An igniter of the conventional type consists of layers of explosive substances contained in a casing, at least one of said layers consisting of an igniting primer containing one or a plurality of detonating agents, another usually thinner layer consisting of an explosive. The object of the detonating agent, which has less energy than the explosive, is to ignite the explosive, since, in general, the latter cannot be ignited directly by an external impulse.

Attempts are continuously being made to improve igniters both with respect to sensitivity and in the effect. Sometimes the dimensions are reduced. In connection with impact and friction ignition it has been proposed to introduce an inert body into the igniting primer, the body serving as an anvil when impact ignition is employed. In some cases the introduced body has prevented dividing the detonating composition into two layers. It has been considered important that communication between the igniting layers on both sides of the body be unbroken. In igniters which are not designed to be ignited by pins extending into the igniter there was no cause for introducing an inert body of any kind into the igniter primer. So far as the improvement of the blasting effect of the igniter is concerned, there was normally no other possibility than to select more efficient explosives or to increase the quantity of the same.

The present invention relates to an igniter adapted to be ignited by a shock impulse, for example by impact or a detonation wave, or by a heat impulse, for example an ignition flame, electric spark or incandescent filament, and in which increased ignition sensitivity and explosive effect is obtained. The invention is characterised in that a partition wall made of explosive material is arranged in good contact with a main detonating agent layer and that a thin layer of a detonating agent is arranged on the outside of said wall. Furthermore this partition wall is fitted in the casing to form a dividing wall or partition between the thin detonating agent layer and the main detonating agent layer on the other side of the wall, to prevent free ignition communication between said two layers.

Such an igniter has proved to have a substantially increased sensitivity, for example it is ignited at an appreciably greater distance from a given source of a detonation wave or by a less intensive ignition flame. The explosive effect is also improved to a substantial degree. The reason for this improvement has not been fully discovered. It is however clear that it is caused to a substantial degree by the partition wall inserted in the igniter. This partition acts as a barrier to the detonation wave from the thin detonating agent layer. The detonation wave probably achieves sufficient ignition strength only after the greater part of the detonating agent layer has been ignited. The detonation wave as it passes through the wall then ignites the detonating agent on the other side of the partition simultaneously over the whole of its surface contacting said wall. As a result the time necessary for the acceleration of combustion in the latter detonating agent to full detonation speed is reduced. Any significant delay in the ignition of the thin detonating agent layer should not on the other hand, occur owing to the great speed at which this layer is fully ignited. The ease with which the thin ignition layer is ignited by shock or heat impulse certainly contributes to the sensitivity of the igniter. Ignition occurs even when the thin layer has a very small thickness. Thus a detonating agent layer of 1/2 mm is sufficient. Very surprisingly the sensitivity decreases when the layer thickness is appreciably increased. The greatest thickness which can be used depends, inter alia, on the thickness of the partition wall, but experience has shown that the thickness of the layer should not exceed 4 mm, and is preferably between 1/4 and 1 mm. The most suitable thickness for a partition wall is between 1 and 5 mm. When the thickness of the thin detonating agent layer is between 1/2 and 1 mm, the thickness of the partition wall should be between 1 and 3 mm.

It is possible to use for the partition wall widely different materials such as metal, plastic, wood, ceramic materials, glass, etc. The wall should not however absorb to an excessively large extent the blast wave originating from the thin detonating agent layer. When the ignition is effected by a shock impulse, a soft material should not be used. The most suitable material for the partition wall material such as metal, metal alloys of iron or copper, or glass, but porcelain or hard plastics may also be used. The hardness of the wall is of special significance in impact ignition since the wall then serves as an anvil.

In igniters which are ignited solely by a detonation wave a special advantage is obtained in that the thin detonating agent layer does not have to contain a detonating agent of an extremely sensitive type, for example trinitro, as is usual. It is, for example, advantageous to use only lead azide both in the thin detonating agent layer and in the main detonating agent. In this way the risks accompanying the use of such an extremely sensitive detonation explosive are avoided without reducing the sensitivity of the igniter to the intended impulse.

In an igniter according to the present invention it is also possible to effect ignition by mechanical impact without the use of a pin projecting into the detonating agent. Owing to defects in construction and control, in the use of such a pin often results in unreliable ignition. In a suitable embodiment of an igniter according to the invention a body is mounted for this purpose on the thin detonating agent layer, and the surface of the body that faces the explosive layer is provided with a coating containing sharp-edged, hard and preferably brittle granules, for example of glass, the size of which exceeds the thickness of the thin detonating agent layer. The body must be made so that it can possibly be displaced or pivotable. It is preferably constituted by a washer or foil which is forced into the casing and which may possibly serve as an end closure for the igniter. The coated surface of the body may be planar or convex towards the detonating agent layer.

