

March 26, 1968

E. A. PIKE
DETONATING TAPE

3,374,737

Filed Feb. 15, 1967

2 Sheets-Sheet 1

FIG. 1

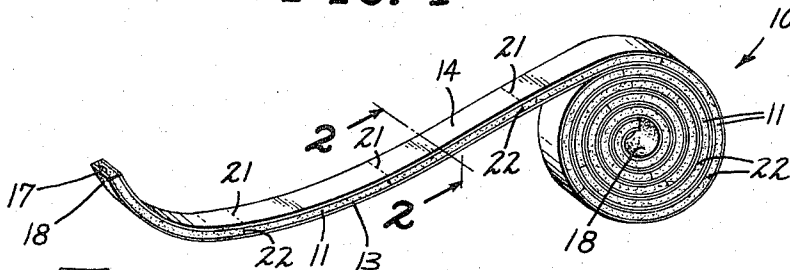


FIG. 2

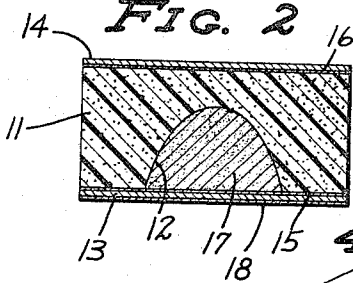


FIG. 3

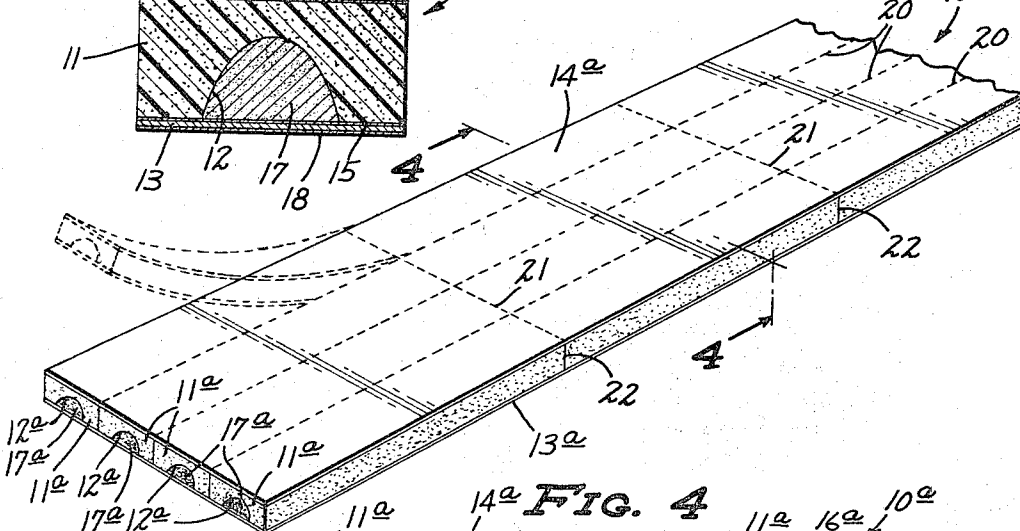


FIG. 4

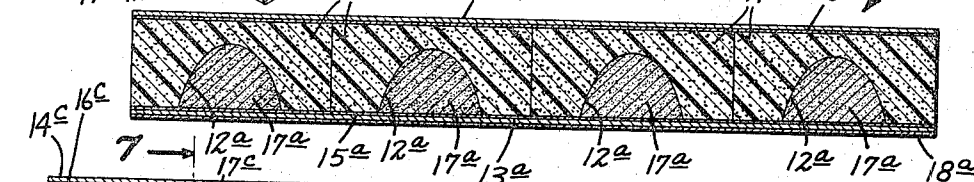


