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[54] **MANUFACTURE OF SAFETY FUSE**

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[51] **Int. Cl.** **F42b 33/02**

[58] **Field of Search** ..... 86/1, 22, 20 R; 141/34, 141/71, 73; 222/56

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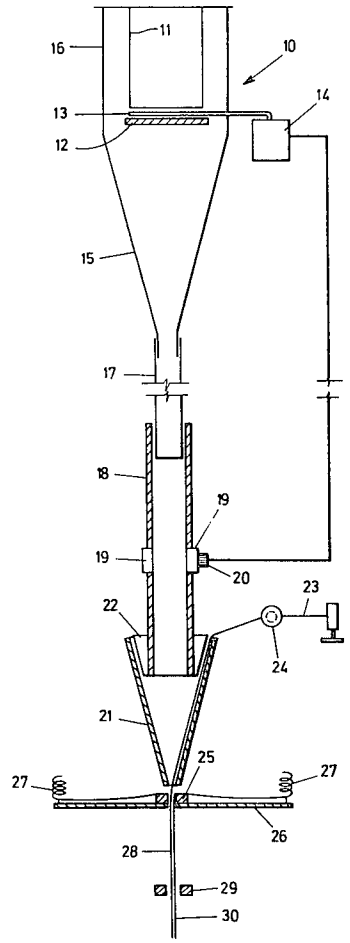
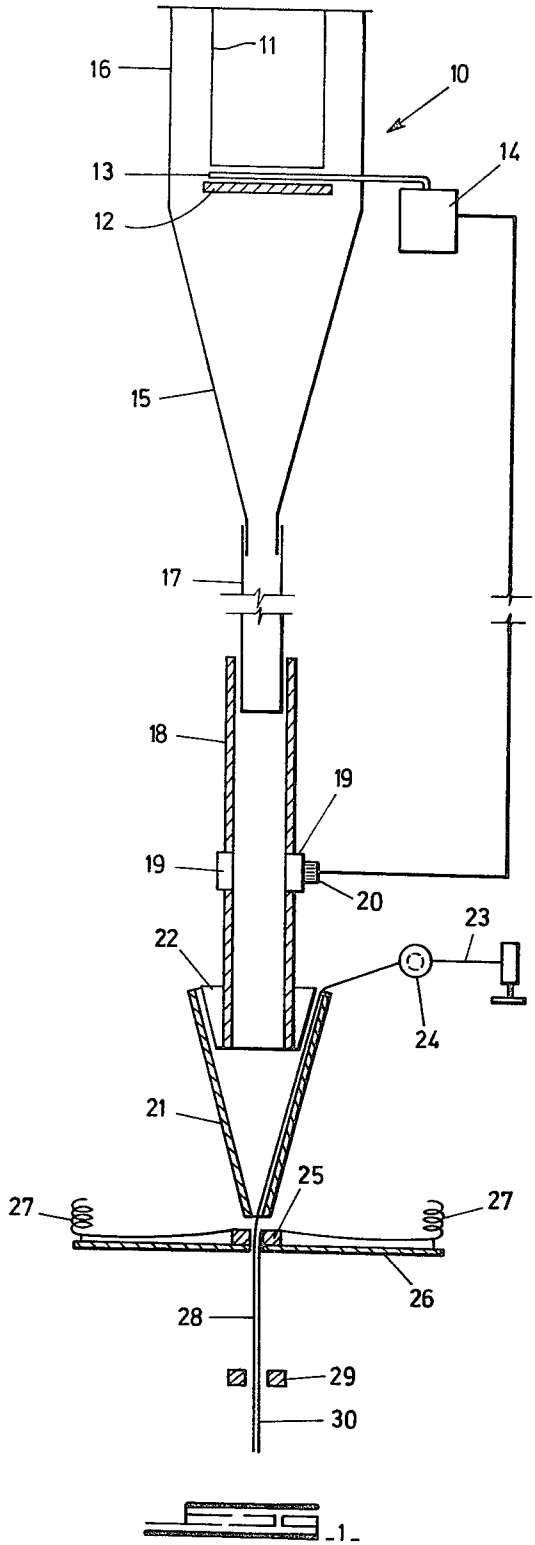
[57] **ABSTRACT**

The manufacture of safety fuse having a core of black powder meal instead of grains, by feeding discrete quantities of the meal into a tubular hopper positioned above the spinning cup. The level of the meal in the tubular hopper is kept substantially constant.

10 Claims, 1 Drawing Figure

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MANUFACTURE OF SAFETY FUSE

The present invention relates to improvements in the manufacture of safety fuse. More particularly, it related to the manufacture of safety fuse having a core of incendiary powder.

