June 17, 1930. J. PLUM 1,764,979

DROP KEEL FOR SUBMARINES

Filed July 24, 1929 4 Sheets-Sheet 1

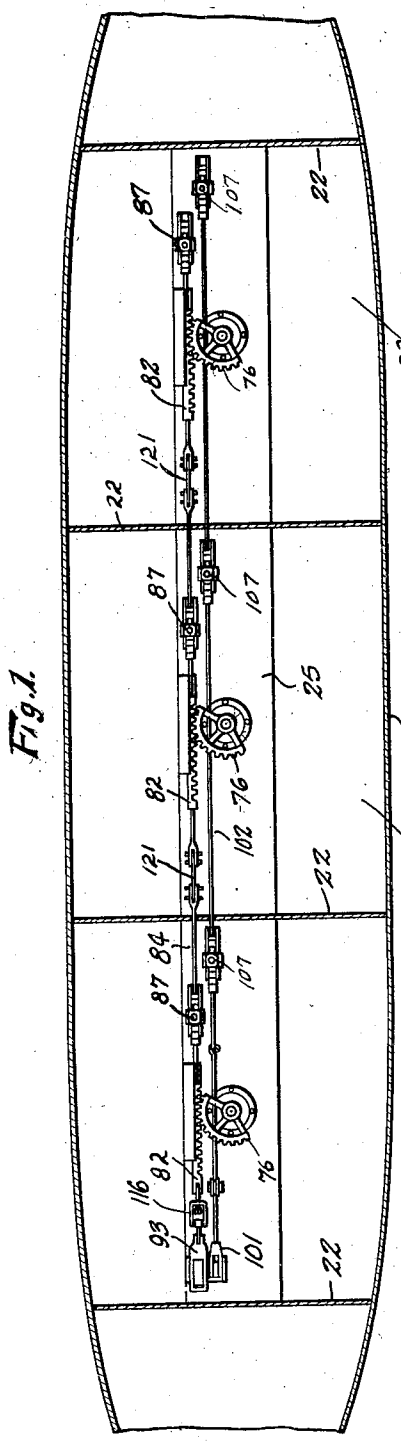


Fig. 1.

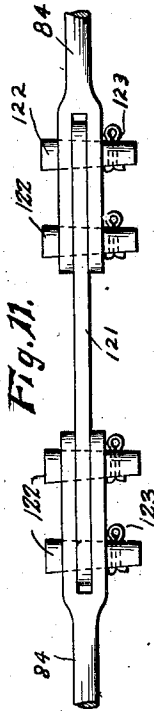


Fig. 11.

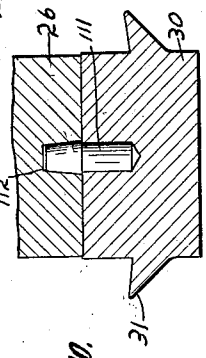


Fig. 10.

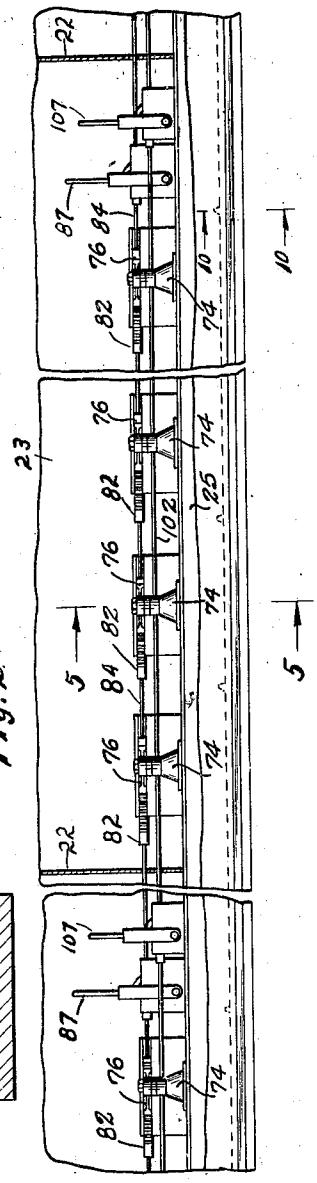


Fig. 2.

