

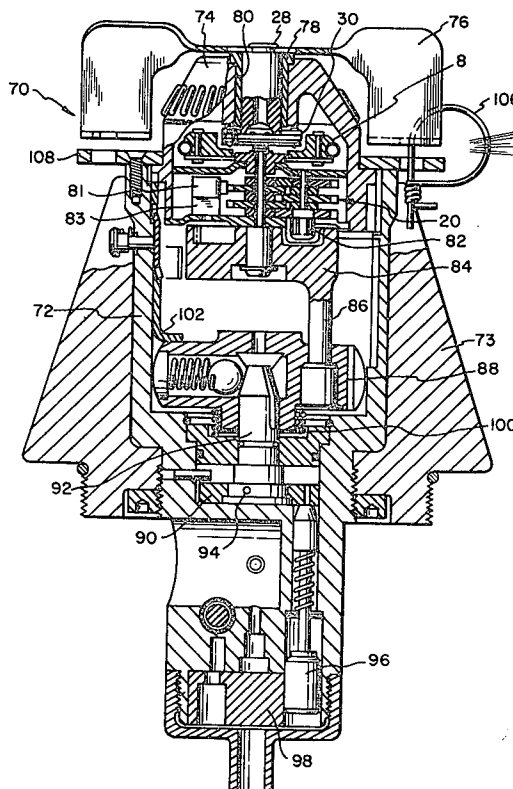
- [54] **ARMING DEVICE WITH SPEED DISCRIMINATING CLUTCH**
- [75] Inventors: **William H. Reams**, Keedysville; **Sherman L. Min**, Potomac, both of Md.
- [73] Assignee: **The United States of America as represented by the Secretary of the Navy**, Washington, D.C.
- [22] Filed: **Dec. 17, 1973**
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- [52] U.S. Cl. **102/79; 192/103 B**
- [51] Int. Cl.² **F42C 15/22**
- [58] Field of Search **102/79, 80, 81, 81.2; 192/103 B, 105 CD, 104 C**

- [56] **References Cited**
- UNITED STATES PATENTS**
- 3,131,797 5/1964 Bochan 102/103 B
- 3,308,912 4/1967 Sheckells 102/105 CD
- 3,677,185 7/1972 Reams 102/81.2 X

Primary Examiner—Stephen C. Bentley
Assistant Examiner—Harold Tudor
Attorney, Agent, or Firm—R. S. Sciascia; J. A. Cooke; F. K. Yee

[57] **ABSTRACT**
 An arming device in which a speed-discriminating, centrifugal clutch controls the movement of an arming rotor from an unarmed to an armed position. The centrifugal clutch transmits rotary motion from a first rotating shaft to a second rotatable member only when the first rotating shaft has an angular speed of a value between predetermined upper and lower angular speeds. A first circular plate is fixed to the rotating shaft and a pair of spring-biased members are pivoted to the circular plate and are adapted to move outwardly during rotation at a sufficient angular speed. A plurality of arcuate weights are slidably mounted on a second circular plate and adapted to engage the members on the first plate. After rotational speed increases beyond a predetermined upper limit, the weights move outwardly relative to the plate and disengage the clutch. A gear train couples the clutch to the arming rotor, the gear train being provided with friction means to prevent undesired extraneous motions.