When the outside of the granule coated body is struck, it is moved towards the detonating agent layer and the granules are forced through the layer towards the partition. The granules act as a large number of teeth points and as a anvil, whereby reliable and rapid ignition is obtained, particularly if the granules are very hard and brittle so that they are shattered on striking the wall. A condition for efficient operation of this ignition system is undoubtedly the small thickness required by the invention of the thin detonating agent layer. In such an igniter ignition occurs to a large extent independently of the shape of the object which is the granule coated body in the igniter. A disadvantage is the risk of accidental ignition. This risk can however be eliminated, conveniently by fitting a protective wall in the form of a disc or strip, which is removable sideways through a slit in the casing between the granule coated surface and the detonating agent layer. An igniter of the above type may likewise be used when
ignition is effected by a detonation wave, for example from an impact fuze. The present invention is also applicable in connection with electrical ignition. In previously used igniters the impulse producing part of the electrical pole system is imbedded in the detonating agent, whereby ignition progresses from one point in all directions which results in a delayed acceleration of the combustion up to detonation speed.

However, the impulse producing parts of the pole system do not have to be imbedded in the detonation composition. It is sufficient if they are in good contact with the layer of the detonating agent.

According to the embodiment of the present invention the electrical pole system is mounted in the casing of the igniter on the outside of the thin detonating agent layer so that the impulse producing parts of the pole system are in contact with said layer. The impulse producing member may be an incandescent wire, preferably surrounded with beads of a detonating agent but may also be pole ends for producing an electric spark. In the latter case the one pole is preferably shaped as a ring which is concentrically fixed in the end of the casing of the igniter in good contact with the wall of the casing, and the other pole is in the form of a central rod inserted into this ring and insulated therefrom, for example by a plastic ring. In this embodiment a good and reliable contact between the pole system and the detonating agent layer may be achieved. In these embodiments of an igniter in which ignition is initiated by a heat impulse, either by electrical flame, or heat, which is produced in connection with electric ignition, the thin detonating agent layer should contain a substance sensitive to the ignition flame, for example trinitro, which on the other hand does not have to be included in the other detonating composition. This is a great advantage, inter alia, from the manufacturing point of view.

The invention will now be described in greater detail with reference to the accompanying drawings, which illustrate three embodiments of an igniter according to the invention.

FIG. 1 is a vertical cross sectional view of an igniter which may be considered the basic form and is adapted to be used for ignition by a detonation wave, for example by a blast jet from a fuze or by a heat impulse, for example an ignition flame.

FIG. 2 shows a similar view of an igniter which is ignited by impact but which also may be ignited by a detonation wave.

FIG. 3 shows a similar view of an igniter for electrical ignition by means of a spark.

The igniter according FIG. 1 has a cylinrical metal casing 5 with openings 1 and 9 at its ends. In this metal casing there are located two layers 3 and 6 of detonating agents, mainly consisting of lead azide or silver azide, a blasting explosive layer 7 of trityl or other usual secondary blasting explosive and an approximately 2 mm. thick partition of metal, for example of copper or iron. This metal partition 4 is arranged to separate the two layers of detonating agents from each other. The detonating agent layer 3 forms an approximately 0.75 mm. thin layer which is applied to the front side of the partition wall. At the opening 1 the layer 3 of the detonating agent is covered by an aluminum foil 2, and the lower end of the trityl layer 7 as seen in FIG. 1 is covered by a disk 8 of metal or plastic located at the lower end of the casing 5.

In this embodiment the igniter is adapted to be ignited by a pressure wave, for example a detonation wave from a fuze. For ignition by flame the thin detonating agent layer 3 ought to contain an additive of trinitrate for increasing the ignition sensitivity.

The igniter according FIG. 2 has a metal casing with end closures, contains detonation layers and a partition, the parts of which are of substantially the same character as in the igniter of FIG. 1, and are therefore designated in the same manner. The partition is made of steel, glass or similar hard material. The end closure 12 is made of aluminum or thin steel plate, for example at the end of the casing, for example by bonding. On its inner side this foil is provided with a coating containing sharp-edged, substantially freely projecting granules 12', preferably having a size which exceeds the thickness of the detonating agent layer 3 so that the point of the granules, when subjected to an external impulse or pressure impulse against the foil 12', are caused to penetrate the layer, the partition wall 4 then serving as an anvil. Between the granule coating 12' and the detonating agent layer 3 there is fitted a safety disc 2' which is removable sideways, so as to be withdrawn from the casing 5 through a slit in the wall of the casing.

