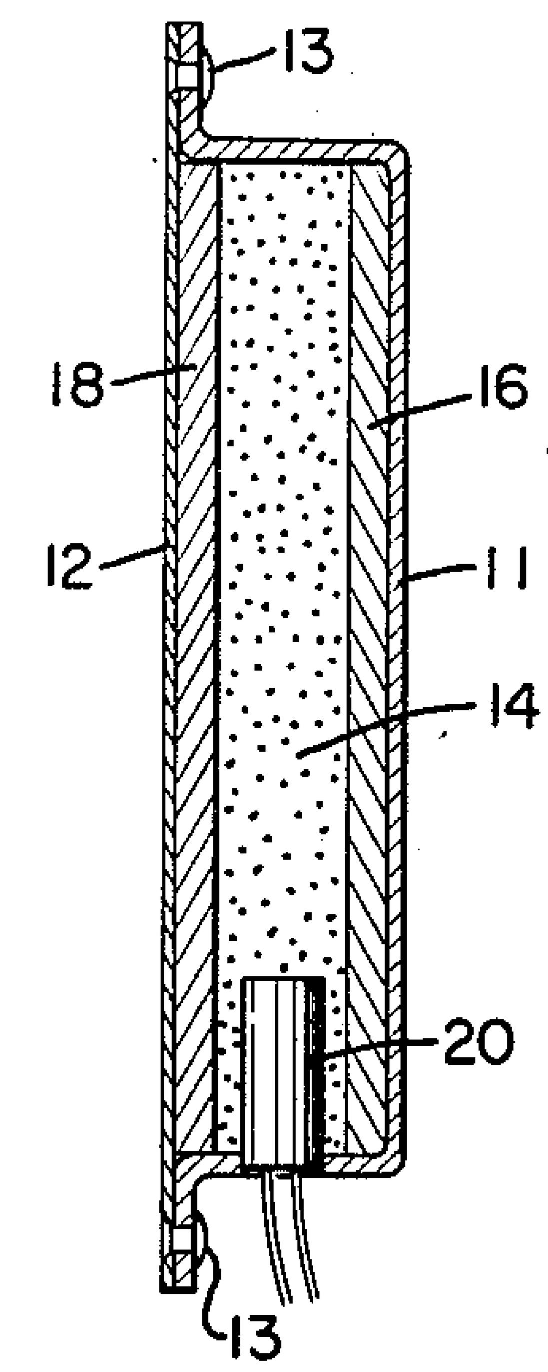

FIG. 2

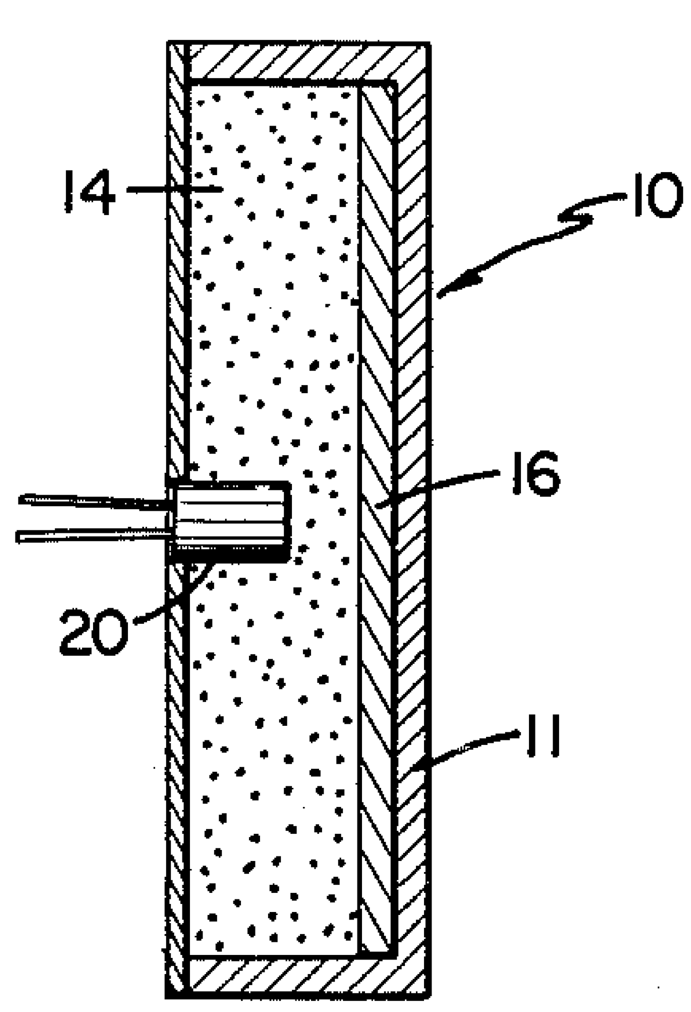

FIG. 3

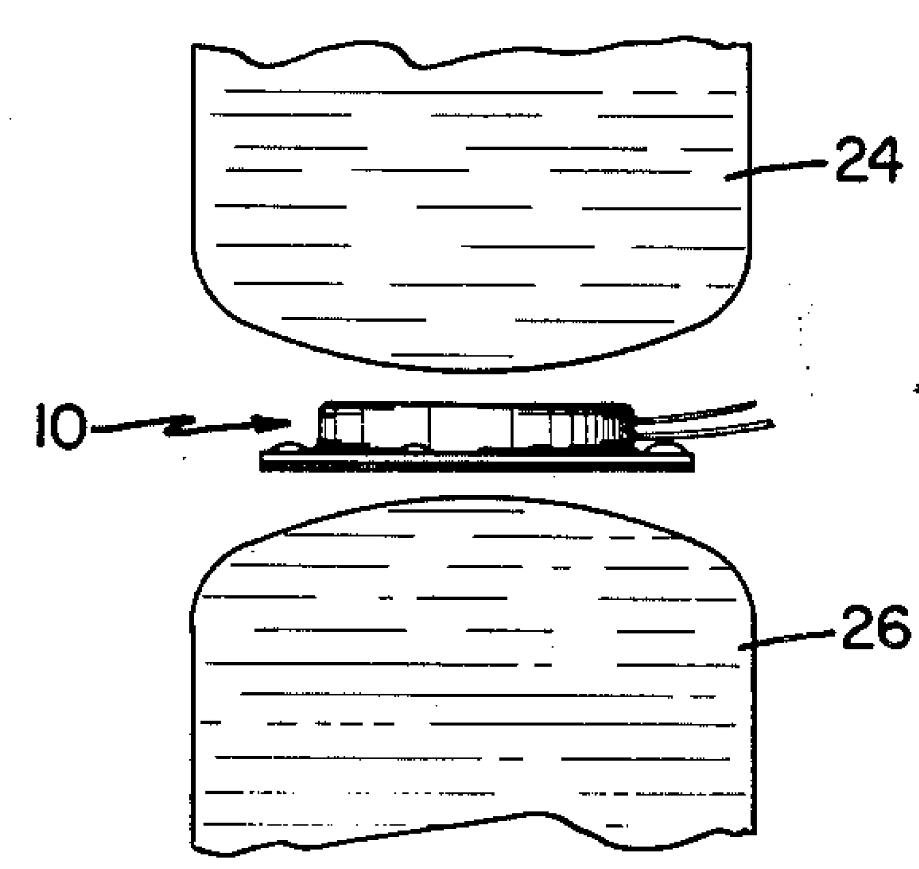

FIG. 4

