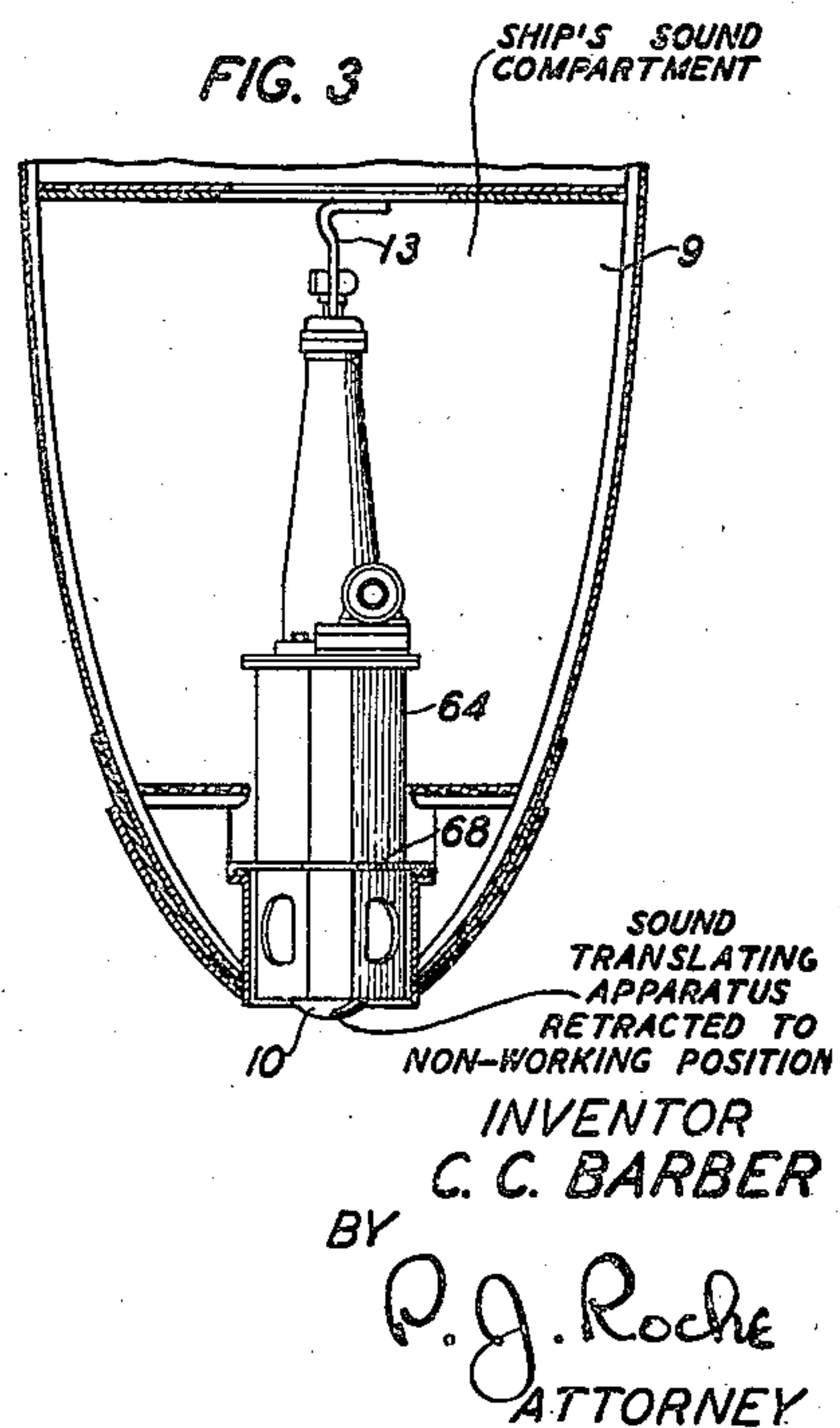
