April 1, 1947. W. A. CALDWELL ET AL 2,418,333

METHOD FOR THE MANUFACTURE OF HEATING CARTRIDGES

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Fig. 1.

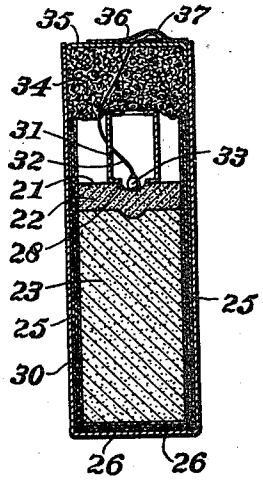


Fig. 2.

Fig. 3.

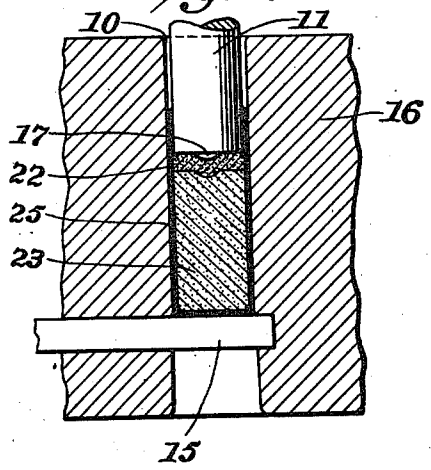
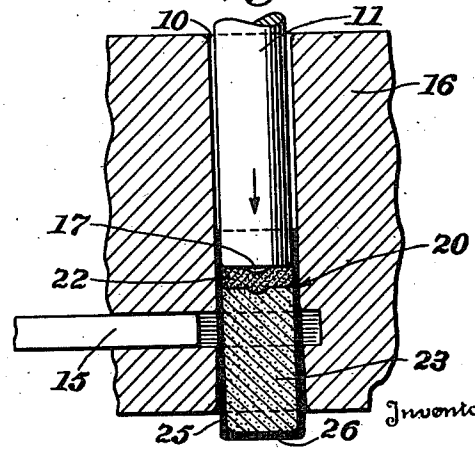


Fig. 4.



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METHOD FOR THE MANUFACTURE OF HEATING CARTRIDGES

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5 Claims. (Cl. 86—20)

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The present invention relates to the manufacture of chemical heating cartridges of the kind adapted for use in chemical immersion heaters and produced by compressing, into the open end of a tubular envelope of a deformable material, a chemical heating composition comprising inorganic oxidising and reducing agents and adapted when ignited to react with evolution of heat and formation of non-volatile reaction products without any considerable quantity of gaseous products.

For the purpose of igniting chemical heating cartridges of the kind described there is employed at the open end of the envelope a more easily ignitable composition, of which the main reaction product is likewise a hot non-volatile residue. This may take the form of an igniter external to the compressed heating composition, but more frequently the more readily ignitable composition is pressed over the main body of the chemical heating composition to form a priming composition and is in turn ignited by means of an igniter comprising a still more easily ignitable composition yielding a hot non-volatile residue and located in external contact with the surface of the priming composition. This igniter conveniently comprises the said still more easily ignitable composition in a cemented form, and may be formed around the end of a fuze.

The cartridge, whereof the envelope may consist of an insulating material such as asbestos paper, is intended to be slipped into a tube of greater length than itself, so that the envelope at the end remote from the ignition end is in contact with the end wall of the immersion heater, while there is a space between the ignition end of the column of the charge and the venting end of the tube. Although in the immersion heater this space accommodates a filter and the necessary means for conducting the ignition from the primary source of ignition to the aforesaid compositions, it is to a large extent unoccupied by solid material. The ignition end of the charge is thus left in the immersion heater without any external support effective to prevent particles from it becoming dislodged and scattered in transport and handling should the compressed material tend to be lacking in cohesion, with the result that the contact between the igniter and the end of the charge, or even between the terminal

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priming portion and the main portion of the charge may be impaired or broken; and the main portion of the charge may thus fail to be ignited. The compositions ordinarily used for the charge are based on mixtures of metallic oxides and reducing elements or compounds, and these usually have poor binding properties.

