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APPARATUS FOR MANUFACTURING FUSES

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FIG. 1

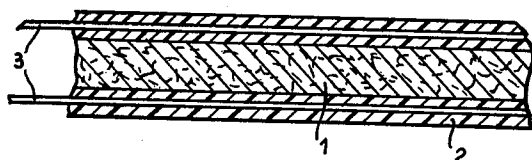


FIG. 2

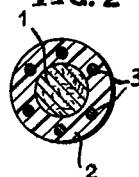


FIG. 3

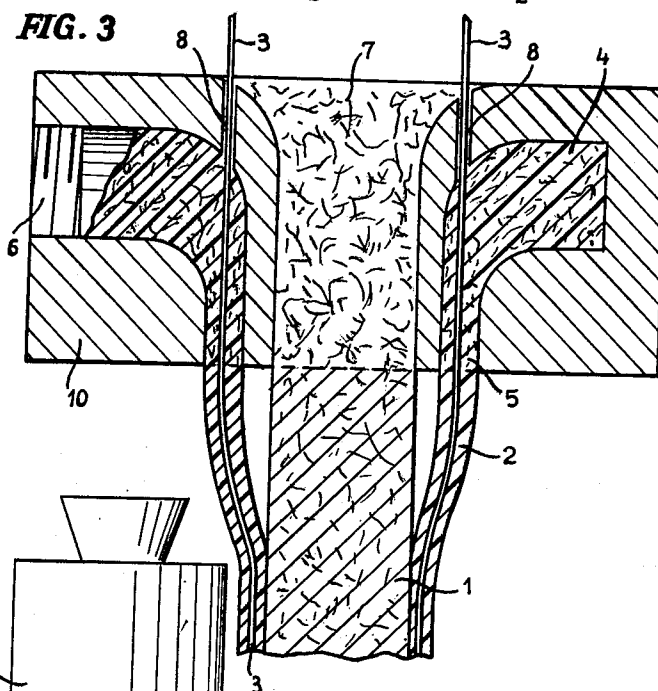
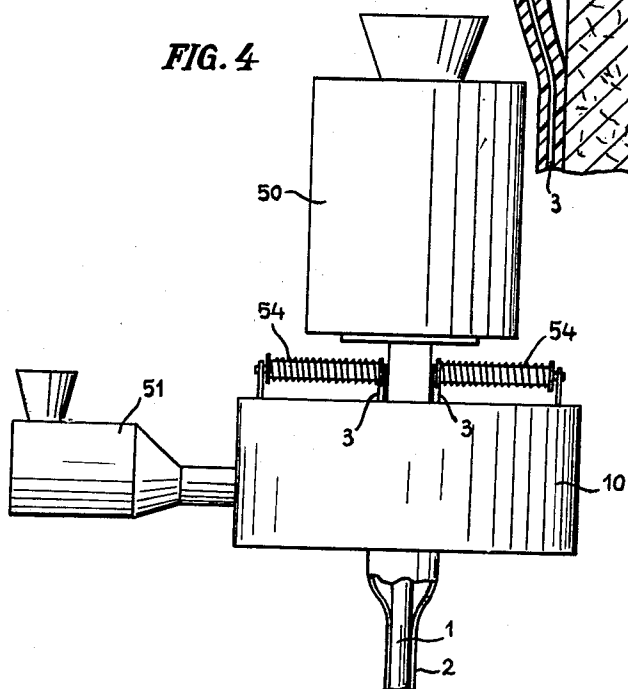


FIG. 4



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APPARATUS FOR MANUFACTURING FUSES

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2 Claims. (Cl. 18-13)

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This invention relates to apparatus for manufacturing matches or fuses for all civilian uses in which explosives are employed, such as blasting or road building, mining, demolition and the like.