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DROP KEEL FOR SUBMARINES

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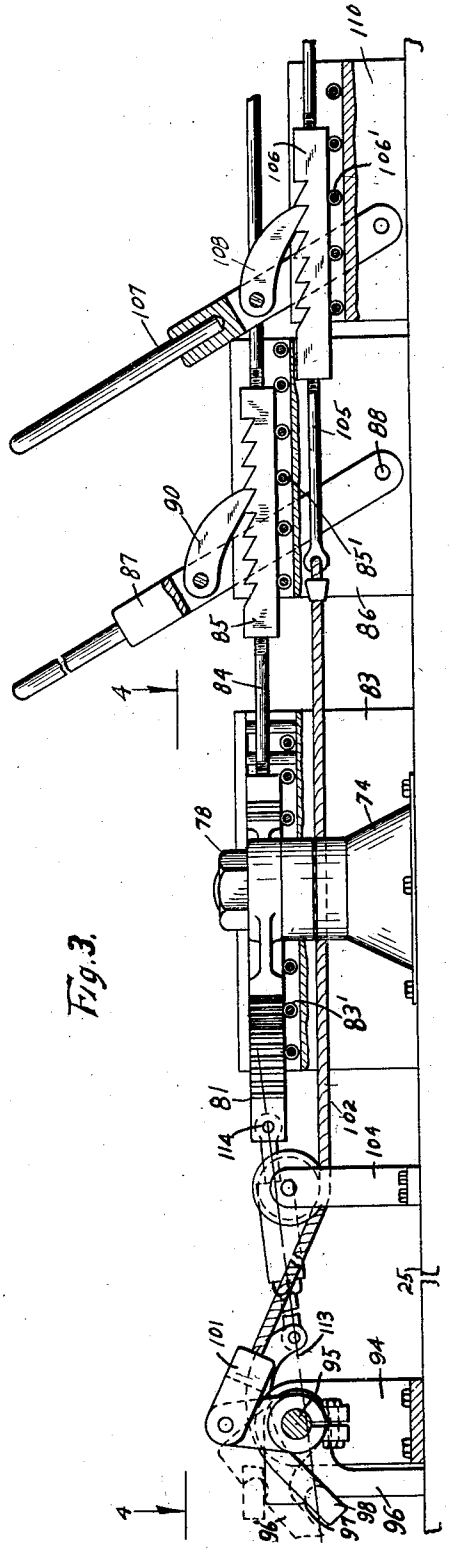


Fig. 3.

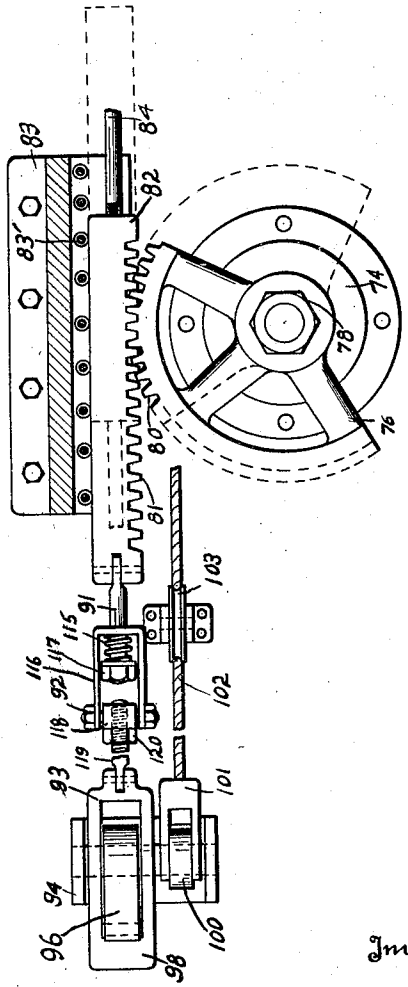


Fig. 4.

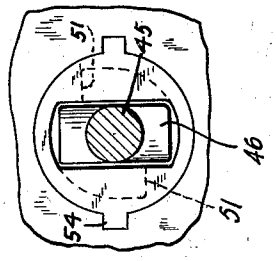


Fig. 9.

