

[54] CENTRIFUGALLY DRIVEN SPIN DEVICE

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[51] Int. Cl. **F42c 15/26**

[58] Field of Search **102/78, 79, 80, 70; 73/512, 515, 521**

[56] **References Cited**

UNITED STATES PATENTS

3,621,782	11/1971	Biggar	102/79
3,425,354	2/1969	Carlson	102/79
3,313,236	4/1967	Lohmann	102/76 R X
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[57]

ABSTRACT

An apparatus for providing a continuous path along an axis in a chamber only when the chamber rotates about the axis. The apparatus includes a plurality of discs or members in the chamber, with each member having a path forming portion in approximately its center of floatation which, if the member is uniform, is the center of the disc. The members are stacked upon each other with the plane of each member being substantially perpendicular to the axis. The chamber has a cross sectional area measured perpendicular to the axis which is of a size to permit the members to align themselves to provide the continuous aperture about the axis when all of the members are in a predetermined position. There is additionally provided a fluid in the chamber so that as the chamber is rotated about the axis, when there is fluid in the chamber, the member move to their predetermined positions, centering the center of floatation to yield the continuous path.

3 Claims, 3 Drawing Figures

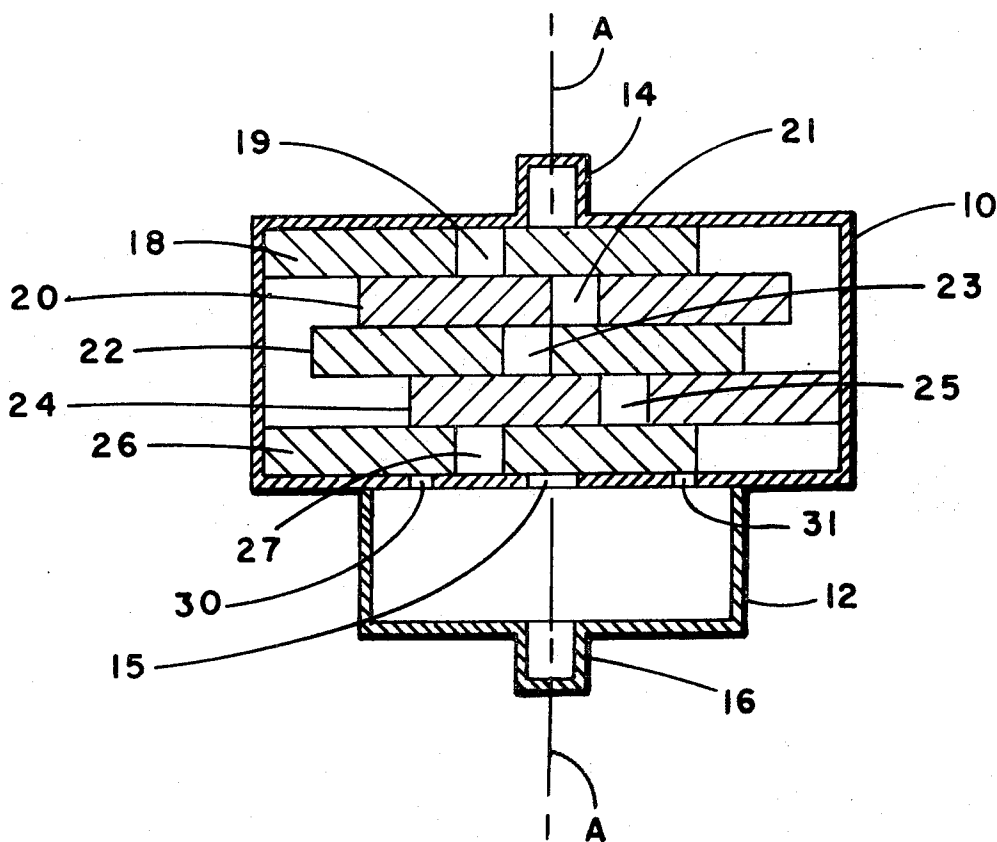


FIG. 1

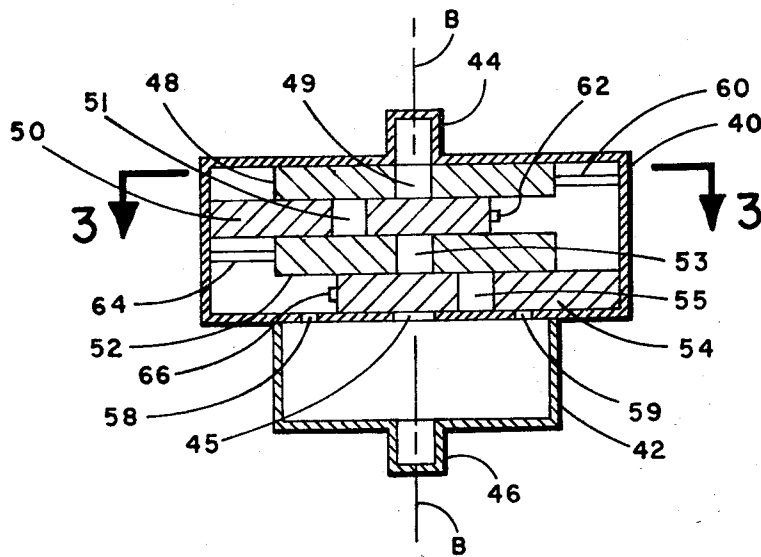
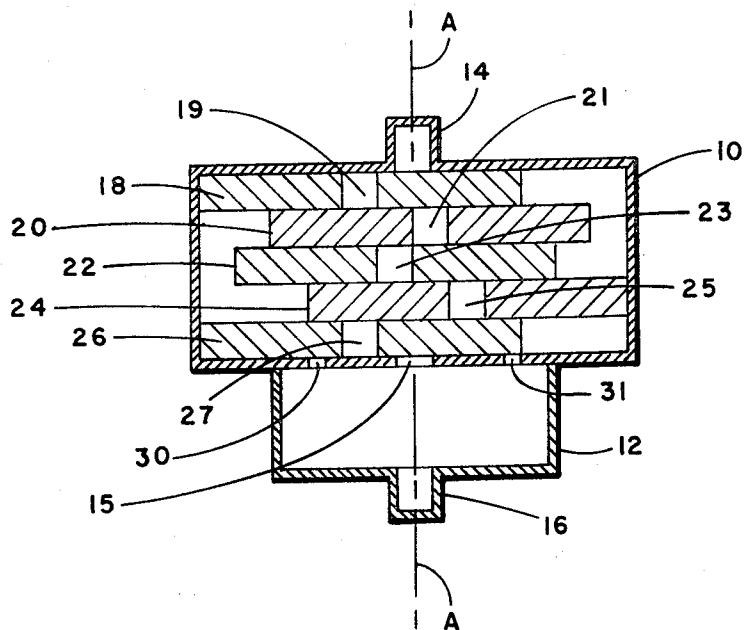