Safety fuse is used extensively in explosive blasting technology.

Safety fuse is manufactured generally by feeding black powder grains to a rotating spinning cup and spinning a covering sheath of, for example, jute yarns around the flow of grains leaving the spinning cup. The flow of grains through the spinning cup is normally assisted by passing one or more moist threads, preferably cotton yarns, through the cup containing the grains so that the grains adhere to the threads. The flow is further assisted by the taper of the inside wall of the spinning cup, which taper is not uniform between the top and the bottom outlet orifice of the spinning cup.

The enclosed powder gains or semi-fuse, as it is called, is then passed to the finishing plant where the semi-fuse is coated, dusted, varnished and put onto reels for sale or for cutting into standard lengths.

In this method of manufacture, it is essential to use grained black powder to give a constant flow of grains of black powder so as to ensure that the safety fuse has satisfactory burning characteristics.

The manufacture of grained black powder is a time consuming and hazardous batch process wherein black powder meal, which has been prepared by comminuting in edge runner mills a mixture of charcoal, sulphur and potassium nitrate, is compacted into press cakes. These press cakes are then broken into pieces and fed to a corning machine wherein the pieces are crushed between rollers into smaller particles. The particles of required size are then removed from the dust and the oversize particles by sieving and these particles are polished and glazed by rolling them in a wooden drum in the presence of graphite to produce grained black powder.

The use of black powder meal in the manufacture of safety fuse is considered to have too many disadvantages such as segregation of the components of the powder, bridging of the powder in the feeding apparatus and the spinning cup, the formation of hazardous quantities of dust and the irregular burning characteristics of the fuse obtained.

It has now been found that the above disadvantages associated with the use of black powder mean can be overcome and it is an object of the present invention to provide a method of producing safety fuse having a core of incendiary powder.

A further object of the invention is to provide apparatus for the manufacture of safety fuse having a core of incendiary powder.

According to the present invention therefore there is provided a method of producing safety fuse having a core of incendiary powder including the steps of charging discrete quantities of incendiary powder into a tubular hopper, delivering incendiary powder from the tubular hopper into a spinning cup at a rate of flow governed by the rate of flow of incendiary powder from the spinning cup while simultaneously replenishing the mass of incendiary powder in the tubular hopper by said discrete quantities to maintain substantially a constant head of incendiary powder in the tubular hopper, passing at least one thread through the incendiary powder in the spinning cup at an angle to the vertical axis of the cup, feeding the incendiary powder and the thread from the spinning cup to a spinning die, forming a covering sheath around the incendiary powder and the thread, counter spinning the sheath to produce a semi-fuse, and finishing the semi-fuse in a known manner to provide safety fuse having a core of incendiary powder.

The invention further provides apparatus for manufacturing safety fuse having a core of incendiary powder which includes in combination means for discharging discrete quantities of incendiary powder, a tubular hopper adapted to receive the discrete quantities of incendiary powder, means to maintain the mass of incendiary powder in the tubular hopper substantially at a required level, a spinning cup located below the discharge end of the tubular hopper, a device for passing at least one thread through the incendiary powder in the spinning cup at an angle to the vertical axis of the cup, a spinning die adapted to receive the incendiary powder and the thread from the spinning cup and to form a covering sheath thereon and a spinning head to counter spin the sheath to form a semi-fuse.

The semi-fuse is then finished using known equipment for coating, dusting and varnishing the semi-fuse.

The incendiary powder may be, for example, a suitable powder for the purpose such as black powder meal.

The feeding of discrete quantities of incendiary powder to the tubular hopper is essential to avoid bridging of the incendiary powder in any part of the apparatus. If discrete quantities are fed, the incendiary powder will flow through the apparatus, provided that the discrete quantities are kept sufficiently small so that blocking cannot occur. Other methods of feeding powdery material such as fluidisation are not suitable since these may give rise to the segregation of the components of the incendiary powder.

Means suitable for feeding discrete quantities of incendiary powder may consist of a vertical cylinder open at both ends, and adjustable horizontal plate of any suitable plan which is equal to or larger than the opening of the cylinder and mounted below the lower end of the cylinder at a suitable distance therefrom, a movable blade adapted to move between the horizontal plate and the lower end of the cylinder and a funnel in the shape of an inverted, truncated cone mounted below the plate and having an initial diameter larger than the plate to receive the powder dispensed over the plate by the blade. The lower end of the funnel communicates with the tubular hopper. The quantities of powder dispensed can be adjusted by raising or lowering the horizontal plate, by using different thicknesses for the movable blade and by adjusting the extent and/or rate of movement of the blade. The blade should move freely between the horizontal plate and the lower end of the cylinder to avoid friction and possible ignition of the incendiary powder.