FIG. 6

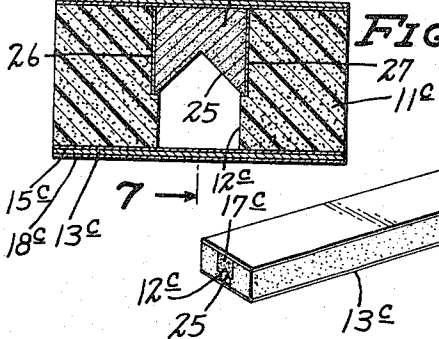
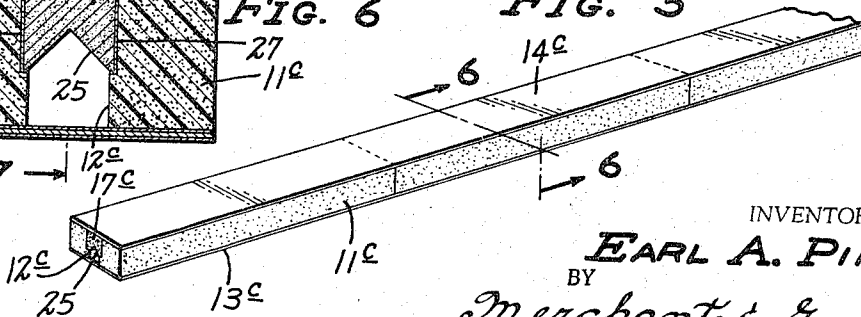


FIG. 5



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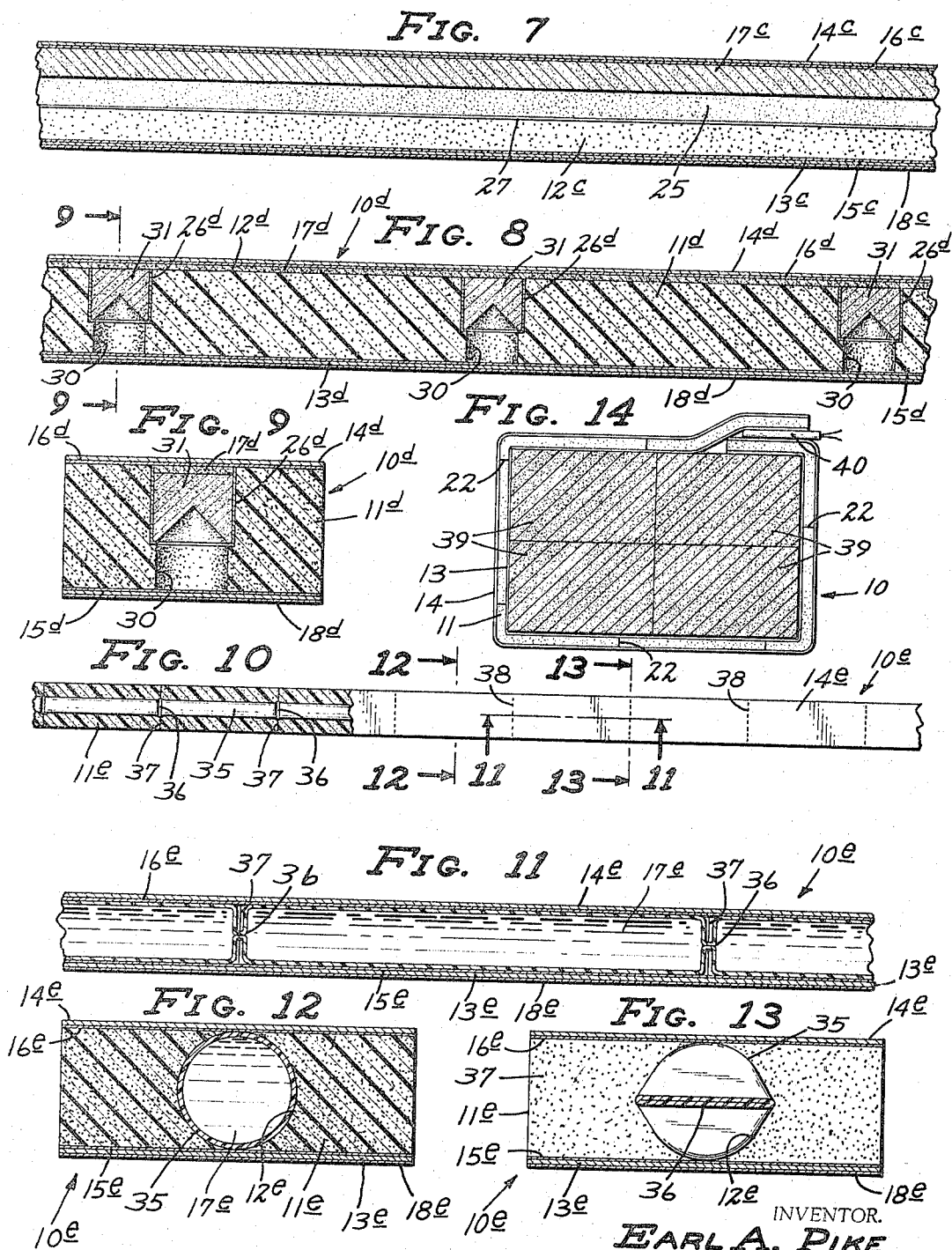
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Filed Feb. 15, 1967

