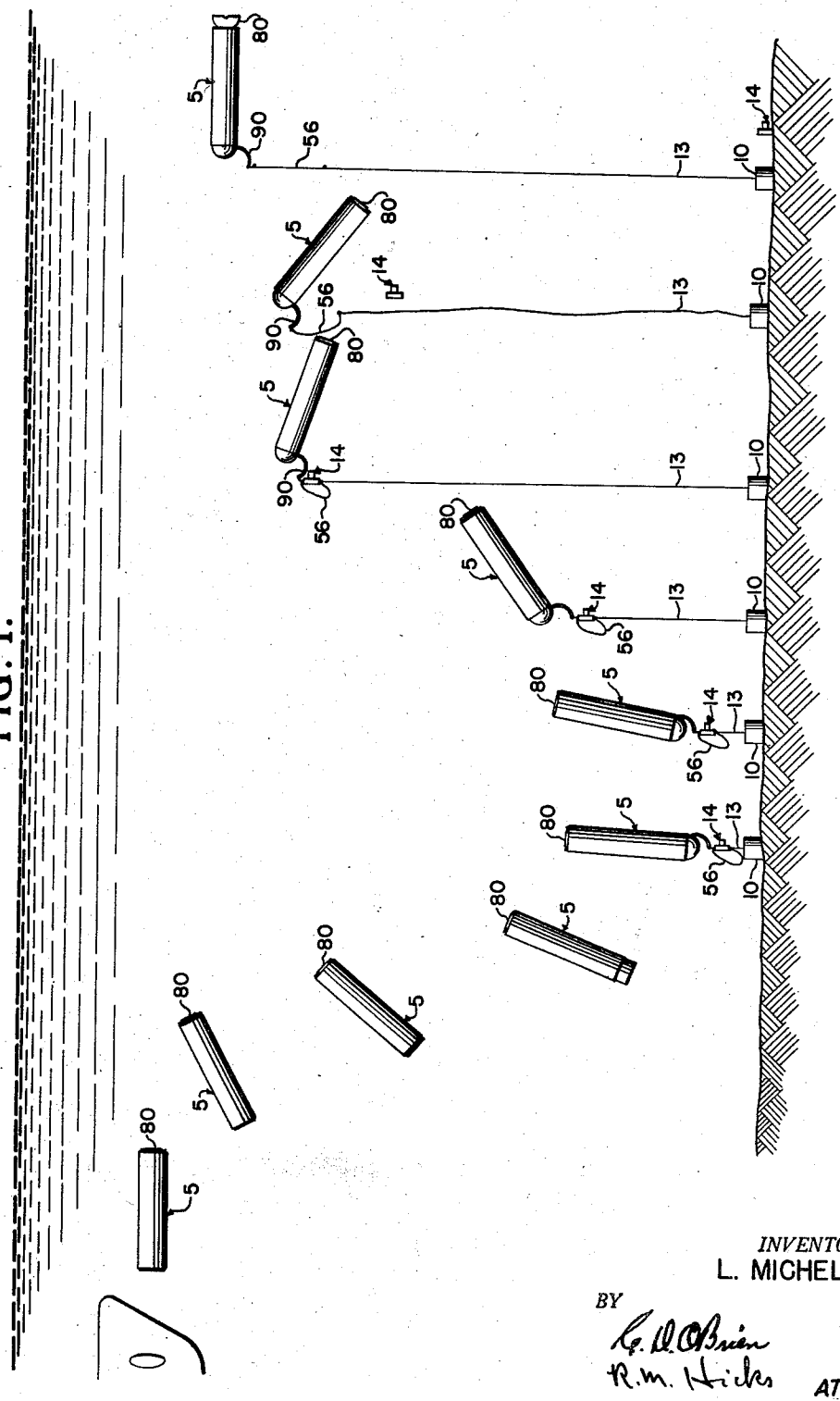
June 30, 1959 L. MICHELSON 2,892,401

ANCHOR EJECTING MOORED MINE

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FIG. 1.



INVENTOR.
L. MICHELSON

BY
G. M. O'Brien
R. M. Hicks ATTYS.

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ANCHOR EJECTING MOORED MINE

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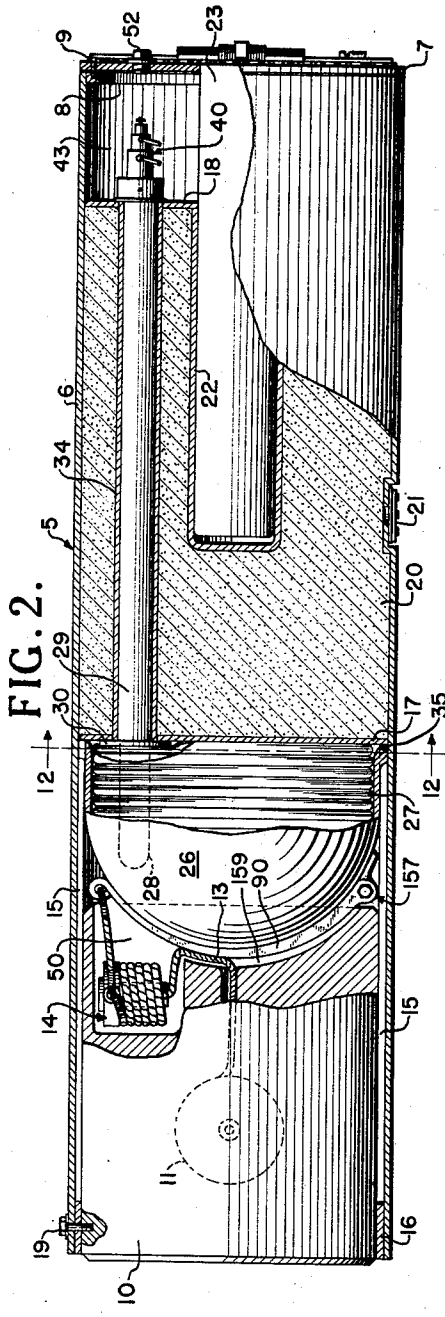


FIG. 2.

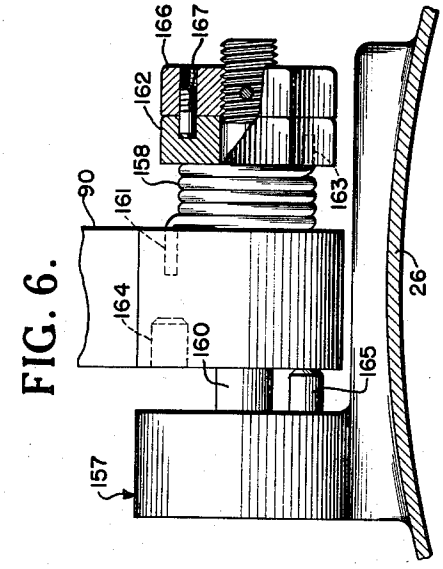


FIG. 6.

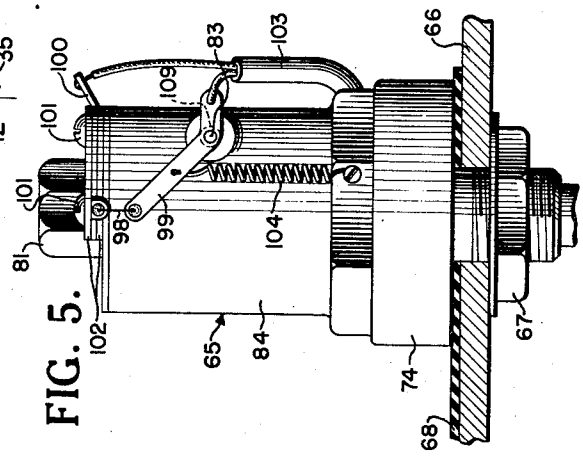


FIG. 5.