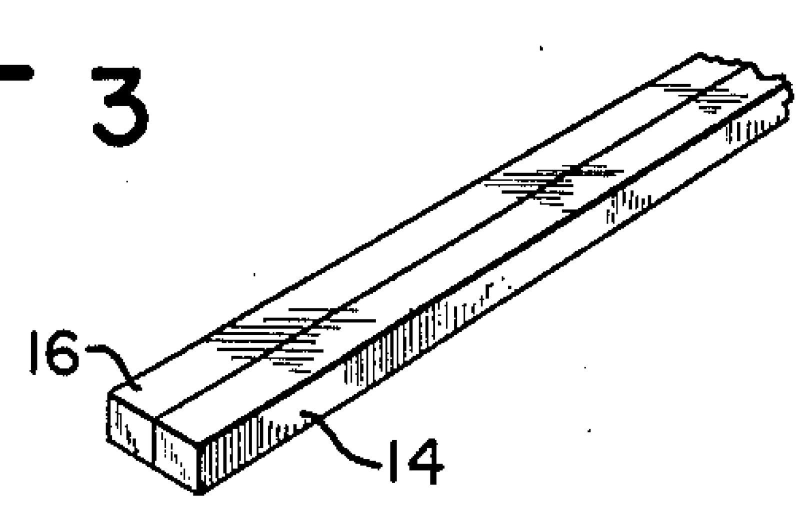

FIG. 5

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United States Patent Office
3,196,791
Patented July 27, 1965

