

[54] APPARATUS FOR AMMUNITION DISPOSAL

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[22] Filed: June 16, 1971

[21] Appl. No.: 153,639

[52] U.S. Cl. 86/1 R, 86/1 A, 102/1 R,
432/45

[51] Int. Cl. F42b 33/00

[58] Field of Search 102/1; 89/1; 86/1;
432/45, 46; 219/21, 25

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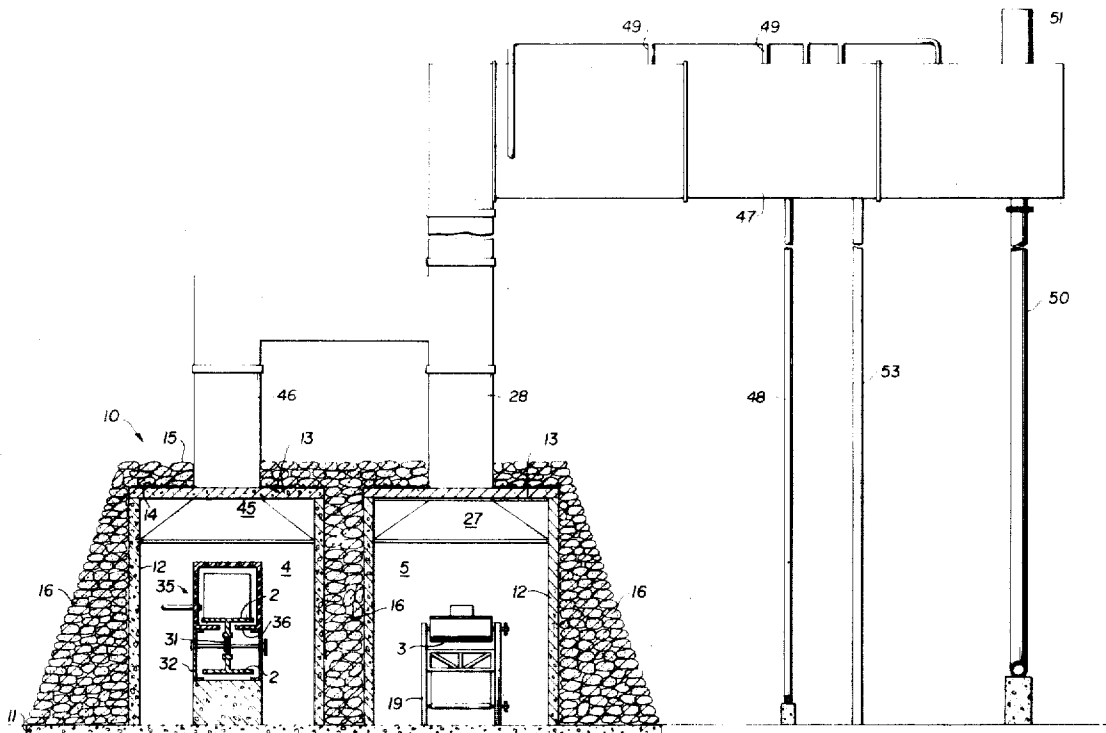
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[57] ABSTRACT

A bunker has therein a light charge and a heavy charge chamber with light and heavy charge conveyors, respectively, extending therethrough. Burners within the light charge chamber ignite light charges therein, and resultant ashes fall through the links of the light charge conveyor onto a cinder conveyor. Within the heavy charge chamber is an explosion chamber having separate preheat, main heat and detection sections. In both the light and heavy charge chambers are located charge presence detectors which activate time relays. Subsequently, the charges are scanned by temperature detectors, whereby if the charges have not been ignited, the conveyors will be shut down. In the heavy charge chamber, the temperature detector may be replaced by an acoustic shock detector.