INVENTOR.
L. MICHELSON

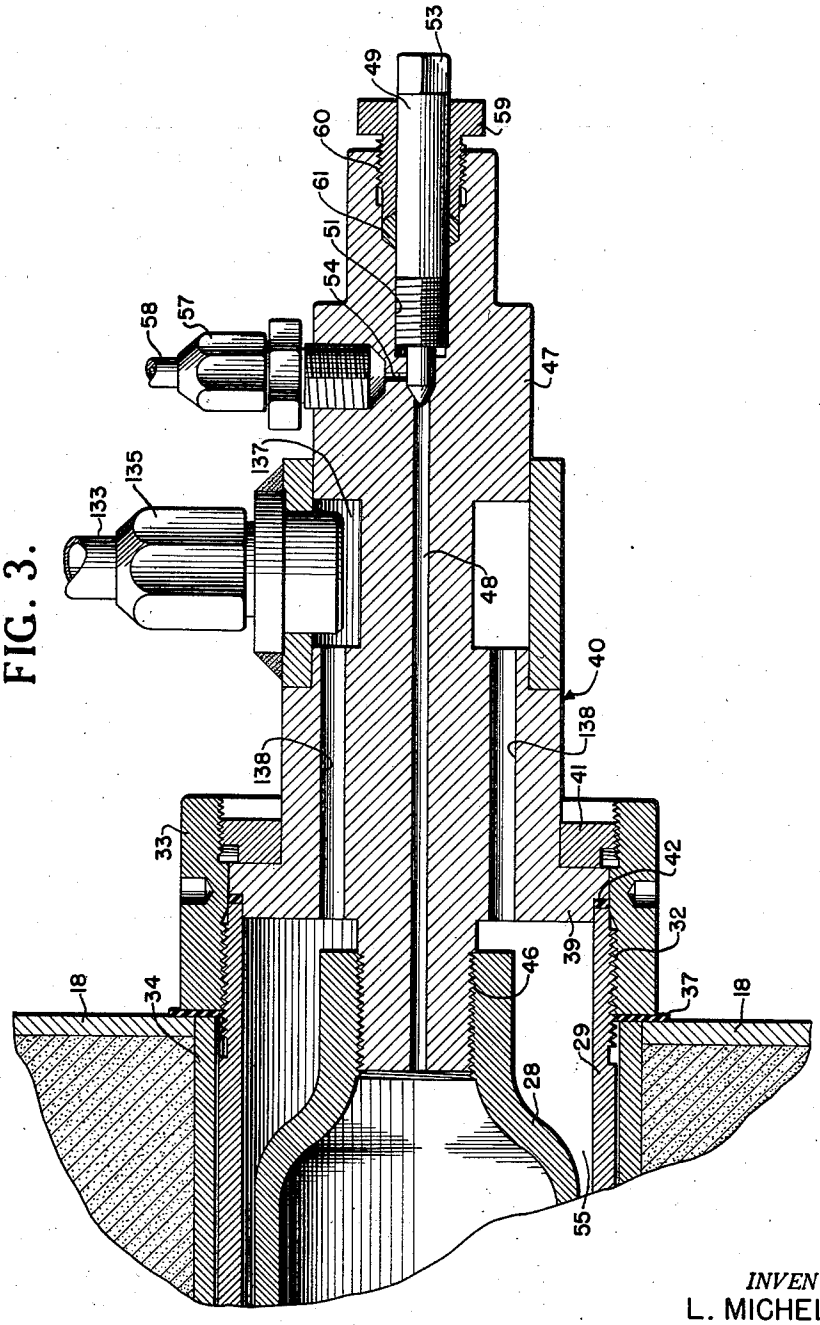
BY
G. O. O'Brien
R. M. Hicks ATTYS.

June 30, 1959 L. MICHELSON 2,892,401

ANCHOR EJECTING MOORED MINE

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FIG. 3.



INVENTOR.
L. MICHELSON

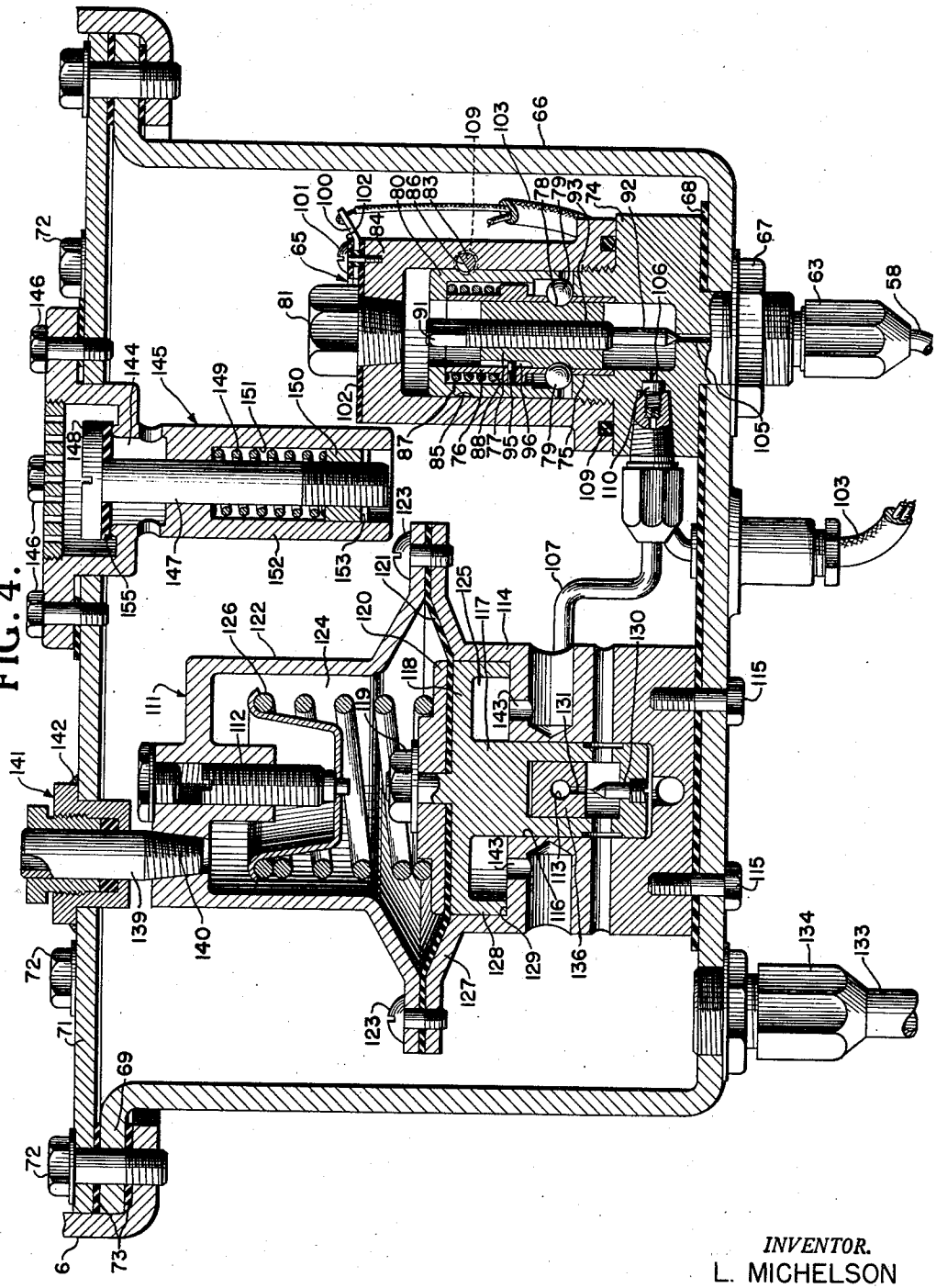
BY
G. D. O'Brien
R. M. Hicks *ATTYS.*

June 30, 1959 L. MICHELSON 2,892,401

ANCHOR EJECTING MOORED MINE

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FIG. 4.