FIG. 2

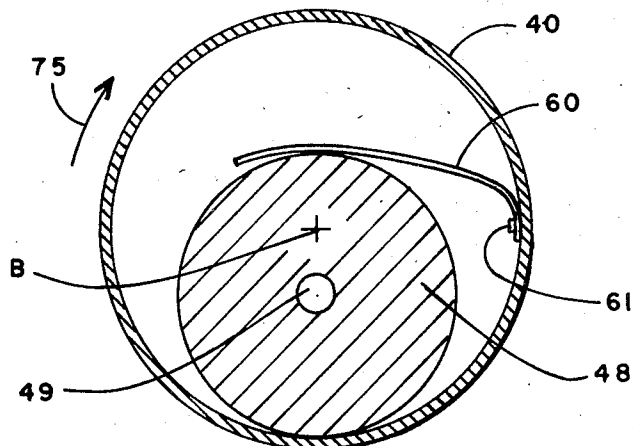


FIG. 3

CENTRIFUGALLY DRIVEN SPIN DEVICE

BACKGROUND OF THE INVENTION

It is often times desirable to provide a device which is capable of permitting the transfer of a signal along an axis only under certain specific conditions. In the production of artillery shells and other munitions, fuses are employed which initiate the explosives contained therein for firing at a predetermined time. Because of the highly explosive nature of artillery shells, it is desirable that the fuses be incapable of firing the shell at times other than the proper time during use.

It has become desirable to create some form of apparatus which provides a satisfactory block or impass which prevents ignition of the shell during all times except after firing. Many such devices have been designed, some of which are expensive and/or intricate to manufacture. Other fuzes, while sound in principle, fail to provide the desired reliability during mass production.

Some fuses which have been generally accepted and which describe the general state of the art are set forth in U. S. Pat. Nos. 2,641,186, 3,118,379 and 3,425,354.

SUMMARY OF THE INVENTION

The present invention is seen to be a significant advance in the state of the art. The apparatus described herein is simple and relatively inexpensive to manufacture yet it provides a perfectly safe method for arming an artillery shell after firing.

The present invention provides an arming and time delay mechanism for spin operated fuzes and other devices which rotate about an axis. Its unique feature is that it employs a number of buoyant washer shaped discs which are randomly dispersed in a fluid housing. In the unarmed condition, the discs prevent transmission between the detonator and the booster since the various buoyant washer shaped discs are not centered about the axis to provide a path. The discs may be randomly dispersed, or they may be biased in a position prohibiting the formation of the continuous aperture. Activation of the device is caused by spin of the device about an axis. During spin, fluid is caused to flow into a chamber containing the buoyant washer shaped discs. Inasmuch as the density of the fluid is at least on the average greater than that of the discs or members, the lighter discs are centered such that their center of floatation in the fluid is at the axis of spin. Thus, once sufficient flow has taken place to float the discs and center their center of floatation, a continuous aperture or path is provided.

BRIEF DESCRIPTION OF THE DRAWINGS

For a more complete understanding of the present invention, reference is hereby made to the drawings, in which:

FIG. 1 is a cross sectional view of one embodiment of the invention;

FIG. 2 is a cross sectional view showing a second embodiment of the present invention; and

FIG. 3 is a cross sectional top view of the device shown in FIG. 2.

DETAILED DESCRIPTION OF THE DRAWINGS

With reference to FIG. 1, showing a cross section of the present invention, a chamber 10 is provided and contains a number of disc-like members 18, 20, 22, 24

and 26. These discs have a path forming portion proximate their center of rotation, 19, 21, 23, 25 and 27. Normally the path forming portion of the member is a hole, and such path forming member will hereinafter be referred to as such. However, this portion may be conductive to electrical or optical signals, such as a conductive couple inserted in a plastic disc or a clear portion in an opaque disc. Such path forming portions are clearly within the scope of the present invention. All that is needed is to have a portion of the member be suitable for passage of a signal while the balance of the member prohibits passage of that signal. The entire device is centered about an axis A and, when in use, is rotated about this axis A. Also attached to the chamber 10 is a reservoir 12 which is suitable for holding fluids contained in either the chamber 10 or the reservoir 12 prior to use of the device. Along the axis A is a source of signal 14 and a receiver of signal 16. These signal sending and receiving means 14 and 16 can be anything which transmits a signal, such as for example, signal transmitting means 14 can be a detonator while signal receiving means 16 can be a booster. Thus, when the detonator is activated, such as upon impact, a blast or charge is fired from the detonator 14 and is impacted upon the booster 16 which then causes explosion of the shell in which this fuse is incorporated. The discs 18, 20, 22, 24 and 26 have suitable holes at their center of floatation such that, when all of the discs are centered, the signal transmitted by the sender means 14 goes down through the center holes 19, 21, 23, 25 and 27 into the reservoir 12 and is received by the signal receiving means 16.