2 Sheets-Sheet 2



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3,374,737

DETONATING TAPE

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Filed Feb. 15, 1967, Ser. No. 616,213

16 Claims. (Cl. 102—27)

ABSTRACT OF THE DISCLOSURE

The basic embodiment disclosed is an adhesive backed, flexible detonating tape that can be cut to a desired length and quickly attached to a secondary explosive or other object. The tape has a central carrier member with a longitudinal channel formed therein to house and support an explosive column having a predetermined configuration. The carrier member is adhesively attached between a base member and a top member, both of which have a ribbon-like configuration. A suitable adhesive coating is provided on the bottom surface of the base member.

Also disclosed is an embodiment in which a plurality of carrier members are supported in a side-by-side relationship between a base member and a top member, both of which are provided with one or more rows of longitudinal perforations to permit the tape to be longitudinally split into sections. Each section has the same construction as to the above described basic embodiment. Both embodiments can be formed into a roll for ease of storage and handling.

Background of the invention

Field of the invention.—This invention relates generally to the field of explosive tapes, and more particularly relates to improvements in the construction of flexible, adhesive backed explosive tapes.

Description of the prior art.—In the field of explosives, flexible explosive cords or tapes have many uses. An explosive cord can itself be used to perform useful work, it can be used to transmit explosive forces over relatively long distances, or it can be used to initiate a more insensitive secondary explosive. Commercially available explosive cords such as "Primacord" and "Deta Sheet" are now being used to perform these various functions. For example, "Primacord" is cap sensitive and can be used by itself in applications where only a small amount of explosive force is required. The amount of explosive force available from "Primacord" can of course be increased by using different lengths or by wrapping the "Primacord" around the object to be worked. "Primacord" can also be used to initiate relatively insensitive explosives such as TNT.

Self supporting explosive compositions have also been developed that can be formed into thin sheets that can be used in many applications including demolition work and metal working. These self supporting explosive compositions can also be formed into strips or tapes for use in applications similar to that described above for "Primacord." The characteristics and uses of self-supporting explosive compositions are described in the Loving et al. Patent 3,218,972 that issued Nov. 23, 1965.

The explosive cords of the prior art have certain disadvantages that limit their application. A cord such as "Primacord" cannot be quickly and firmly attached to a surface, especially to a vertical surface or to the underside of a horizontal surface, since the cord has no built-in means for attachment. If attachment is required, an external fastening means such as adhesive tape must be used. This not only reduces the speed at which the cord can be attached to a surface, but also increases the types and number of materials that must be carried by the person applying the cord.

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A cord such as "Primacord" also requires a cutting tool to obtain the proper length of cord for a particular application. The fabric liner that is used to support the cord cannot be torn by hand, but must be cut with a knife or other tool.

The so-called self supporting explosive compositions of the prior art also present certain problems. These compositions are not structurally strong and can be easily cracked or torn if not handled properly. If the sheets are roughly handled so that the composition becomes cracked or torn, some impairment of the propagation characteristics of the explosive occurs. To prevent such damage, the self supporting sheets must be packaged in special containers and handled with care.

Other problems involved in the application of prior art detonating cords include those of detaching and applying the proper amount of cord for a particular application. In some cases, several strips of detonating cord must be attached to a secondary explosive to assure proper initiation of the secondary explosive. Difficulties in explosive propagation between the detonating cord and the secondary explosive can also arise if the detonating cord does not have the proper configuration or if it is not properly attached to the secondary explosive. Much of the explosive force of conventional cords or tapes is often wasted, since no means are provided to direct the explosive force in the proper direction to achieve maximum propagation. Prior art detonating cords and sheets appear to have been designed with specific applications in mind. If a particular type of cord is used in the application for which it was designed, optimum results will be achieved. If it is not so used, however, such results cannot be expected. This failure to achieve optimum performance when used in varying applications is a common characteristic of prior art detonating cords and tapes.