INVENTOR.
L. MICHELSON
BY G. O. O'Brien
R. M. Hicks ATTYS.

June 30, 1959 L. MICHELSON 2,892,401

ANCHOR EJECTING MOORED MINE

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FIG. 8.

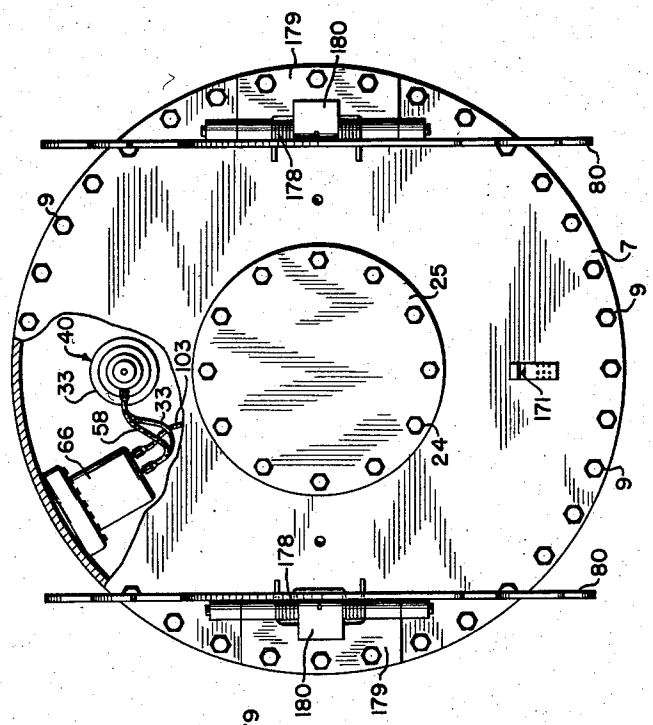


FIG. 7.

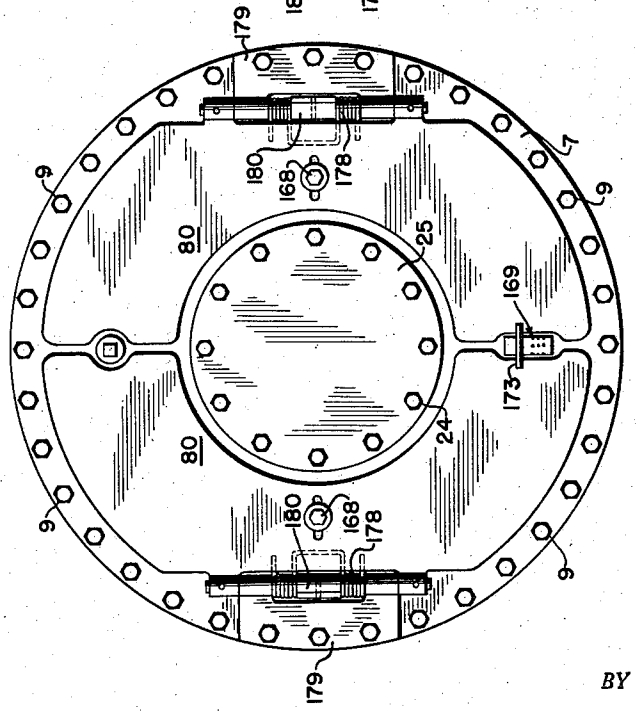
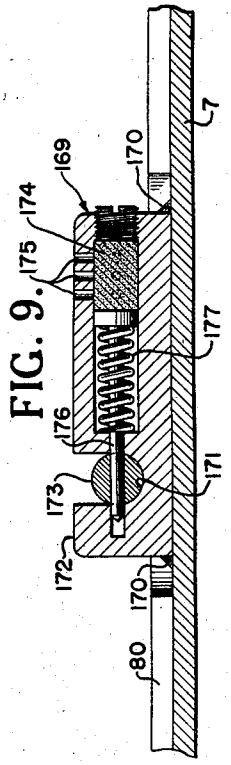


FIG. 9.



INVENTOR.
L. MICHELSON

BY
G. M. O'Brien
R. M. Hicks *ATTYS.*

June 30, 1959 L. MICHELSON 2,892,401

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FIG. 11.

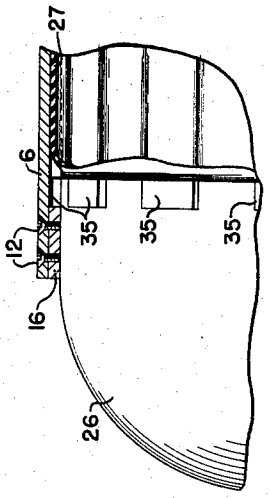


FIG. 12.

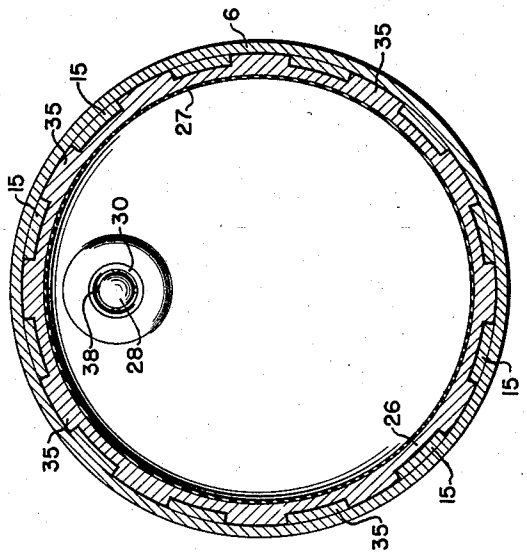
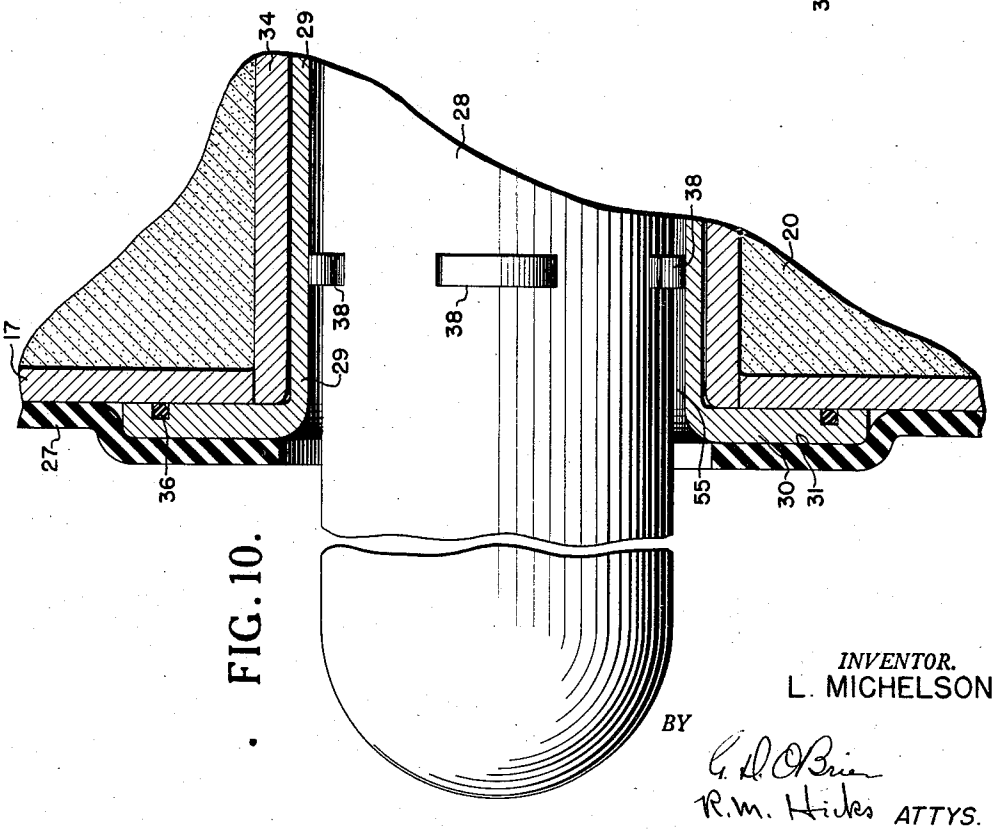