12 Claims, 6 Drawing Figures



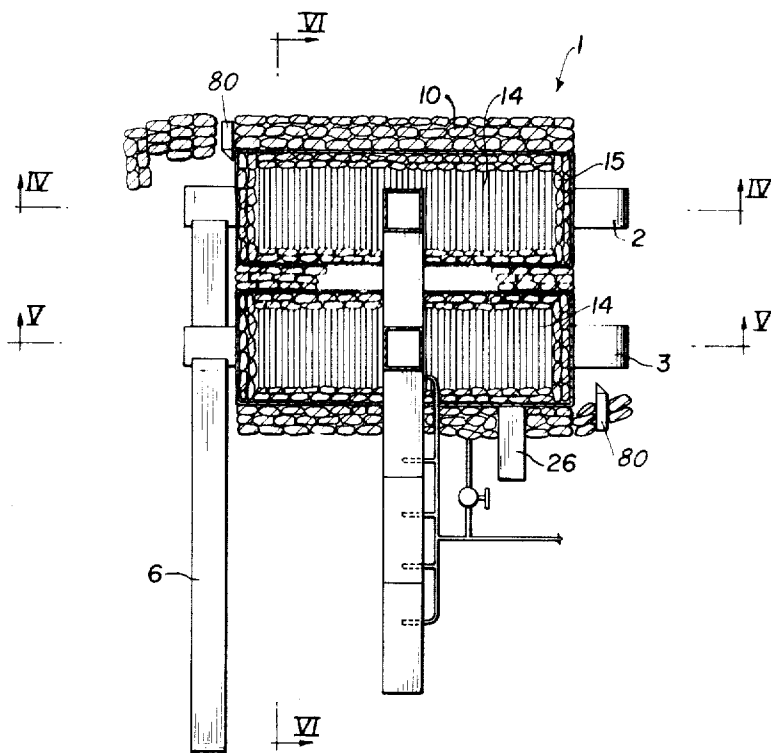


FIG 1

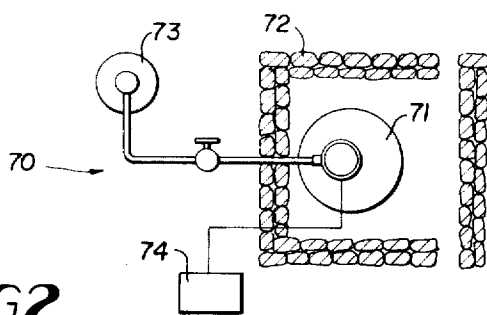
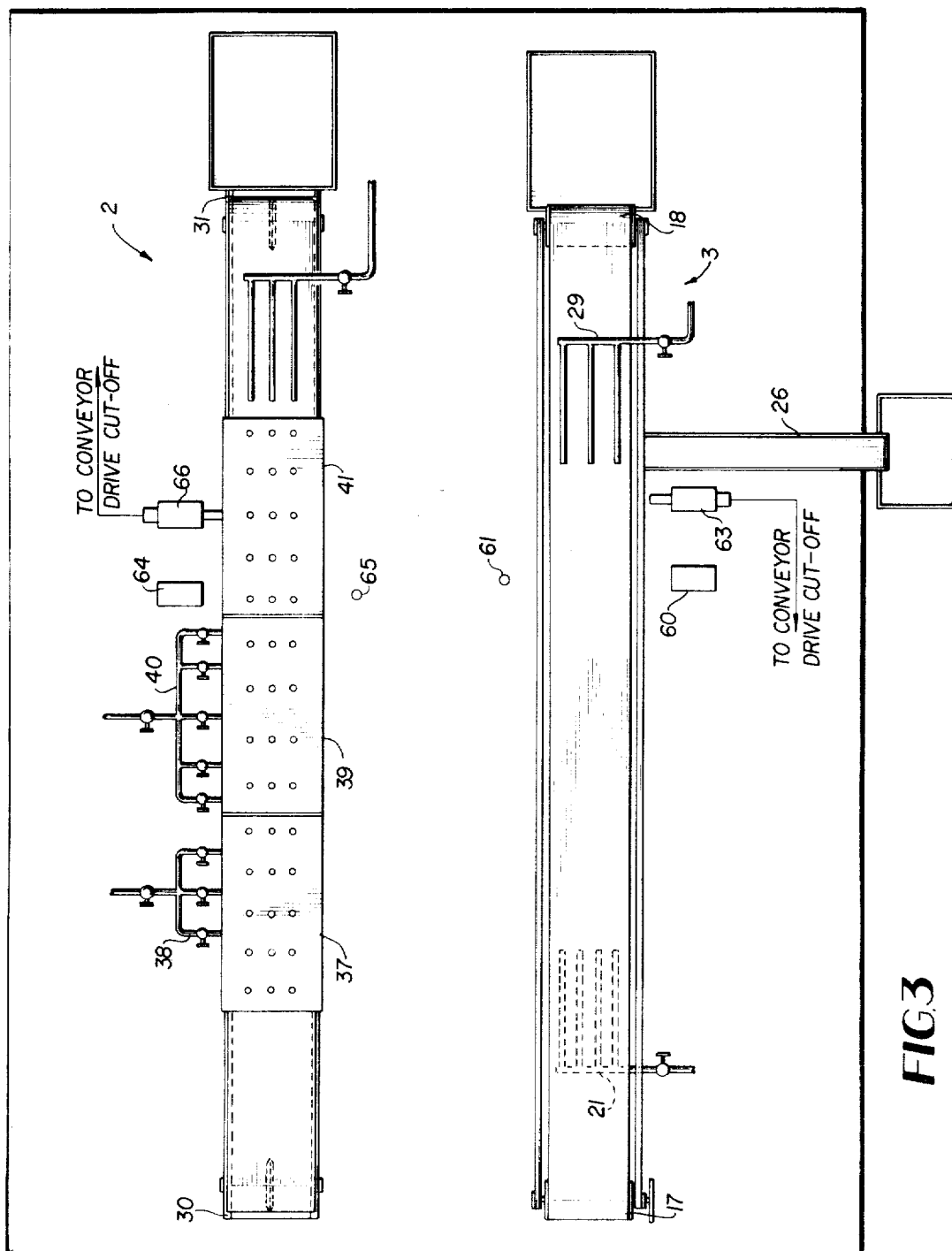


