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TAILLESS CONNECTOR

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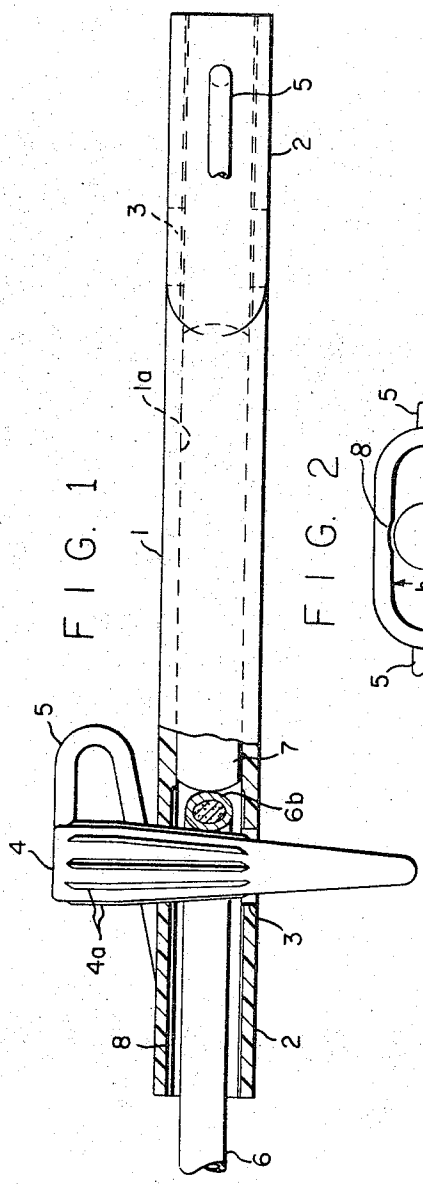


FIG. 1

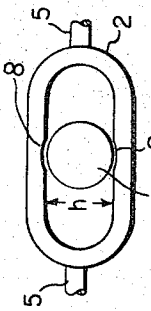


FIG. 2

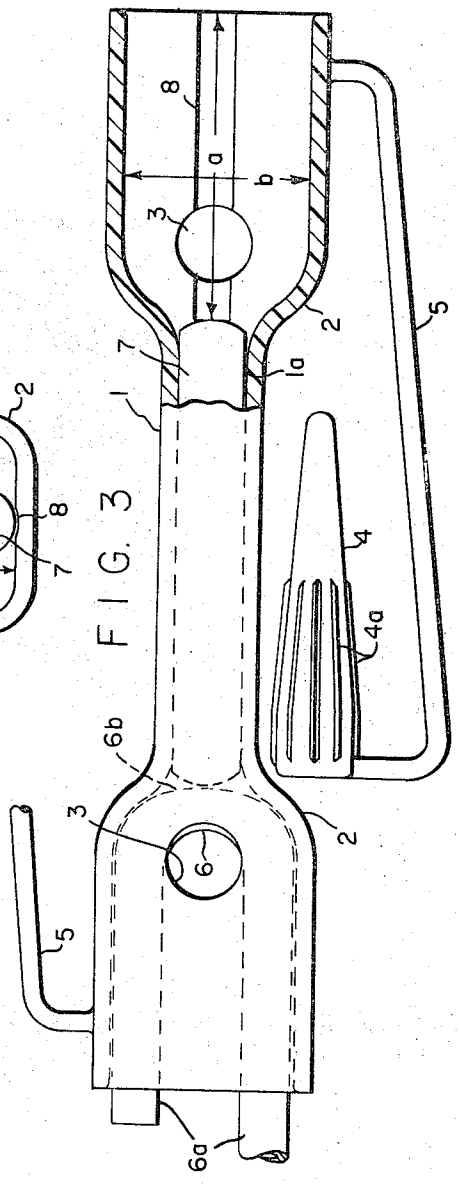


FIG. 3

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TAILLESS CONNECTOR

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This invention relates to the art of blasting with explosives and particularly to a connector for securely positioning detonating fuse and a delay device in operative relationship so that a detonation stimulus can be propagated from one to the other.

Commercial blasting operations often employ detonating fuse or cord in conjunction with delay devices whose function is to permit firing the main blasting charges in the desired sequence. In such assemblies, it is necessary to secure the explosive cord in propagating relationship to the delay device so that the detonation impulse from one will be reliably propagated to the other. Typical of the means used heretofore for this purpose is the delay connector described in U.S. 2,736,263. This connector comprises a tubular metal shell which centrally houses an encapsulated delay train, the ends of which abut the cut ends of lengths ("tails") of detonating fuse, e.g., "Primacord," that are crimped into the shell's initially open ends. In the field, the connector is inserted into the blasting array by cutting a trunk line of detonating fuse and securing the tails of "Primacord" to the two cut ends with a square knot or tape. Although these connectors are superior to other available types of connectors, provision of the tails of detonating fuse both increases the cost of manufacturing the connectors and complicates their classification and shipment. Also, in spite of the skill and care exercised by the blasting technician, moisture can seep through the crimped joint between the detonating fuse and metal shell and then into the cut end of each tail of detonating fuse, thus desensitizing its explosive core.