21 Claims, 15 Drawing Figures



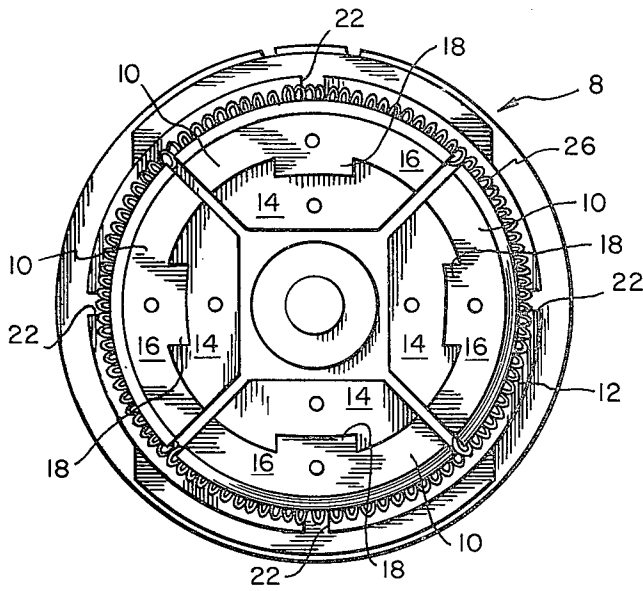


FIG. 2

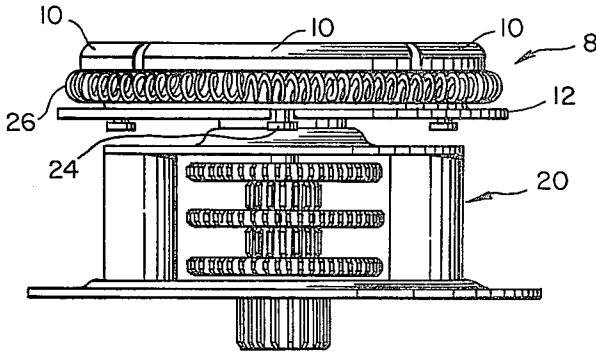


FIG. 1

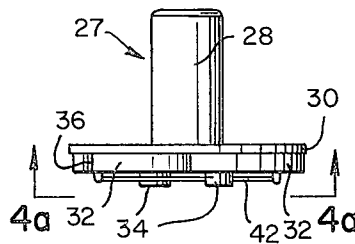


FIG. 3a

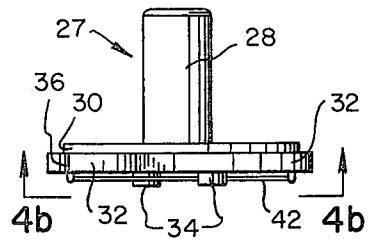


FIG. 3b

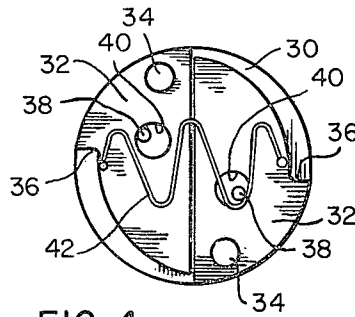


FIG. 4a

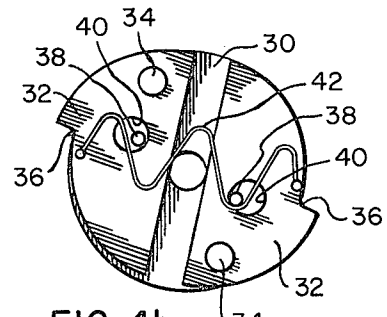


FIG. 4b

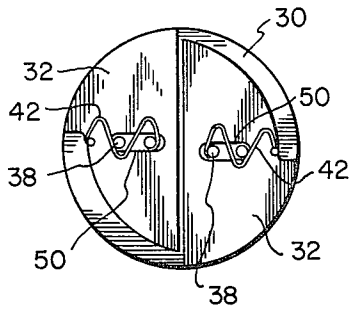


FIG. 5

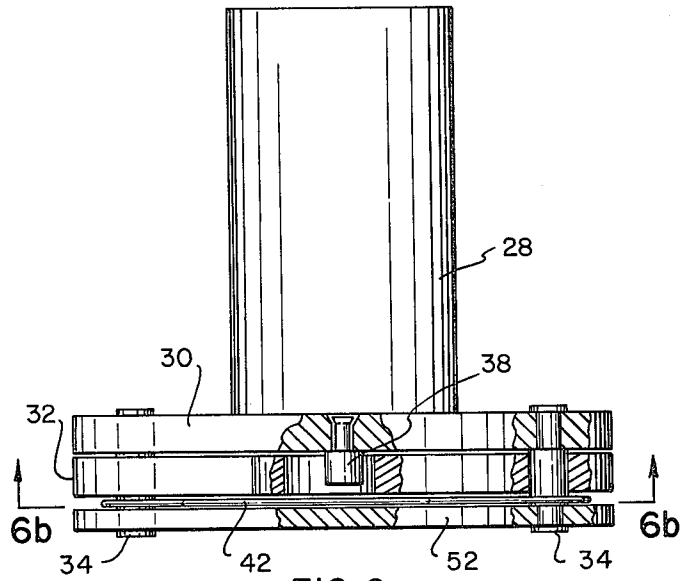


FIG. 6a

FIG. 7a

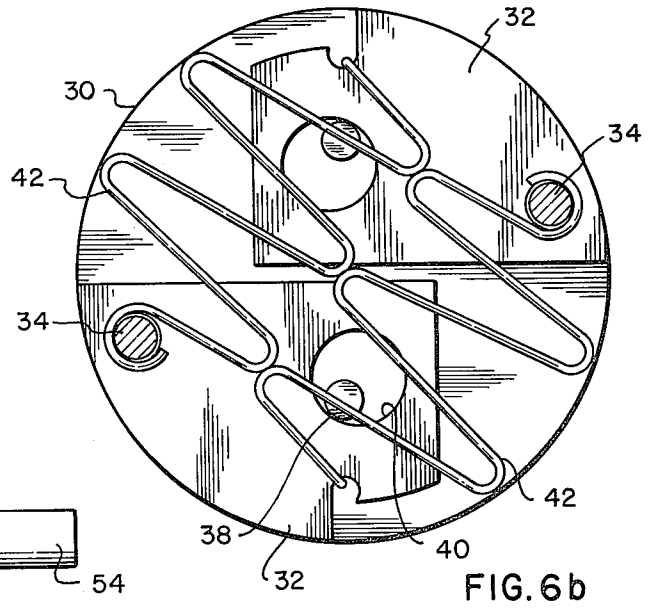
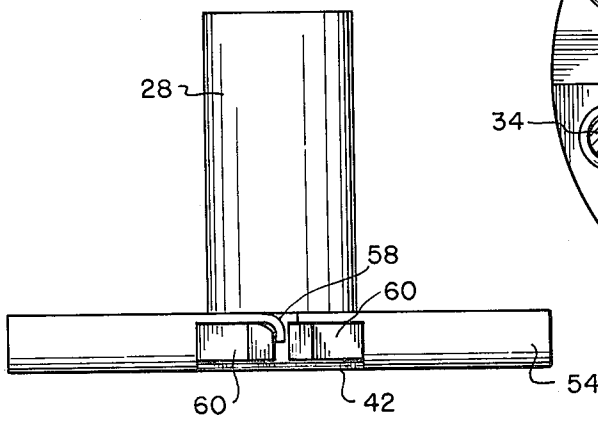