Summary of the invention

My invention provides an adhesive backed, flexible detonating tape that is capable of being formed into a roll for storage purposes and for ease of handling, and that is capable of being quickly unfurled in a selected width and length for quick attachment to a surface. In its preferred form, my invention includes a flexible, elongated carrier member having an open channel formed longitudinally therein. The channel is adapted to carry and support a column of flexible explosive material. The carrier member has a top member and a base member adhesively attached thereto to provide support for the carrier member. The bottom of the base member is coated with adhesive so that the tape can be quickly and firmly attached to any surface. Since the tape is flexible, it can be formed into a roll and portions thereof can be unrolled and cut off as needed. Preferably, the tape can be torn by hand so that no special cutting tools are required.

In a further embodiment of my invention, several carrier members are mounted in a side-by-side relationship between appropriately wider top and base members. In this case, the top and base members are longitudinally perforated in widths corresponding to the widths of the carrier members so that individual sections, corresponding in construction to the basic embodiment of my invention, can be quickly detached from the plural unit. Thus, a single unit can be detached and used, or the entire unit can be left intact if more explosive force is required for a particular application. Thus, not only can different lengths of detonating tape be easily obtained, but different widths as well.

In the preferred form of my invention, the open channel in the carrier member lies adjacent the base member and has a dome-shaped cross section. The explosive column carried within the channel also has a dome-shaped cross section with a flat bottom portion lying ad-

adjacent the base member. The upper rounded portion of the explosive column is completely surrounded and supported by the carrier member. With this configuration, the greatest amount of explosive force will be directed through the base member toward the surface to which the tape is attached.

For special purpose applications, the explosive column can be constructed as a linear shaped charge. In the linear shaped charge form, the tape provides a means of easily, accurately, and securely placing the explosive shape over the surface to be severed. Another configuration of my invention provides conical shaped charges mounted beneath the explosive column at predetermined intervals. With this configuration, holes can be punctured in a material at predetermined intervals with a minimum amount of time expended in placing the charges.

The detonating tape of my invention has external physical characteristics similar to masking tape. It performs the same general functions as the previously described commercially available cords, but is infinitely more versatile in use than prior art explosive cords and is capable of specialized applications for which they are not designed. The basic form of my invention is a general purpose detonating tape. In addition, the tape of my invention can be manufactured in a variety of other forms that are designed to accomplish specific tasks.

Brief description of the drawing

FIGURE 1 is a perspective view of a partly unfurled roll of the basic form of detonating tape of my invention;

FIGURE 2 is a cross-sectional view taken along line 2—2 of FIGURE 1, on an enlarged scale;

FIGURE 3 is a perspective view of the plural form of detonating cord of my invention, a partially removed section thereof being shown in phantom;

FIGURE 4 is a cross-sectional view taken along line 4—4 of FIGURE 3, on an enlarged scale;

FIGURE 5 is a perspective view of a modification to the basic form of my invention;

FIGURE 6 is a cross-sectional view taken along line 6—6 of FIGURE 5, on an enlarged scale;

FIGURE 7 is a longitudinal section of the modified form of invention shown in FIGURE 5, taken along line 7—7 of FIGURE 6, on a reduced scale;

FIGURE 8 is a longitudinal vertical section of another modification to the basic form of my invention;

FIGURE 9 is a cross-sectional view taken along line 9—9 of FIGURE 8, on an enlarged scale;

FIGURE 10 is a top plan view of another modification to the basic form of my invention with portions thereof being broken away and shown in section;

FIGURE 11 is an enlarged longitudinal sectional view taken along line 11—11 of FIGURE 10;

FIGURE 12 is an enlarged cross-sectional view taken along line 12—12 of FIGURE 10;

FIGURE 13 is an enlarged cross-sectional view taken along line 13—13 of FIGURE 10; and

FIGURE 14 is a cross-sectional view of the basic form of detonating tape according to my invention wrapped around and attached to several blocks of explosive to be initiated, portions thereof being shown in side elevation.