FIG. 10.



INVENTOR.
L. MICHELSON

BY

G. H. O'Brien
R. M. Hicks ATTYS.

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2,892,401

ANCHOR EJECTING MOORED MINE

Louis Michelson, University Park, Md., assignor to the United States of America as represented by the Secretary of the Navy

Application December 8, 1950, Serial No. 199,905

16 Claims. (Cl. 102—14)

(Granted under Title 35, U.S. Code (1952), sec. 266)

This invention relates generally to submarine mines and more particularly to a new and improved mine of the subfloating type adapted for mooring at a predetermined depth beneath the surface of the water and wherein the anchor therefor is initially stored within the flotation chamber of the mine for ejection therefrom after a predetermined interval following the launching of the mine with means being provided for excluding the water from the chamber from which the anchor is expelled whereby the mine is thusly made buoyant.

It has been the general practice heretofore with mines of the subfloating or moored type to releasably secure the anchor to the after portion of the mine whereupon as the mine descends through the water following the launching thereof the anchor is caused, by any one of several methods, to separate from the mine case and to come to rest upon the bed of the body of water leaving the then buoyant mine free to rise with a mooring cable to mooring position at some preselected depth nearer the surface of the water.

There is generally provided upon the mooring cable and in close adjacency with the mine a hydroresponsive mechanism adapted as the mine reaches mooring position within the water to release a bight formed in the mooring cable and thereby to produce in the cable a momentary lessening in tension thereon effective to cause the operation of a cable securing mechanism within the mine's anchor whereby further paying out of the cable therefrom is thusly prevented to secure in this manner the mine at the depth within the water previously selected.

The method of securing the anchor externally to the after portion of the mine case as hereinbefore indicated, has the particular disadvantage of increasing the overall size of the mine and anchor assemblies and thereby increasing the space required for transportation and storage thereof as well as to increase the cost of handling and crating. One of the purposes of the present invention is to provide means for reducing the overall size of such assemblies by storing the anchor therefor in the buoyancy chamber of the mine until after the mine is planted thus, by reducing the length of the mine in this manner, the tactical and logistic factors in favor of their use for submarine and aircraft planting is greatly enhanced. This is particularly true in view of the fact that the primary objection to buoyant mines for submarine and aircraft planting, heretofore, has been their relatively great size in comparison to the small quantities of explosives carried thereby.

According to the arrangement of the present invention, there is provided a buoyant mine wherein the anchor therefor is stored within the buoyancy chamber of the mine until some predetermined time following the mine's launching whereupon the anchor is then ejected by the expansion of a gas filled bellows, or the like, with the bellows thereafter becoming the buoyancy chamber of the mine with further means being provided for reducing the pressure within the bellows as the mine rises to mooring position within the water.

It is an object of the present invention to provide a new and improved subfloating mine wherein the anchor therefor is initially stored within the buoyancy chamber of the mine and is ejected therefrom following the launching of the mine.

A further object of the present invention is to provide a buoyant mine wherein the anchor therefor is initially stored within the buoyancy chamber of the mine for ejection therefrom at a predetermined time subsequent to the launching of the mine.

A still further object is to provide a new and improved buoyant mine wherein the anchor therefor is ejected from the buoyancy chamber of the mine following the launching thereof by the expansion of a gas filled bellows adapted to fill the buoyancy chamber and make buoyant the mine subsequent to the ejection of the anchor therefrom.

A further object is to provide a buoyant mine wherein the gaseous pressure within the bellows employed to eject the anchor from the buoyancy chamber of the mine is maintained at a predetermined relative value with respect to the surrounding water pressure.

Another object is to provide a buoyant mine wherein the gaseous pressure system operative to eject the anchor from the buoyancy chamber is controlled from a position intermediate the gaseous supply and the buoyancy chamber from which the anchor is ejected.

Other objects and many of the attendant advantages of this invention 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 shows in diagrammatic form the launching and mooring of a submarine mine of the type of the present invention;

Fig. 2 is a view partly in elevation and partly in section through the mine of the present invention and showing the arrangement of the anchor therefor as assembled within the mine case;

Fig. 3 is a view partly in section of the pressure storage tank and cap assembly therefor as arranged within the mine;

Fig. 4 is a sectional view through the pressure control housing of the mine and showing in section the various control elements therein;

Fig. 5 is a side view in elevation of the electroresponsive valve assembly of the mine;

Fig. 6 is a view partly cut away of the mooring arm bracket of the mine;

Fig. 7 is an end view of the mine with the stabilizing fins therefor as shown in folded position;

Fig. 8 is an end view of the mine with the stabilizing fins therefor as shown in extended position;

Fig. 9 is a sectional view partly in elevation of a soluble plug release assembly for releasing the stabilizing fins of the mine following the launching of the mine;

Fig. 10 is a view partly in section and partly cut away of the bellows and supply tube therefor and showing the arrangement of the high pressure tank therein;

Fig. 11 is a fragmentary view partly in elevation of the cap piece as secured by the retaining ring therefor within the end of the mine; and

Fig. 12 is a sectional view through the mine, bellows and cap piece as taken along the line **12—12** of Fig. 2.

Referring now to the drawings and more particularly to Fig. 2 thereof the mine of the present invention generally designated **5** is shown therein to include a cylindrically formed casing **6** having one end thereof closed as by an end plate **7** secured about its periphery to an internal flange section **8** of the casing as by stud bolts **9**.