FIG. 6b

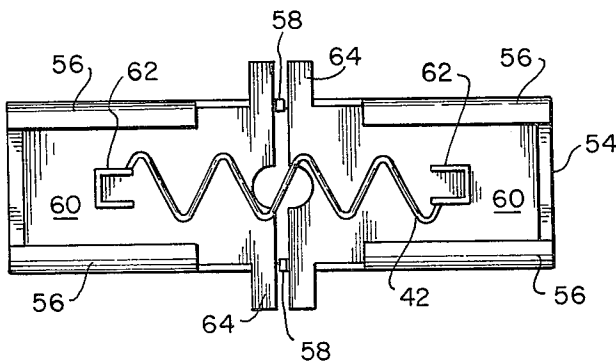


FIG. 7b

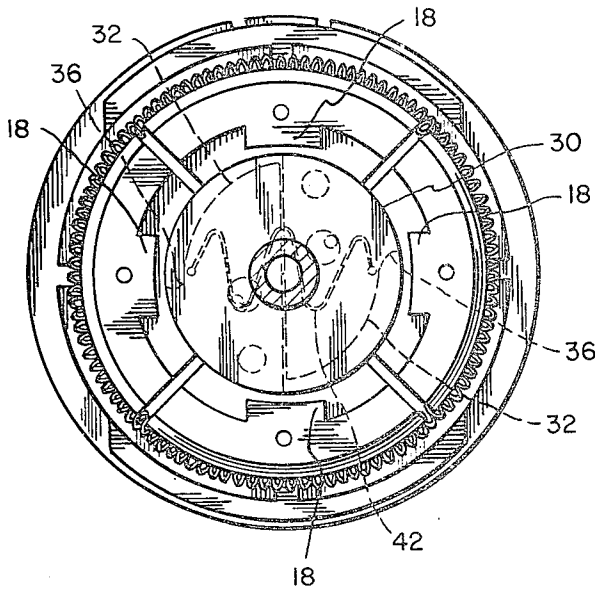


FIG. 9a

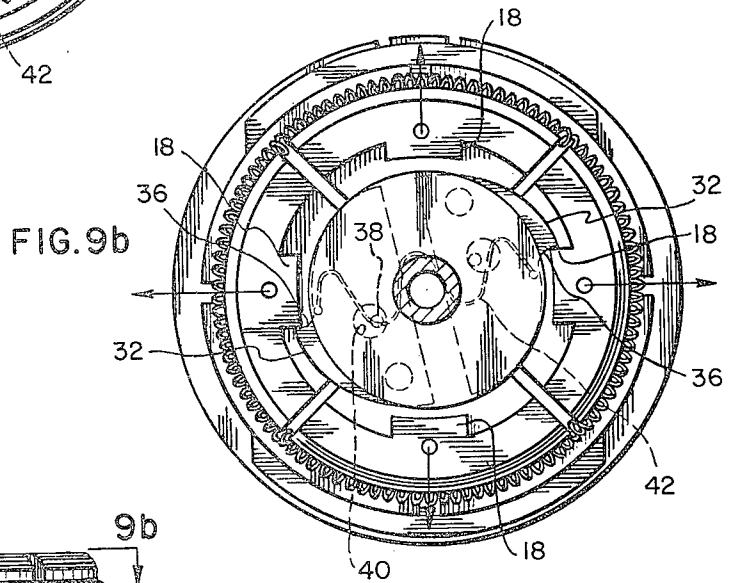


FIG. 9b

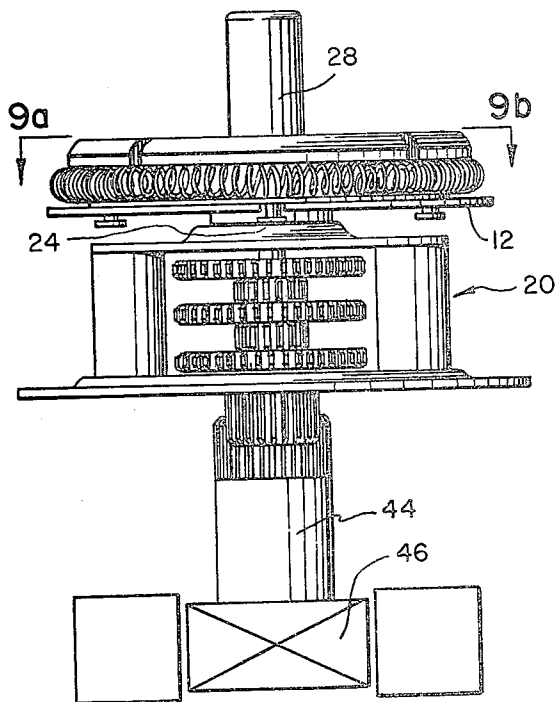
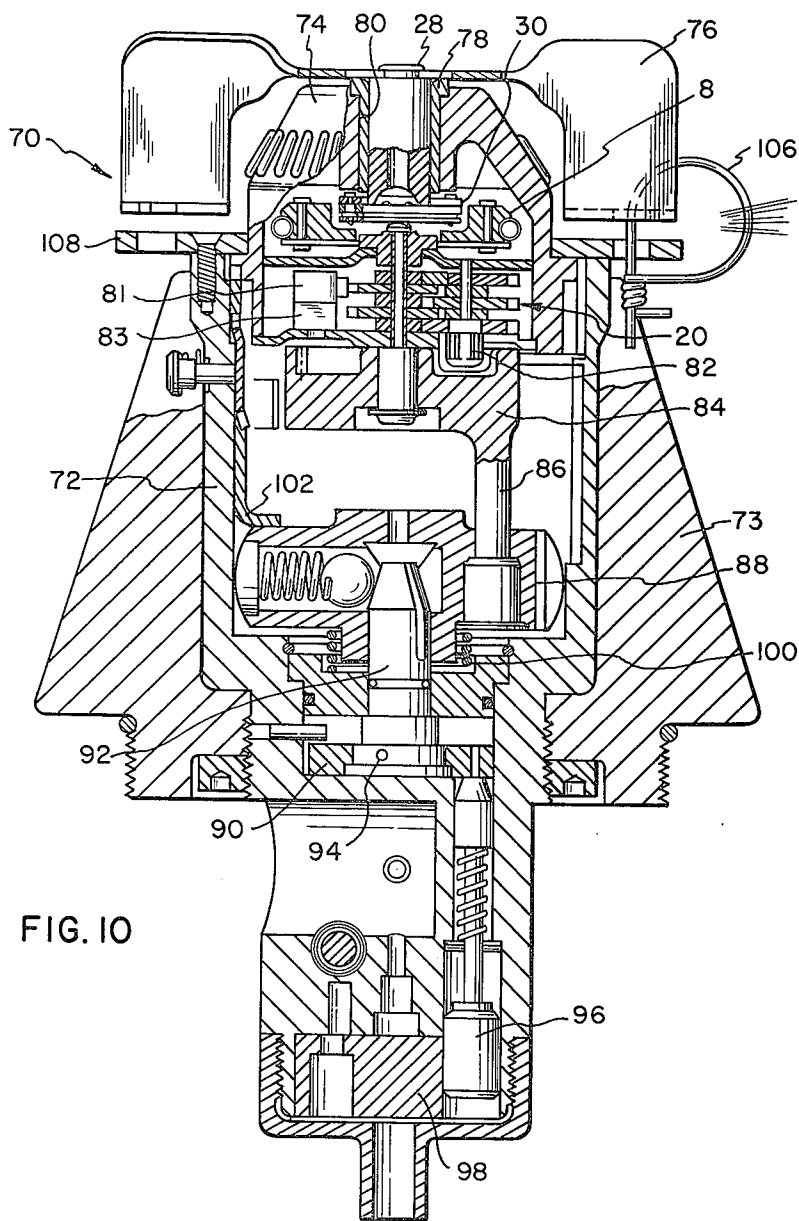


FIG. 8



ARMING DEVICE WITH SPEED DISCRIMINATING CLUTCH

CROSS REFERENCE TO RELATED APPLICATION

This application is for an improvement of the invention disclosed in application Ser. No. 235,205, filed Mar. 16, 1972, by William H. Reams and now U.S. Pat. No. 3,804,222.