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DROP KEEL FOR SUBMARINES

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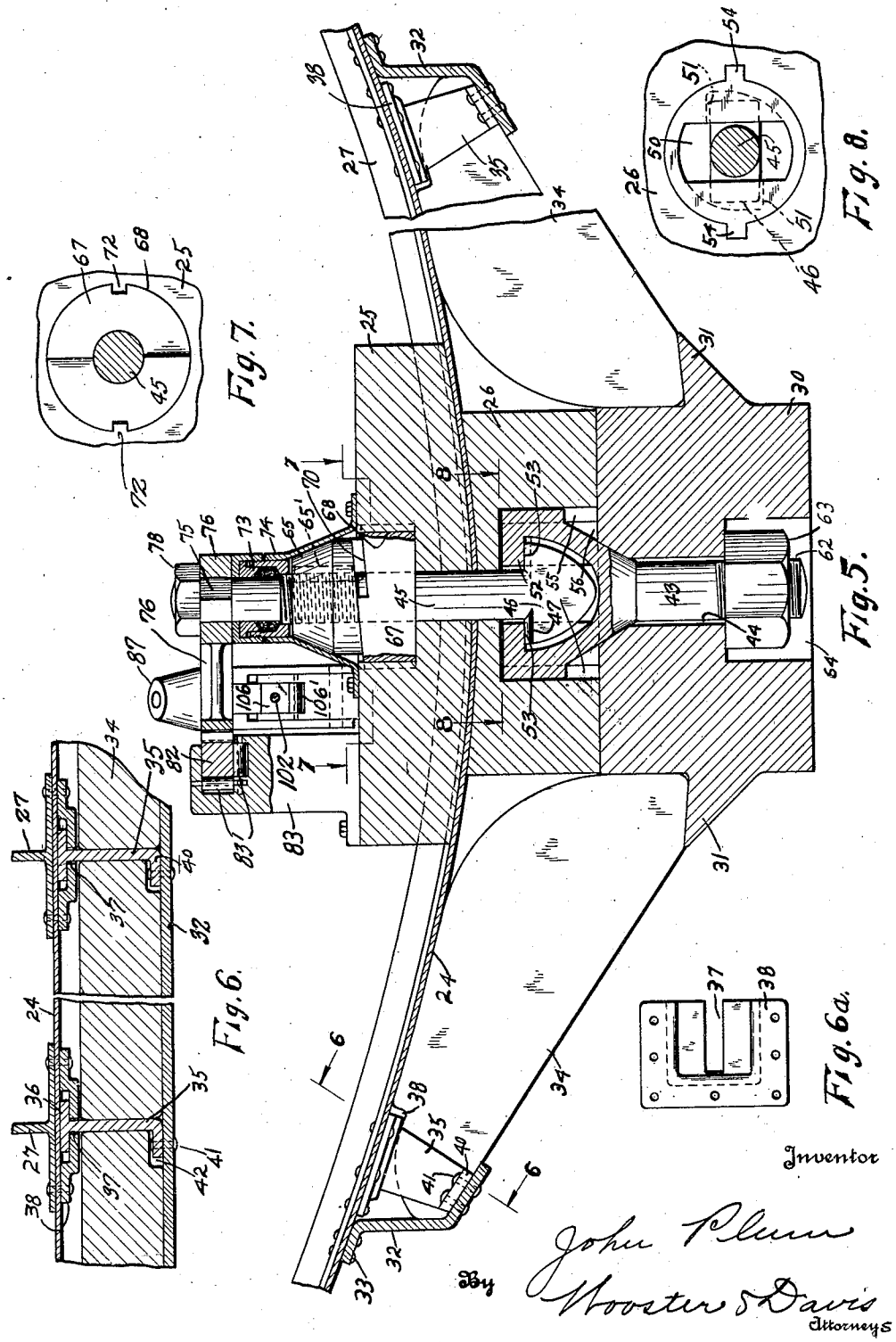


Fig. 5.

Fig. 6.

Fig. 6a.

Fig. 7.

Fig. 8.

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DROP KEEL FOR SUBMARINES

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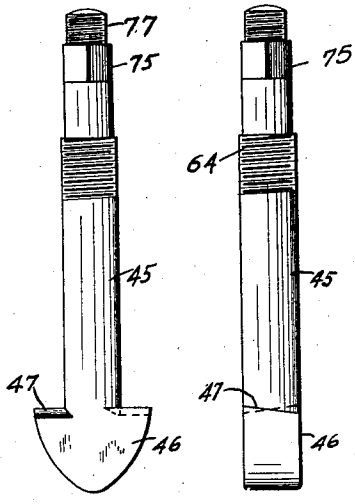


Fig. 12.

Fig. 13.

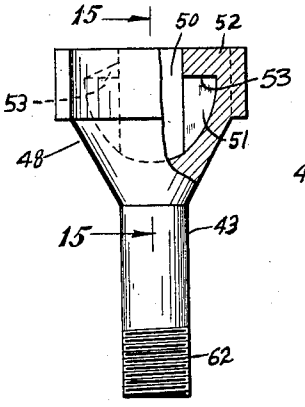


Fig. 14.

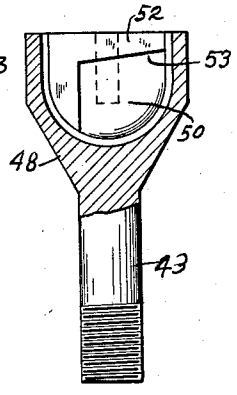


Fig. 15.

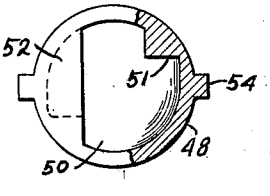


Fig. 16.

Fig. 18.

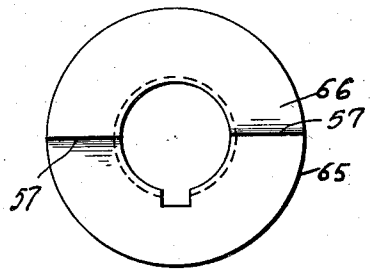
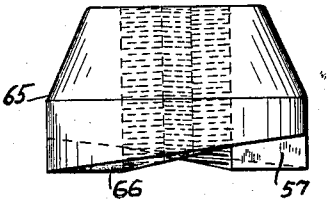


Fig. 17.