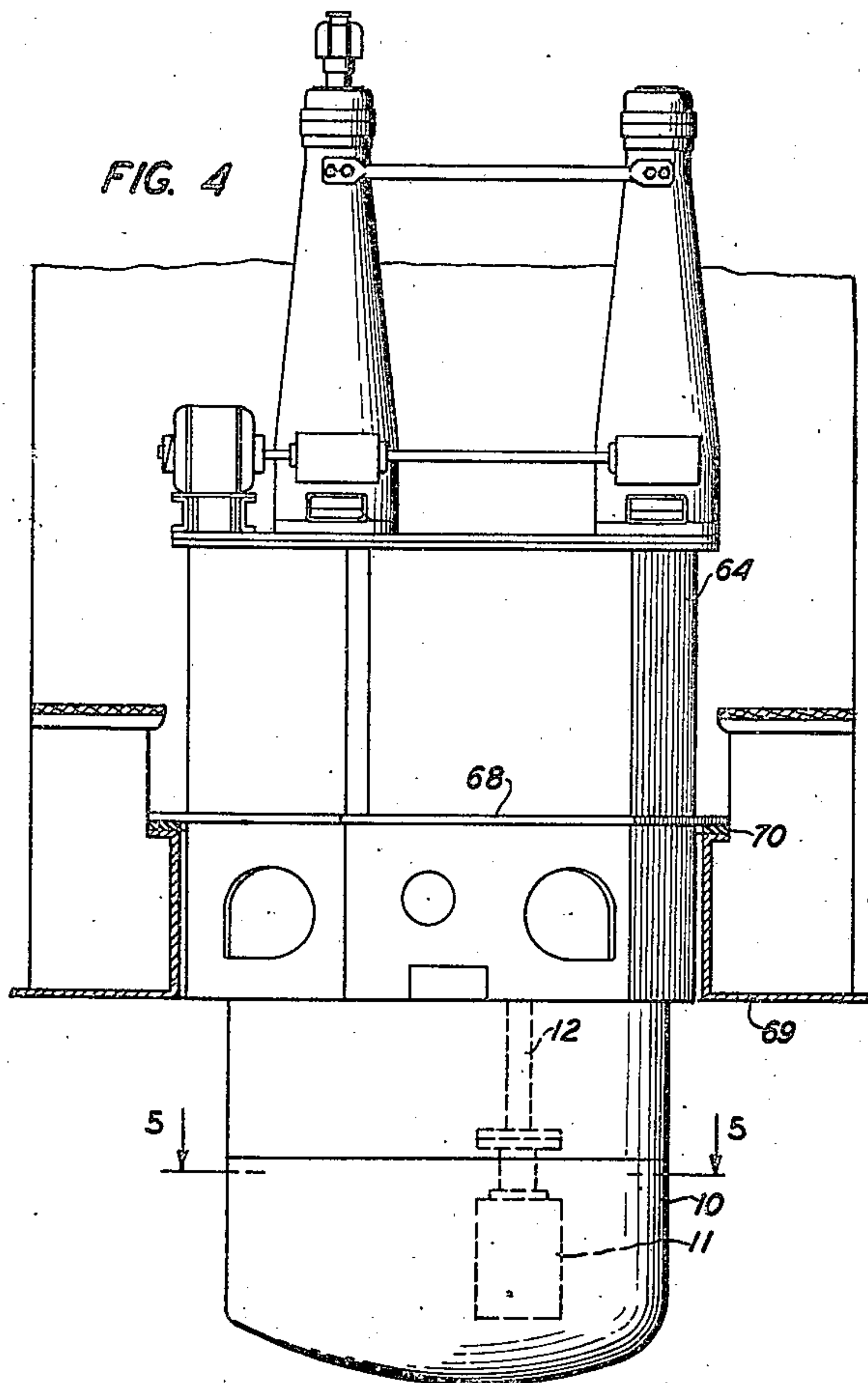
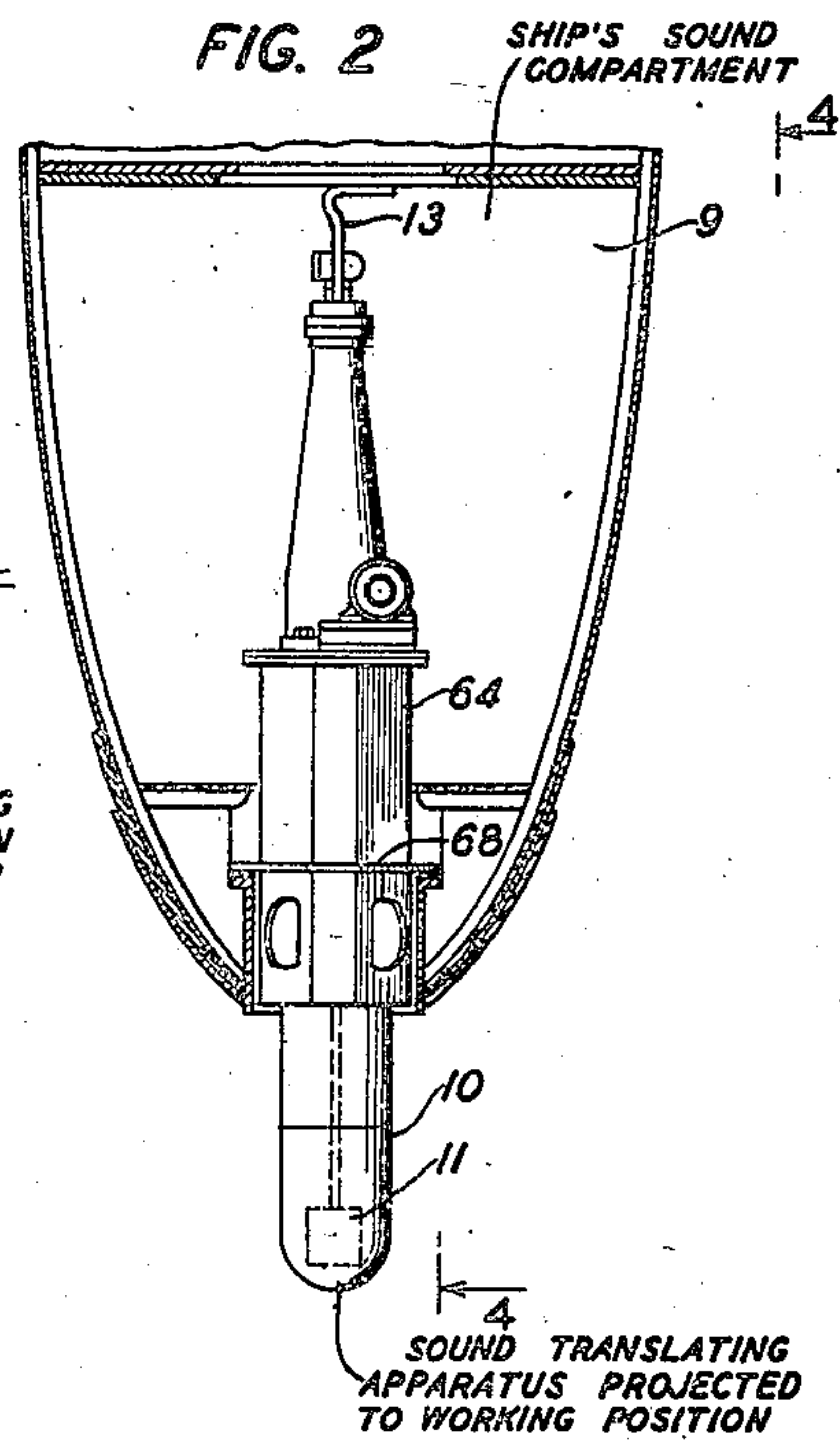