BACKGROUND OF THE INVENTION

This invention relates generally to arming mechanisms, and more particularly, to an arming device which incorporates a speed-discriminating clutch mechanism which will transmit rotary motion from a rotating shaft to a rotatable member only when the shaft rotates at an angular speed between predetermined upper and lower angular speeds. The clutch controls the positioning of an arming rotor from an unarmed to an armed position in an explosive train.

In air-delivered ordnance vehicles, for safety purposes it is a common practice to maintain the firing system thereof in a "safe" or unarmed mode for a period of time subsequent to launch. A conventional method by which such vehicles are armed is through the rotation of an air vane on the nose of the vehicle which causes an explosive element, normally out-of-line in an explosive train, to move into an armed position thereby completing the explosive path. Problems have arisen, however, in the use of this method. For example, it has been frequently found that premature arming of the device occurs. More specifically, after launch of the ordnance vehicle, the explosive train is completed prior to the predetermined time for which this event was scheduled. Another problem which has occurred is that, upon the air vane reaching extremely high angular velocities, the explosive element is caused to "overshoot" its intended position and therefore render the weapon a dud.

SUMMARY OF THE INVENTION

Accordingly, one object of this invention is to provide a new and improved arming mechanism.

Another object of this invention is to provide a new and improved arming mechanism having an improved, simple and easy-to-manufacture clutch mechanism which has a speed discriminating feature.

Another object of the invention is the provision of a new and improved arming mechanism having an improved clutch mechanism for transferring rotational motion to an explosive train.

Still another object of the invention is the provision of a new and improved arming mechanism having an improved clutch mechanism with a predetermined lower angular velocity limit below which the clutch is maintained in a disengaged configuration.

Yet another object of the present invention is to provide a new and improved arming mechanism having a clutch mechanism adapted to attain a disengaged configuration at angular velocities above predetermined upper angular velocity limit.

A still further object of the instant invention is to provide a new and improved arming mechanism having a clutch mechanism which will be in an engaged configuration when the angular velocity is in between two predetermined values.

Briefly, in accordance with one embodiment of this invention, these and other objects are attained by pro-

viding an arming device in which a shaft of a centrifugal clutch is connected to the air vane at the nose of an ordnance vehicle. A pair of pivotally mounted members are coupled at the end of the rotating shaft and are adapted to move outwardly during rotation at a speed greater than a predetermined angular speed. The members rotate within a governor weight assembly provided with arcuate, slidable weights adapted to be engaged by the members. The output shaft of the governor weight assembly controls the positioning of an explosive element into the armed position of an explosive train via a gearing arrangement and a safety arming assembly. Friction means stabilize the gearing arrangement against extraneous motion.

At speeds greater than an upper predetermined angular velocity, the arcuate weights move outwardly and disengage the clutch to prevent overshooting the armed position.

BRIEF DESCRIPTION OF THE DRAWINGS

A more complete appreciation of the invention and many of the attendant advantages thereof will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein:

FIG. 1 is a side view of the governor weight assembly and accompanying gear arrangement of the present invention;

FIG. 2 is a plan view of the apparatus illustrated in FIG. 1;

FIGS. 3a and 3b are side views of the driving assembly with the spring-biased pivotal members in their unextended and extended configurations, respectively;

FIGS. 4a and 4b are views taken along lines 4-4 of FIGS. 3a and 3b;

FIGS. 5, 6a, 6b 7a and 7b are views of alternate embodiments of the driving assembly;

FIG. 8 is a side view of the clutch mechanism in its assembled form schematically showing a connection to an explosive element of an explosive train; and

FIGS. 9a and 9b are views taken along lines 9-9 of FIG. 8 with the pivotal members in their unextended and extended configurations, respectively; and

FIG. 10 is an embodiment of the arming device of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings wherein like reference characters designate identical or corresponding parts throughout the several views and more particularly to FIGS. 1 and 2 thereof, the driver assembly 8 of the centrifugal clutch of the present invention comprising the governor weight assembly is shown to include four arcuate-shaped weights or shoes 10 slidably coupled to a circular plate 12. Each shoe 10 has a planar portion 14 and an arcuate lip 16 formed on the outer edge thereof. The concave surface of the arcuate lip 16 of each arcuate shoe 10 has an inwardly extending projection 18 formed thereon.

The circular plate 12 is rotatably mounted on a shaft directly coupled to a gear or escapement arrangement 20 of a conventional type. The plate 12 has four equally spaced radial slots 22 formed therein. Each arcuate shoe 10 has two lugs 24 projecting from the lower surface thereof which are adapted to be slidably posi-

tioned within each slot 22. Therefore, each arcuate shoe 10 is radially slidable on circular plate 12. The arrangement of shoes is held in a configuration wherein each shoe is as close as possible to the center of plate 12 by an elongate spring 26 which extends circumferentially along the outer surface of arcuate lip 16, thereby urging each shoe to its most inward position. It can be seen that, when the shoes 10 are rotated by an external force, the circular plate 12 is caused to rotate under the action of lugs 24 and thereby actuate the escapement mechanism 20.