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3,196,791
METHOD OF RUPTURING WALLS

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Filed June 6, 1962, Ser. No. 200,379
5 Claims. (Cl. 102—23)

This application is a continuation-in-part of our application Serial No. 145,709 filed October 17, 1961, entitled "Wafer Destruct Charge."

This invention relates to a method and apparatus for directionally propelling projectiles by means of explosives without the aid of a projection chamber.

The present invention is principally concerned with the use of explosively propelled metal projectiles for simultaneously rupturing fuel tanks of missiles and destroying boosters and other mechanism of space vehicles and other jet propelled devices, for the purpose of self-destructing the devices when they are off-course and have assumed eratic and uncontrolled paths of travel. The invention will be described and illustrated principally in connection with this application but it is by no means limited thereto.

It is now standard practice to incorporate self-destruct devices in missiles and in propelling devices for spacecraft to provide for automatic self-destruct of the device when it is off-course. Ordinarily, self-destruct devices rupture fuel tanks which results in destruction of the missile either through loss of pressure in the fuel tank, loss of fuel, explosions, or for other reasons. In the case of missiles fueled with hypergolic propellants wherein fuel and oxidizer are carried in separate tanks, self-destruct is achieved by simultaneously rupturing both tanks to permit the fuel and oxidizer to come together and ignite so that the resultant violent reaction rips the missile apart, terminating the mission.

Achieving self-destruct by causing structural damage to tanks or parts of missiles is ordinarily accomplished with explosive bombs or shaped charges. Bombs or shaped charges are placed against the outside fuel tank walls, against domes of fuel tanks, or upon the guidance mechanism.

This method of achieveing self-destruct is subject to a number of disadvantages. The damage to missile parts must be directional and specified and if two tanks containing hypergolic fluids are to be ruptured, rupturing of both tanks must be accomplished substantially simultaneously. When bombs are used, the fragmentation of the metal case is random and fragment particle sizes vary so that it is difficult to precisely control the direction of particles with accuracy to achieve destruction in the specified areas.

When linear shaped charges are used, damage is greatest when standoff distances are exact and predetermined and this is not always possible of attainment. Shaped charges are more effective in penetrating thick masses of material and causing damage within a narrow specified radial diameter. When used against targets which require a wide area to be destructed, shaped charges are ineffective. Even when bombs or shaped charges can be placed against the outside tank walls, against domes, or upon the guidance mechanisms, failures often result in propagation of the shock wave due to sharp bends or poor contact between joining strands.

Now that missiles and space vehicles are traveling outside the atmosphere where the creation of shock waves by explosives is no longer possible, the use of explosive devices is further limited. For example, when bombs are used to rupture domes of propellant tanks in the atmosphere, the failure of the domes is caused principally by air blast waves since fragmentation is random and uncontrollable. Obviously, since it is impossible to form shock waves in outer space this method of destruction cannot be used there.

It therefore is an object of this invention to provide a method and apparatus for directionally and accurately propelling projectiles without the use of a propelling chamber.

It is another object of this invention to provide a method for accomplishing self-destruct of jet propelled missiles.

It is still another object of this invention to provide a method and apparatus for simultaneously rupturing a plurality of missile fuel tanks for the purpose of self-destructing a missile, and

It is a further object of this invention to provide a method and apparatus for accomplishing self-destruct of missiles in outer space where the creation of shock waves is not possible because of the lack of atmosphere.

The invention comprises a method for directionally propelling projectiles which consists in fitting one surface of a substantially flat metal plate which serves as the projectile over a corresponding surface of a sheet of explosive and detonating the explosive to propel the plate flatwise along a desired path with controlled accuracy.