Description of the preferred embodiments

Referring now to the drawings in which like reference characters designate like or similar elements throughout the several views, there is disclosed in FIGURES 1 and 2 the basic form of detonating tape according to my invention. As shown in FIGURE 1, the detonating tape 10 is flexible and can be formed into a roll for storage purposes and for ease of handling. Tape 10 includes a light, flexible, elongated carrier member 11 having a continuous channel 12 formed longitudinally therein. Attached to the bottom surface of a carrier member 11 is a ribbon-like base member 13. Attached to the top sur-

face of carrier member 11 is a second ribbon-like member 14. Both base member 13 and the second member 14 are the same width as carrier member 11, and both are relatively thin and quite flexible. The top surface of base member 13 is firmly attached to the bottom surface of carrier member 11 by means of a suitable adhesive 15 or by a forming extrusion process. The bottom surface of second member 14 is also attached by a suitable adhesive 16 or by an extrusion process to the top surface of carrier member 11. A flexible explosive column 17 is mounted within channel 12 along the full length thereof.

Base member 13 and second member 14 are preferably strips or ribbons of material such as paper, plastic, or woven cloth. Preferably, a paper-backed pressure-sensitive tape commonly known as masking tape is used. In some applications, it may be desirable to use an aluminum or other metal ribbon. A plastic ribbon with an aluminum coating can also be utilized. In all cases, a suitable adhesive coating 18 is applied to the bottom surface of base member 13. By means of adhesive coating 18, detonating tape 10 can quickly and easily be attached to any surface.

Carrier member 11 is preferably formed from a light, flexible, inert material such as a foam plastic. Foam plastics that can be used in this application include urethane foams and styrofoam. Other materials having the desired physical characteristics can also be used.

Explosive column 17 is preferably a high-velocity detonating explosive, such as pentaerythritol tetranitrate (PETN) in either granular or self supporting form. A self supporting form of PETN is disclosed in the Fassnacht et al. Patent 2,992,087 that issued July 11, 1961. Other types of cap-sensitive high explosive compounds such as RDX can also be used. Again, the particular type of explosive composition that is used is not important as long as it meets the physical and chemical requirements of the application.

An important use of my invention is in the initiation of secondary relatively insensitive explosive materials. In such applications, detonating tape 10 is affixed to the surface of the secondary explosive by means of adhesive coating 18. In order to insure proper initiation of the secondary explosive, it is desirable to provide maximum propagation contact between explosive column 17 and the explosive to be initiated. In my invention, maximum propagation contact is achieved by utilizing proper design and placement of explosive column 17. First of all, explosive column 17 is placed in contact or at least closely adjacent to the top surface of base member 13 along the entire length thereof. For this reason, no portion of inert carrier member 11 lies between explosive column 17 and the secondary explosive to be initiated. The only impediment to maximum propagation contact is the relatively thin base member 13. To further increase propagation contact, explosive column 17 is formed so as to have a dome-shaped cross section with a generally flat bottom surface. This flat bottom surface of explosive column 17 lies adjacent the top surface of base member 13 to further maximize propagation contact. The natural affect of this dome-shaped cross-sectional configuration is to direct the maximum explosive force in the direction of the flat bottom surface. As best shown in FIGURE 2, channel 12 has the same dome-shaped configuration as explosive column 17. Carrier member 11 thus completely surrounds the upper curved portion of explosive column 17, and is in direct contact therewith, to further enhance the explosive effect in a direction toward base member 13. As previously mentioned, the purpose of the dome-shaped explosive configuration, the backing provided by carrier member 11, and the flat bottom surface mounted adjacent base member 13 is to maximize propagation contact between explosive column 17 and an object to which detonating tape 10 is attached. If other considerations, such as cost or ease of manufacture dictate, the con-

figuration and placement of explosive column 17 can be varied without departing from my invention.

The basic form of my invention as shown in FIGURES 1 and 2 is manufactured and assembled as follows. First, carrier member 11 is formed to the desired width and height, and channel 12 is formed therein. Carrier member 11 can be formed or molded so as to initially contain channel 12, or channel 12 can later be cut into the pre-formed carrier member 11. Explosive column 17 can be molded in advance to fit the configuration of channel 12, or can be simply placed in channel 12 in granular form. After explosive column 17 is placed in channel 12, base member 13 and second member 14 are structurally or adhesively secured to carrier member 11. The completed detonating tape 10 can then be formed into a roll for storage and handling. Preferably, detonating tape 10 is approximately one-fourth inch in width and approximately one-sixteenth to one-eighth inch thick.