Referring now to FIGS. 3 and 4, the driving assembly of the clutch mechanism is shown as including a driving shaft 28 having a thin circular plate 30 fixed centrally thereto at one end. On the surface of plate 30, opposite the surface on which shaft 28 is connected, a pair of substantially crescent-shaped members 32 are pivotally mounted at diagonally opposed pivot points 34. Each member 32 has an outer portion cut therefrom so as to form a shoulder 36. Further, plate 30 has provided thereon a pair of small rods 38 which extend through openings 40 formed in each member 32. A spring 42 has its ends mutually connected to each member 32 by conventional means and normally urges them together in a manner whereby shoulders 36 overlie plate 30 and do not extend over the edge thereof.

Shown in FIGS. 5 and 6 are alternative embodiments of the driving assembly. In FIG. 5, an elongated slot 50 coaxing with a pair of rods 38 has replaced the pivot point 34, rod 38 and opening 40 in each member 32. A spring 42 has its ends attached to member 32 and one of the pair of rods 38 to retain member 32 within the periphery of plate 30. Upon rotation of the plate, members 32 are displaced radially outward by centrifugal force against the force of springs 42 guided by rods 38 and radial slots 50. The spacing of rods 38 and the dimension of slots 50 determine the radial displacement of members 32. In the embodiment of FIG. 6, the pivotal members 32 have slightly different contours and each member is provided with a spring 42. The use of dual springs permits of greater reliability and a closer tolerance on the rotational speed of plate 30 prior to the outward displacement of members 32. FIG. 6a shows a circular cover plate 52 overlying springs 32 and members 32 and being supported by and attached to the pivotal points 34. Cover 52 prevents the springs 42 from being dislodged by vibration or shock.

In FIGS. 7, a clutch carrier 54 made, for example, from a thin, rectangular plate is fixed to shaft 28, replacing the circular plate 30 in the embodiments of FIGS. 3-6. A central portion of both sides of clutch carrier 54 is removed with the remaining portions bent so that the edge portions 56 are substantially parallel to the base of the carrier, forming a C-shaped cross section as seen from the end. Slidably positioned on clutch carrier 54 are a pair of T-shaped slider members 60, held abuttingly against upstanding divider tabs 58 formed adjacent the central, lateral edges of plate 54. Transverse tabs 64 are provided on the inner end portion of slider members 60 which interfere with edge portion 56 to prevent complete radial separation of the slider member under rotation of the clutch carrier. A spring 42 has the ends thereof attached to upstanding tabs 62 formed on the slider member 60. When shaft 28 is rotated, clutch carrier 54 is caused to be rotated, imparting centrifugal force to slider members 60 which move outwardly against the force of spring 42. At rota-

tional speeds above the predetermined minimum, slider members 60 engage projections 18 of the arcuate shoes to impart rotation thereto.

It should be noted that the features illustrated in FIGS. 3-7 are not mutually exclusive, but may be combined and interchanged. Accordingly, the pivotal members shown in FIGS. 4a and 4b may be provided with two springs instead of one and a cover plate similar to plate 52 of FIG. 6a may be provided for any of the rotary plates 30 or the clutch carrier 54. Similarly, the radial slots-and-rods combination shown in FIG. 5 may be incorporated into the embodiment of FIGS. 7a, b.

Referring now to FIGS. 8 and 9, upon assembly of the clutch mechanism, the plate 30 and attached pivotal members 32 are positioned within the area whose outer boundary is defined by the four arcuate lips 16 with the shoulders 36 coplanar with the inwardly extending projections 18. In operation, the circular plate 30 is caused to rotate due to the rotation of shaft 28. The shaft 28 may be connected to an air vane positioned at the nose of an air-delivered ordnance vehicle, as described more fully below. As shaft 28 and plate 30 begin to slowly rotate, spring 42 is still able to overcome the centrifugal force on crescent shaped members 32 so as to retain these members in the configuration shown in FIG. 9a. At this point, there is no engagement between the arcuate shoes 10 and shoulders 36 and, therefore, there is no transmission of the rotation of shaft 28 to the gearing arrangement 20. As shaft 28 increases in rotational speed due to the increase in speed of the ordnance vehicle, the centrifugal force acting on members 32 increases, thereby causing the members to move outwardly. The extent of outward movement is limited by the interference of rods 38 and openings 40. When a predetermined minimum rotational speed is attained, the members 32 attain a configuration wherein shoulders 36 extend over the perimeter of plate 30 as shown in FIG. 9b. As rotation continues, shoulders 36 contact the edge of inwardly extending projections 18. As this occurs, plate 12 is caused to rotate by lugs 24 extending therethrough, thereby transmitting rotary motion through the escapement mechanism 20 and to a rotatable member 44 (FIG. 8). This rotatable member 44 may be coupled to an explosive element 46 comprising an element of an explosive train. The rotation of this explosive element 46 is from an out-of-line "safe" position to an in-line "armed" position. As the rotational speed of shaft 28 increases with the consequent increase in rotational speed of the arcuate shoe arrangement, the increasing centrifugal force on the arcuate shoes 10 cause these members to move outwardly on plate 12 (in the direction of the arrows in FIG. 9b) in slots 22 against the force of spring 26. When a specified predetermined upper rotational speed is attained, the inwardly extending projections 18 have moved a sufficient distance to disengage from the shoulders 36 of the crescent shaped members.

