

[54] **DELAY ARMING DEVICE FOR
SUBMARINE LAID MINES**

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[73] Assignee: **The United States of America as represented by the Secretary of the Navy**

[22] Filed: **June 28, 1957**

[21] Appl. No.: **668,834**

[52] U.S. Cl. 102/16, 102/70 R, 102/81, 102/83

[51] Int. Cl. F42c 15/10

[58] Field of Search.....102/7, 8, 10, 16, 17, 81, 82, 102/70

[56] **References Cited**

UNITED STATES PATENTS

2,414,804 1/1947 Duncan 102/81

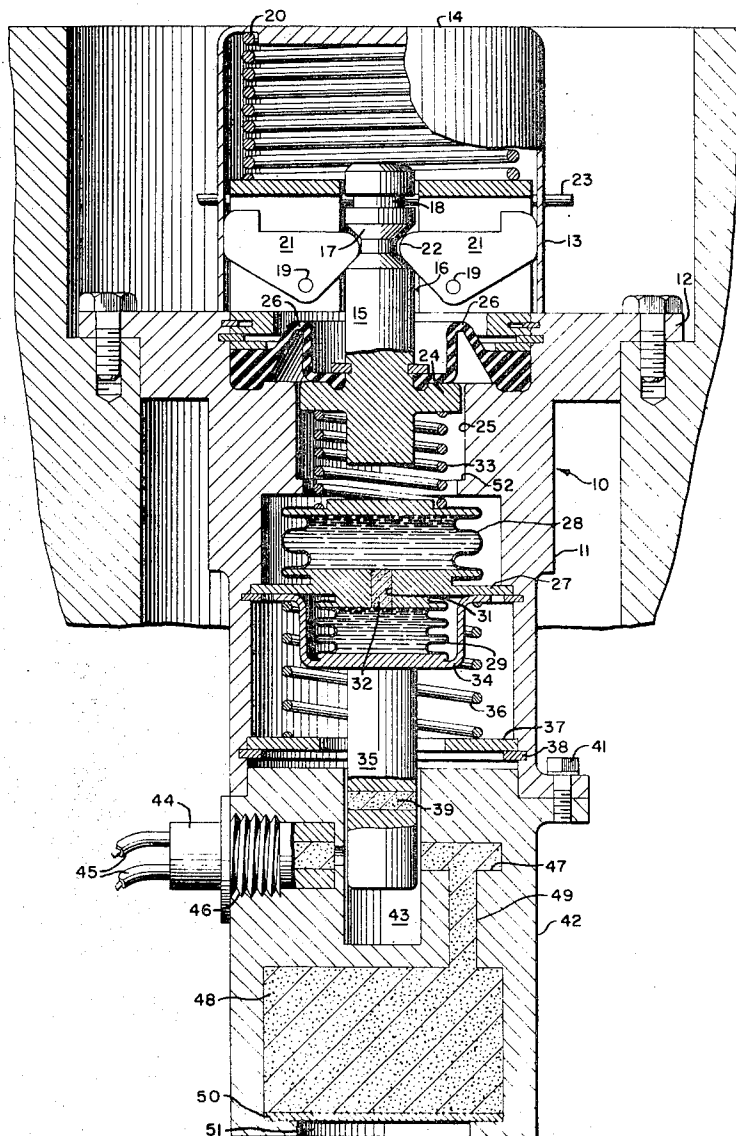
2,789,502 4/1957 Willis 102/81
2,795,189 6/1957 Haberland.....102/16

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EXEMPLARY CLAIM

1. An arming device for a mine comprising a hydrostat, a first oil filled bellows movable by the hydrostat, a second oil filled bellows of less cross-sectional area than said first bellows, a means including baffle having a porous element interconnecting the interior of said first and second bellows to delay operation of the second bellows as the hydrostat operates, said second bellows movable at a faster rate and through a greater distance than said first bellows, a plunger actuable by the second bellows from an initial position of rest to an armed position, and an explosive train arranged transversely within said plunger and movable from a safe position to an armed position as the plunger is moved to the armed position.