A plural form 10a of detonating tape 10 is shown in FIGURES 3 and 4. In this plural form, a plurality of carrier members 11a are held in a side-by-side relationship between a longitudinally perforated base member 13a and a longitudinally perforated second member 14a. In the embodiment shown in FIGURES 3 and 4, four carrier members 11a are held in the side-by-side relationship. Each section of detonating tape 10a, including the carrier member, the channel, the explosive column, the base member, and the second member, is constructed in the same manner as that described for the basic embodiment of FIGURES 1 and 2. Carrier members 11a are not glued together at their adjoining edges, therefore they can be easily separated from the plural unit. To further facilitate separation of the individual sections or columns, base member 13a and second member 14a are each provided with several rows of longitudinal perforations such as 20. Perforations 20 extend from one end to the other of detonating tape 10a and lie parallel to each other and parallel to the edges of detonating tape 10a. Perforations 20 are placed apart a distance equal to the width of a corresponding carrier member 11a so that each row of perforations is in line with the junction between a pair of adjoining carrier members 11a. Base member 13a and second member 14a can thus be easily divided into a plurality of sections, each section extending the full length of detonating tape 10a.

As shown in FIGURE 3, a single detonating tape 10 can be quickly and easily removed from the plural form of detonating tape 10a by tearing along the corresponding rows of perforations in base member 13a and second member 14a. One or more tapes 10 can be quickly removed from tape 10a to any desired length.

As shown in FIGURE 3, additional rows of transverse perforations can be formed at predetermined intervals in base member 13a and second member 14a, as shown at 21. Transverse perforations 21 will further facilitate the removal of one or more tapes 10 from plural tapes 10a. Carrier members 11a can also be transversely severed, as at 22, at lengths corresponding in location to perforation rows 21 if desired. The transverse rows of perforations 21, and the accompanying transverse severing 22 of carrier members 11a, although not a necessary part of my invention, will in some cases facilitate the use thereof.

The plural form of detonating tape 10a permits the operator to adjust the energy level of the explosive force transmitted to the secondary explosive, to that level necessary to initiate the particular type of secondary explosive that is being used. Thus, for relatively insensitive secondary explosives such as picric acid, all four columns might be necessary. However, if the tape is used to initiate more sensitive secondary explosives such as tetryl comp. B, octol, PBX's or pentolite, only one or two rows of tape 10 would be necessary. It is noted that explosive columns 17a of plural tape 10a are sufficiently close together to insure cross propagation between the columns.

Thus, if more than one row of tape 10 is used to initiate a secondary explosive, only a single detonator need be used to initiate the tape.

A modified form of my basic invention is shown in FIGURES 5, 6 and 7. In this modification, explosive column 17c is a linear shaped charge having a concave groove 25 formed in the face thereof directed toward the top surface of base member 13c. In the preferred form of this modification, channel 12c extends from base member 13c to second member 14c and explosive column 17c is mounted therein adjacent second member 14c. Carrier member 11c is thicker than the shaped charge to provide a stand-off distance between concave groove 25 and base member 13c. This stand-off distance will enhance the performance of the linear shaped charge in the normal manner. As best shown in FIGURE 6, explosive column (linear shaped charge) 17c is structurally or adhesively attached to the bottom surface of second member 14c by means of adhesive 16c. It is also adhesively attached to the side walls of channel 12c by means of suitable adhesive layers 26 and 27. The bottom portion of channel 12c can also be reduced in width as shown in FIGURE 6 to further prevent explosive column 17c from dropping downwardly therein. In constructing this form of my invention, second member 14c is preferably formed from a thin flexible sheet of metal to enhance the performance of the shaped charge. This modification of my invention can also be manufactured in a variety of sizes to meet a wide range of cutting requirements.

FIGURES 8 and 9 disclose another modification of the basic form of my invention, employing conical-shaped charges. In this embodiment, channel 12c is formed in an upper portion of carrier member 11d adjacent second member 14d. Explosive column 17d is mounted in channel 12d and is separated from base member 13d throughout most of its length by the major bottom portion of carrier member 11d. A series of vertical openings 30 are formed in carrier member 11d at predetermined distances apart. Openings 30 extend from explosive column 17d to base member 13d. Individual shaped charge explosive units 31 are mounted in each of the openings 30 in close proximity to explosive column 17d to insure proper explosive propagation between the explosive column and the shaped charge unit upon detonation of the explosive column. Shaped charge units 31 are attached to the walls of openings 30 by suitable adhesive coatings 26d. Carrier member 11d is thicker than the shaped charge units 31 to provide a stand-off distance between the shaped charge units and the base member 13d. Openings 30 can again be reduced in diameter between shaped charge units 31 and base member 13d to provide further support to the shaped charge units.