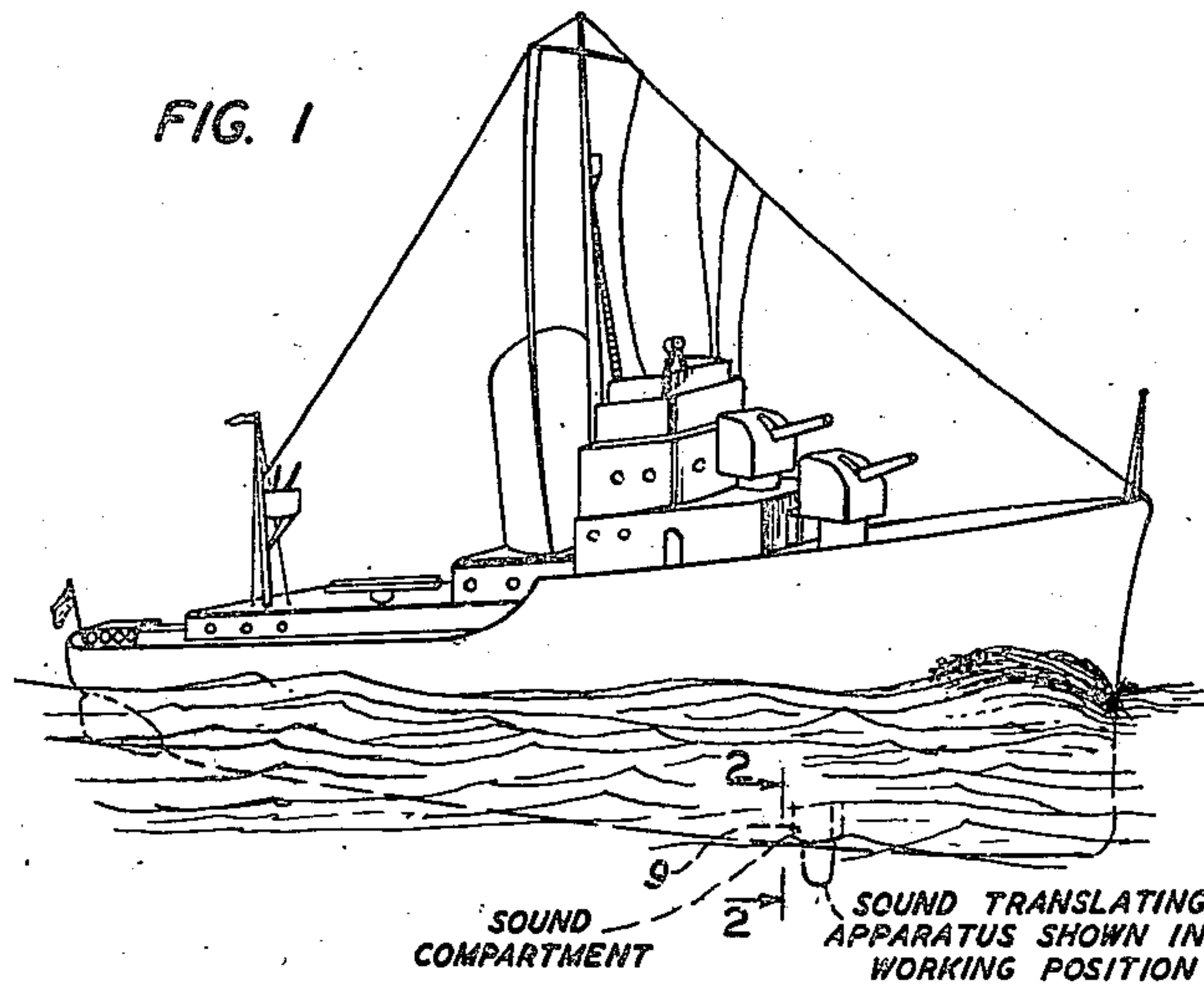