Accordingly, this invention provides an inexpensive, reliable and easily manipulated, tailless connector for securing detonating fuse to each end of a delay device or unit in the field without using special tools. The connector comprises a central tubular portion whose bore is adapted to receive the tubular shell of a delay unit; a fuse-receiving section at each end of the tubular portion and communicating with its bore, each such section

being adapted to internally receive a substantially U-shaped segment of detonating fuse with the two arms of the U lying in substantially the same plane as the longitudinal axis of the bore and the apex of the U positioned adjacent the end of the bore, and having a pair of oppositely disposed apertures whose axis is substantially perpendicular to said plane; and

two tapered pins, one mateable with each pair of apertures and adapted to extend through the apertures and between the arms of the U-shaped segment of fuse, and to hold the apex of the U adjacent the end of the delay unit.

Preferably the tailless connector of this invention is of one-piece construction with the tapered pins integrally connected to the central tubular portion or the fuse-receiving sections by thin flexible webs. Such a connector is conveniently made of thermoplastic by injection molding.

By "detonating fuse" is meant relatively brisant detonation-transmitting explosive cords that will both accept and donate a detonation stimulus through their sides. Such cords include the conventional "Primacord," "E-Cord," and "Detacord" detonating fuses which contain a core of high velocity detonating explosive, usually PETN, encased in a flexible textile sheath, and the more recently developed flexible extruded explosive cords such as the commercially available "Detaflex" cords described in U.S. 2,992,087 or U.S. 2,999,743, and the cord described in coassigned, copending application S.N. 481,150, filed Aug. 19, 1965, which comprises superfine high explosive such as PETN in a plasticized polymeric metallocarboxylate elastomer binder, preferably containing a central reinforcing element (string) and a polyurethane.

The terms "delay unit" and "delay device" refer to devices comprising a tubular shell that encapsulates a one- or two-way delay train which may be of the type known in the art, e.g., as described in U.S. 2,475,875 or U.S. 2,736,263.

In order to describe this invention in greater detail, reference is now made to the accompanying drawings wherein:

FIGURE 1 is a side view, in partial section, of a preferred connector of this invention, showing a length of detonating fuse in one end in propagating relationship to a delay unit,

FIGURE 2 is an end view of the same connector, and

FIGURE 3 is a partially sectional plan view of the connector of FIGURE 1.

In the drawings, which show the relative sizes of the various components of the connector, like numerical designations designate like parts.

Referring now to the drawings, there is shown a one-piece body of thermoplastic material having a central tubular portion **1** with an axial bore **1***a* which communicates at each of its ends with identical fuse-receiving sections **2**, whose configuration is generally that of a semi-elliptic arch (semielliptic paraboloid) having a major axis *a* (FIGURE 3) that is coaxial with the longitudinal axis of bore **1***a*, a minor axis *b*, and a height *h* (FIGURE 2). A pair of oppositely disposed apertures **3** extend transversely through each semielliptic arch section **2**, with the axis of each pair being normal to the longitudinal axis of bore **1***a*. Tapered pins **4**, one of which is shown in its operating position in FIGURE 1 and the other of which is shown in its as-molded position in FIGURE 3, have vertical ribs **4***a* of triangular cross-section, that tightly engage the periphery of the apertures. Each pin **4** is integrally connected by a thin flexible web **5** to the side of the fuse-receiving section **2** with which it is to cooperate. This positioning of the webs permits inserting pin **4** into apertures **3** from either the top or bottom of the connector, positioned as shown in FIGURE 1.

From FIGURES 1 and 3, it is seen that apertures **3** are positioned relative to the end of bore **1***a* and the position of the U-shaped segment of detonating fuse **6** so that the tapered pins pass between arms **6***a* of the fuse and wedge its apex **6***b* against the end of delay device **7**. For proper staking action by pins **4**, the space between arms **6***a* preferably is at least about equal to the fuse's diameter, and accordingly, axis *b* of section **2** is at least about three times the fuse's diameter. Contact between apex **6***b* and the end of delay **7** is preferred, but not essential where the air-gap sensitivity of the detonating fuse or base charge of the delay unit, as the case may be, is such that detonation will be propagated from one to the other absent such contact. For example, 50 grain per foot "Primacord" will propagate a detonation impulse through its sheath and over a gap of about ¼ inch and will be initiated through its sheath by a delay unit containing a base charge of 4.8 grains of lead azide spaced from the apex of the fuse by up to ¾ inch.

As best seen in FIGURE 2, each fuse-receiving section **2** has a pair of oppositely disposed arcuate passages **8** of slightly larger diameter than bore **1***a*, thereby facilitating insertion of the delay device into the bore. These passages are optional and would not be needed where the height

h of sections **2** is larger than the diameter of bore **1***a*. The diameter of bore **1***a* is such that it peripherally engages delay device **7**, a snug force fit being preferred.