Again, tape 10d can be attached to a surface by means of adhesive coating 18d. A detonator is used to initiate explosive columns 17d. The explosive force generated by column 17d initiates each of the individual shaped charge units 31. Shaped charge units 31 act in their normal manner to punch holes in the object to which tape 10d is attached. To further enhance performance, top member 14d can again be constructed from a flexible metal or plastic strip or foil. This type of detonating tape can be manufactured in a variety of individual forms differing in the penetrating ability of the shaped charge units and in the distance between them, to meet individual use requirements. It is evident, of course, that any of these modified forms of my invention can be packaged as a plural unit of the type shown in FIGURE 3.

FIGURES 10, 11, 12 and 13 disclose another modification of the basic form of my invention in which the explosive column comprises a liquid explosive 17e carried by a flexible hollow sealed tube 35. In the embodiment shown, tube 35 has a circular cross section, and the walls thereof are pinched together and sealed at predetermined intervals, indicated by the numeral 36, to form a series of sealed tubes along the length of tape 10e.

Detonating tape 10e can thus be severed at these intervals 36 without leakage of the liquid explosive 17e. To further facilitate the severance of the tape 10e at the predetermined intervals 36, carrier member 11e can be severed at the same intervals 36 as shown at 37 in FIGURE 10 with base member 13e and second member 14e being perforated as at 38.

Tube 35 is preferably a plastic tube of the type that can be pinched together at intervals and heat sealed. As best shown in FIGURE 11, the distance between each pair of sealed tubes should be as short as possible to insure explosive propagation along the entire length of tape 10e. Explosive 17e can be liquid, semi-liquid, or a gel. An example of a suitable liquid explosive is "Astrolite" manufactured by the Explosive Corporation of America.

FIGURE 14 discloses a typical application of my invention. A plurality of blocks of explosive 39 are to be detonated. Blocks 39 are composed of a relatively insensitive explosive such as TNT. Adhesively attached to the surface of blocks 39 is a strip of detonating tape 10. A single detonating tape 10 can be used, or the plural form as shown in FIGURE 3 can be used. Detonating tape 10 is securely attached to blocks 39 to insure good explosive propagation, and also acts to hold blocks 39 securely together. If desired, a longer length of tape 10 than shown can be used and wrapped around blocks 39 several times. A suitable detonator 40 is mounted adjacent tape 10 as shown. The adhesive coating on the base member of tape 10 also acts to hold detonator 40 securely in place. When detonator 40 is initiated, either electrically or mechanically, detonation of tape 10 results. The detonation of tape 10 in turn causes detonation of explosive blocks 39.

The various detonating tapes of my invention have many applications. In addition to their use as initiators, they can be used in release devices, in metal hardening, and the like. Although the basic embodiments of my invention have been described in detail in the foregoing specification, it is understood that other changes can be made without departing from the invention. Therefore, I intend to be limited only by the following claims.

I claim:

1. An adhesive backed, flexible detonating tape capable of being formed into a roll for storage purposes and for ease of handling, and capable of being quickly unfurled for attachment to a surface, comprising:

- (a) a relatively thin, ribbon-like, flexible base member having top and bottom surfaces;
- (b) a first adhesive coating on said bottom surface of said base member;
- (c) a light, flexible elongated carrier member having a continuous channel formed longitudinally therein, and having top and bottom surfaces;
- (d) a flexible explosive column mounted in said channel of said carrier member;
- (e) means for securely attaching said bottom surface of said carrier member to said top surface of said base member;
- (f) a second relatively thin, ribbon-like, flexible member having top and bottom surfaces; and
- (g) means for securely attaching said bottom surface of said second flexible member to said top surface of said carrier member.

2. The apparatus of claim 1 wherein said base member and said second member are constructed of paper, wherein said carrier member is formed from a plastic material and wherein said means for securely attaching said carrier member to said base member and to said second member include adhesive coatings between said members, whereby said roll can quickly be unfurled and a selected length of detonating tape separated from said roll by tearing across the width thereof.

3. The apparatus of claim 1 wherein said detonating tape is attached to a secondary explosive by said first adhesive coating and is used to initiate said secondary explosive, and wherein said explosive column is in contact

with said base member along the entire length thereof to increase the propagation contact with the secondary explosive to be initiated.