By varying the dimensions and weights of the arcuate shoes 10 and crescent shaped members 32, the predetermined upper and lower rotational speed may be varied in accordance with the applications for which the mechanism is to be used. The operation of the centrifugal clutch is the same as set forth above when the radially-displaceable members of the embodiments of the driving assembly illustrated in FIGS. 5, 6 and 7 are substituted.

The foregoing description of the velocity-discriminating, centrifugal clutch as the controlling element in aligning an explosive element in the "armed" position is of general applicability and may be incorporated into any arming and safing devices. FIG. 10 illustrates an embodiment of an ordnance arming device incorporating the present centrifugal clutch into the arming mechanism. It is to be understood that the arming mechanism shown is by way of example only and that the speed discriminating centrifugal clutch may be used in any arming mechanism activated by a rotating, fluid-driven vane. Arming assembly 70 may be substantially of the type described in U.S. Pat. No. 3,677,185, issued July 18, 1972, to W. H. Reams, comprising a housing 72 adapted to be mounted on the nose or forward portion of a bomb or the like, a conical, shock-absorbing collar 73, and an ogive-shaped nose housing 74 which closes the open, forward end of the housing 72. An air vane 76 is rotatably mounted within a suitable bearing 78 in a central aperture 80 provided in the nose housing 74. Shaft 28 of the driving assembly 27 of the centrifugal clutch is fixedly attached to air vane 76 and is rotated thereby. Gear arrangement 20, coupled to plate 12 of the governor weight assembly 8, is driven by vane 76 by means of the centrifugal clutch. An anti-rotation spring 81 is mounted on spacer 83 and bears against one of the gears in the gear arrangement 20. Spring 81 may be of flat, spring steel with the end shaped into a V which abuts between the teeth of the gear to prevent free rotation of the gear. The purpose of spring 81 will be considered more fully below. The arming stop 84 is rotated by the output shaft 82 of the gear arrangement 20. A striker body 88 in turn is rotated by the output shaft 86 of the arming stop 84. The striker body 88 is coupled to a blocking ring 90 by way of a stem 92 secured to the ring 90 by a shear wire 94. Blocking ring 90 prevents a spring-biased plunger 96 from moving upwardly, the lower end portion of plunger 96 maintaining a spring-biased rotor element 98 in a position whereby an explosive element contained therein is positioned in an out-of-line or safe mode in a firing train.

Striker body 88 is provided with a notched-out surface (not shown) on one part of the periphery. A tab or lug 102 protrudes interiorly of the housing 72 and contacts the upper or forwardly disposed surface of striker body 88. Turning of nose housing 74 angularly displaces the notched-out surface on striker body 88 relative to tab 102, this angular displacement being related to the arming time or the time lapse for striker body 88 to be rotated in order to align tab 102 with the notched-out surface. Time-to-arm indicia markings are provided on the surface of the nose retaining ring 108.

During air flight of the weapon, the air vane 76 rotates, causing plate 30 to rotate. At speeds greater than a minimum threshold speed, members 32 pivot outwardly to engage shoes 10, as described above. Rotary motion is then transmitted to blocking ring 90. Upon a predetermined angular rotation, plunger 96 undergoes a limited upward movement into a pocket formed within the blocking ring (not shown). This same rotation is undergone by striker body 88 which is allowed to move upwardly under the force of spring 100 after predetermined angular rotation orients the notched-out surface on striker body 88 with the tab 102. The upward movement of striker body 88 creates a space immediately above stem 92 which is immediately filled

by a spring-biased ball 104. Upon target impact, stem 92 is pushed downwardly, thereby shearing wire 94 and allowing blocking ring 90 to become freely disposed for movement with the plunger 96 under the influence of the spring associated therewith. Upon movement of the plunger, a path is cleared for the rotor element 98 to rotate into an explosive train-aligning position and thereby complete the arming cycle of the weapon.

To prevent accidental turning of vane 76 during shipping and handling, which would affect the zero time setting, a safety wire clip 106 is passed through aligned holes in the vane and in the annular nose retaining ring 108 and secured. After the arming assembly 70 has been installed in the nose of the ordnance item, the aircraft's arming wire is inserted through another pair of holes in the vane 76 and ring 108 and clip 106 is removed. This arming wire is automatically removed as the ordnance item falls away permitting vane 74 to rotate.