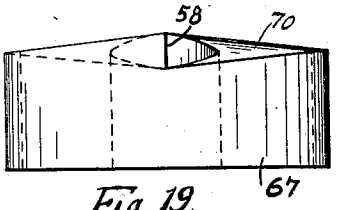


Fig. 19.

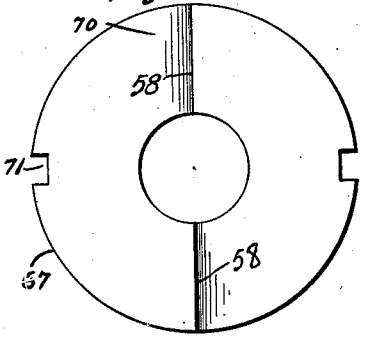


Fig. 20.

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UNITED STATES PATENT OFFICE

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DROP KEEL FOR SUBMARINES

Application filed July 24, 1929. Serial No. 380,546.

This invention relates to submarine safety devices, and has for an object to provide an improved means whereby the occupants of a submarine may lighten the submarine by releasing drop keels and weights from within the submarine shell.

A further object of this invention is to provide a means which will securely hold the attached weights against accidental loss from outside sources, which will permit the occupants of a sunken submarine to manually detach one or more drop keels and corresponding weights from within the submarine to provide means operable from any compartment of the submarine to detach at least one drop keel or to detach all the drop keels as may be desirable, to provide means locking said detaching means against accidental operation, and to provide means likewise operable from any bottom compartment to unlock said locking means.

A still further object of this invention is to provide a very effective means for holding said drop keels against longitudinal movements, thus preventing any longitudinal shearing stresses on the attaching means, to provide a novel attaching and detaching means which is easily operable to release the weights and which will always release them when operated; to provide a means for causing each drop keel section to assist in holding in place at least one drop weight which drop weight will operate to prevent any lateral shearing stresses on the drop keel holding means; to provide means to prevent longitudinal shifting of the drop weights, which means however, shall be removable to permit longitudinal shifting of the drop weights to permit replacement of said weights, and particularly to provide means for attaching the weights which will not bind, but will always release the weights and cause them to drop when released.

With the foregoing and other objects in view, this invention embodies the constructions, combinations and arrangements of parts hereinafter set forth, disclosed and claimed in the following specification considered in connection with the accompanying drawings.

In these drawings:

Fig. 1 shows a diagrammatic top plan view of a horizontal section of a submarine to which an embodiment of this invention has been applied.

Fig. 2 shows a somewhat enlarged and vertical plan and partly broken view of an embodiment of this invention, the detail being somewhat differently arranged than in Fig. 1.

Fig. 3 shows a still more enlarged vertical view of an embodiment of the manual operating means and locking means constituting part of this invention.

Fig. 4 is a top plan view of the operating gear rack and pinion and locking means on line 4—4 of Fig. 3.

Fig. 5 is an enlarged and partly broken view on the line 5—5 of Fig. 2.

Fig. 6 is a vertical cross-section on line 6—6 of Fig. 5.

Fig. 6[a] is a plan view of part of the mounting means.

Fig. 7 is a horizontal section on line 7—7 of Fig. 5.

Fig. 8 is a horizontal section on line 8—8 of Fig. 5 showing the male bolt in holding position.

Fig. 9 is a horizontal section similar to Fig. 8 with the male bolt turned to the detaching position.

Fig. 10 is a cross section on line 10—10 of Fig. 2, showing the dowel pins for preventing shearing stresses on the drop keel attaching means.

Fig. 11 shows an enlarged view of the separable links and pins connecting the several gear racks.

Fig. 12 is a front view of the male bolt or joining member.

Fig. 13 is a side view of Fig. 12.

Fig. 14 is a partly broken side view of the female bolt or joining member.

Fig. 15 is a view on line 15—15 of Fig. 14.

Fig. 16 is a top plan view, partly broken of Fig. 14.

Fig. 17 is a side view of the flange to be screwed onto or otherwise attached to the male bolt showing how its bottom is screw pitched.

Fig. 18 is a bottom plan view of the flanges in Fig. 17.

Fig. 19 is a side view of a correspondingly screw pitched washer placed in the keelson to support the flange and bolt, and

Fig. 20 is a bottom plan view of Fig. 19.

There is shown diagrammatically at 21 a submarine to which an embodiment of this invention has been attached. The submarine is shown diagrammatically divided by partitions 22 into compartments 23, no attempt being made to show in detail the construction of the submarine, the submarine bottom or shell 24 having the usual keelson 25 and the usual stationary keel 26, there being the usual brace or ribs 27 riveted to the inside of the shell.