If simultaneous destruction of two or more walls, such as the walls of dual propellant tanks of a missile, is required, a metal plate is arranged on each side of the explosive and this arrangement positioned between the two walls so that upon detonation of the explosive the walls will be substantially simultaneously ruptured with the two plates. A principal feature of the invention is the selection of a metal, such as, lead or alloys containing at least ten percent lead which will not fracture or be prohibitively deformed by plastic deformation under impulsive loading such as results when the explosive of an explosive-metal interface is detonated. The accuracy of the projectile plate is, of course, achieved by selecting a flat plate which can be propelled in a straight line.

The invention is best described by reference to the accompanying drawing in which like parts are represented by like numerals and in which,

FIG. 1 is a plan view of an assembled destruct device in which two circular plates are used to form a wafer, one on each side of a sheet of explosive;

FIG. 2 is a cross sectional view on the line 2—2 of FIG. 1;

FIG. 3 is a cross sectional view of a destruct device in which only one plate is used as the projectile;

FIG. 4 is a schematic showing of the destruct device of FIGS. 1 and 2 arranged between propellant tanks, one containing oxidizer and the other containing fuel, the mixture of fuel and oxidizer forming a hypergolic mixture when mixed; and

FIG. 5 is a perspective view of a modification (schematic) of the destruct device in which a rectangular shaped wafer is used, the case being omitted.

Referring to FIGS. 1 and 2, the self-destruct device **10** is illustrated with the outer metal case **11** of aluminum bolted to the back **12** of the case by means of bolts **13** or other suitable means.

Referring to FIG. 2, a sheet of explosive charge is represented at **14** sandwiched between two lead plates **16** and **18** to form a wafer destruct charge. Any conventional explosive can be used, such as, TNT, PBX, composition A, PETN, or other type explosives. The material of the plate is critical for use of the device in the atmosphere and as discussed below must be one which responds properly when an explosive adjacent to its surface is detonated. Preferably, lead and alloys containing at least ten percent lead are used as the metal must be one which will not fragment or become prohibitively deformed by the explosion before travelling an adequate distance. The outer case is not an essential part of the invention but merely serves as a support to hold the lead plates securely against the face of the explosive before detonation of the explosive. Other equivalent means for accomplishing this can obviously be used. As will be seen, the mating surfaces of explosive and lead plates are flat, and the plate surfaces conform perfectly to the surfaces of the explosive charge.

For detonating the explosive a detonator **20** of a conventional design is provided with lead wires connected to an initiator not shown.

Reference is now made to FIG. 3 in which a modification of FIG. 2 is shown. In this modification a single lead plate **16** is used on one side of the explosive charge **20**, the assembly of explosive and plate being surrounded by case **11** in this modification. The detonator **20** in this instance is positioned centrally of the explosive charge on the side opposite of the target, as shown.

FIG. 4 shows the destructor device **10** illustrated in FIG. 2 positioned between two propellant tank domes **24** and **26** for simultaneous rupturing of the two domes. In this application the tanks will be ruptured substantially simultaneously by the metal plates on either side of the explosive when the explosive is detonated.

In the modification of FIG. 5, the destruct device is constructed of flat lead rods and a flat rod of explosive, the length dimension being large in relation to the width dimension. In this modification the thickness of the lead plate or slab is ⅛″ while that of the explosive is ½″, although these dimensions are not critical.

It is essential that the projectile plates be projected directionally and with accuracy. This can only be accomplished if the mating surfaces of explosive and metal are flat and conform perfectly with no substantial voids in between. The amount of explosive used will of course be a factor in the extent of impulsive loading to which the lead projectile plates will be subjected. The size of the metal plates will also be a factor in the operation of the destruct device.

The plates are preferably made of lead or alloys containing at least about 10% of lead. The metal which may be used for the material of the projectile plates is one which will not fracture when the explosive of the metal-explosive interface is detonated. It has been found that when the metal plate is placed on top of the explosive as in the modifications described, plates of lead and alloys containing at least ten percent lead perform most satisfactorily. Other metals have a greater tendency to fracture and disintegrate before travelling through the atmosphere far enough to accomplish the purpose of the invention. It has been found that lead plates will travel up to ten feet without fracture or other deterioration provided they are flat. Surfaces which are not flat will result in fracture of the plate. The operation of the device can be explained by reference to FIG. 4. In this application the self-destruct device is arranged between two fuel and oxidizer tanks **24** and **26** in a large missile, the fuel and oxidizer being hypergolic. If the missile suddenly travels off course while in the atmosphere or in space the explosive can be detonated automatically or by remote control to propel the plates on either side of the explosive into the propellant tanks to rupture them and permit mixture of the hypergolic fluids. Contact of the fluids with each other results in a violent reaction or explosion which destroys the missile.