When the vane 76 is not turning or at any other time that pivotal elements 32 are not in engagement with shoes 10, the governor weight assembly 8 becomes free wheeling to a limited extent such that vibrations or shocks may cause the weight assembly to "jiggle" or rotate thus distorting the zero time setting. One means of preventing this undesirable rotation is to place a friction element against a free-wheeling part of the driven assembly in the clutch, such as spring 26 or against one or more gears of the gearing arrangement 20, as shown in FIG. 10. The spring 81 is of sufficient strength to prevent free wheeling of the governor weight assembly but will not interfere with the rotation upon driving engagement by the pivotal members 32.

Obviously, numerous modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims, the invention may be practiced otherwise than as specifically described herein.

What is claimed as new and desired to be secured by Letters Patent of the United States is:

1. An ordnance arming assembly comprising:

a movable arming member adapted to be positioned between an out-of-line, safe position and an in-line, armed position in an explosive train;

an arming train for controlling the position of said arming member in response to an external stimulus;

a speed-discriminating, centrifugal clutch responsive to rotational speed to activate said arming train, said clutch including:

a first rotatable member;

a spring-biased, radially displaceable member coupled to said rotatable member;

a rotatable plate adjacent said radially displaceable member;

a second rotatable shaft secured to said plate;

an arcuate-shaped member slidably positioned on said plate having an inwardly-extending projection thereon engagable by said spring-biased displaceable member;

a spring extending circumferentially of said arcuate-shaped member,

whereby said radially displaceable member engages said arcuate member only when said first rotatable member is rotated at speeds between predetermined lower and upper bounds; and

a gearing arrangement for transmitting motion from said second rotatable shaft to said movable arming member, said gearing arrangement provided with friction means preventing rotation of said arrangement when said second rotatable shaft is not operatively coupled to said first rotatable member.

2. The arming assembly of claim 1 wherein said arming train further comprises:

an elongate member normally disposed in a first position to restrain said arming member in said out-of-line position;

a rotatable and axially movable blocking ring engageable with said elongate member for maintaining said elongate member in said first position; and

a rotatable and axially movable striker member operatively coupled to said blocking ring and said gearing arrangement,

whereby rotation of said second rotatable shaft causes said blocking ring to rotate, said elongate member to move out of said first position, and said arming member to move into said armed position.

3. The arming assembly of claim 2 wherein said first rotatable member comprises a first rotatable shaft secured to a circular plate.

4. The arming assembly of claim 3 wherein said first rotatable shaft is coupled to a fluid-driven vane.

5. The arming assembly of claim 4 wherein said radially displaceable member comprises a pivotally-mounted member having a shoulder formed on the outer edge thereof.

6. The arming assembly of claim 5 further comprising a circular cover plate positioned to overlay said pivotally-mounted member.

7. The arming assembly of claim 4 wherein said radially displaceable members comprise a pair of pivotally-mounted members having a shoulder formed on the outer edge thereof.

8. The arming assembly of claim 7 wherein a spring interconnects said pair of pivotally-mounted members.

9. The arming assembly of claim 7 wherein each of said pivotally-mounted member is provided with a biasing spring.

10. The arming assembly of claim 2 wherein said first rotatable member comprises a first rotatable shaft secured to a rectangular member.

11. The arming assembly of claim 10 wherein said displaceable member comprises a flat member slidably positioned on said rectangular member.

12. The arming assembly of claim 10 wherein said displaceable member comprises a pair of flat members slidably positioned on said rectangular member.

13. The arming assembly of claim 11 further comprising a cover plate positioned to overlay said slidable flat member.

14. The arming assembly of claim 1 wherein said first rotatable member is a first rotatable shaft coupled to a fluid-driven vane and secured at one end to a first circular plate.

15. The arming assembly of claim 14 wherein said radially displaceable member comprises a pivotally-mounted member having a shoulder formed on the outer edge thereof.

16. The arming assembly of claim 14 wherein said radially displaceable member comprises a pair of pivotally-mounted member having a shoulder formed on the outer edge thereof.

17. The arming assembly of claim 15 further comprising a circular cover plate positioned to overlay said pivotally-mounted member.

18. The arming assembly of claim 14 wherein said radially displaceable member comprises a slidably-mounted, crescent shaped member having a shoulder formed on the outer edge thereof.

19. The arming assembly of claim 1 wherein said first rotatable member is a first rotatable shaft coupled to a fluid-driven vane and secured at one end to a rectangular member.

20. The arming assembly of claim 19 wherein said displaceable member comprises a flat member slidably positioned on said rectangular member.

21. The arming assembly of claim 20 further comprising a rectangular cover plate positioned to overlay said slidable flat member.

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