7 Claims, 3 Drawing Figures



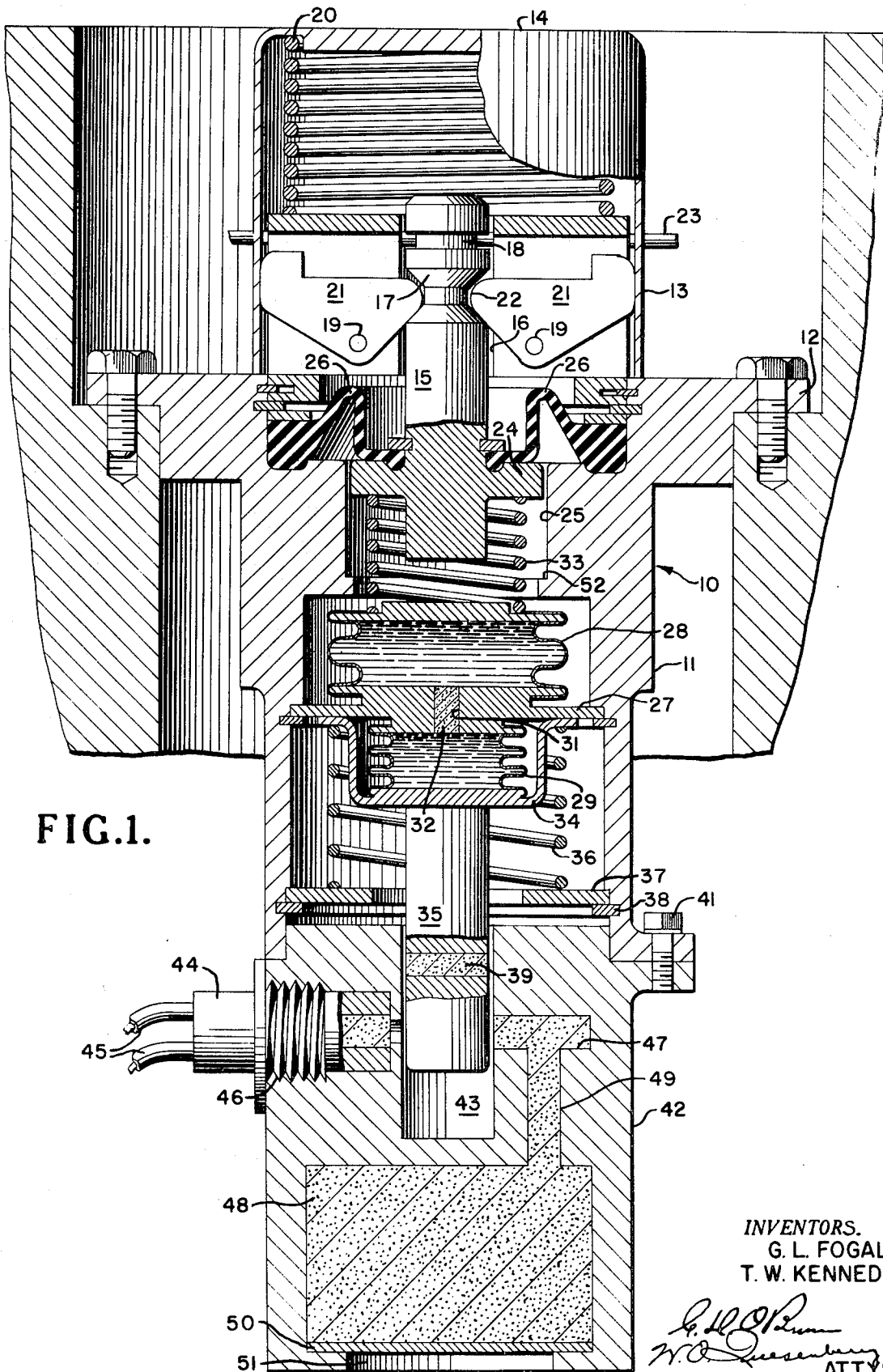


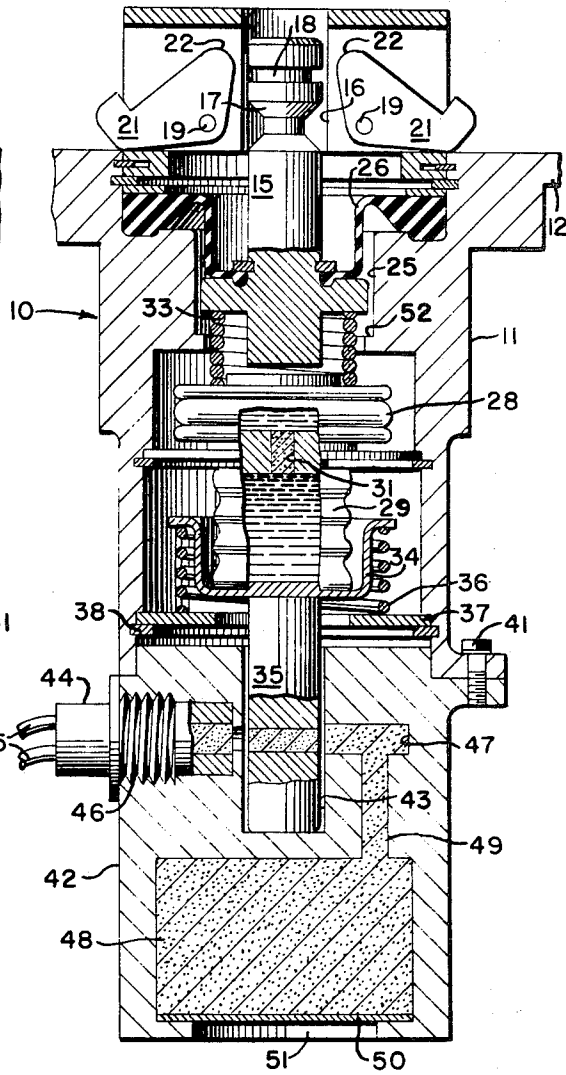