FIG 2

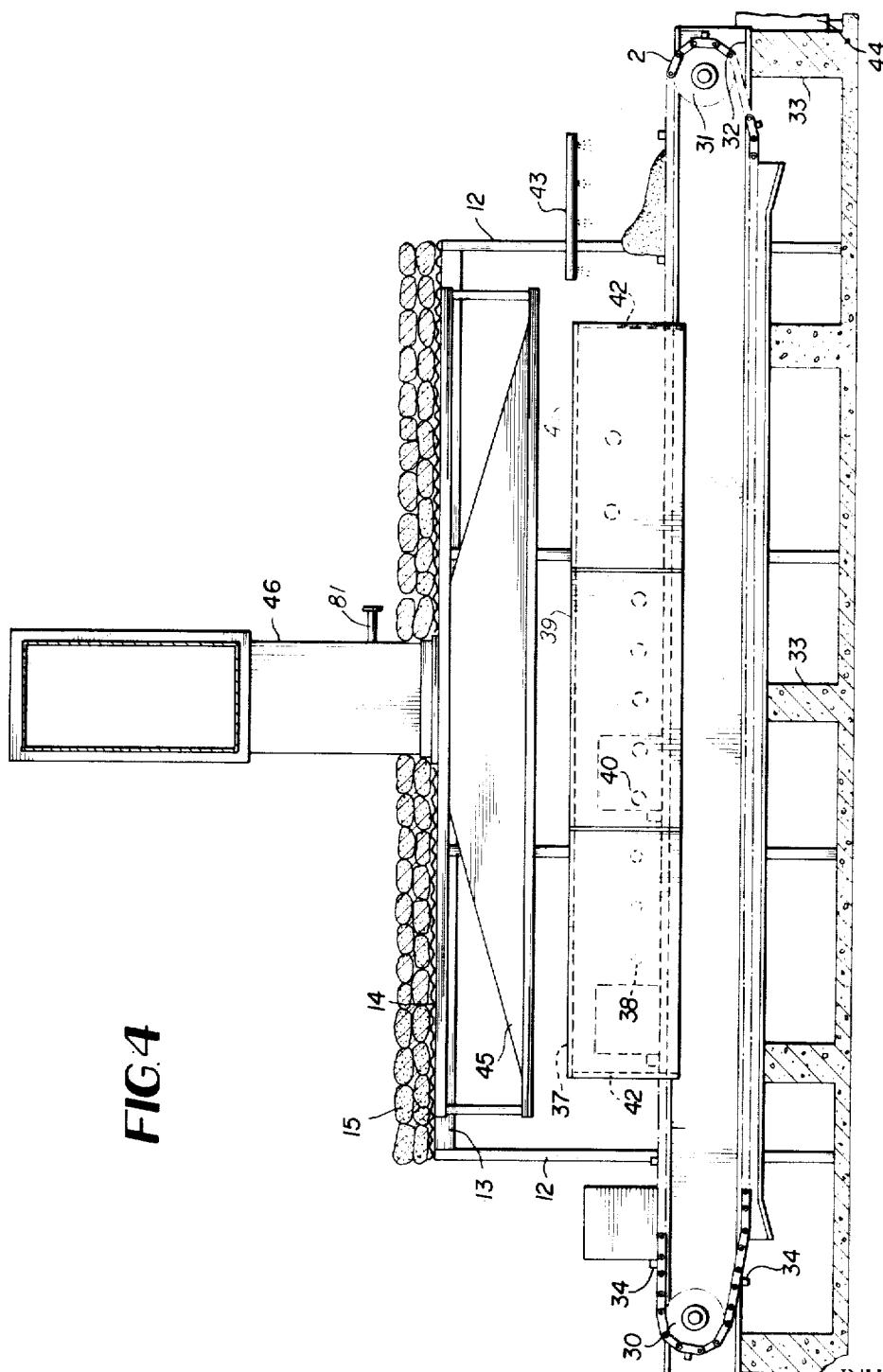
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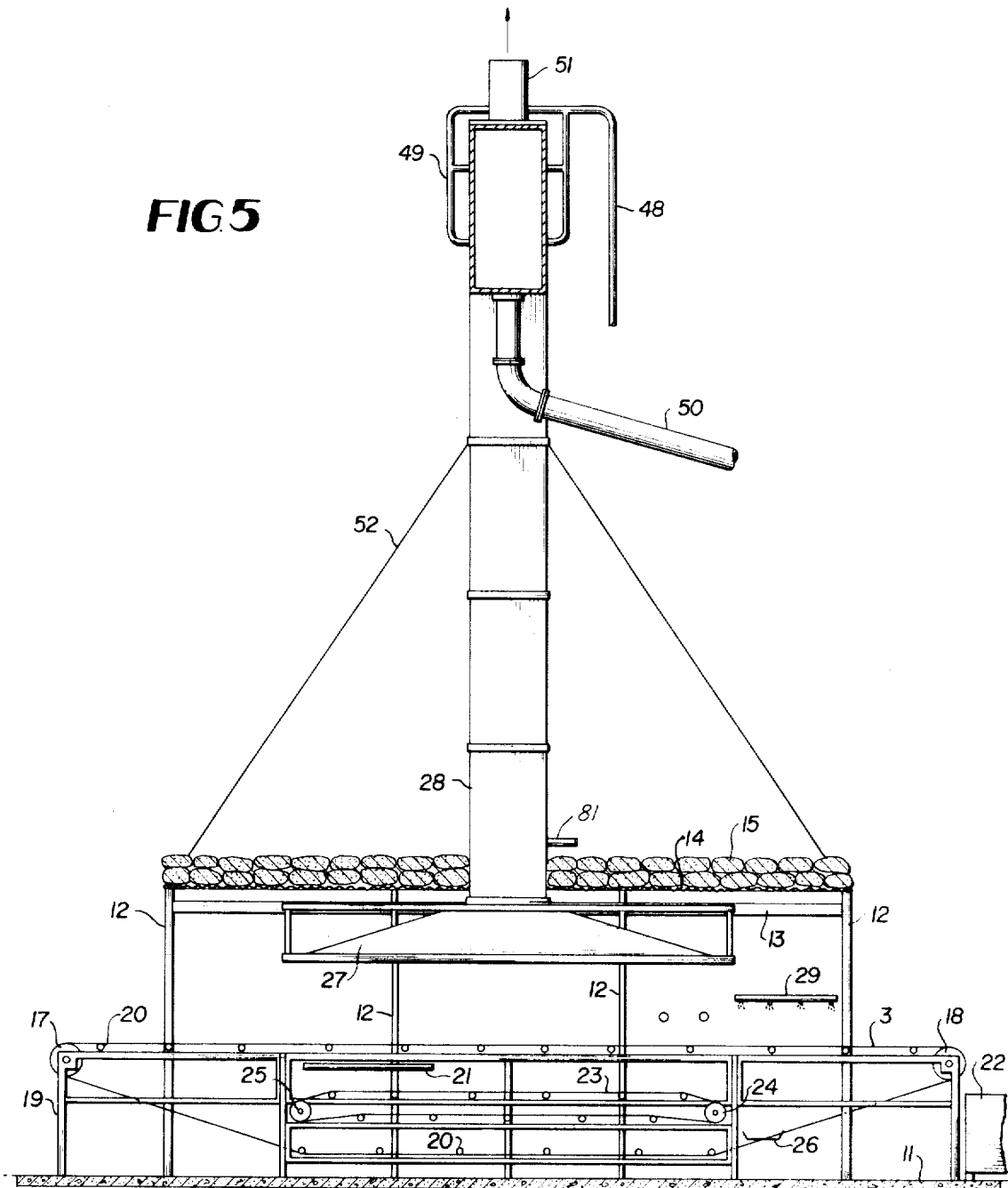
FIG. 4