The discs themselves can take any shape which is desirable as long as the hole or path forming portion is centered at the center of floatation. Moreover, the discs may be constrained in one or more directions, so that floatation by the fluid will cause them to move in a specific direction, seeking to locate the center of floatation at the axis, thereby performing useful work. The specific center of floatation for any given member can readily be determined. Normally, in a uniform regularly shaped disc this center will be at its geometric center. In irregular shaped, some degree of visual experimentation may be necessary. Likewise, as fluids of extremely high or low density are employed or as the fluid's density is significantly greater than the density of the disc, irregular shaped members may have different centers of floatation for different shaped chambers and different quantities of fluid.

Depending upon the relative densities of the disc materials and the liquids, and of the geometry of the chamber 10 and reservoir 12, a fixed amount of fluid will be required in the chamber 10 in order to centrifugally float and center the discs 18 through 26. If, as it is intended, the device is to be used as a fuse in an artillery shell, the device will experience what is known as set back, a force due to the firing of the shell. Set back will cause as much fluid as possible to flow through opening 15 into the reservoir 12. As the reservoir 12 and chamber 10 spin about axis A, fluid will flow through openings 30 and 31 communicating between reservoir 12 and chamber 10. The amount of fluid which accumulates in the upper chamber 10 can, if viscosity and rotation are suitable, be a function of the angle through which the spinning projectile has been rotated about the axis A. It can easily be seen that all of the parts of the reservoir are closer to the axis of spin

A than is at least part of the chamber. Accordingly, when the apparatus is spun about the axis A, the fluid will be transferred through ports or connecting means 30 and 31 to the chamber 10. The density of the fluid and the size of the openings 30 and 31 will determine the number of revolutions necessary to permit the flow of a sufficient quantity of fluid into the chamber to permit floatation of the discs 18 through 26. For most munitions, 26 revolutions is deemed to be a safe distance away from the firing for arming. At this time, the discs will float and align their center holes after this number of revolutions. There will then be a clear path from the signal sending means 14 to the signal receiving means 16. Moreover, due to the spin of the device, the liquid will be centrifuged outward so that the central path along axis A will be dry and free of liquid.

The device of the present invention offers features which prevent accidental arming of the device prior to the proper number of revolutions as set forth above. Basically, the discs originally are randomly oriented in the chamber. Moreover, the signal which is sent by the signal means 14 should not be so strong as to be able to penetrate even one of the discs. Thus, the centering of the disc elsewhere so as to block the path along the axis A will prevent activation of the signal receiving means. By simple calculation, it can be shown that if the number of discs are sufficiently great, and if the hole is sufficiently small, the probability of all of the holes accidentally lining up to permit the formation of the continuous aperture along the axis is insignificant and therefore impossible from a practical standpoint. For example, if the discs have a diameter D and are contained in a chamber having a diameter ND , and if the disc center hole diameter is ED , then the discs have an area in which they can move around in of: $A_{free} = \pi/4 (N - 1)^2 D^2$. The area of the center is equal to $A_{center} = \pi/4 E^2 D^2$. The chances of the center hole overlapping its position at the center of the device is: $P = A_{center} / A_{free}$, which in turn equals $E^2 / (N - 1)^2$. If there are M number of discs, the chances of them all centering sufficiently so that there is an open central path down through their central holes is: $P = [E^2 / (N - 1)^2]^M$, which in turn equals $(E/N - 1)^{2M}$. If for example purposes we choose values such that: $E = 0.15$; $N = 1.5$; and $M = 8$; then the probability P equals $(0.15/0.5)^{16}$ or is approximately $1/200,000,000$. This analysis is based upon the assumption that the discs move independent of one another.