It is to be understood that the self-destruct device is relatively small in comparison with other parts of the missile, such as, the tanks, this being one of the reasons for its use. Space and weight limitations on large missiles require the use of a destruct device which is as mall and light as possible.

The self-destruct device described has been tested extensively under conditions accurately simulating destruction of domes of propellant tanks and has proved to be entirely satisfactory. A self-destruct device composed of PETN sheet explosive ½″ thick and a lead plate ⅛″ in thickness and 7″ in diameter was positioned two feet from a dome

10′ in diameter constructed of aluminum alloy .062″ in thickness. Upon detonation of the explosive complete destruction of the dome resulted.

In another application a destruct device comprised of a PETN explosive sheet ½″ thick sandwiched between lead plates ⅛″ thick and 7″ in diameter was mounted in the center of a reinforced propellant tank 10′ in diameter and detonated, with complete destruction of the tank. Numerous tests similar to the above have been equally successful. The device is now being used in large missiles.

The invention has been described by its application to a destruct device for simultaneously destructing opposing walls of missile fuel tanks. Obviously, it is by no means limited to its application in a destruct device as this application is for the purposes of illustration only. The invention may be used in a single projectile device as that shown in FIG. 3 for various purposes. It finds use in any application wherein it is necessary or advantageous to propel a projectile without the use of a projectile chamber. It is thus seen to have many applications in space vehicles and missiles traveling in the atmosphere, or in outer space wherein conventional explosives cannot be used to effect damage by traveling shock waves.

The invention has been illustrated with the use of plates of lead and alloys containing at least ten percent lead as projectiles in the atmosphere. Other metals may be used, particularly, outside the atmosphere.

It is therefore to be understood that various modifications and changes may be made in the construction and arrangement of parts of the present invention without departing from the spirit and scope thereof as defined by the appended claims.

While the term "plate" has been used herein to describe the metal projectile this is not to be considered as restricting the shape of the projectile as practically any shape of projectile can be used, the main requirement being that the adjacent surfaces of explosive and projectile conform and be substantially flat in the preferred modification.

What is claimed is:

1. The method of substantially simultaneously rupturing a plurality of walls which comprises positioning a flat plate of a material from the class consisting of lead and alloys containing at least ten percent lead in front of each wall with one face of each plate facing a wall and the other face of said plate contiguous to and conforming to a face of an explosive charge, and detonating said explosive charge to simultaneously and directionally propel said plates flat-wise against said walls to rupture them.

2. The method of simultaneously rupturing spaced apart walls of two fuel tanks to release therefrom fluids to be mixed, which comprises: placing a piece of explosive material having at least two flat opposed parallel faces between said spaced apart walls of said tanks and spaced apart from said tanks with each of said faces facing a corresponding one of said walls; supporting a flat plate contiguous to each of said opposed faces, each plate conforming precisely to the corresponding face of explosive and being of a material from the class consisting of lead and alloys containing at least ten percent lead; and detonating said explosive; whereby each of said plates is propelled flat-wise and directionally against the wall it faces to shatter it and thereby permit mixing of said fuels.

3. The method of simultaneously rupturing a plurality of walls which comprises: supporting a piece of explosive material having a flat face corresponding to each of said walls in a position such that each face is facing a wall to be ruptured; supporting a flat plate of metallic material contiguous to each face, each of said plates conforming precisely to the corresponding face of explosive and being of a material from the class consisting of lead and alloys containing at least ten percent lead; and detonating said explosive; whereby each of said plates is propelled flat-wise and directionally against the wall it faces to rupture it.

4. The method of claim 3 in which the said flat surfaces of said explosive charge are parallel.

5. The method of rupturing a wall of a body which comprises supporting a flat plate having frontal surface dimensions greater than its thickness of a material from the class consisting of lead and alloys containing at least ten percent of lead in front of said wall with one face of the plate facing a wall and in line therewith and the other face of said plate contiguous to and conforming to a wall of an explosive charge; and detonating said explosive charge to propel said plate directionally against said wall to rupture it.

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