Sept. 10, 1946.

C. C. BARBER  
PROJECTING AND RETRACTING MECHANISM FOR  
AN UNDER-WATER SIGNAL SOURCE  
Filed Dec. 18, 1943

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INVENTOR  
C. C. BARBER  
BY  
P. J. Roche  
ATTORNEY



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FIG. 5

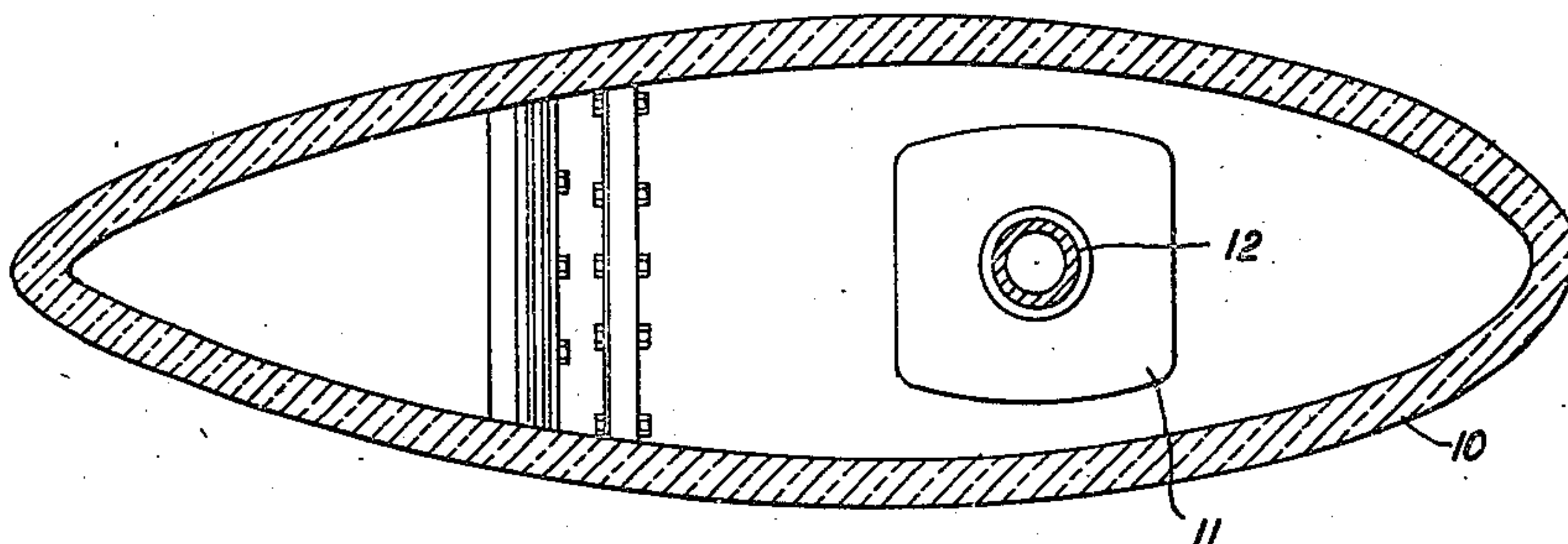


FIG. 8