It is known that matches or fuses for such purposes generally consist of gunpowder or special explosive mixtures, enclosed in a tubular casing formed by helical wound textile threads. As a rule, a plurality of helical windings are made with alternately right-handed and left-handed thread. Between the textile layers gums or solutions thereof or other materials are interposed in order to hold together the threads of the various layers and form a sheath withstanding bending or slight tensile stresses. The solution of gum or other material further tends within certain limits to protect the match or fuse against moisture, but this result is in practice hardly satisfactory, for an exposure of matches or fuses of this type to moisture makes them useless or, at least, seriously impairs their efficiency. Moreover, with a coating of this kind the matches or fuses treated with gums or other special mixtures tend to expand when the matches or fuses are subjected to small radius curves or frequent bending in course of laying, which often makes the match or fuse inoperative. Finally, the coating requires a lengthy operation, as gums, paints or the like should be allowed to dry after the formation of each helical layer before the next layer is begun.

A further coating in use for matches or fuses consists of a sheath of soft lead, within which the explosive material is compressed. This coating also has various disadvantages in practice, among which the most serious is certainly the low resistance to frequent bending, more particularly at acute angles. In this case, on account of the material of which it is constituted the coating tends to crack and operation of the match or fuse is generally impaired. If the coating is well made the match or fuse is safely protected against moisture, but it can only be manufactured to limited lengths, which are in many cases insufficient for practical use. The manufacture of this match or fuse is carried out by successive drawing of sections of tubes of lead or lead alloys, in which a certain quantity of gunpowder has previously been filled. Successive drawing operations of lead with the explosive therein, while

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they gradually reduce the inner diameter of the tube and its thickness accordingly, also effect a certain compression of the gunpowder packing the latter. Frequent drawing operations are, however, necessary and, apart from the considerable unavoidable waste, the production of tube sections of considerable length is not possible.

A further known match or fuse coating consists of interwoven threads, instead of threads helically wound about the blasting charge. The interwoven layer is coated with a waterproof paint which protects, to a certain extent only, against moisture. The chief drawback of this coating is that on close bending the hose may be strangled, the match or fuse interrupted so that the unit becomes inoperative, for the material composing the outer hose is not elastic.

A considerable improvement over the above types of matches and fuses is a fuse having a coating of synthetic substances. Said synthetic substances are preferably thermoplastic materials, for instance products of polymerisation and mixed polymerisation of vinyl compounds, polycondensation products, such as polyamides or polyurethanes, and polymerisation products of acryl, styrol compounds, and the like, or softened cellulose acetate or ethylcellulose compounds.

Since thermoplastic materials are generally slightly elastic, which might result in objectionable discontinuities under considerable tensile stresses of the inner explosive filling of the match or fuse, the coating is reinforced by means of strong longitudinal threads, for instance of natural or artificial silk or, better, of polycondensed resins of the amino group such as nylon.

The advantages of the fuse having an outer coating of thermoplastic material, reinforced by means of longitudinal threads, are as follows:

- (1) The fuse is absolutely water-proof even if steeped in water or other liquids;
- (2) The coating is protected against acids, bases, oils, fats, saline solutions, sea water, etc.;
- (3) The fuse can be bent even to a loop without any danger of damaging either the coating or the explosive charge contained therein;
- (4) The reinforced coating provides a high resistance against tensile stresses and small elongation;
- (5) The fuse can be permanently colored, using

colored matter mixed with the synthetic substances forming the outer layer.

The invention relates to an apparatus for manufacturing fuse having an outer layer of thermoplastic material provided with reinforcing threads of high tensile strength. The apparatus according to the invention affords the possibility of manufacturing said fuse in one operation and of any desired length. The thermoplastic material is processed in any known manner, but preferably by means of extrusion machines of the screw press type, and the hardness and flexibility of the coating can be varied by suitably admixing the raw material with particular substances of various types, such as plasticizers or softening agents.

The apparatus is described with reference to accompanying drawings, in which Figures 1 and 2 show a part axial section and cross section of the fuse, Figure 2 shows the bored head for manufacturing the reinforced fuse and Figure 4 is a diagrammatical view of the apparatus.

The fuse, Figures 1 and 2, comprise a core 1 of explosive material enclosed in a sheath 2 of synthetic material in which strong threads 3 (for instance nylon) of low elongation are embedded in a longitudinal direction.