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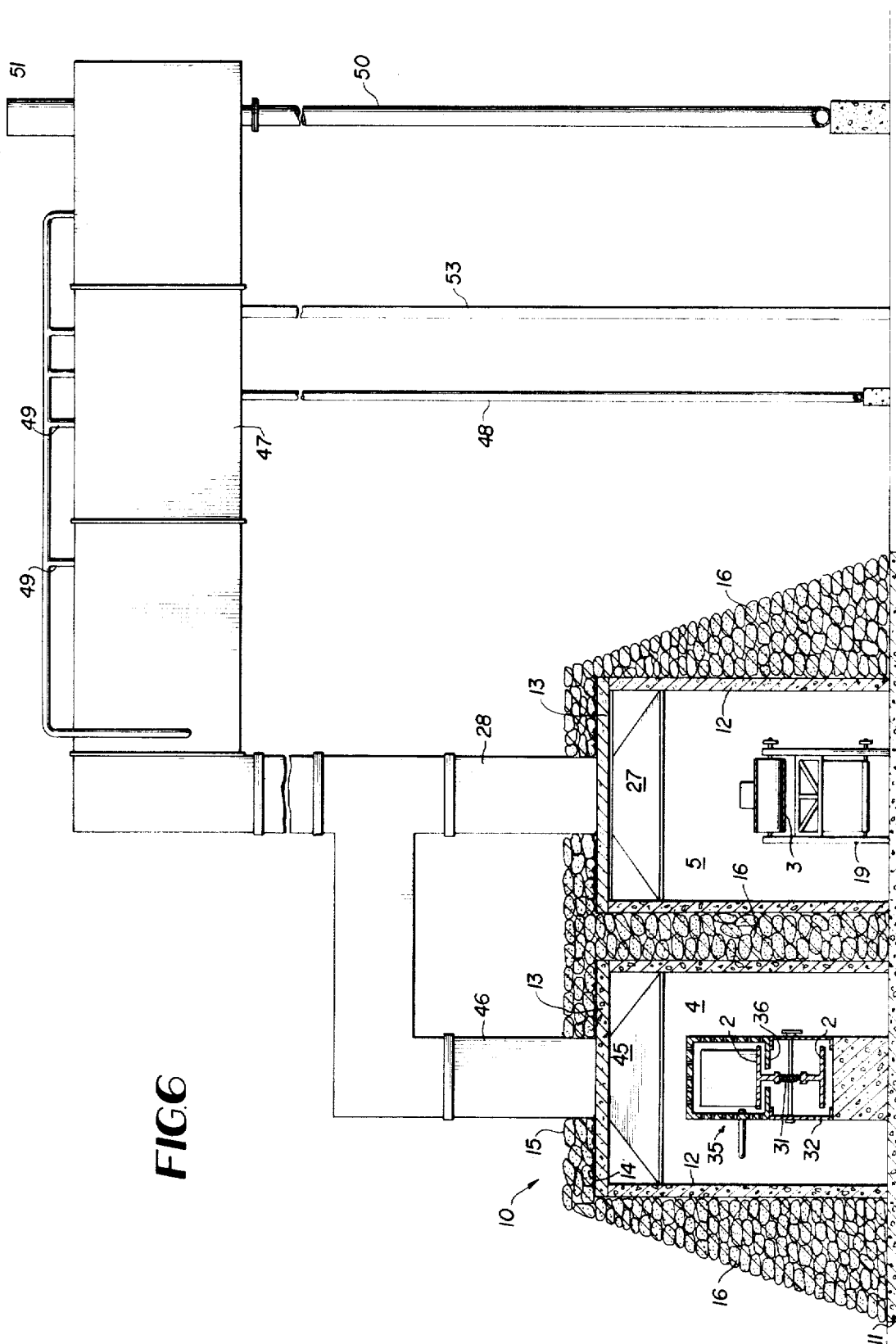
FIG 5