In the process hitherto employed for the production of the heating cartridges, the envelope of deformable material is inserted into a moulding cavity defined by a channel in a block of rigid material and an end wall, also of rigid material capable of relative motion thereto, the composition or compositions is or are introduced and eventually the plunger is advanced until the charge has been compacted to the required extent, and is then retracted, whereupon a terminal aperture is opened by relative motion between the block and the end wall, and the cartridge is expelled by advancing a plunger. In practice very considerable pressures are required to produce serviceable cartridges; and as the plunger is retracted from the charge in the moulding cavity, owing to the resilience of the mass of particles pressed against the envelope lining the rigid wall of the mould cavity, an expansive movement of recovery of the particles tends to take place towards the ignition end of the charge with the result that the surface at this end is not satisfactorily consolidated. The cross sectional area of the expelled cartridge is also greater than that of the moulding cavity.

The plunger employed has usually a protuberance on its working end in order to recess the end surface of the compacted composition for the purpose of increasing the area of contact between the charge and the external igniter, and when the plunger is so shaped its withdrawal permits expansive movement of the particles in a direction inwards from the rigid wall of the channel towards the recess, which increases the tendency to loose packing of the composition or compositions at the ignition end of the cartridge, at which end it is most important that the packing should be firm in order to ensure certainty of action of the cartridge as hereinbefore explained.

The principal object of the present invention is to provide, in the manufacture of chemical heating cartridges of the kind described, a new or improved method of compressing the heating

composition or compositions into the envelope. A further object of the present invention is to provide an improved process for the manufacture of heating cartridges of the kind described in order to reduce the occasional risk that, on actuation of the ignition means, the cartridge may fail to act.

According to the present invention a method for the manufacture of chemical heating cartridges of the kind described comprises loading a heating composition into an open ended tubular envelope of deformable material, advancing a press plunger in order to compact the heating composition within the envelope while the same is supported in a press chamber, thereafter maintaining the press plunger in contact with the composition, causing relative displacement between the end closure of the press chamber and said press chamber while so maintaining the press plunger in order to leave an aperture through which the cartridge can be expelled, and expelling the cartridge by advancing the press plunger. Preferably the press plunger, after compacting the heating composition, is maintained in contact therewith under a pressure which is insufficient to expel the cartridge through the aperture when the end closure is displaced, the pressure on the press plunger being thereafter increased in order so to expel the cartridge.

Figure 1 is a vertical section of a heating cartridge made in accordance with the method of the present invention.

Figure 2 is a vertical sectional view of an apparatus which may be used to carry out the method.

Figure 3 is a similar, fragmentary view of a subsequent step in the method and,

Figure 4 is a view like Figure 3, showing another step.

The process of the present invention may be carried out in a press having a press chamber 10 of tubular form and provided with a press plunger 11 actuated, for example by means of a screw or hydraulic mechanism 12, the press chamber being provided with a sliding or other end closure 15 adapted for easy and rapid displacement, under the influence of any desired actuating mechanism, as indicated at 15' in Figure 2. If desired automatic means may be employed to control the sequence of compressing the heating composition, reducing the pressure, opening the end closure 15, and increasing the pressure to expel the cartridge.

When the cartridge 20 is formed according to the method of the present invention, using a compacting pressure not less than about 4 tons per square inch, the ignition end 21 is found to be well consolidated, and failures of the more easily ignited composition 22 forming the igniter in contact with the end of the charge 23 to bring about the reaction of the whole cartridge when it has itself been ignited are reduced in frequency.

The invention is further illustrated in the following example.

Example

The moulding channel 10 in a pneumatic press has a diameter of .963 inch, and the press plunger 11 a diameter of .850 inch. The envelope 25 consists of three thicknesses of asbestos paper $\frac{4}{1000}$ of an inch thick, wrapped into the form of a tube and turned over to form an end closure 26. The resulting asbestos tube, which weighs about 6 grams, is introduced into the cavity 10 in the moulding block 16 so as to rest on the end plate 15, and there is first introduced into it a charge of about 45 to 48 grams of a mixture of the composition,

	Per cent
Calcium silicide	46
Hammer-scale	46
China clay	8

This is shaken down by tapping the moulding block 16, and then a further charge of 5 grams of a mixture of the composition,

	Per cent
Calcium silicide	28.5
Red lead	67.0
China clay	4.5

is added and similarly shaken down. The plunger 11 is brought down on to the surface of the last mentioned composition under a dead load of 2½ tons, and the material compressed, as shown in Figure 3. The pneumatic pressure is then relieved to such an extent that the dead load pressure on the charge of the cartridge is about one hundredweight, and the end wall 15 of the cavity 10 is moved away so as to uncover its end. The dead load on the plunger 11 is thereupon increased until the cartridge 20 is bodily ejected, as indicated in Figure 4, which usually necessitates a dead load not less than about five hundredweights. The end face of the press plunger 11 has a paraboloid projection 17 which extends for about $\frac{5}{16}$ of an inch at its maximum height, which is at the centre of the face, so that the surface 21 of the last mentioned composition in the cartridge is correspondingly dimpled, as indicated at 28. This completes the cartridge proper.