Thus it can be seen that the device is safe in the following respects. First of all, if the liquid fill were to be omitted, or leak away, the disc could not be floated and (within the $1/200,000,000$ probability) would not line up to permit detonation. Secondly, if it were somehow possible for the discs all to be centered with the projectile non-spinning, there would be some fluid in the center path which would block transmission of the signal or detonation. Moreover, if the projectile itself were to tumble or wobble in flight, the spin would not be uniform about the axis and the discs would become disorganized, again preventing the propagation of the detonator blast.

To further insure the safety of such a device, the embodiment shown in FIG. 2 may be employed. Specifically, an axis B is provided, about which the device spins. Chamber 40 and reservoir 42 are connected to spin about this axis B. Signal generating means 44 is provided to pass a signal through aperture 45 connect-

ing the chamber 40 and reservoir 42 to signal receiving means 46. Again 44 and 46 may be detonators and boosters in an artillery shell.

Discs 48, 50, 52 and 54 are provided within the chamber 40 and have holes 49, 51, 53, and 55 respectively. By alignment of these holes about the axis B, the signal transmitting path from signal transmitting means 44 to signal receiving means 46 along axis B is clear. However, the discs 48, 50, 52 and 54 are maintained in a position other than centered by spring means 60, 62, 64 and 66. Thus each of the four discs are blocking passage along the axis B. As shown in FIG. 3, the chamber 40 is centered about axis B and contains disc 48. The disc 48 has a hole 49 at a center of floatation. However, the disc 48 is positioned by spring 60 mounted to chamber 40 by rivet 61 so as to place the hole 49 at a point other than the center axis B. However, during rotation in the direction shown by arrow 75, the spring 60 will be forced away from the disc 48 and floatation of the disc 48 in the chamber 40 will permit alignment of the hole 49 about axis B, since the hole is centered at the center of floatation of the disc 48.

Thus, upon spin, the device in FIG. 2 will permit relaxation of springs 60, 62, 64 and 66, allowing holes 49, 51, 53 and 55 to be centered about axis B.

Thus it can be seen that the apparatus of the present invention is suitable for providing a safe condition wherein which transmitting means is incapable of transmitting a signal to receiving means except under certain specified conditions, namely sufficient spin to properly float the disc-like members to align the holes at their center of floatation. While this device has been described as being useful in a spin activated fuze for armament shells, it is equally useful in other applications. For example, such a device could be adapted to rotate about its axis during rotation of a drive shaft to permit free passage of the signal through the aperture only when the drive shaft would be in operation.

Having thus described the invention, what is claimed is:

1. An apparatus for providing a continuous path along an axis in a chamber substantially only when said chamber is caused to rotate about the axis, comprising:
 - a plurality of members in said chamber, each member having a path forming a portion approximate to its center of floatation, each member being substantially perpendicular to the axis;
 - said chamber having a cross sectional area perpendicular to said axis of a size to permit members aligning to provide a continuous path about said axis when all of said members are in a predetermined position in their planes;
 - means defining a reservoir, said reservoir being positioned adjacent to said chamber such that all parts of said reservoir are closer to said axis than is at least a part of said chamber;
 - means connecting said reservoir to said chamber for providing a continuous path along said axis;
 - means connecting said reservoir to said chamber for permitting flow of fluid, said fluid flow means being adapted to permit flow of a known quantity of fluid from said reservoir to said chamber during a known number of revolutions; and
 - a fluid in said reservoir, said fluid being capable of flowing through said fluid flow means during rotation about said axis and having sufficient density to move said members to the predetermined position.

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2. The apparatus of claim 1 wherein said members are all of substantially the same density, said member density being less than said fluid density.

3. The apparatus of claim 1 which further includes bias means for locating at least one of said members at

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a position different from its predetermined position, said bias means being further adapted to release said member upon rotation of said chamber about said axis.

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