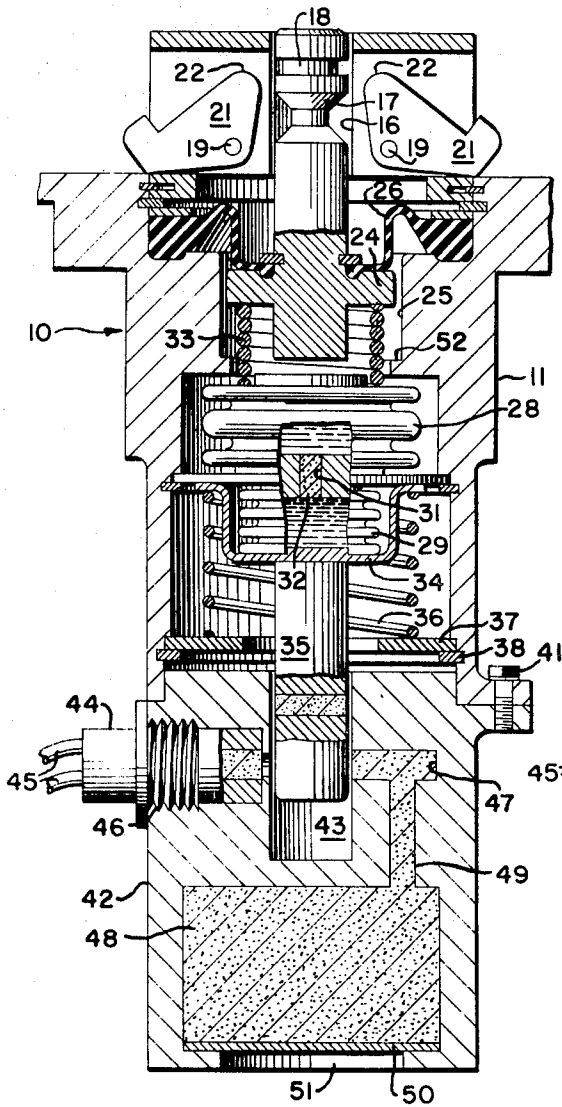
FIG. 1.

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FIG.2.

FIG.3.