The cartridge 20, which after expulsion has a diameter slightly greater than the diameter of the moulding cavity 10, is slipped into a metal tube 30 in which it forms a sliding fit.

The asbestos paper envelope 25 of the cartridge extends beyond the ignition end 21 of the charge sufficiently to provide a thermal insulation between the whole column of the hot residue obtained as a result of the reaction and the wall of the tube 30, which extends slightly beyond the end of the envelope of the cartridge.

A metal framework spacer 31 is inserted so as to rest on the surface 21 of the compressed composition at the ignition end of the charge, and there is also inserted a quickmatch fuse 32 terminating in a bead 33 weighing about 0.2 gram of a mixture of red lead 69 per cent., calcium silicide 29 per cent. nitrocellulose of high viscosity characteristics 2 per cent. made by evaporation from a dope consisting of a suspension of the mixture of red lead and calcium silicide in a nitrocellulose solution, so that the bead is accommodated in juxtaposition to the compressed priming composition 22 in the dimple 28 formed in the latter. The spacer 31 extends about the same distance as the end of the envelope, and on top of it is pressed a pad 34 of asbestos wool which forms a gas filter. The chemical immersion heater is then provided with a terminal wall 35 having a vent 36 through which the end of the fuse 32 is accessible, and this vent is provided with a suitable temporary closure such as a tear-off 37. Such a chemical immersion heater may be embodied in a self-heated food or beverage can.

We claim:

1. The method of making a chemical heating cartridge, which comprises supporting one end and the side walls of a tubular envelope of deformable material against deformation, substantially filling the envelope with a pulverant heat-

ing composition, applying endwise compacting pressure to the composition from the open end of the envelope, decreasing but not completely relieving the pressure, removing the end support for the envelope, and then increasing the compacting pressure to discharge the envelope and the compacted composition from the side wall support.

2. The method of making a chemical heating cartridge, which comprises supporting the end and side walls of a tubular envelope of deformable material against deformation, substantially filling the envelope with a pulverant heating composition, applying endwise compacting pressure to the composition from the open end of the envelope, without completely relieving the pressure, decreasing the same to an amount insufficient to move the envelope bodily when the end support is removed, removing the end support, and then increasing the compacting pressure to discharge the envelope and the compacted composition from the side wall support.

3. The method of making a chemical heating cartridge, which comprises supporting the end and side walls of a tubular envelope of deformable material against deformation, substantially filling the envelope with a pulverant heating composition, applying endwise compacting pressure to the composition from the open end of the envelope, and simultaneously moulding a cavity in the end face of the composition, decreasing, but not completely relieving, the pressure, thereby preventing expansion of the composition adjacent the open end of the envelope, removing the end support for the envelope while the pressure is so decreased, and then increasing the compacting pressure to discharge the cartridge from the side wall support.

4. The method of making a chemical heating cartridge, which comprises supporting the end and side walls of a tubular envelope of deformable material against deformation, substantially filling the envelope with a pulverant heating composition, applying endwise compacting pressure to the composition from the open end of the envelope, reducing, but not completely relieving, the pressure at the open end of the envelope, thereby preventing expansion of the compacted composition at the end, relieving the support at the opposite end of the envelope while the pressure is reduced, and thereafter applying additional pressure to the open end to discharge the cartridge from the side wall support.

5. The method of making a chemical heating cartridge, which comprises positioning a tubular envelope of deformable material having a closed end in a mould cavity of corresponding shape, substantially filling the envelope with a pulverant heating composition, applying endwise compacting pressure to the composition from the open end of the envelope, thereafter decreasing, but not completely relieving, the pressure, thereby holding the composition at the open end of the envelope against expansion resulting from the release of pressure, opening the closed end of the mould cavity to permit expansion of the cartridge in that direction, and increasing said pressure to discharge the cartridge through the last mentioned end of the cavity.

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