Detachably fastened below the keel by a later described means is a drop keel 30, and this drop keel may be made in several sections, each section forming an individual drop keel. On either or each side of the drop keel 30 is formed a flange 31 preferably integral therewith. Spaced from the drop keel flanges 31 and parallel therewith is a flange 32 affixed to the outside of shell 24 by rivets 33, there being a flange 32 on each side of the keel 30. The flanges 31 and 32 are designed to hold between them and the shell 24 a series of heavy weights 34 of lead or similar material, the weights being made in sections so as not to be too unweildly in assembling, and further, to permit sections of the weight to be detached together with the individual drop keels when it is found unnecessary to detach the entire series of drop keels. A T-shaped bracket 35 has its T head 36 fitted into a slot 37 of a holder 38 riveted to the shell 24. The bracket 35 has a lip 40 which is riveted as at 41 to the flange 32, each weight 34 being recessed as at 42 to fit over lip 40. After a section of the drop keel has been put in place, the weight is slid within the flanges 31 and 32, the recessed end 42 fitting over the lip 40 of a bracket 35 already in place. Another bracket 35 may then be placed in position beside the section of keel just placed in position and with its head 36 fitted into slot 37 in the next holder 38 and then it is riveted at 41. When replacing a weight or weights that have been dropped, it is only necessary to knock out rivets 41 to remove the bracket 35 to permit a new weight to be slid into place and fastened thereby, or the weights may be inserted by reversing the dropping action and before placing the corresponding keel sections 30 in position. Thus the bracket 35 serves a double function, it is removable to permit the weights to be replaced, and serves to hold the weights against longitudinal movement once they are in place, and it supports the lower end of member 32. At the same time it does not interfere with the detaching of the weights when the drop keel is detached, as is necessary when the submarine has been sunk and is unable to rise in its customary manner due to some accident to its machinery or otherwise. The sections of the weights and keel are preferably of a length corresponding to the distance between an adjacent pair of ribs of the submarine or twice this distance, altho they may be longer if desired.

The means for holding the drop keels securely to the submarine and permitting them to be detached in case of an accident will now be described. This means includes a male joining bolt and a female joining bolt one of these bolts projecting through the drop keel 30 and the other projecting through the stationary keel 26, shell 24 and keelson 25 of the submarine. In this case, the female bolt 43 projects through an opening 44 in the drop keel 30, while the male bolt 45 projects through the shell. The head 46 of the male bolt 45 is somewhat heart shaped and projects beyond the stem of the bolt, the projecting portions being screw pitched as at 47. The head 48 of the female bolt 43 has a cavity 50 corresponding in shape to the male head 46 to permit it to enter therein. The cavity 50 is recessed to permit the male head 46 to turn a quarter revolution, there being a stop 51 to prevent further turning, while a flange 52 above and over-hanging this recessed portion prevents the male head 46 from being withdrawn when it is in the position shown in Figs. 5 and 8 with the inclined shoulders 47 lying under these flanges, the flanges 52 being correspondingly screw pitched as at 53. To prevent the female bolt from revolving, and thus separating from the male bolt, the female head 48 is formed with a pair of projecting tongues 54 which will enter corresponding grooves 55 in the recess 56 in keel 26. The end of bolt 43 is screw threaded as at 62 and a nut 63 serves to hold the drop keel 30 in place, the keel 30 being recessed at 64 to receive the nut 63.

The male bolt 45 is screw threaded as at 64 to receive a supporting flange or nut 65 which after mounting is secured to turn with the bolt by any suitable means as a key 65′. The bottom surface of flange or nut 65 is screw pitched as at 66, this pitch being in the reverse direction to that of pitched surfaces at 47 and 53, but being of the same pitch or inclination to facilitate the turning operation required in releasing the weights. A supporting washer 67 is placed in a recess 68 in the keelson 25 and is screw pitched at 70 corresponding to the pitch 66. The shoulders 57 and 58 coact as stops to limit relative turning movements between the members 65 and 68 and are so arranged that when together the head 46 of the male bolt is in alignment with the elongated opening to the recess 50 as shown in Fig. 9 and therefore insures stopping of the turning movement of bolt 45 in proper position to release the bolt 43 and permit it to separate therefrom. The

slots 71 in washer 68 receive tongues or keys 72 projecting from the sides of recess 68 and prevent washer 67 from rotating. On bolt 45 above flange 65 a stuffing box 73 serves to prevent leakage along the bolt into the submarine, and a frustum shaped shell 74 is affixed to the keelson 25 about the stuffing box and flange to protect and conceal these working parts. The bolt 45 is reduced adjacent its upper end to a square shaped neck 75 so as to receive the correspondingly shaped bore of a gear or pinion 76, and above neck 75 bolt 45 is again reduced to a threaded portion 77 to receive a nut 78 to fasten pinion 76 securely to the bolt.