Although the particular construction of the delay device does not constitute part of this invention, I prefer to use a symmetrical two-way delay device having a delay train of the type described in U.S. 2,736,263, e.g., one composed of a central thick-walled lead tube having an axial bore, and in sequence from *each* end of the bore, (1) an exothermic charge such as, e.g., a 30/35/35 mixture, by weight of magnesium, barium peroxide and selenium, (2) a thin metal partition, (3) a heat-sensitive charge such as an 85/15 lead azide/tetracene mixture, by weight, and (4) a terminal base charge of detonating explosive, e.g., lead azide. This delay train is encapsulated by inverting a metal capsule over each end of the train, inserting this assembly in a metal sleeve of about the same length, and then crimping the sleeve and capsules in place around the lead tube, thus completing construction of the delay unit. Delay units of the type described in coassigned, copending application S.N. 517,317, filed Dec. 29, 1965, can also be employed.

The delay unit preferably is inserted in, and thus made part of the connector before it is sent to the field so that the user only need insert segments of detonating fuse in each of the fuse-receiving sections. This is done simply by folding back about two or more inches of the fuse at its cut end to form a U-shaped loop and then inserting this loop into the fuse-receiving section of the connector until the apex of the U abuts the end of the delay unit. After the U-looped section of fuse is thus inserted, pin **4** is inserted through the aligned apertures **3** passing between the arms of fuse, providing a compressive and staking action which helps retain the configuration of the U-loop and maintains the apex of the loop in propagating relationship to the delay unit.

The connector can be made of any suitable thermoplastic material, such as polypropylene, acetal resins, polytetrafluoroethylene, nylon, unplasticized polyvinyl chloride, polystyrene, acrylic polymers, polyurethanes, and phenolic resins having the appropriate characteristics of strength, tear resistance, and flexibility. The material chosen should not be subject to undue hardening in cold temperatures or undue softening at warm temperatures. The high density polyethylene resin, commercially available as "Alathon" 7516, is particularly satisfactory for manufacturing the connectors by injection molding.

An embodiment of the invention preferred for use with detonating fuses having an outside diameter between about 0.14 and 0.24 inch, e.g., 50 grain/foot "Primacord" and 25 grain/foot "E-Cord," and a delay unit about 1.75 inches long and 0.25 inch in diameter, is made of "Alathon" 7516 in the configuration shown in FIGURES 1 to 3 and has an overall length of about 4 inches; a wall thickness of about 00.5 to 0.08 inch; a bore **1***a* of about the same diameter and length as the delay element; fuse-receiving sections **2** having a major axis *a* of about 1.13 inch, a minor axis *b* of about 0.7 inch, a height *h* of about 0.25 inch, arcuate passages **8** having a diameter of about 0.27 inch, and about 0.3 inch-diameter apertures **3** whose centers are about 0.86 inch from the ends of the connector; and tapered pins **4** about 1.4 inches long, which have a maximum diameter (including the ribs) about 0.03 inch larger than the diameter of apertures **3** and are integrally connected to the sides of the fuse-receiving sections by webs **5** having a diameter of about from 0.06 to 0.08 inch and an overall length of about 2.75 to 3.00 inches.

I claim:

1. A tailless connector for holding detonating fuse in propagating relationship to each end of a delay unit, comprising a central tubular portion whose bore is adapted to receive the tubular shell of a delay unit; a fuse-receiving section at each end of the tubular portion and communicating with its bore, each such section

being adapted to internally receive a substantially U-shaped segment of detonating fuse with the two arms of the U lying in substantially the same plane as the longtiudinal axis of the bore and the apex of the U positioned adjacent the end of the bore, and having a pair of oppositely disposed apertures whose axis is substantially perpendicular to said plane; and

two tapered pins, one mateable with each pair of apertures and adapted to extend through the apertures and between the arms of the U-shaped segment of fuse, and to hold the apex of the U adjacent the end of the delay unit.

2. A connector of claim **1** which is of one-piece, thermoplastic construction and wherein each tapered pin is attached to the fuse-receiving section with which it cooperates by a thin flexible web of the thermoplastic.

3. A connector of claim **2** wherein the pins are substantially vertically ribbed.

4. A connector of claim **2** wherein a tubular delay unit of substantially the same length as the bore in the tubular portion is peripherally engaged by the walls of said bore.

5. A connector of claim **2** wherein the tubular portion is of cylindrical configuration and each fuse-receiving section is of semielliptic arch configuration.

References Cited

UNITED STATES PATENTS

2,736,263	2/1956	Lewis et al.	102—27 X
2,952,206	9/1960	Becksted	102—27
3,020,844	2/1962	Miller	102—27
3,175,491	3/1965	Robertson	102—27

FOREIGN PATENTS

707,129	4/1965	Canada.

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