When the cylinder is filled with incendiary powder, each movement of the blade across the horizontal plate will push a certain quantity of the powder over the edge of the plate into the funnel and this quantity will flow freely down the side of the funnel into the tubular hopper, without causing blockages therein, or to such hopper via a supply line communicating with the tubular hopper.

The tubular hopper used for supplying the spinning cup is preferably a vertical tube having an inside diameter which increases slightly towards the lower end of the tube to avoid bridging of the incendiary powder in the tube.

The tubular hopper may, for example, be provided with at least one window. The inside surface of the window or windows should be flush with the inside wall of the tubular hopper so that the incendiary powder can flow freely past the windows, thus wiping them clear of dust as it does so. The level of the incendiary powder may be controlled automatically by mounting a light sensitive device on the outside of one window or in the wall of the hopper opposite a window which device is adapted to feed a signal to the mechanism actuating the blade when the level of the black powder falls below the window, thereby permitting light rays to pass through the tube and the opposite window. The light source sending rays through the opposite window may be a natural or artificial light source. The blade will then move across the plate in a to-and-fro motion until the discrete quantities of incendiary powder dispensed from the funnel cause the level of powder to rise in the tubular hopper to obscure the passage of light rays to the device, when the mechanism will stop operating the blade.

In this way, the quantity of incendiary powder in the tubular hopper is added to and kept at a substantially constant level adjacent the window or windows.

The spinning cup is preferably a rotating spinning cup having an inside wall in the shape of an inverted cone, the wall being inclined at about 15° to the vertical axis of the spinning cup. The inclination of the wall may be varied according to the other requirements of any specific embodiment of the invention.

The spinning cup may be provided with a collar which surrounds the discharge end of the hopper to avoid spillage of powder from the cup. The collar may be provided with vanes located at the inside wall of the collar to counteract the tendency of the powder to rise and be forced between the collar and the discharge end of the tubular hopper by the centrifugal force of the rotating spinning cup.

The thread or threads passing through the incendiary powder in the spinning cup, are kept under tension by a tensioning device such as, for example, a tensioning device as used on a sewing machine.

The threads should be dry and preferably pass through the powder close to the inside wall of the spinning cup and may wipe such wall. In this way the flow of powder through the spinning cup is maintained at a regular rate and blockages due to bridging of the powder are prevented.

The threads used normally are cotton yarns and it is preferred to use two threads located opposite each other.

The incendiary powder and the threads emerging from the discharge orifice of the spinning cup are fed to a spinning die located underneath the orifice where a covering sheath is formed around the powder and the threads. The sheath is formed preferably by spinning about ten jute yarns around the powder and the threads. This sheath is then counter spun in a spinning head using suitable yarns and a semi-fuse suitable for finishing is obtained. The equipment used for finishing the semi-fuse is the same as the equipment used at present for finishing conventional fuse presently manufactured.

In the method of the present invention the difficulties normally associated with the use of black powder meal have been successfully overcome and the invention provides a clean and safe method for making safety fuse having a core of incendiary powder.

The particle size of the incendiary powder is preferably within the range of 50 to 80 percent passing 300 mesh BSS.

The present invention is further described with reference to the accompanying drawing without restricting the scope of the invention to the embodiment shown therein.

FIG. **1** is a schematic representation of apparatus used in an embodiment of the invention.

In FIG. **1** the means **10** for discharging discrete quantities of incendiary powder, which in this example is black powder meal, consists of open ended cylinder **11,** horizontal plate **12,** blade **13,** which is connected to and is capable of being actuated in a pivotal movement in a horizontal plane by pneumatic valve **14** across plate **12** and funnel **15.** The means **10** is provided with dust cover **16** to prevent contamination of the surrounding area by dust. the black powder meal is charged into cylinder **11** and discharged in discrete quantities by blade **13.** The lower end of the funnel **15** is attached to powder supply line **17** which connects the means **10** with the hopper **18.** The powder supply line **17** may be of any length required. For example, it may be required for safety reasons to locate the means **10** in a separate compartment above the other elements of the apparatus. Accordingly the powder supply line may have a length of about 5 meters or more depending on the arrangement of the entire apparatus.