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FIG. 6



APPARATUS FOR AMMUNITION DISPOSAL

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a method and apparatus for the disposal of ammunition, for instance ammunition such as fuses or primer caps.

More particularly, the present invention relates to such a method and apparatus wherein the ammunition is disposed of by igniting the charge thereof under controlled temperature conditions.

Even more particularly, the present invention relates to such a method and apparatus capable of continuous and automatic operation.

2. Description of the Prior Art

Heretofore, the disposal of large quantities of unused ammunition has been an extreme problem. All prior disposal attempts have been for various reasons unsatisfactory.

One commonly used disposal method is to merely dump the ammunition at sea. This is of course extremely expensive. Furthermore, large quantities of metals such as brass, bronze and stainless steel which could otherwise be reclaimed are lost. This method also represents a threat to the environment.

Another prior disposal method involves the uncontrolled burning of the ammunition. In addition to resulting in the loss of otherwise reclaimable metals, this method is extremely dangerous.

Up to now, the most involved prior art disposal system employs the use of a rotary kiln. However, although capable of some degree of temperature control, such system still has numerous disadvantages. First, the only source of heat for ignition is a single relatively large flame opening, thereby creating the possibility of passing a projectile. Second, in order to heat large quantities of ammunition with a single flame, it is necessary to require a large heat input. This results in the entire kiln attaining a relatively high temperature, and thus necessitates the use of expensive materials throughout the kiln. Also, explosion relief can be from the ends of the kiln only. The most important disadvantage of this system, however, is the difficulty in controlling erratic movement of the irregularly shaped ammunition through and along the kiln. This makes it virtually impossible to accurately control the temperature of the ammunition.

OBJECTS AND BRIEF DESCRIPTION OF THE INVENTION

With the above discussion in mind, it is a principal object of the present invention to provide a method and apparatus for the disposal of unused ammunition by ignition under controlled temperature conditions.

It is a further object of the present invention to provide such a method and apparatus by which either relatively light or relatively heavy charges can be ignited.

It is a yet further object of the present invention to provide such a method and apparatus which is of continuous and automatic operation.

It is a still further object of the present invention to provide such an apparatus which may be operated safely to insure that a nonignited charge will be detected and prevented from leaving the unit.

It is even a still further object of the present invention to provide such an apparatus which may be manufac-

tured inexpensively and which may be operated efficiently.

These objects are achieved in accordance with the present invention by the provision of an ammunition disposal system including a bunker having therein a light charge chamber and a heavy charge chamber. Extending through the heavy charge and light charge chambers are heavy charge and light charge conveyors, respectively. Heavy or light charges of ammunition are supplied to the respective conveyors by suitable feed conveyors. The interior of the light charge chamber includes suitable burners for heating the chamber. As the chamber is heated, the light charge is heated to a preset temperature and ignited. Near the exit end of the light charge chamber is a temperature monitor including a photosensitive device and a radiation pyrometer. Movement of an object through the chamber is detected by the photosensitive device to start a time delay. Further movement of the object through the chamber will cause the object to be scanned by the pyrometer. If the temperature of the object has not reached a preset temperature above the predetermined ignition temperature of the object, the time delay will be allowed to continue, and the conveyor will be shut down. On the otherhand, if the temperature of the object has reached the preset temperature, the time delay will be interrupted and reset, whereby the conveyor will be allowed to continue.

The heavy charge is ignited in a similar manner. However, the heavy charge conveyor moves through a three second explosion chamber within the heavy charge chamber. This explosion chamber is made of heavy steel and has therethrough suitable smoke escape ports. The first section of the explosion chamber is a preheat section for preheating the heavy charge. The second section is the main burner section for primary heating and ignition of the heavy charge. In the third section of the chamber, temperature detection is carried out. This may be done with a photosensitive device and a pyrometer, as is the case in the light charge chamber. However, an acoustic shock detecting device may be substituted for the pyrometer. Such device would detect the shock created by the explosion of the heavy charge, and this detection could be used in the same manner as the positive detection of a predetermined temperature by the pyrometer to control the movement of the conveyor. The waste from both the heavy charge and the light charge chambers may be conveyed to and deposited in suitable waste receptacles. The exhaust gases may be conveyed by suitable smokestacks and scrubbed in a scrubber box to eliminate particulate matter.