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DELAY ARMING DEVICE FOR SUBMARINE LAID MINES

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

This invention relates to a delay arming device for a marine mine and more particularly to a fluid controlled delayed device for a submarine laid mine in which the arming thereof is delayed for a relatively long period of time after the mine has been planted. In devices of this type heretofore devised it has been the usual practice to employ soluble washers, clockwork mechanisms and other devices such as an electrolytic cell for preventing arming of the mine for a predetermined period of time after the mine has been planted. Whereas such devices in general have proven satisfactory for the purpose intended they possess certain disadvantages when employed with mines laid from a submarine in which the arming time of the mine is required to be of relatively long duration after the mine has been planted thereby to allow the submarine to be not only a safe distance therefrom in the event of a premature explosion of the mine but to invariably and positively prevent arming of the mine until the submarine has had time to travel at a considerable distance therefrom sufficient to prevent the whereabouts of the submarine being known to the enemy in the event that the mine should explode when or shortly after the arming operation has been completed.

Furthermore, the operations of the prior art arming devices of this type have been adversely affected by moisture, aging of the elements comprising the detonator and explosive train, for example, and, in the case of clockwork mechanisms particularly, as the result of damage received during transportation and handling prior to planting within the water.

These disadvantages are eliminated in accordance with the present invention by employing a sealed fluid system including a baffle or barrier member having a porous element therein through which the fluid is forced at a slow rate to achieve the desired delay when the mine is discharged from the torpedo tube of a submarine or otherwise planted within the water. Furthermore the device avoids the deleterious effects of aging of the explosive train and detonator therefor by providing a detachable element carrying these components which may be secured in an operative position with respect to the remainder of the device, if desired, just prior to launching of the mine as will more clearly appear as the description proceeds.

One of the objects of the present invention is to provide a new and improved arming device for a mine in which there is no possibility of premature arming before the expiration of a predetermined interval of time as the result of environmental conditions to which the mine may be subjected before planting.

Another object is to provide a delayed arming device for a marine mine in which new and improved means are employed for restricting the flow of a fluid in an enclosed fluid system to achieve the delay.

A still further object is to provide a new and improved delay arming mechanism for a submarine laid mine suitable for use with different explosive trains whereby the arming device may be tested for operation

just prior to use and a selected explosive train assembly may be secured thereto after the test has been completed.

Still other objects, advantages and improvements will be apparent from the following description taken in connection with the accompanying drawings of which:

FIG. 1 is an elevational view in section of the device of the present invention in an initial unarmed condition according to a preferred embodiment thereof;

FIG. 2 is a view similar to FIG. 1 on which is shown the device in an unarmed condition just after planting within the water; and

FIG. 3 is a view similar to FIG. 2 showing the device in an armed condition.

Referring now to the drawings on which like numerals of reference are employed to designate like or similar parts throughout the several views and more particularly to FIG. 1 thereof there is shown thereon a delay arming device particularly well suited for use with a submarine laid mine and designated generally by the numeral 10 comprising a support 11 having a flange 12 thereon for securing the device to the casing of the mine. When so employed a locking cap 13 detachably secured thereto is positioned within a well formed within the casing of the mine in such manner that the upper surface 14 thereof is in contact with a locking bar (not shown) detachably carried by the mine casing and maintained in the locking position by the interior surface of the torpedo tube of the submarine from which the mine is launched.

A plunger 15 is slidably disposed within a bore 16 formed on an upstanding portion of the support 11 and provided with an annular recessed portion 17 and a register 18 substantially as shown. Pivoted to the upstanding portion of support 17 as by the pins 19 are a pair of locking detents 21, each of the detents having a protuberant cam portion 22 for engagement with the plunger 15 at the recessed portion 17 thereof when the detent is maintained in the locking position by the interior surface of the locking cap 13. An arming wire 23 disposed within a pair of mutually aligned bores within the upstanding portion of support 11 and a pair of aligned apertures in the locked cap 13 is employed to prevent movement of the plunger 15 by registration with the register 18 formed on the plunger.

The plunger 15 is provided with an annular flange 24 slidable within a bore 25 formed within the support 11. The outer surface of the flange is in sealed engagement within a flexible diaphragm 26, the outer peripheral portion of which is sealed to the support 11 substantially as shown.