In FIG. 3 also, the casing, detonating agent layers, the partition and the base end closure are designated as in FIG. 1. A cylindrical body containing a pole system for spark ignition is arranged in the casing 5. This body consists of a conductive pole sleeve 13 and a pole pin 15, which is fixed in the sleeve by a filling 14 of enamel or plastic. The cylindrical body is arranged with its two poles in contact with the detonating agent layer 3. The latter consists of silver or lead azide having a 3% addition of graphite for promoting the spark formation.

The igniters illustrated are adapted to ignite a blasting charge, but may also be used for igniting other explosive products, such as pyrotechnics, in which case the explosive layer 7 may be omitted. Further detonating agent layers of other explosives may be included in the igniter.

The invention is not restricted to the illustrated embodiments, and a plurality of modifications may be adopted within the scope of the claims.

What we claim is:

1. An igniter comprising a sleeve, end closures at opposite ends thereof, a main detonating layer containing a detonating agent, a thin detonating layer containing a detonating agent, and a partition wall of explosively inert material arranged between the two detonating layers so as to fill the total cross-section of said sleeve to prevent free ignition communication between said detonating layer; said main detonating layer being in contact with the entire area of one face of said partition wall, said thin detonating layer being arranged in contact with the entire area of a second face of said partition wall, and having a thickness which is less than the thickness of the partition wall.

2. An igniter comprising a sleeve containing a detonating material, a non-explosive partition wall embedded in said detonating material, said partition wall having an area which completely fills the total cross-section of said sleeve to divide the detonating material into a thin layer and a main layer, said thin layer being an initiating charge layer covering one face of said partition wall, said main layer being thicker than said first layer and being in direct contact with the opposite face of said partition wall where-by the main detonating layer is initiated only after the greater part of the thin detonating layer has been ignited, and said thin layer having a thickness less than the thickness of said partition wall.

3. An igniter comprising a sleeve containing a detonating material, a non-explosive partition wall embedded in said detonating material, said partition wall having an area which completely fills the total cross-section of said sleeve to divide the detonating material into a thin layer and a main layer, said thin layer being an initiating charge layer covering one face of said partition wall, said main layer being thicker than said first layer and being in direct contact with the opposite face of said partition wall whereby the main detonating layer is initiated only after the greater part of the thin detonating layer has been ignited, and said thin layer having a thickness less than the thickness of said partition wall, said thin layer having a thickness substantially between 0.5 mm. and 1 mm., said partition wall having a thickness substantially between 1 mm. and 3 mm.
4. An igniter comprising a sleeve, end closures at opposite ends thereof, a main detonating layer containing a detonating agent, a thin detonating layer containing a detonating agent, a partition wall of non-explosive material arranged between the two detonating layers, internal igniting means for igniting said thin detonating layer, said main detonating layer being in contact with the entire area of one face of said partition wall, said thin detonating layer being in contact with the entire area of a second face of said partition wall, said partition wall having an area which fills the total cross-section of said sleeve to prevent free ignition communication between said detonating layers and said thin layer having a thickness less than the thickness of said partition wall.

5. An igniter according to claim 4 wherein said partition wall is made of hard material to enable said partition wall to serve as an anvil.

6. An igniter according to claim 5, wherein said thin layer has a thickness substantially between 0.5 mm. and 1 mm., and the partition wall has a thickness substantially between 1 mm. and 3 mm.

7. An igniter comprising a sleeve having a slot therein, end closures at opposite ends thereof, a main detonating layer containing a detonating agent, a thin detonating layer containing a detonating agent, a partition wall of non-explosive material arranged between the two detonating layers, internal igniting means for igniting said thin detonating layer, said main detonating layer being in contact with the entire area of one face of said partition wall, said thin detonating layer being in contact with the entire area of a second face of said partition wall, said partition wall having an area which fills the total cross-section of said sleeve to prevent free ignition communication between said detonating layers, said internal igniting means comprising a body facing said thin layer and spaced a small distance from said thin layer, said body being movable toward said thin layer, the surface of said body being provided with a coating containing hard, brittle granules, said movable body comprising a foil forming one of said sleeve end closures, and a protective sheet adapted to be removed from the igniter through said slot in said sleeve.