Disposed within the opposite end of the casing from the end plate **7** is a somewhat elongated mine anchor **10** wherein is arranged a conventionally formed cable supply

reel 11 and control therefor, not shown, of the type adapted, in response to a signal received through the cable 13 as from the cable bight release mechanism 14, for example, to lock the reel and thereby secure the mine at a predetermined depth beneath the surface of the water. The cable bight release mechanism 14 and the cooperating control therefor in the anchor may be of the same general type disclosed in the copending application of Joseph D. Turlay et al. for Depth Regulating Device for a Moored Mine, Serial No. 465,931, filed November 17, 1942, now Patent 2,706,948 issued April 26, 1955. Alternatively, this suitable means, well known in the art, may be provided for locking the cable drum or reel 11 within the anchor as the mine reaches mooring position. Also, for example, a mechanism, not shown, may be employed for this purpose of the type which utilizes a magnetized cable for measuring unit lengths of the cable as it is dispersed from the drum 11.

The anchor 10 is adapted for free sliding movement within the casing upon a plurality of horizontally arranged runners 15 preferably secured as by welding to the inner wall section of the casing, Fig. 12, and whereby the frictional surface between the anchor and casing is thusly reduced during the operation of ejecting the anchor following the launching of the mine within a body of water.

Arranged within the open end of the casing wherein it is preferably secured as by screws 12, Fig. 11, is an annular ring member 16 through which extends a plurality of easily removable bolts 19 adapted for connecting as by threading with the anchor 10 for fixedly securing the anchor to the casing during transportation thereof but removable for freeing the anchor as the mine is prepared for launching.

Abutting the opposite end of the runners 15 from the ring 16 is an annular partition 17 preferably welded or otherwise similarly secured about its periphery to the inner wall section of the casing to form therebetween and a similarly secured partition 18 a compartment now shown filled with a suitable explosive material 20 preferably cast therein through an opening in the casing thereafter closed as by a cover plate 21. The explosive charge 20 is adapted when detonated to explode the mine and thereby destroy or damage, as the case may be, a vessel then moving within lethal range of the mine.

Supported centrally within the charge 20 as by the well section 22 of the partition 18 is an elongated fire control housing 23 adapted for insertion, upon assembly of the mine, through the end plate 7 to which it is thereafter secured as by bolts 24. Suitable gaskets interposed between the housing 23 and cover 25 therefor and the end plate 7 of the mine provides thereby a pressure and moisture sealing connection therebetween as the securing bolts 24 for the housing are tightened. A fire control mechanism arranged, but not shown, within the housing 23 is adapted to explode the charge 20 by producing an electric signal for detonating the charge upon the approach of an enemy vessel within the vicinity of the mine. A fire control mechanism suitable for this purpose may be of any one of several types well known in the art.

Interposed between the anchor and partition 17 is an oval shaped cap piece 26 adapted for sliding movement within the casing outwardly upon the runners 15 and against the anchor 10 as pressure is applied internally thereagainst by the inflation therein of a bellows member 27 preferably formed from rubber and initially retained in a collapsed condition within the cap as illustrated in Fig. 2. The end of the anchor 10 is preferably concave in form for better receiving therein the cap piece 26 and whereby the space within the assembled mine is thereby conserved.

The inflation of the bellows 27 whereby the anchor is caused to be expelled from the end of the casing 6 is accomplished by the admission within the bellows of high pressure gas from any suitable supply source such, for example, as the pressure tank 28 connected with the bellows by way of a tubular conduit 29 to which the bellows is secured as by vulcanizing to a flange section 30 of the tube as at 31, Fig. 10.

The free end of the tube 29 is adapted as at 32, Fig. 3, for threading with an annular nut member 33 whereby the tube is secured by this nut within a cylindrically formed guide member 34 therefor connectingly secured by welding to the partitions 17 and 18 respectively. Suitable gaskets 36, Fig. 10, and 37 arranged beneath the flange and nut 30 and 33 respectively provide thereby a pressure sealing connection therebetween and the partitions 17 and 18 respectively as the securing nut 33 for the tube is tightened. After the tube and bellows attached thereto have been assembled within the mine from the anchor receiving end of the latter the cap piece 26 is then inserted within the casing in a manner to enclose the bellows, as illustrated in Fig. 2, whereupon the retaining ring 16 is then secured within the end of the casing, as by screws 12, Fig. 11. The ring 16 serves to intercept a flange section 35 of the cap piece 26 as the latter is moved outwardly by the inflation of the bellows 27 therein to the position for expelling the anchor 10, the cap piece thereafter closing the end of the mine case as well hereinafter be more fully descibed.

After the securement of the tube 29 within the guide 34 in the manner aforedescribed, the high pressure tank 28 may then be inserted within the tube from the direction of the end of the mine now shown closed as by the end plate 7 with the tank thereafter being secured within the tube as by a ring screw 41, Fig. 3. This screw 41 is so arranged as by threading within the nut 33, that, when tightened, serves to compress between the end of the tube 29 and an extending flange section 39 of a tank cap assembly, generally designated 40, a suitable sealing washer 42 whereby pressure thereafter admitted to the tube 29 is thusly prevented escaping by way of this connection into the mine cavity 43. The tank 28 is supported in spaced relation with respect to the inner wall section of the tube 29 at the opposite end of the tank from the cap flange 39 as by spaced lugs 38 preferably secured as by soldering about the outer periphery of the tank as illustrated in Fig. 10 . The space 55 between the tank and tube provides a channel for communicating gas from the tank cap 40 to the bellows for the purpose hereinbefore set forth.

The cap assembly 40 adapted for threading into the end of the tank as at 46 is comprised of an elongated body section 47 wherein is provided a centrally arranged bore 48 shown herein closed as by a valve stem 49 after the tank has been properly filled by way of the valve port 54. The stem 49, threaded with the body section 47 as at 51, may be actuated to valve open position by the insertion of a socket wrench or like tool, not shown, through an opening in the mine end plate 7, now shown closed as by the cap screw 52, to connect with the square end section 53 of the stem whereby, as the latter is rotated from closed position over the bore 48, gaseous pressure from the tank 28 is allowed to pass therefrom and into the valve port 54 to which is secured as by a coupling 57 the conduit 58. It will be understood, however, that in lieu of the tank 28 any suitable form of gas generating apparatus may be provided for supplying the necessary pressure to the conduit 58 for subsequent inflation of the bellows 27.

Upon movement of the valve stem 49 from the port 48, a gland nut 59 arranged as illustrated about the stem 49 and threaded with the body section as at 60 is then rotated in a similar manner to the stem 49 to compress about the stem an annular gasket member 61 of material such, for example, as soft lead or the like thereby to provide between the stem and body section 49 and 47 respectively a pressure sealing connection whereby gas is prevented from escaping about the stem and into the

mine cavity 43 during the time the valve stem 49 is in open position with respect to the port 48.

Connected with the conduit 58 by means of a coupling member 63, Fig. 4, is an electroresponsive valve assembly generally designated 65 adapted for retaining the high pressure gas from the tank 28 after the valve stem 49 has been operated to valve open position in the manner heretofore described.

Enclosing the valve 65 is a substantially rectangular control housing 66 wherein the valve is fixedly secured within the base thereof as by a clamp nut 67. A suitable gasket 68 interposed between the valve and housing 66 provides thereby a pressure sealing connection therebetween as the securing nut 67 for the valve is tightened.

The housing 66 is so constructed as to include a flange section 69 whereby the housing and cover plate 71 therefor are secured about their peripheries, as by bolts 72, within an opening formed therefor in the mine casing 6, Fig. 4, with suitable gaskets 73 interposed between the cover, housing and casing to provide a pressure sealing connection therebetween as the securing bolts 72 for the housing and cover are tightened.