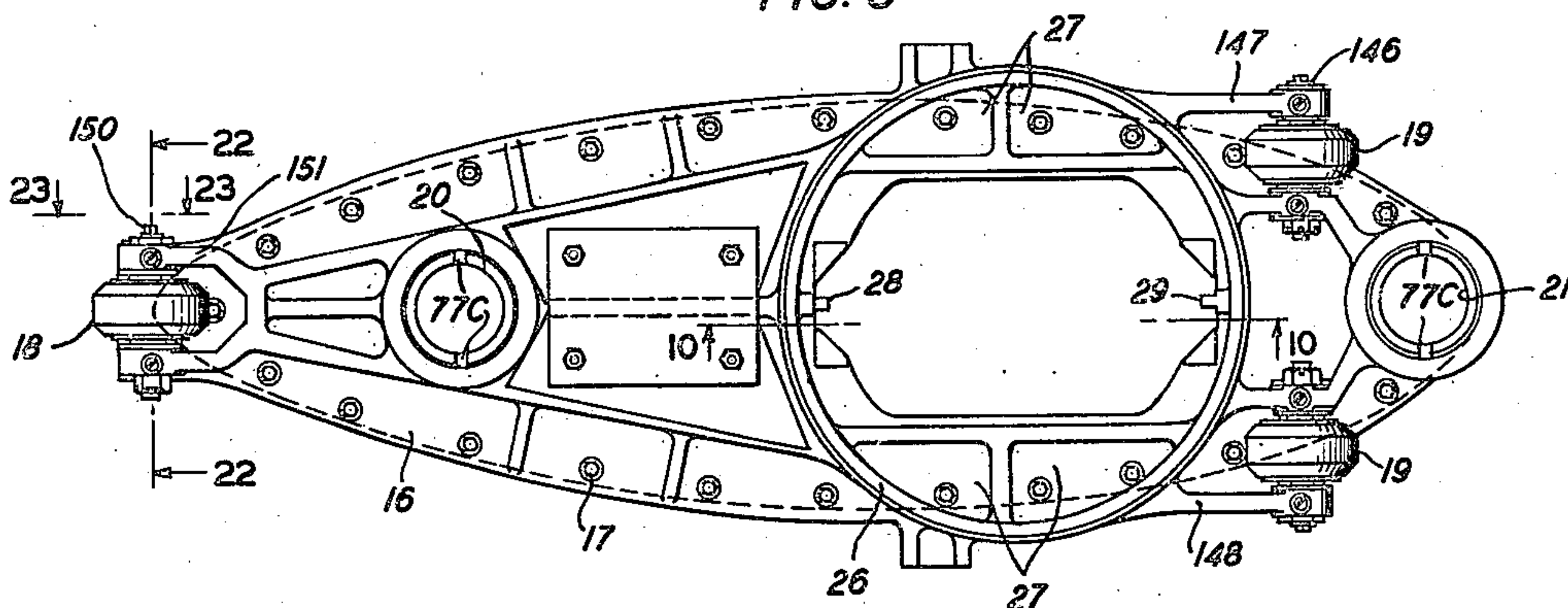


FIG. 22

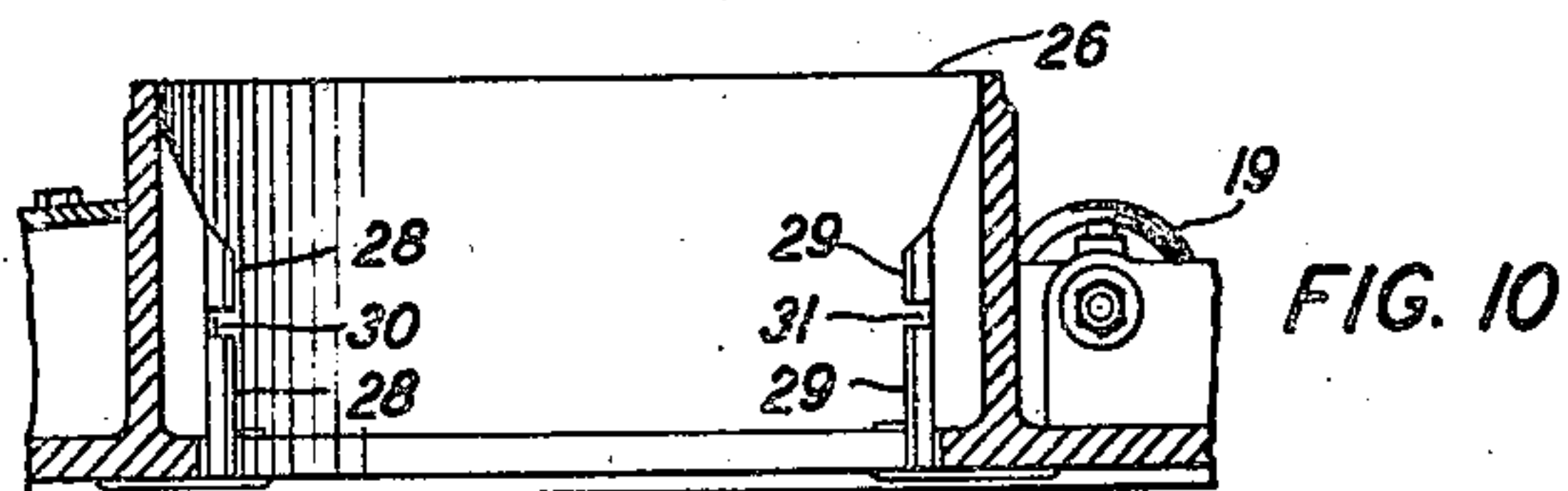
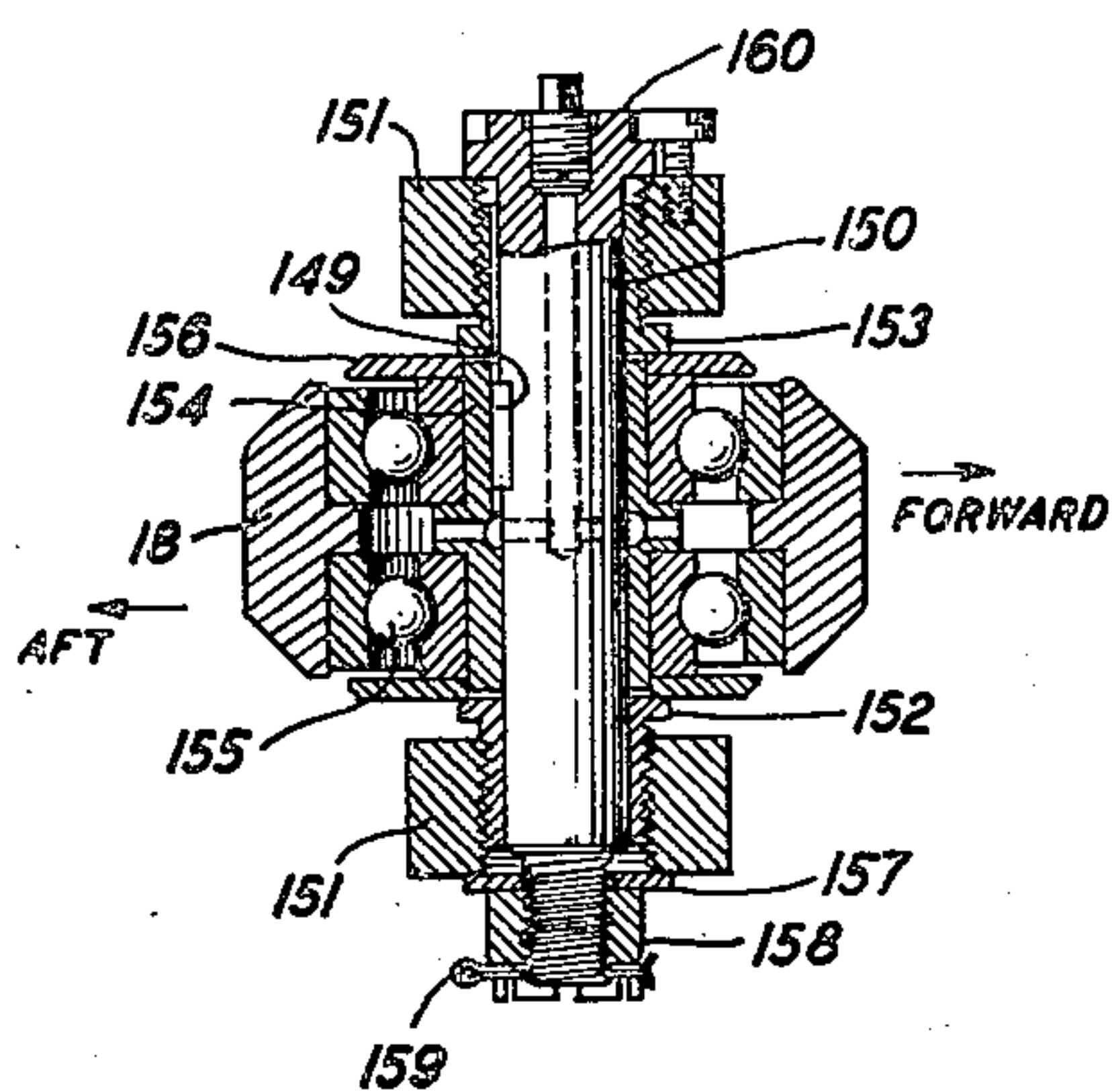
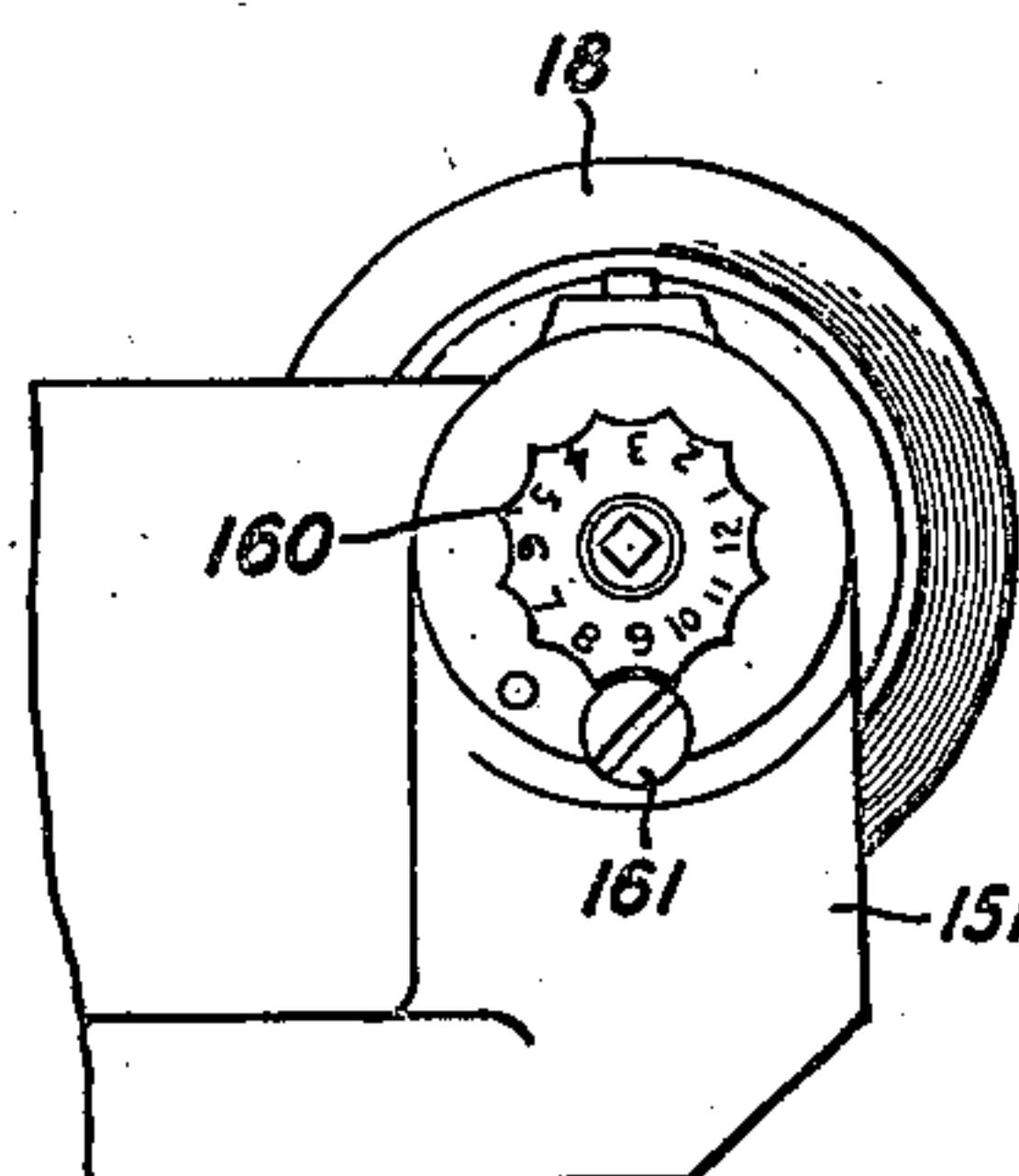