Other objects, features and advantages of the present invention will be made clear by the following detailed description taken together with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a plan view of the overall ammunition disposal system of the present invention;

FIG. 2 is a partially schematic plan view of an ignition temperature determining station in accordance with the present invention;

FIG. 3 is a detailed plan and partially schematic view of the system in accordance with the present invention, but for the sake of clarity, without the inclusion of the bunker thereof;

FIG. 4 is a view partially in cross-section and partially in elevation taken generally along the line IV—IV of FIG. 1;

FIG. 5 is a view partially in cross-section and partially in elevation taken along line V—V of FIG. 1, but with the smokestack scrubber system thereof fully shown; and

FIG. 6 is a view partially in cross-section and partially in elevation taken along line VI—VI of FIG. 1.

DETAILED DESCRIPTION OF THE INVENTION

With reference now to the drawings, a preferred embodiment of the method and apparatus of the present invention will be described in more detail.

The ammunition disposal system 1 includes a bunker 10 having extending therethrough a heavy charge chamber 4 and a light charge chamber 5, a heavy charge conveyor 2 extends through heavy charge chamber 4, and a light charge conveyor 3 extends through light charge chamber 5. Suitable ammunition charges are adapted to be supplied to conveyors 2 and 3 by feed conveyor 6.

The system 1 is supported on a suitable concrete slab 11. Attached to slab 11 are suitable upright support beams 12, preferably made of steel. Joining upright beams 12 are horizontal support beams 13 to provide a bunker frame. The top of the bunker frame is covered by light weight sheets, such as corrugated aluminum or steel sheets 14. Around the edges of sheets 14 are placed a number of means, such as sandbags 15, for holding sheets 14 against the bunker frame. Across the spaces between upright beams 12 is spread flexible netting such as wire mesh or fencing. Sandbags 16 are then piled around the bunker frames against the netting. It will be apparent that the combination of sheets 14 and sandbags 15 and the vertical netting and sandbags 16 provide for a bunker having flexibility sufficient to insure relief from the ignition of large charges interiorly thereof.

Light charge conveyor 3 is mounted around a drive sprocket 17 and an idler sprocket 18 journaled for rotation in a suitable frame 19 mounted on slab 11. A plurality of rollers 20 are provided on frame 19 to further support and facilitate the movement of conveyor 3. Light charge conveyor 3 may be of any suitable design and material which will resist temperatures and pressures attained in chamber 5. In the preferred embodiment however, conveyor 3 is a link chain belt made of 25–20 chrome nickel alloy.

Light ammunition charges are supplied to light charge conveyor 3 from feed conveyor 6. The term "light charge" as herein used, normally refers to individual primer caps or fuses, the explosive charges of which weigh from one to two ounces. It is of course to be understood that larger charges may be found useable in the light charge chamber. A light charge conveyor 3 moves the light charge thereon from the left to the right as viewed in FIG. 5, burners 21 positioned beneath conveyor 3 will cause the charge to be heated. In the preferred embodiment, burners 21 are supplied by a gas such as propane. However, it is to be understood that many other types of burners can be used. When the charge reaches its ignition temperature, it will be ignited. Residual metal will be deposited by conveyor 3 in waste collection bin 22. Also, due to the fact that there are spaces between the links of conveyor 3, the resultant ashes will fall through the conveyor 3 to be

deposited on a cinder conveyor 23. This conveyor is mounted in a conventional manner on frame 19 such as by drive sprocket 24 and idler sprocket 25. The ashes collected on cinder conveyor 23 are deposited in cinder removal chute 26. Smoke resulting from the ignition of the light charge is collected by smoke hood 27 and conveyed through smokestack 28. Smoke hood 27 and smokestack 28 are supported by the bunker frame. Positioned at the exit of low charge ignition chamber 5 is a water quench 29. Water quench 29 consists of a plurality of water pipes connected to a suitable source of water and adapted to direct a spray downwardly onto the residual metal and any ashes remaining on conveyor 3.

The heavy charge conveyor 2 is mounted around a suitable drive sprocket 30 and an idler sprocket 31 which are journaled for rotation in a frame 32 mounted on support piers 33. The support piers 33 may be conveniently constructed of concrete, reinforced if so desired. Heavy charge conveyor 2 is made of very heavy duty material to resist the force of detonation of the heavy charge. In the preferred embodiment, heavy charge conveyor 2 is a chain conveyor of the type commonly referred to as "mill or draw works chain". Such a chain conveyor has no gaps or holes therethrough. At suitable spacings along conveyor 2, for instance every fifth link, are attached transverse bars 34. These bars act as draw bars to convey a heavy charge supplied from feed conveyor 6.

As herein used, the term "heavy charge" normally refers to many individual primer caps or fuses together, often packed in their original shipping container.

Due to the force of the explosion of the heavy charge, a three section explosion chamber 35 is provided within chamber 4 to surround conveyor 2 while conveying the heavy charge. Explosion chamber 35 is formed from heavy steel, preferably of at least 1.5 inch minimum thickness, and is supported by frame 32. The upper length of conveyor 2, that is that section of conveyor 2 conveying the heavy charge, is supported by the bottom plate 36 of explosion chamber 35. The top and sides of explosion chamber 35 have openings 35a therein to permit escape to combustion gases and also to provide relief of the detonation pressures.