The valve 65 is comprised of a chassis member 74 wherein is centrally secured as by soldering thereto at 75 a cylindrical guide member 76 adapted for maintaining therein a vertically movable block member 77. The block 77 is adapted as by an annularly formed groove 78 therein to be releasably secured to the guide 76 by inward movement into engagement with the groove of a plurality of diametrically arranged balls 79 formed preferably of stainless steel or the like and movable inwardly within bores provided therefor in the guide 76 to engage the groove 78 as a locking sleeve 80 is moved, during the cocking operation of the valve, downwardly over the outer edge of the balls to the position indicated in Fig. 4, wherein the valve is shown in closed and locked position.

The sleeve 80 is releasably secured in this downward ball locking position as by a sear 83 mounted horizontally within a suitable bore provided therefor in the valve cover 84 and rotatable therein to engage an annular groove 85 in the sleeve 80 as the latter is urged downwardly beyond the sear for engaging the outer edge of the balls 79. These balls are subsequently released from their engagement with the groove 78 in block 77 by rotation of the sear 83 to the position for bringing the flat section 86 thereof into parallel relation with respect to the sleeve 80 whereupon the sleeve is then allowed to be accelerated to ball releasing position as by the expansion of a helical spring 87 interposed therebetween and a flange section 88 of the guide 76.

After the block 77 has been secured to the guide 76 by the balls 79 in the manner aforedescribed, a suitable wrench, not shown, may then be inserted through an opening in the valve cover 84, now shown closed as by a threaded plug member 81, to connect with the square end section 91 of the valve stem 92 threaded with the block as at 93 whereby, as the stem is properly rotated therein by the wrench, the conical end section of the stem is forcibly driven into closing position with the entrance port 105. Passage of gas from port 105 and into the discharge port 106 of the valve is thusly prevented. Any suitable means such, for example, as the pin and slot 95 and 96, respectively, may be provided for preventing rotation of the block 77 as the stem 92 therein is rotated. This arrangement of the valve shown provides for a structure impervious to shock and capable of retaining extremely high pressure for long periods of time without leakage.

Securing the sear 83 in sleeve locking position is a fusible element 98, Fig. 5, extending from the end of an outer arm section 99 of the sear to a terminal plate 100 fastened as by screws 101 to the valve cover 84 with the plate being electrically insulated from the cover as by washers 102. As current is applied to the element 98 by way of a conductor cable 103 extending from any suitable form of time delay or pressure responsive mechanism preferably arranged, but not shown, within the housing 23, the element 98 is thereupon ruptured to allow the arm 99 of the sear to be drawn downwardly by an attached spring 104 whereby the flat section 86 of the sear is then rotated within the housing to the position for freeing the sleeve 80 which is then moved to ball freeing position.

Movement of the sleeve 80 from about the balls 79 allows them to be cammed by the surface of the groove 78 free of the block 77 thereby permitting the block and valve stem 92 threaded therewithin to be lifted from the valve port 105 by the gaseous pressure within the port. The gas is then passed from the valve into the discharge port 106 of the valve and hence to the conduit 107.

If desired, an additional spring, not shown, may be provided between the block and chassis 77 and 74, respectively, whereby the block may be accelerated to valve open position more positively than by the force exerted thereupon by the gaseous pressure within the entrance port 105 of the valve. Suitable O-ring gaskets 109 arranged about the sear shaft 83 and between the valve chassis 74 and cover 84 therefor provide a pressure sealing connection between these members as high pressure is admitted to the valve by movement of the stem 92 from the port 105.

Upon the opening of the valve 65 in the manner aforedescribed, gaseous pressure from the tank 28 is discharged therefrom by way of a restricting orifice 110, interposed between the conduit 107 and valve port 106, to a regulating valve assembly generally designated 111 and adapted to maintain within the housing 66 a predetermined pressure differential with respect to the pressure of the surrounding water with means being provided in the valve as by a set screw 112 for varying selectively this pressure differential as will hereinafter become more clearly apparent.

The valve 111 is comprised of a chassis structure 114 adapted for being secured within the housing as by volts 115 and having therein a centrally arranged bore 116 wherein is guided the vertically movable piston member 117. This piston is equipped with a flared or flanged end section 118 against which is clamped as by a nut and washer 119 and 120, respectively, a flexible diaphragm member 121. As a cap piece 122 is secured as by screws 123 over the diaphragm and to the flange section 127 of the chassis in the manner illustrated, the outer periphery of the diaphragm is clamped therebetween to form within the valve and adjacent the upper and lower surface of the diaphragm a pair of pressure chambers 124 and 125, respectively.

A helical spring 126 retained within the cap 122 and compressible, by adjustment of the screw 112, to the surface of the washer 120 provides thereby a biasing force upon the diaphragm 121 whereby the latter is deflected inwardly for resting upon the upper surface of the flange section 127 of the chassis with a depending flange section 128 of the piston resting upon the chassis as at 129. The positioning of the piston by the flange 128 provides for maintaining a valve stem 130, aranged as by threading within the end of the piston in spaced relation with respect to an admission port 131 fluidly connected with the conduit 107 by way of a bore 113 through which gas from the tank 28 is communicated to within the housing 66. The block member 136, wherein is arranged the port 131, is received within a correspondingly formed opening provided therefor in the valve housing 114 with the block thereafter being fixedly secured to the housing in any suitable manner as by a clamp screw, not shown.

Pressure admitted to the housing 66 by way of the valve 111 is communicated therefrom to the tank cap 40 by way of a connecting conduit 133 secured to each respectively as by coupling members 134 and 135, respectively. From the port 137 within the tank cap 40, Fig. 3, the gas is passed by way of the bores 138 and space 55 between the tank and guide tube 29 therefor and into the

bellows 27 and is effective as the pressure therein exceeds by a predetermined value the pressure of the surrounding water to eject from the end of the mine the anchor 10.

By reason of the restricting orifice 110 in the discharge port 106 of the valve 65 the flow of gas therefrom into the housing 66 by way of the valve 111 is regulated to that which may be communicated from the housing by way of the conduit 133 to the bellows 27 wherefore the pressure within the housing and bellows is thereby maintained relatively uniform at all times during the operation of the mine.

The structure of the regulating valve 111 is such that the hydrostatic pressure about the mine is communicated to the outer surface of the diaphragm 121 thereof by way of a tubular connection 139 secured as by threading with the valve as at 140 and extending outwardly therefrom through an opening in the cover plate 71 about which a pressure sealing connection is established by the arrangement thereover of a conventional gland nut assembly generally designated 141 and secured as by welding to the outer face of the cover plate 71 as at 142.

Gaseous pressure admitted to the valve 111 from the tank 28 and applied to inflate the bellows 27 is concurrently communicated by way of ports 143 to the base of the diaphragm 121 whereupon as the pressure within the housing and bellows 66 and 27, respectively, exceeds by a predetermined value the combined pressure of the surrounding water and the adjusted force of the spring 126 as applied to the outer surface of the diaphragm 121, the diaphragm is caused thereby to be deflected outwardly to the extent of lifting the piston and thereby the valve stem 130 into closing position with the valve port 131 whereby further passage of gas through the valve and into the housing 66 is thusly prevented.

The shutting off of the gas supply in this manner rather than exhausing it, as may be done in accordance with an alternative method into the surrounding water by way of a relief valve assembly shown herein and generally designated 145, provides for maintaining a pressure reserve within the tank 29 which may thereafter be admitted by way of the regulating valve 111 into the system should the pressure therein drop below a predetermined value with respect to the surrounding water pressure as the result of leakage occurring in the system over a long period of time as, for example, one year which may be the proposed operating time of the mine.