There is also provided within the support 11 a plate or baffle member 27 having an expansible bellows 28 sealed thereto. A second expansible bellows 29 of lesser cross sectional area than the bellows 28 is sealed to the opposite side of plate 27 in such manner that the interior of the bellows 28 and 29 are in mutual communication by reason of an aperture 31 formed in the baffle member 27. The aperture is provided with a porous plug 32 composed of material suitable for the purpose such, for example, as unglazed porcelain and the interior of the bellows 28 and 29 is completely filled with a fluid of low viscosity such as ether or a light oil. A spring 33 is provided between the upper surface of bellows 28 and the lower surface of flange 24 to yieldably

supply pressure to bellows 28 when the plunger 15 has been moved downwardly in response to pressure of the water against diaphragm 26, the force of spring 33 being sufficient to cause a slow flow of fluid from bellows 28 through porous element 32 into bellows 29.

The lower end of bellows 29 is engaged by a cup-shaped member 34 to which is secured a plunger 35, the cup-shaped member and plunger 35 being retained in the position shown on FIG. 1 by a spring 36 until moved therefrom by fluid within the bellows 29 entering through the porous plug 32. The other end of spring 36 is in engagement with a washer 37 secured transversely within support 11 in any suitable manner as by the split ring 38 illustrated. The plunger 35 is provided with a transverse bore within which is carried a quantity of explosive material forming a movable explosive train 39.

Secured to the support 11 in any suitable manner as by the bolts 41 is a container 42 having a bore 43 therein within which the piston 35 is adapted to move when the container is secured to the support. The container is provided with an electroresponsive detonator 44 having a pair of firing leads 45 for receiving and applying a firing impulse thereto, the detonator being preferably secured to the container 42 as by threading of the parts together at 46 such that the detonator is in line with a transverse bore 47, the other end portion of bore 47 being in communication with an explosive chamber 48 by way of bore 49. A quantity of explosive forming an explosive train is disposed within bore 47 and 49 and a booster charge is arranged in chamber 48 and retained therein by a disc 50 enclosing aperture 51. The bore 47, it will be noted, is normally blocked by the lower end position of piston or plunger 35 when the device is in an unarmed position, FIG. 1. When the plunger 35, however, has been moved to the armed position, FIG. 3, the explosive train 39 interconnects with the detonator at the bore 47 whereby operation of the detonator is effective to explode the booster charge within chamber 48 and fire the mine.

The operation of the device will now be described. Let it be assumed, by way of example, that the mine employing the delay device has been inserted into the torpedo tube of a submarine, the arming wire 23 has been withdrawn and locking cap 13 is held in the position shown in FIG. 1 by the locking bar. As the mine is discharged from the torpedo tube, the locking bar falls free and the cap 13 is forced outwardly by spring 20 and detached from the support 11. When this occurs the detents 21 are unlocked and moved out of locking engagement with recessed portion 17 of plunger 15 as the plunger is moved inwardly by pressure of the water against diaphragm 26. Movement of the plunger 15 inwardly compresses spring 33 thereby causing an increase in the pressure of the fluid within bellows 28 sufficient to cause a fluid flow therefrom through porous plug 32 into bellows 29. The position of the plunger 15 at this time is shown on FIG. 2. As fluid enters into bellows 29, the expansion of the bellows causes plunger 35 to move inwardly, the rate of such movement being controlled by the rate of flow of the fluid through the porous plug.

When a sufficient period of time has elapsed such, for example, as several hours the plunger 35 is moved to the armed position shown on FIG. 3 with the explo-

sive train 39 carried thereby in alignment with the detonator 44 and the explosive train within bore 47, the piston 15 moving concurrently therewith in response to the hydrostatic pressure of the surrounding water against diaphragm 26. When the device is armed the flange 24 is preferably resting against a shoulder 52 formed within support 11 or, if desired, the parts may be so proportioned that the flange 24 is closely spaced with respect thereto as shown on FIG. 3.

By employing a bellows 28 of greater cross-sectional area than the cross-sectional area of bellows 29 the degree of axial movement of bellows 29 and plunger 35 secured thereto exceeds the degree of movement of bellows 28 in the same ratio as the cross sectional area of bellows 28 exceeds the cross-sectional area of bellows 29. With this arrangement explosive train 39 within the plunger 35 is at a greater distance from the detonator and bore 47 when the device is in an initial unarmed position than the distance through which the diaphragm 26 is required to move in order to arm the device. A greater safety factor is thus achieved.