The first section of the explosion chamber is preheat section 37 which has extending therein burners 38 for providing initial heat to the heavy charge. The second section of the explosion chamber 35 is main burner section 39 which has main burners 40 extending therein and wherein detonation of the heavy charge occurs. The third section of explosion chamber 35 is detection section 41 having therein a detector to be described in more detail below. Burners 38 and 40 extend through certain of the openings 35a so as to not impinge flame directly on the chamber. At the inlet and outlet ends of explosion chamber 35 are provided flexible, but strong, chain link nets or mats 42 to contain the force of explosions within the explosion chamber. The nets 42 are sufficiently flexible, to not impede the entrance and exit of the heavy charge. Second section 39 may be enclosed in a reflective material to reduce heat loss therefrom. Also, section 39 is made from a material having a relatively high chromium content to thereby resist oxidation. Sectioning of the explosion chamber tends to interrupt the possibility of free flow of heat there-through, thus also helping to avoid heat loss from section 39.

The exploded heavy charge is quenched by suitable water quench 43 similar to water quench 29. The ashes or waste are then deposited by conveyor 2 into waste collection bin 44. Waste gases are collected by smoke hood 45 and conveyed to smokestack 46.

As shown in FIG. 6, smokestack 46 is joined to smokestack 28, and the waste gases from both smokestacks are thus conveyed to scrubber box 47 for removing particulate matter therefrom. Water is supplied from inlet 48 to spray pipes 49 which spray chilled water onto the waste gas. The resultant heated water along with particulate matter is collected by water return line 50. The particulate matter may be trapped by conventional means, and the water from return line 50 may be recycled into supply line 48. The waste gas having particulate matter removed therefrom is exhausted to the atmosphere through stack 51. Guide wires 52 may be provided as necessary or desired to support smokestack 28. Also, one or more support legs 53 may be provided for supporting scrubber box 47.

The primary safety controls of the present invention will now be described. A presence detection device is positioned adjacent the discharge end of chamber 5. For instance, a light source 60 provides a light beam across light charge conveyor 3 in a manner to be interrupted by a light charge thereon. Photosensitive device 61 is positioned opposite light source 60. As an object such as an exploded light charge is moved along by conveyor 3, it interrupts the light beam to photosensitive device 61. This interruption initiates a time delay relay. As the object proceeds further, it comes into the view of temperature detector 63. In the preferred embodiment, temperature detector 63 is a radiation pyrometer. If the temperature of the object has reached a predetermined "working temperature," to be discussed in detail below, the time delay relay is interrupted and restored. However, if the temperature of the object has not reached the "working temperature," then pyrometer 63 will not interrupt the time delay relay. Therefore, the time delay relay will shut down the conveyor 3. Additionally, time delay relay may desirably sound an alarm. Once the conveyor has been shut down, it will not restart automatically. Accordingly, it will be apparent that it is impossible for a light charge which has not been exploded due to malfunction of the system to be discharged from conveyor 3. It is to be understood that photosensitive device 61 and temperature detector 63 may be any conventional device other than those specifically shown.

Heavy charge conveyor 2 has a similar control consisting of light source 64, photosensitive device 65 and temperature detector 66. The operation of these elements is exactly the same as the safety elements discussed above with regard to conveyor 3. However, due to the fact that the heavy charge conveyed by conveyor 2 may explode with a substantial noise, an explosion detector may be substituted for the temperature detector 66. Such an explosion detector might be any conventional acoustic shock detector. The signal from the shock detector might be used to interrupt or not interrupt the time delay relay in the same manner as the temperature detector 66.

With reference now to FIG. 2 of the drawings, the determination of the "working temperature" will be explained. Those skilled in the art will realize that each type of ammunition charge will have a different ignition temperature, that is the temperature at which explosion

occurs. Therefore, it is not possible to set the ammunition disposal system of the present invention to operate at one temperature to dispose of all types of ammunition charges. To insure that the system is operating at a temperature to cause explosion of a given ammunition charge, the ignition temperature of each batch of charges should be determined. This may be done at a separate ignition temperature determining station 70 located a safe distance from the ammunition disposal system 1. Station 70 includes a test chamber 71 adapted to receive an ammunition charge. A gas source 73 is adapted to supply fuel to a burner located within chamber 71. The charge is placed in chamber 71, and the temperature thereof is slowly and uniformly increased, while such temperature is measured by a suitable temperature sensor 74. It will be apparent that the ignition temperature of each individual charge may thus be determined after sampling several charges from a given batch of ammunition. From this ignition temperature a safe "working temperature" may be determined. Preferably, the working temperature is said to be a suitable increment such as 200°F. above the ignition temperature of a given batch of ammunition. Based upon this working temperature, the amount of fuel to be supplied to burners 21 or 38 and 40 is determined. This also allows the settings of temperature detectors 63 and 66 to be made.

As discussed above, it is impossible to accurately list the ignition temperatures or working temperatures for all ammunition. However, generally the temperatures involved for ignition would be between 900° and 1500°F. It is of course to be understood that given batches of ammunition might have ignition temperatures below or above this range.

It is furthermore to be understood that successful heating and ignition of the ammunition charges is a function not only of temperature, but also of the speed of conveyors 2 and 3. That is, the charges must remain in chambers 4 and 5 long enough to be heated to their ignition temperatures. Accordingly, and since the ignition temperatures of various batches of ammunition will vary, it is desirable to be able to vary the speeds of conveyors 2 and 3 to insure that each charge is heated a sufficient amount to reach the ignition temperatures thereof. Thus, the means (not shown) for driving sprockets 17 and 30 are preferably made variable. It will be recognized that it is not possible to list the lengths of times which the various charges will be in the chambers. However, these times are generally contemplated to be from 5-25 minutes.