The tubular hopper **18** is a tube having an inner diameter which increases toward towards the bottom of the tube The tubular hopper **18** is provided with opposing windows **19** to enable a check inspection to be made of the level of black powder meal in the tubular hopper **18.** A light sensitive cell **20** is mounted on the outside of one window **19.** This cell **20** sends a signal to pneumatic valve **14** whenever the level of black powder meal in the hopper **18** drops below the cell **20** to allow rays of light from the light source to affect it. The blade **13** then moves across plate **12** and powder is fed to the tubular hopper **18** in discrete quantities until the light rays are interrupted by the rising level of powder, when movement of the blade ceases.

Rotating spinning cup **21** is located below the discharge end of the tubular hopper **18.** To prevent spillage of powder from the cup **21,** vanes **22** are attached to the outer surface of the tubular hopper **18** at its discharge end located within the spinning cup **21.**

A thread **23** is passed through the spinning cup **21** via a tensioning device **24.** The black powder meal and the thread **23** are fed into a spinning die **25** mounted in spinning table **26** which table is provided with 10 reels of jute yarn **27.** These yarns form a covering sheath **28** around the black powder meal and the thread **23** and this sheath **28** passes through a spinning head **29** where suitable yarns are counter spun onto the sheath **28.** The semi-fuse **30** thus obtained is sent to the finishing plant.

By using the method and apparatus of the present invention, the dirty and hazardous process of making black powder grains is eliminated and considerable sav-

ings are effected in the manufacturing costs of safety fuse.

What we claim is:

1. A method of producing safety fuse having a core of incendiary powder including the steps of charging discrete quantities of incendiary powder into a tubular hopper, delivering incendiary powder from the tubular hopper into a spinning cup at a rate of flow governed by the rate of flow of incendiary powder from the spinning cup while simultaneously replenishing the mass of incendiary powder in the tubular hopper by said discrete quantities to maintain substantially a constant head of incendiary powder in the tubular hopper, passing at least one thread through the incendiary powder in the spinning cup at an angle to the vertical axis of the cup, feeding the incendiary powder and the thread from the spinning cup to a spinning die, forming a covering sheath around the incendiary powder and the thread, counter spinning the sheath with another layer of yarn to produce a semi-fuse, and finishing the semi-fuse to provide safety fuse having a core of incendiary powder.

2. A method as claimed in claim 1 wherein the incendiary powder is black powder meal.

3. A method as claimed in claim 1 wherein the discrete quantities of incendiary powder are chosen so as to ensure that the incendiary powder flows to the tubular hopper without filling the cross section of the delivery tube completely and thereby preventing blocking of the tube.

4. Apparatus for manufacturing safety fuse which apparatus comprises in combination means for feeding discrete quantities of incendiary powder, a tubular hopper to which the discrete quantities of incendiary powder is fed via a delivery tube means to maintain the mass of incendiary powder in the tubular hopper substantially at a required level, a spinning cup located below the discharge end of the tubular hopper, a device for passing at least one thread through the incendiary powder in the spinning cup at an angle to the vertical axis of the cup, a spinning die adapted to receive the incendiary powder and the thread from the spinning cup and to form a covering sheath thereon and a spinning head to counter spin the sheath to form a semi-fuse.

5. Apparatus as claimed in claim 4 wherein the means for feeding discrete quantities of incendiary powder comprises in combination a vertical cylinder open at both ends, an adjustable horizontal plate of any suitable plan which is equal to or larger than the opening of the cylinder and mounted below the lower end of the cylinder at a suitable distance therefrom, a movable blade adapted to move between the horizontal plate and the lower end of the cylinder, and a funnel in the shape of an inverted, truncated cone mounted below the plate and having an initial diameter larger than the plate to receive the powder dispensed over the plate by the blade.

6. Apparatus as claimed in claim 4 wherein the tubular hopper comprises a vertical tube having an inside diameter which increases slightly towards the lower end of the tube to avoid bridging of the incendiary powder in the tube.

7. Apparatus as claimed in claim 4 wherein the means to maintain the mass of incendiary powder in the tubular hopper substantially at the required level comprises a light sensitive device mounted on a window or in the wall of the hopper opposite another window which device is adapted to feed a signal to the mechanism actuating the blade of the means for feeding discrete quantities of incendiary powder.

8. Apparatus as claimed in claim 4 wherein the spinning cup is a rotating spinning cup having an inside wall in the shape of an inverted cone, which wall is inclined at about 15° to the vertical axis of the cup.

9. Apparatus as claimed in claim 8 wherein the spinning cup is provided with a collar surrounding the discharge end of the hopper to avoid spillage of incendiary powder.

10. Apparatus as claimed in claim 8 wherein the thread or threads passing through the incendiary powder are stationary threads kept under tension.

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