In mesh with teeth 80 of pinion 76 are the teeth 81 of a rack 82 slidably guided and supported by a bracket 83 affixed to keelson 25, and the rack is backed up and supported by rollers 83′ to give easy operation of the rack. In order to move the rack 82 in the operative direction, (to the right in Figs. 1 to 4), it is connected by a link bar 84 to a rack 85 slidably guided and supported by bracket 86 also affixed to keelson 25 in alignment with bracket 83. The member 85 is also mounted on antifriction rollers 85′ to facilitate its movement. A lever 87 pivoted to bracket 86 as at 88 has a depending pivoted pawl 90 adapted to mesh with rack 85 and when lever 87 is operated, the pinion will be turned to rotate the male bolt 45 to the detaching or releasing position shown in Fig. 9.

To prevent accidental operation of this mechanism, another link bar 91 connected to the opposite end of rack 82 passes through the closed end of a U-shaped clevis 116 and carries a nut 117 between which and the clevis is a spring 115. The clevis is pivoted as at 92 to a nut 118 threaded on a link 119 connected to the member 93. By turning clevis 116 the length of the connection from rack 82 to member 93 may be adjusted and also the tension of spring 115 when the device is in locked position may likewise be adjusted. A lock nut 120 maintains them in adjusted position, as clearly shown in Fig. 4, to a curved drawbar 93 forming part of a toggle locking mechanism. This locking mechanism includes a U-shaped bracket 94 affixed to the keelson, and has pivoted on a shaft 95 therein a toggle member 96 which normally hangs downwardly to the keelson in locked position as shown in full lines in Fig. 3. At a point slightly below pivot 95 when in this position, an indentation 97 serves to receive the end 98 of the opening in drawbar 93, which drawbar is curved up around the pivot 95. Due to this curvature, any pressure tending to move rack 85 or 82 will be resisted so long as end 98 remains in indentation 97 and toggle 96 remains in the locked beyond center position shown, that is when the center of shaft 95 is above line 113 joining recess 97 and pivot 114. With this arrangement the greater the pull the more securely it is locked. An arm 100 fastened to and above pivote pin or shaft 95 serves to rotate the shaft so as to rotate toggle 96 to above center position 96′ whereupon it will release the drawbar 93 and allow racks 85 and 82 to be operated. In this movement of the toggle spring 115 yields to permit end 98 to pass over the center of the shaft. Affixed to arm 100 by a forked link 101 is a cable 102 which passes under a guide pulley 103 in a bracket 104 affixed to the keelson. The other end of cable 102 is affixed to a link bar 105 which is connected to a rack 106, carried on antifriction rollers 106′. Rack 106 with its operating lever 107, pawl 108 and guiding bracket 110 is identical in construction with the operating details of rack 85, and no further disclosure hereof is necessary.

The drop keel 30 may consist of one or more sections as is found desirable, and each section may be provided with one or more male and female joining or supporting members with their attendant mechanism as above described, constituting a joining member unit. To assist in holding the drop keel 30 against shifting, and thus prevent any shearing stresses on the joining members or bolts, the drop keel is provided with a number of dowels 111 which project into recesses 112 in the stationary keel 26.

Every compartment 23 of the submarine is provided with at least one unlocking lever 107 and one operating lever 87, and with one or more joining member units, there being obviously at least one joining member unit for every individual drop keel, as shown in Fig. 1, although preferably two or more joining member units or bolts will be used. The several joining member units are connected by the bar links 84 so that operation of one will simultaneously operate all the connected units. When several sections of drop keels are provided, it may be desirable to provide means to detach only certain of the drop keels and their corresponding weights. To provide for this link bar 84 is divided by a separable link 121 held therein by tapered detachable knockout pins 122 held in place by cotter pins 123 and there is one of these detachable link connections in each compartment or where found desirable.

The operation is as follows. This invention is intended as a safety device for submarines, and is for the purpose of preventing a repetition of such submarine disasters which recently shocked the Nation, wherein a submarine was sunk and it was impossible to raise the submarine in time to save the lives of the survivors who were entrapped therein. After such accidents, the submarine machinery is usually out of order and hence is unable to lighten the submarine sufficiently to cause it to float. Although some compartments in the sunken submarine may be flooded, survivors in other compartments usually