FIG. 23



INVENTOR  
C. C. BARBER  
BY P. J. Roche  
ATTORNEY

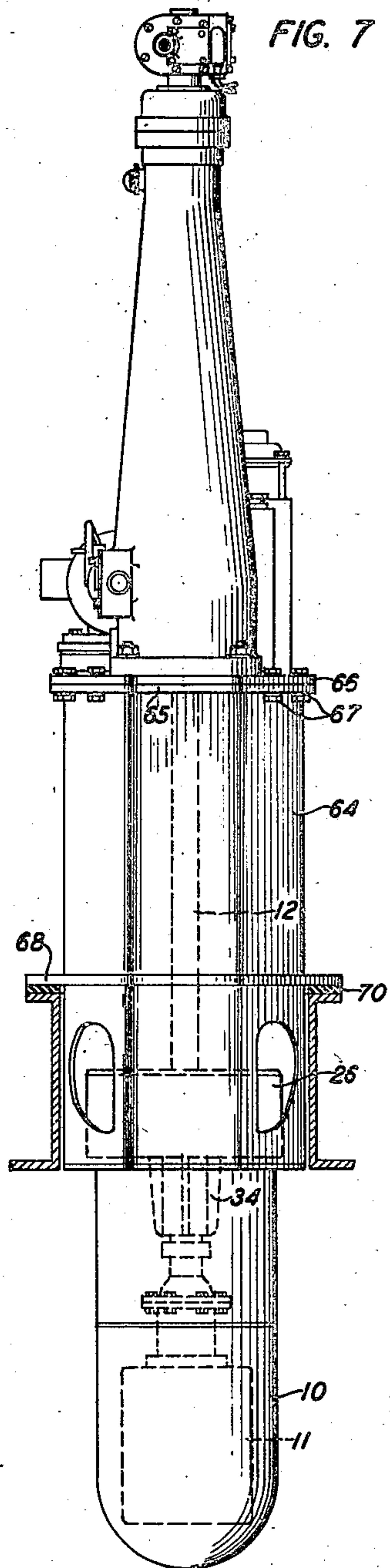
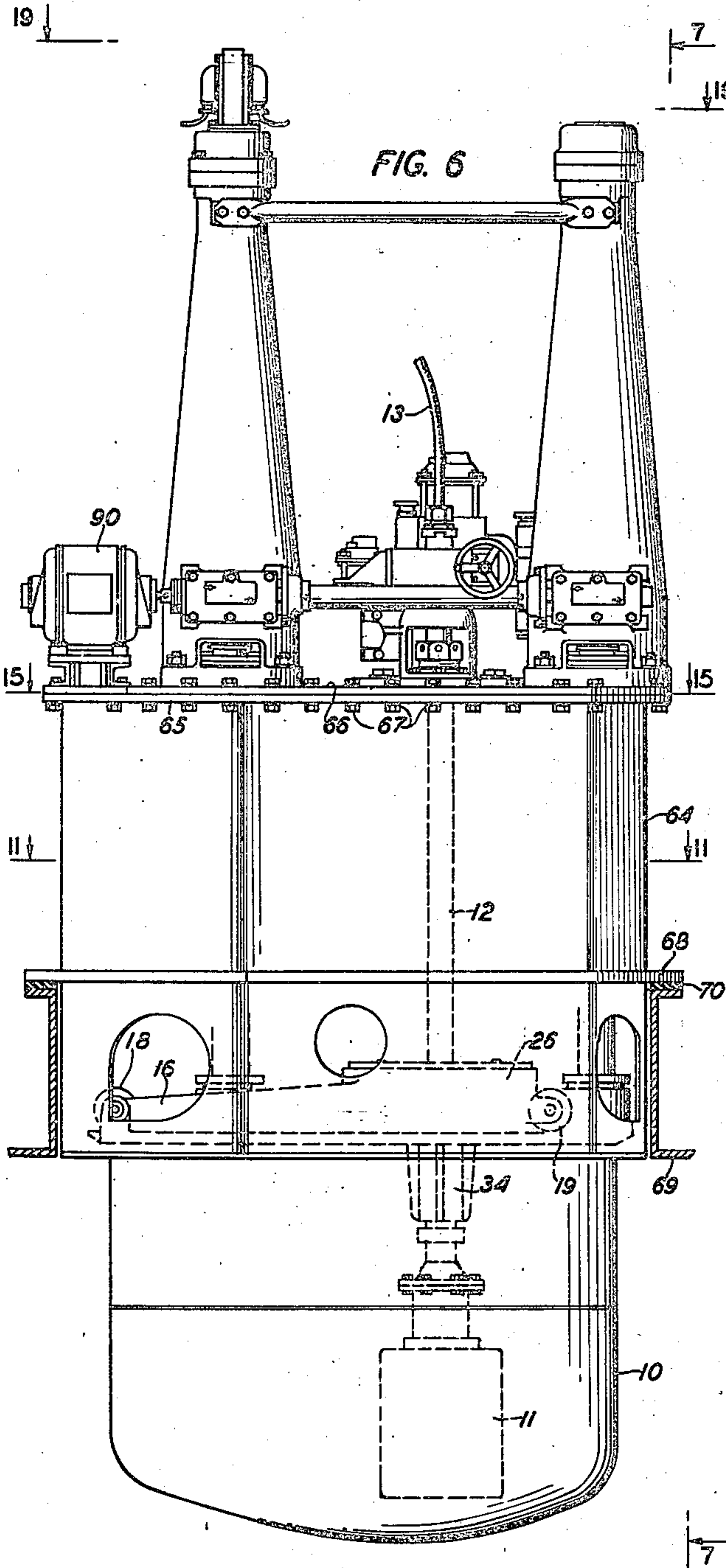


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INVENTOR  
C. C. BARBER  
BY P. J. Roche  
ATTORNEY