It is also to be understood that the circuitry between the conveyor drives and sensors 60, 61, 63, 64, 65 and 66 will be conventional. Therefore, and for purposes of clarity, a detailed description of such circuitry has not been included.

The system 1 may also have other automatic operational features. For instance, the burners 21, 38 and 40 might be supplied with flame detectors. Thereby, if for some reason, one of the burners were not lit, an alarm could be sounded or the conveyors 2 or 3 could be shut down. Also, switches such as pressure switches could be positioned widthwise across conveyor 3 to detect the presence of more than a single charge at a given longitudinal position along the conveyor. Such switches could be wired to sound an alarm or shut down the conveyor if such condition existed, thereby insuring that

each charge is subjected to scanning by temperature detector 63.

It is to be further understood that system 1 may include suitable means such as periscopes 80 for viewing the interior of chambers 4 and 5.

Also, if desired, smokestacks 28 and 46 may be supplied with suitable explosive mixture detectors 81 to insure gases exhausted by the system contain no flammable material.

Furthermore, it is to be understood that the disposal of ammunition other than primer caps or fuses is intended to be within the scope of the present invention.

Although a preferred embodiment of the invention has been described in detail, such description is intended to be illustrative only, and not restrictive, since many details of the construction of the invention may be altered or modified without departing from the spirit or scope thereof.

What is claimed is:

1. An ammunition disposal system comprising a bunker having therein a light charge chamber and a heavy charge chamber, a light charge conveyor extending through said light charge chamber, a heavy charge conveyor extending through said heavy charge chamber, means to supply light and heavy charges of unused ammunition to said light and heavy charge conveyors, respectively, means to drive said conveyors to cause said charges on said conveyors to be moved through said chambers, means in each of said chambers for heating said charges above the ignition temperature thereof, means positioned in each of said chambers for automatically determining whether said charges have been ignited and for stopping said drive means if said charges have not been ignited.

2. A system as claimed in claim 1, wherein said bunker comprises a solid supporting frame and sides and a top enclosing said frame and being sufficiently flexible to absorb shocks due to ignition of said charges.

3. A system as claimed in claim 1, wherein said light charge conveyor comprises a link chain belt made of material suitable to withstand temperatures and pressures involved in the ignition of said light charge.

4. A system as claimed in claim 3, further comprising a cinder conveyor mounted in said light charge chamber for movement beneath said light charge conveyor for removal of ashes resulting from the ignition of said light charge.

5. A system as claimed in claim 1, wherein said heavy charge conveyor comprises a mill chain conveyor having no openings therethrough.

6. A system as claimed in claim 5, further comprising a heavy pressure and temperature resistant explosion chamber positioned within said heavy charge chamber, said explosion chamber including bottom, top and side plates, the upper length of said heavy charge conveyor being supported by said bottom plate, said top and side plates having openings therethrough.

7. A system as claimed in claim 6, wherein said explosion chamber further comprises separate preheat, main heat, and detection sections, said heating means in said

heavy charge chamber comprising burners extending through said explosion chamber into said preheat and main heat sections.

8. A system as claimed in claim 1, wherein said determining means in said light charge chamber comprises means positioned to detect the presence of a light charge on said light charge conveyor, said presence detection means being operatively connected through a time delay relay to said means to drive said conveyors, whereby detection of said light charge activates said time delay relay, and temperature detection means positioned a predetermined distance downstream of said presence detection means for determining whether the temperature of said light charge has reached a working temperature greater than said ignition temperature, said temperature detection means being operatively associated with said time delay relay such that if said working temperature has not been reached, said time delay relay is not reset and said conveyors are stopped.

9. A system as claimed in claim 8, wherein said presence detection means comprises a photosensitive device, and said temperature detection means comprises a radiation pyrometer.

10. A system as claimed in claim 1, wherein said determining means in said heavy charge chamber comprises means positioned to detect the presence of a heavy charge on said heavy charge conveyor, said presence detection means being operatively connected through a time delay relay to said means to drive said conveyors, whereby detection of said heavy charge activates said time delay relay, and temperature detection means positioned a predetermined distance downstream of said presence detection means for determining whether the temperature of said heavy charge has reached a working temperature greater than said ignition temperature, said temperature detection means being operatively associated with said time delay relay such that if said working temperature has not been reached, said time delay relay is not reset and said conveyors are stopped.

11. A system as claimed in claim 10, wherein said presence detection means comprises a photosensitive device, and said temperature detection means comprises a radiation pyrometer.

12. A system as claimed in claim 1, wherein said determining means in said heavy charge chamber comprises means positioned to detect the presence of a heavy charge on said heavy charge conveyor, said presence detection means being operatively connected through a time delay relay to said means to drive said conveyors, whereby detection of said heavy charge activates said time delay relay, and an acoustic explosion detector positioned downstream of said presence detection means for determining whether said heavy charge has been ignited, said acoustic explosion detector being operatively associated with said time delay relay such that if said heavy charge has not been ignited, said time delay relay is not reset and said conveyors are stopped.

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