manage to block off the flooded compartments and remain within the unflooded compartments. Due to the fact that the machinery is usually disabled, this invention is intended to be operated manually, and may be operated from any compartment. If only a minor accident had occurred, and only a small part of the buoyancy has been lost, it is not necessary to detach all the keels. It may happen that only one compartment has been flooded, and it may only be necessary to detach one drop keel section and its dependent weights. When this is desirable the survivors remove the cotter pins 123 and then pins 122 in the compartment nearest the flooded one on each side of the joining member unit in that compartment. This will release this unit from the remaining units, as well as from the locking mechanism, which may be released by operating lever 107 and then by operating lever 87, rack 85 will move to pull rack 82 and thus operate pinion 76 and turn the male bolt 45 to the released position. Due to the screw pitch on the male and female heads, and likewise on the flange and supporting washer, the drop keel will be held firmly and securely and cannot be accidentally lost. However, as the screw pitches or inclined surfaces on head 46 are of the same pitch or inclination as the pitches or inclined surfaces on the members 65 and 68 but reversed as above described, this arrangement greatly relieves the friction tending to prevent the male bolt from being rotated and makes it possible for it to be easily rotated by even a single survivor. When the male bolt has been turned a quarter of a revolution, it will no longer hold the female bolt as the head is in the position of Fig. 9 and in alignment with the entrance to cavity 50, and the drop keel will detach itself from the submarine shell, at the same time, the weights 34 held in place by the particular keel section being detached will likewise separate due to the removal of the drop keel which acts as a key stone and support for holding them in place. Due to the heart shape of the male head, and the position of the keel flanges 31 and shell flanges 32, the keel and weights will separate even though the submarine is rolled on one side or on end, as often happens in submarine accidents.

If the detachment of one drop keel section and its weights is not sufficient to restore buoyancy, additional sections may be dropped, and the link 121 may be replaced with the pins 122 to reconnect the several joining member units. When necessary to drop several or all the drop keel sections, the lever 107 is operated to unlock the locking mechanism to release the toggle mechanism. The lever 87 is then operated and through its links 84, serves to operate all the connected joining member units or bolts to detach the appropriate drop keel sections and weights, and this should be sufficient to restore the buoyancy to the submarine even if several compartments are flooded.

Thus, if ever one survivor finds himself in any compartment, he can, by operating first lever 107 and then lever 87 restore the buoyancy and raise the submarine to the surface. It will be understood that the rods 84 and 105 pass through stuffing boxes (not shown) in the partitions 22 to prevent passage of water from one compartment to another and maintain the isolation of individual compartments where desired.

When the submarine is thereafter brought to the drydock, and the damage has been repaired, new keel sections are placed onto the supporting bolts which are then returned to lock position. Then rivets 41 are knocked out, permitting brackets 35 to be removed, to allow new weight sections to be slid longitudinally into place between flanges 31 and 32. As each weight section is restored, its appropriate bracket 35 is restored and new rivets 41 used to hold it in place or the weights may be inserted as above explained without removing the supports 35.

Having thus set forth and described this invention, what is claimed is:

1. A submarine safety device comprising a drop keel, weights held to the submarine bottom by said drop keel, means for securely attaching said drop keel to the submarine, and means for detaching said drop keel and weights from any compartment in the submarine.

2. A safety device for submarines divided into separate compartments comprising a drop keel extending longitudinally of the submarine and including a plurality of sections, individually operable means for detachably securing the various sections to the submarine, means for operating said individually operable means extending into all the compartments whereby the keel sections may be released from any compartment, and detachable connections in said operative means whereby to permit release of individual sections independently of the other sections.

3. A submarine safety device comprising a series of detachable drop keels, means for securely attaching said drop keels to the submarine, a series of weights held outside the submarine shell by said series of drop keels, and means for detaching any or all of said drop keels from within the submarine, to thereby also detach the corresponding weights.

4. A submarine safety device comprising a drop keel extending longitudinally of the submarine, means for securing said keel to the under side of the submarine, means within the submarine for releasing the keel, weights secured to the outside of the submarine on opposite sides of the keel to protect the keel at these opposite sides, and means

for supporting the weights to release them when the keel is dropped.

5. A submarine safety device comprising a drop keel and means for securely attaching said drop keel to said submarine and for detaching the same at will, a weight secured to said submarine by said drop keel, said means including male and female securing members, one of said members projecting through said drop keel, the other of said members projecting through said submarine shell, said last member being rotatable to release the first member to thereby permit the drop keel and weight to separate from the submarine, means for locking said last member against rotation, means for unlocking said locking means, and means for turning said member.

6. A submarine safety device comprising a series of drop keels and a series of weights, means for releasably securing said drop keels to the submarine, each of said drop keels serving to hold at least one of said weights in place and to permit said weight to separate from the submarine when said drop keel separates, said means including male and female joining members, at least one of said members being attached to each drop keel, the others of said members rotatably projecting through the submarine shell, means in each submarine bottom compartment for rotating all said other members to detach all said attached drop keels and weights, means for permitting said last means to drop less than all said drop keels and weights, means for locking said other members against rotation, and means in each compartment for unlocking said locking means.

7. A submarine safety device, comprising a drop keel extending longitudinally of the submarine, means for securing said keel to the under side of the submarine, means operable within the submarine for releasing the keel, a weight on one side of the keel, means on the keel for supporting one end of the weight, and means on the submarine for supporting the other end of the weight and adapted to release the weight when the keel falls.