The relief valve 145 is of the conventional type secured as by bolts 146 within an opening in the cover plate 71 and including a movable plunger 147 of which the cap portion 148 thereof is initially maintained in closed position over the discharge port 144 of the valve as by a helical spring element 149 arranged over the plunger and initially compressed between an adjusting nut 150 for the spring and the base of a bore 151 formed in the base end of the valve body 152 as illustrated. The nut 150 is provided with a transverse slot 153 for receiving therein a spanner wrench or like tool, not shown, whereby the nut may be rotated by the tool to an adjusted position of compression with the spring 149 and the pressure responsive characteristics of the valve may thusly be selectively regulated. Arranged against and secured as by cementing to the under surface of the cap portion 148 of the plunger is a resilient washer 155 suitable for maintaining a pressure sealing connection between the cap and the valve port 144 during the time the valve is in closed position.

The valve 145 may be regulated to open for discharging into the surrounding water pressure from within the housing 66 when the presure therein exceeds by a predetermined value as, for example 25 pounds the pressure of the surrounding water thereby preventing an accumulation of pressure within the system which could possibly damage the components thereof including the bellows 27. As the mine rises toward mooring position following the discharge of the anchor 10 therefrom, the resultant decrease in pressure about the mine is accordingly compensated for by an exhausting of pressure from the system by way of this relief valve 145 whereby in this manner the pressure differential selected may be maintained relatively constant over wide ranges of external pressure about the mine.

As the anchor 10 clears the end of the mine case 6, a mooring arm 90, pivotally secured as by a bracket assembly generally designated 157 to the cap piece 26, is urged by a torsion spring 158, Fig. 6, of the bracket assembly from an initial folding position against the cap piece 26 and within a groove 159 formed therefor in the anchor 10 to an extended position, Fig. 1, whereby the mine is caused thereby to maintain a horizontal position within the water from the end of the mooring cable 13 after rising within the water to mooring position at a predetermined depth beneath the surface.

The torsion spring 158 arranged upon the shaft 160 of the bracket assembly and connected at one end as at 161 with the arm 90 and at the other end with the nut 162 as at 163 is initially so compressed as to cause movement of the arm along the shaft for bringing a bore 164 therein into locking position with the lug 165 of the bracket assembly as the arm is rotated by the spring to its mooring position. The nut 162, initially free upon the shaft 160, is secured thereto by way of a pin-secured or fixed nut 166 after the nut 162 is rotated with the spring end 163 sufficiently to cock or apply the necessary torque to the spring for causing rotation of the arm 90 to mooring position. A set screw 167 threaded with the fixed nut 166 and engageable with the free nut 162, as shown, provides means for securing the nuts together after the nut 162 has been rotated to the desired spring cocking position.

In order that the mine may be made more stable when in moored position within the water, there is provided upon the plate closed end of the mine a pair of retractable stabilizing fins 80 initially retained, for the purpose of transporting and handling of the mine as well as the conservation of space, in folded position against the end plate 7 of the mine as by a pair of retaining bolts 168, Fig. 7. As the mine is prepared for launching, these bolts 168 are removed for thereafter allowing the fins to be retained in a retracted position as by a soluble plug release assembly generally designated 169 and secured as by welding to the end plate 7 of the mine as at 170, Fig. 9.

Arranged in a transverse slot 171 formed in the bracket portion 172 of the release assembly is a cross member 173 adapted for engaging, when assembled within the bracket, the inner edges of the fins 80, Fig. 7, whereby the fins are retained in a retracted or folded position against the end of the mine until a soluble plug 174 of the release assembly has been dissolved by a submergence of the mine for a predetermined period of time within the water. After the mine has been launched and water is admitted to the plug 174 by way of the perforations 175 of the bracket 172 and thereupon to cause a dissolving of the plug 174 which may be formed from salt or the like, a retractable pin 176 initially engaging the cross member 173, as shown, is then retracted therefrom by the urge of a spring 177 for freeing the cross member allowing the springs 178 on the fin hinges 179 to rotate the fins to extended position, Fig. 8. Suitable stops 180 carried on the fin hinges and adapted for engaging the plate 7 as the fins are extended serve to position the fins in the extended position wherein the fins may be locked by any suitable form of latch or detent mechanism well known in the art, but not shown herein.

As the anchor separates from the mine following the launching thereof, the aforementioned bight releasing mechanism generally designated 14, which is arranged in the cable 13 between the mine and anchor, is drawn forth from a recess 50 formed therefor in the anchor and is carried with the mine toward the surface of the water,

Fig. 1. The mechanism 14 is hydrostatically operated and adapted as the mine nears mooring position to release a bight 56 formed in the cable 13 for communicating through the cable a signal to the aforementioned reel control mechanism which is operative to lock the cable supply reel 11 whereby further paying out of the cable from the reel is prevented thereby to secure the mine in the desired moored position within the water.

After a lapse of time required for the dissolving of the plug 174 within the fin releasing mechanism 169, the stabilizing fins 80 are freed to swing to extended position, thereby to complete the cycle of operation of the launching and mooring of the mine as disclosed in Fig. 1.

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.

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.

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

1. A submarine mine of the character disclosed adapted for mooring at a predetermined depth beneath the surface of the water including, in combination, a casing, an anchor slideably received in one end of said casing, a source of gas under pressure disposed within said casing, means including an expansible bellows for expelling said anchor from said casing as gas from said source under pressure is admitted to said bellows, pressure responsive means operatively connecting said bellows with said gas source for controlling the supply of gas from said source to said bellows, and means disposed within the casing and responsive to the pressure within the bellows and the pressure of the surrounding water for exhausting pressure from said bellows when the pressure therein exceeds the water pressure by a predetermined value.

2. A submarine mine of the character disclosed for mooring at a predetermined depth beneath the surface of the water including, in combination, a casing, a mooring cable, an anchor slideably received in a chamber formed in one end of said casing and connected by said mooring cable to said mine, a source of gas under pressure, means including an expansible bellows for expelling said anchor from said casing as gas from said source is admitted to said bellows to make buoyant said chamber to cause said mine to rise with one end of said cable to mooring position within the water, and means disposed within the casing and responsive to the pressure within the bellows and the pressure of the surrounding water for exhausting pressure from said bellows when the pressure therein exceeds the water pressure by a predetermined value.

3. A submarine mine of the moored type including, in combination, a casing, an explosive charge arranged in said casing and adapted when detonated to explode the mine, said casing having an opening at one end thereof, an anchor slideably received within said opening and including a mooring cable having one end thereof connected to said mine, inflatable means interposed between said anchor and said explosive charge, a gaseous supply source connected to said inflatable means for inflation thereof to expel said anchor from the casing whereby the mine is made buoyant for rising with said cable towards mooring position beneath the surface of the water, means for controlling the supply of gas from said source to said inflatable means, and means for maintaining within said bellows a predetermined pressure differential with respect to the pressure of the surrounding water as a mine rises therein from anchor-expelling position to mooring position.

4. A submarine mine of the character disclosed for mooring at a predetermined depth beneath the surface of the water including, in combination, a casing, a mooring cable, an anchor telescopically received in one end of said casing and connected by said mooring cable to said casing, a source of pressure, means including an expansible bellows for expelling said anchor from said casing as pressure from said source is admitted to said bellows, pressure responsive means connected between the bellows and the source for controlling the admission of gas from the source to said bellows, and means interposed between said anchor and bellows for closing the end of said casing upon the expulsion of said anchor therefrom.