4. The apparatus of claim 1 wherein said explosive column has a dome-shaped cross section with a generally flat bottom surface, and wherein said flat bottom surface of said explosive column is mounted adjacent said top surface of said base member along the entire length thereof to provide maximum propagation contact with an object to which said tape is attached by means of said first adhesive coating.

5. The apparatus of claim 1 wherein said explosive column has a dome-shaped cross section with a flat bottom surface, said flat bottom surface being mounted adjacent said top surface of said base member to maximize explosive propagation therethrough, and wherein said carrier member completely surrounds the upper curved portion of said dome-shaped explosive column to further enhance the explosive effect of said column in a direction toward said base member.

6. The apparatus of claim 1 wherein said explosive column is a linear shaped charge having a concave groove formed in the face thereof directed toward said top surface of said base member.

7. The apparatus of claim 6 wherein said channel in said carrier member extends from said base member to said second member, wherein said linear shaped charge is mounted in said channel and supported by said carrier member adjacent said second member, and wherein said carrier member is thicker than said linear shaped charge to provide a stand-off distance between said concave groove and said base member to enhance the performance of said linear shaped charge upon detonation thereof.

8. The apparatus of claim 1 wherein said channel is formed in an upper portion of said carrier member adjacent said second member, said flexible explosive column being mounted therein and separated from said base member by a lower portion of said carrier member, wherein openings are formed in said lower portion of said carrier member at predetermined distances apart, said openings extending from said explosive column to said base member, and wherein individual shaped charge explosive units are mounted in said openings and supported by said carrier member, said shaped charge explosive units being held in close proximity to said explosive column to insure proper explosive propagation therebetween upon detonation of said explosive column.

9. The apparatus of claim 8 wherein said carrier member is thicker than the total thickness of said explosive column and said individual shaped charge units to provide a stand-off distance between said shaped charge units and said base member.

10. The apparatus of claim 1 wherein said flexible explosive column comprises a hollow sealed tube filled with a liquid explosive.

11. The apparatus of claim 10 wherein the walls of said tube are pinched together and sealed at predetermined intervals to form a series of sealed tubes along the length of said tape that can be severed from each other without leakage of said liquid explosive.

12. The apparatus of claim 11 wherein said carrier member is transversely severed at said predetermined intervals to form sections thereof, said individual sections being mounted in said tape with the opposite ends thereof lying in the same transverse planes as the opposite ends of a corresponding sealed tube to further facilitate the severance of said tape at said predetermined intervals.

13. The apparatus of claim 1 wherein said explosive column comprises a cap-sensitive explosive composition, in combination with:

- (a) a secondary relatively insensitive explosive charge, said detonating tape being secured to said secondary

charge by said adhesive coating on said base member, and

- (b) a detonator cap mounted in explosive propagation contact with said tape.

14. An adhesive backed, flexible detonating tape capable of being formed into a roll for storage purposes and for ease of handling, and capable of being quickly unfurled in a selected width and length for attachment to a surface, comprising:

- (a) first and second ribbon-like, elongated, flexible support members, each of said support members having a pair of generally parallel edges separated by top and bottom surfaces and each having first and second ends, each of said support members having at least one row of perforations formed therein extending between said ends and parallel to said edges, whereby each of said support members can be easily divided into a plurality of sections;

- (b) a plurality of flexible, elongated carrier members, each having top and bottom surfaces and being equal in width to the width of a section, each carrier member having a longitudinal channel formed therein, said channel being adapted to carry a flexible column of explosive;

- (c) means for securely attaching the bottom surface of one of said carrier members to the top surface of each of said sections of said first support member;

- (d) means for securely attaching the bottom surface of said second support member to the top surfaces of said carrier members mounted on said first tape,

each of said sections of said second support member being aligned with a corresponding carrier member and section of said first support member, said carrier members thereby being held in a side-by-side relationship between said perforated support members; and

- (e) an adhesive coating on said bottom surface of said first support member.

15. The apparatus of claim 14 including a flexible column of explosive mounted in said channel of each of said carrier members.

16. The apparatus of claim 15 wherein each said channel and explosive column has a dome-shaped cross section with a generally flat bottom surface, and wherein said flat bottom surface of each said explosive column is mounted adjacent said top surface of the associated section of said first support member along the entire length thereof to provide maximum propagation contact with an object to which said section is adhesively attached.

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