The present arrangement disclosed herein provides a new and useful structure in which the explosive and detonating components thereof may be readily detached from the delay element and thus the delay element may be tested just prior to use without possibility of danger from the explosive element as the result of such test. Furthermore, a new explosive element may be readily secured to a delay element which has been in storage for a considerable time, if desired, to ensure reliable operation of the device in service.

Obviously many 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.

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

1. An arming device for a mine comprising a hydrostat, a first oil filled bellows movable by the hydrostat, a second oil filled bellows of less cross-sectional area than said first bellows, a means including baffle having a porous element interconnecting the interior of said first and second bellows to delay operation of the second bellows as the hydrostat operates, said second bellows movable at a faster rate and through a greater distance than said first bellows, a plunger actuable by the second bellows from an initial position of rest to an armed position, and an explosive train arranged transversely within said plunger and movable from a safe position to an armed position as the plunger is moved to the armed position.

2. An arming device for a mine comprising a hydrostat, a first oil filled bellows, a resilient element interconnecting said hydrostat and oil filled bellows for applying pressure thereto as the hydrostat operates, a second oil filled bellows of less cross-sectional area than said first bellows, means including a baffle member having a porous element interconnecting said first and second bellows interiorly to delay operation of the second bellows as the hydrostat operates said second bellows movable at a faster rate and through a greater distance than said first bellows, a plunger carried by the second bellows, an explosive train enclosed transversely within said plunger and movable from an

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initial safe position to an armed position by the second bellows in predetermined time delay relation with respect to the operation of said hydrostat.

3. A device according to claim 2 including means for yieldably maintaining said plunger and explosive train in said initial safe position.

4. An arming device according to claim 2 including means for maintaining said hydrostat in an initial locked position until the device has been planted within the water.

5. A delay arming device for a mine comprising a hydrostat, a fluid motion amplifying element operatively connected to said hydrostat, said element comprising a driving expansible fluid container and a driven expansible fluid container of less cross-sectional area than the driving fluid container, means including a delay element comprising a porous plug interconnecting said containers interiorly for delaying the flow of fluid from the driving container to the driven container, means for yieldably connecting said driving container to the hydrostat for operation thereby, and an explosive train movable by the driven container from an initial safe position to an armed position as a predetermined quantity of fluid has flowed therein through said porous plug the degree of movement of said driven fluid container and explosive train each being greater than the degree of movement of said driving fluid container.

6. A hydrostatically controlled delay arming device for a mine comprising a normally locked hydrostat, means for unlocking said hydrostat as the mine is planted, a first fluid filled bellows operatively connected to said hydrostat for actuation thereby as the hydrostat operates in response to the pressure of the surrounding water, a second fluid filled bellows of lesser cross-sectional area than the cross-sectional area

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of the first named bellows, means including a baffle member interconnecting said bellows and having an aperture therein in communication with the interior of each of the bellows for providing a fluid connection therebetween, a fluid porous element disposed within said aperture, a cup member connected to said second bellows and movable therewith and an arming member carried by said cup member and movable from an initial safe position to an armed position when a predetermined quantity of fluid has flowed through the porous element into the interior of the second bellows, the degree of movement of said second bellows being greater than the degree of movement of the first named bellows.

7. An arming device for a mine comprising a hydrostat, a first oil filled bellows actuatable by the hydrostat, a second oil filled bellows of less cross-sectional area than said first bellows means including a baffle having a porous element interconnecting said first and second bellows interiorly to delay operation of the second bellows as the hydrostat operates said second bellows movable at a faster rate and through a greater distance than said first bellows, a plunger movable by the second bellows from an initial safe position to an armed position when a predetermined quantity of fluid has been transferred from the first bellows to the second bellows through said porous element, an explosive train carried by said plunger, and firing means comprising a detonator detachable secured to said arming device in such manner that the detonator is normally out of line with said explosive train when the second bellows is in an initial position of rest and the explosive train is moved into alignment with the detonator when the second bellows is moved to said armed position.

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