8. In a submarine safety device including a drop keel, means for securing said drop keel to the submarine including a pair of male and female joining bolts, one of said bolts projecting through said drop keel and the other of said bolts projecting through the submarine shell, said male bolt having a head, said female bolt having an entrance to permit said male head to enter and a cavity permitting said male head to partly rotate, said female head having a flange across said cavity preventing said male head from being withdrawn while said male head is partly rotated, the inner side of said flange being screw pitched and the rear of the male head being correspondingly pitched, a nut secured to the upper bolt to turn therewith, a supporting nut mounted in the submarine and held against turning, said nuts being provided with engaging surfaces inclined at substantially the same pitch as the flange and head and in the opposite direction.

9. In a submarine safety device including a drop keel, means for securing said drop keel, to the submarine including a pair of male and female joining bolts, one of said bolts projecting through said drop keel and the other of said bolts projecting through the submarine shell, said male bolt having a head, said female bolt having an entrance to permit said male head to enter and a cavity permitting said male head to partly rotate, said female head having a flange across said cavity preventing said male head from being withdrawn while said male head is partly rotated, the inner side of said flange being screw pitched and the rear of the male head being correspondingly pitched, a reversely pitched supporting washer within the submarine shell about the bolt therethrough, and a corresponding reversely pitched flange on said bolt, and means within the submarine to rotate said bolt and detach the drop keel.

10. A submarine safety device including a drop keel, means for securing said drop keel to the submarine including a rotatable bolt projecting through the submarine shell into said drop keel, a pinion secured to said bolt within the submarine shell, a gear rack for rotating said pinion, a beyond center toggle locking said gear rack against operative movement, means for rotating the toggle over its center to unlock the gear rack, and rack and pawl means for operating said gear rack.

11. In a submarine safety device including a series of drop keels, means for securing said drop keels to the submarine including at least one rotatable bolt projecting through the submarine shell into each of said drop keels, a pinion within the submarine on each of said bolts, a gear rack for rotating each of said pinions, a plurality of rack and pawl means for manually operating each of said gear racks, separable links connecting said gear racks whereby each rack and pawl means may be operated to drop a plurality of keels or may be disconnected from the other gear racks so as to operate only its individual rack and pinion to drop only its individual keel.

12. In a submarine safety device including a series of drop keels, means for securing said drop keels to the submarine including at least one rotatable bolt projecting through the submarine shell into each of said drop keels, a pinion within the submarine on each of said bolts, a gear rack for rotating each of said pinions, a plurality of rack and pawl means for manually operating each of said gear racks, separable links connecting said gear racks whereby each rack and pawl means may be operated to drop a plurality of keels

or may be disconnected from the other gear racks so as to operate only its individual rack and pinion to drop only its individual keel, and toggle means to lock said gear racks against operative movement and other rack and pawl means to unlock said toggle means.

13. A submarine safety device comprising a drop keel, means within the submarine for detaching said drop keel, a flange on said drop keel, a spaced flange on the outside of the submarine shell, and a drop weight secured between said shell flange and said drop keel flange.

14. A submarine safety device comprising a plurality of drop keels, means within the submarine shell for detaching any or all of said drop keels, said drop keels being flanged, a spaced flange on the outside of the submarine shell, and a drop weight secured between said shell flange and each said drop keel flange.

15. A submarine safety device comprising a plurality of drop keels, means within the submarine shell for detaching any or all of said drop keels, each of said drop keels being flanged, a spaced flange on said submarine shell, an individual drop weight secured to said submarine shell and shell flange by each said drop keel flange, and separator means in said shell flange preventing longitudinal movement of said individual weights.

16. In a submarine safety device including a drop keel, means for securing said keel to the submarine including a bolt comprising a male and female section having correspondingly inclined engaging shoulders to secure the sections together and arranged to separate on a given turning movement of one of the sections, a supporting washer, a flange on one of the sections, said flange and washer having engaging surfaces similarly inclined to those of the bolt sections and in an opposite direction, means for supporting the washer, and means for turning one section of the bolt and the flange to permit the two sections to separate.

17. In a submarine safety device, a drop keel, means for detachably securing the keel to the under side of the submarine comprising a bolt extending through the submarine shell and provided with a head having inclined shoulders, a bolt in the keel having a socket to receive said head and similarly inclined shoulders to engage those on the head, a flange member on the first bolt having surfaces inclined at substantially the same pitch as those on the head but in the opposite direction, a supporting nut having surfaces inclined similarly to those on the flange member and cooperating therewith to support the bolt, means for holding the nut against turning, and means within the submarine for turning the first bolt to release the keel.

In testimony whereof I affix my signature.

JOHN PLUM.