The device for manufacturing the reinforced fuse is shown diagrammatically in Figure 3 and comprises an extrusion head 10 formed with an axial bore 7, and with a pressure die of annular form 5 concentric with the bore 7 and an inner annular chamber 4 to which the synthetic material adapted to form the sheath 2 is fed by the screw press 51 (Figure 3) fixed at 6. The chamber 4 has conveniently mounted therein a bush for distributing the material fed by the press. The sheath material is forced under pressure towards the pressure die 5. At the same time through holes 8 arranged in a circular row in the rear portion of the extrusion head 10 along a circle equal in diameter to the middle diameter of the pressure die, nylon threads 3, adapted to form the armature for the match or fuse sheath, are conveyed into the chamber 4 towards the pressure die. The material is extruded through the annular pressure die incorporating the nylon threads therein, said nylon threads unwinding from spools 53 on the outer casing of the extrusion head 10. At the same time the explosive charge is fed to the device 50 through the central hole 7 in the extrusion head 10. The synthetic material issues through the extrusion head 10 in cylindrical form which is drawn either by virtue of its own weight or by other means. The traction of the still hot material issuing from the pressure die causes the hose to contract and come thereby into contact with the core of explosive material issuing from the axial bore 7 in the extrusion head 10 form the coating which exerts a slight pressure on the explosive. A short distance from the pressure die, as the coating has cooled down, the match or fuse is definitely formed, its manufacture being obviously continuous and very rapid.

The explosive material may be introduced into the hole 7 either through a hopper or by means of a screw press or a cylinder and piston device. The latter preferably consists of a pair of cylinders and pistons to ensure a continuous feed. If the explosive material is in powder, grain, flake or plate form or the like, it will be possible to employ a binding agent adapted to hold the particles together and prevent the explosive from slipping

out when the match or fuse is cut. The binding agent may likewise be a synthetic material.

In certain cases it may be preferable to employ instead of a continuous explosive core, preformed blocks or cylinders of explosive of small length conveniently threaded on a thread for instance of polyamide resin. These blocks, connected together by the thread, are introduced through the hole 7, caught by the coating and carried along thereby as they are incorporated therewith. When the operation is completed, the resin thread connecting the blocks may be removed.

In most cases, however, the explosive is in power or grain form, and it is then preferable to employ two extrusion presses, one of which compresses the explosive material. A compression of the powder is in any case necessary for avoiding the above mentioned drawback that the powder may pour out of the coating when the match or fuse is cut to length. When compression of the powder is insufficient, a binding agent as mentioned above is admixed thereto for holding together the granules of which it is made. Synthetic resins as binding agents may be admixed with the powder.

In other cases it is possible to employ a paste of explosive powder which can be well compressed in the extrusion press.

What I claim is:

1. Apparatus for manufacturing fuses having a sheath of thermoplastic material comprising in combination an annular chamber, means for feeding thermoplastic material to said annular chamber, an annular extrusion die coaxial with said annular chamber, means for feeding threads of synthetic material to said annular chamber to be embedded in the thermoplastic material, means for extruding a pipe of thermoplastic material having incorporated therein the threads of synthetic material arranged parallel to the axis of the extruded pipe, an inner extrusion die coaxial with said annular chamber, means for feeding an explosive charge to said inner extrusion die, the cross-sectional area of the inner extrusion die being smaller than the cross-sectional area of the annular extrusion die, the pipe of thermoplastic material coming into contact with the continuous core of explosive charge, and exerting a slight pressure on it by effect of a traction exerted on said pipe when hot.

2. Apparatus for manufacturing fuses having a sheath of thermoplastic material comprising in combination an annular chamber, means for feeding thermoplastic material to said annular chamber, an annular extrusion die coaxial with said annular chamber, means for feeding threads of synthetic material to said annular chamber to be embedded in the thermoplastic material, means for extruding a pipe of thermoplastic material from said extrusion die having incorporated therein the threads of synthetic material arranged parallel to the axis of the extruded pipe and along the edges of a regular prism, an inner cylindrical extrusion die coaxial with the said annular chamber, means for feeding an explosive charge to said inner extrusion die, means for extruding a continuous core of explosive material from said inner extrusion die, the cross-sectional area of the inner extrusion die being smaller than the cross-sectional area of the annular extrusion die, the pipe of thermoplastic material coming into contact with the continuous core of explosive charge and exerting a slight pressure on it by effect of a traction exerted on said pipe when hot.

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