5. A submarine mine of the character disclosed for mooring at a predetermined depth beneath the surface of the water including, in combination, a casing, a mooring cable, an anchor telescopically received within a chamber formed in one end of said casing, a source of gas under pressure, an expansible bellows arranged within said chamber to expel said anchor therefrom as gas is admitted to said bellows from said source of gas under pressure, means movable by said expansible bellows for closing the end of said chamber as the anchor is expelled therefrom, and means including said cable for mooring the mine from the expelled anchor.

6. A submarine mine of the sub-floating type adapted for mooring at a predetermined depth beneath the surface of the water including, in combination, a casing, a mooring anchor arranged in a chamber formed in one end of said casing and including a cable interconnecting the mine and the anchor, a source of gas under pressure, a bellows inflatable from said source of gas under pressure for expelling said anchor from said chamber and for rendering said chamber buoyant whereby the mine is caused to rise with one end of said cable to mooring position beneath the surface of the water, and means interposed between said anchor and bellows for closing the end of said chamber when the anchor is expelled therefrom.

7. A sub-floating mine of the type adapted for mooring at a predetermined depth beneath the surface of the water including, in combination, a casing, a source of gas under pressure, an inflatable member arranged within said casing and expandable by gas received from said source of gas under pressure, a mooring anchor disposed in said casing for expulsion therefrom upon the inflation of said inflatable member, a length of cable connecting said mine with said anchor and payable out from said anchor as the mine rises therefrom within the water toward mooring position upon the expulsion of said anchor from the casing, and means responsive to the pressure within the inflatable member and the pressure of the surrounding water for maintaining a predetermined pressure differential therebetween as the mine rises within the water from anchor-expelling position to mooring position.

8. A submarine mine of the character disclosed for mooring at a predetermined depth beneath the surface of the water including, in combination, a casing having an open chamber in one end thereof, an anchor arranged in said chamber and connected by a mooring cable to the casing, a source of gas under pressure, an inflatable member arranged within said casing adjacent said anchor and expansible by the admission of gas thereto from said source under pressure to expel the anchor from the casing and to make the mine buoyant for rising with the water with said cable toward mooring position, pressure controlling means operatively connecting said inflatable means with said gas source and adapted for controlling the flow of gas from the latter responsive to the pressure of the surrounding water, and means for exhausting pressure from said inflatable means as the pressure therein exceeds by a predetermined value the hydrostatic pressure about the mine.

9. A submarine mine of the character disclosed adapted for mooring at a predetermined depth beneath the surface of the water including, in combination, a casing

having a chamber in one end thereof, an inflatable bladder, an anchor for said mine telescopically received in said chamber and expellable therefrom by inflation of said bladder thereby to render said mine buoyant, a cap movable within said chamber and interposed between said anchor and said bladder for closing the end of said chamber upon the expulsion therefrom of said anchor, means for inflating said bladder including a source of gas under pressure, means connected between said source and said bellows and responsive to the pressure within said bellows and the pressure of the surrounding water for controlling the flow of gas from said source, and means responsive to the pressure within said bellows and the pressure of the surrounding water for exhausting pressure from said bellows when the pressure therein exceeds by a predetermined value the pressure of the surrounding water.

10. A submarine mine of the character disclosed for mooring at a predetermined depth beneath the surface of the water including, in combination, a casing, a mooring cable, an anchor telescopically received within a chamber formed in one end of said casing, a source of gas under pressure, an expansible bellows arranged within said chamber to expel said anchor therefrom as gas is admitted to said bellows from said source of gas under pressure, means movable by said expansible bellows for closing the end of said chamber as the anchor is expelled therefrom, means including said cable for mooring the mine from the expelled anchor, a pair of stabilizing fins hingedly secured to the other end of the casing and initially locked in face adjacency therewith, means for yieldably urging said fins into extended stabilizing position with respect to the casing when the fins are released, and means including a soluble washer for locking said fins in said initial position until the washer is dissolved.

11. A submarine mine of the character disclosed adapted for mooring at a predetermined depth beneath the surface of the water including, in combination, a casing, an anchor slideably received in one end of said casing, a source of gas under high pressure disposed within said casing, means including an expansible bellows for expelling said anchor from said casing as gas from said source under pressure is admitted to said bellows, pressure responsive means operatively connecting said bellows with said gas source for controlling the supply of gas from said source to said bellows, anti-shock valve means interposed between said pressure responsive means and said source for preventing release of pressure thereto prior to launching of the mine, electroresponsive means effective during launching of the mine for opening said valve means, and means disposed within the casing and responsive to the pressure within the bellows and the pressure of the surrounding water for exhausting pressure from said bellows when the pressure therein exceeds the water pressure by a predetermined value.

12. A submarine mine of the sub-floating type adapted for mooring at a predetermined depth beneath the surface of the water including, in combination, a casing, a mooring anchor arranged in a chamber formed in one end of said casing and including a cable interconnecting the mine and the anchor, a source of gas under pressure, a bellows inflatable from said source of gas under pressure for expelling said anchor from said chamber and for rendering said chamber buoyant whereby the mine is caused to rise with one end of said cable to mooring position beneath the surface of the water, means interposed between said anchor and bellows for closing the end of said chamber when the anchor is expelled therefrom, and means including a reel disposed within the anchor for paying out a predetermined length of said cable therefrom as the mine rises to said mooring position.

13. In a sub-floating moored mine assembly of the character disclosed, the combination of a casing having a chamber, an anchor and mooring cable for the mine disposed within said chamber prior to launching and planting of said mine assembly onto the bed of a body of water, means including an expansible bellows disposed within the casing and expanded in response to fluid under pressure upon launching of the mine assembly into the water for expelling said anchor from the chamber, a source of fluid under pressure, and cap means supported by said casing within said chamber and movable into sealing engagement therewith by said bellows as the bellows is expanded for sealing and rendering said chamber buoyant after the anchor has been expelled therefrom thereby to buoy the mine to moored position above the anchor.

14. A moored device of the sub-floating type comprising, a combination, a casing having a chamber, anchoring means for said casing initially disposed within said chamber, means including a bellows disposed within the casing and expanded in response to fluid under pressure for expelling the anchoring means from the casing, a source of fluid under pressure, a cap supported by said casing within said chamber and movable a predetermined amount by said bellows as the bellows is expanded, and means on said casing engaged by said cap as the cap is moved said predetermined amount for sealing and rendering said chamber buoyant whereby the casing rises to moored position above the anchoring means.

15. A moored device of the sub-floating type comprising, in combination, a casing having a chamber, anchoring means for said casing initially disposed within said chamber, means including a bellows disposed within the casing for expelling the anchoring means from the casing as the bellows is expanded, means including a closure element supported by said casing within said chamber for sealing and rendering said chamber buoyant when said anchor has been expelled therefrom whereby the casing rises to moored position above the anchoring means, said anchoring means including an anchor and a cable for mooring the casing to the anchor, and cable responsive means disposed within the anchor for paying out a predetermined length of said cable as the casing rises to said moored position.

16. A moored device of the sub-floating type comprising, in combination, a casing having a buoyancy chamber, anchoring means for said casing initially disposed within said buoyancy chamber, a source of pressure disposed within the casing, means responsive to release of said pressure for expelling said anchoring means from the casing and simultaneously therewith rendering said chamber buoyant, means effective as the device is immersed in a body of water for releasing said pressure, and means responsive to the difference between the pressure in said chamber and the pressure of the surrounding water for closing said source when said pressure difference exceeds a predetermined value.

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