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FIG. 11

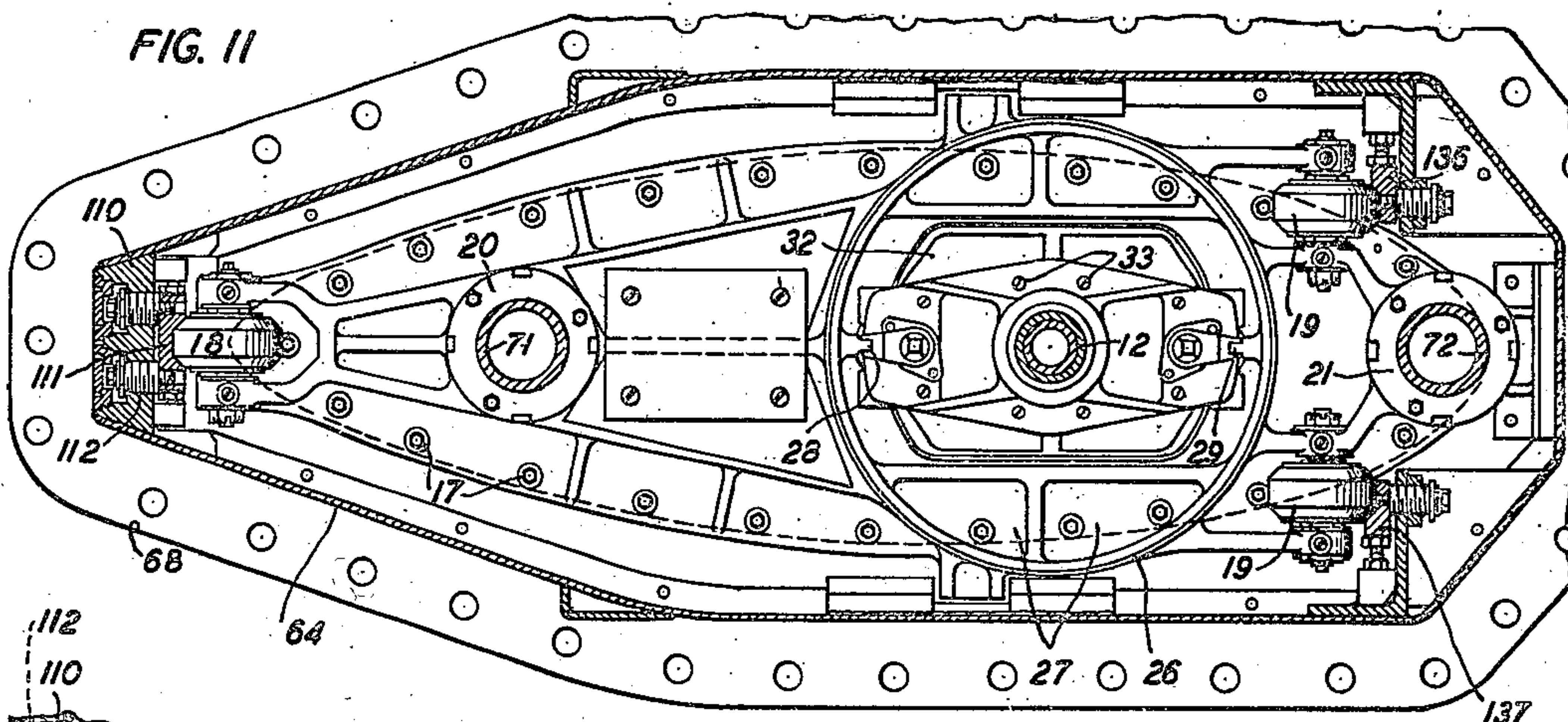
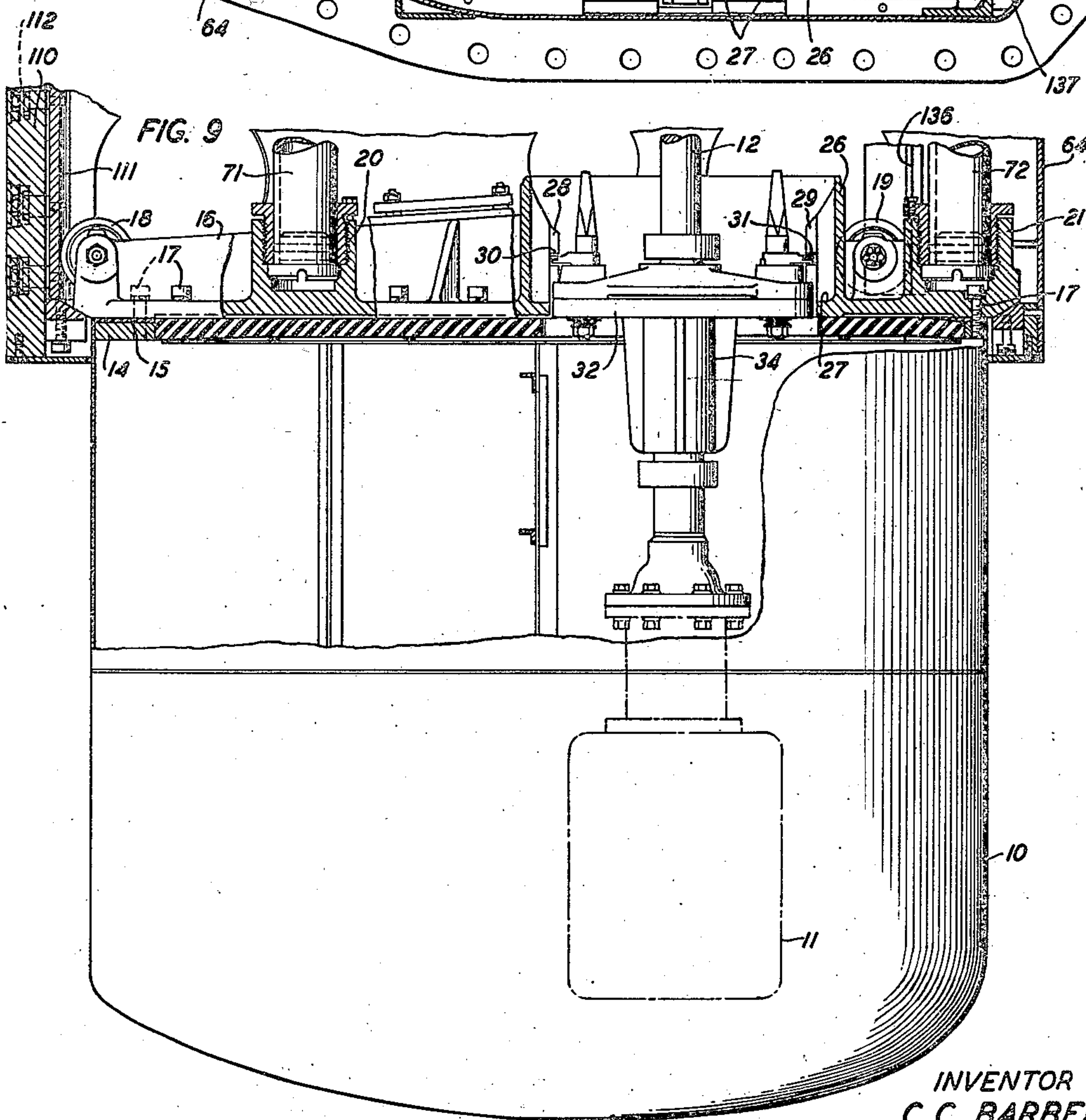


FIG. 9



INVENTOR  
C. C. BARBER

BY  
P. J. Roche  
ATTORNEY

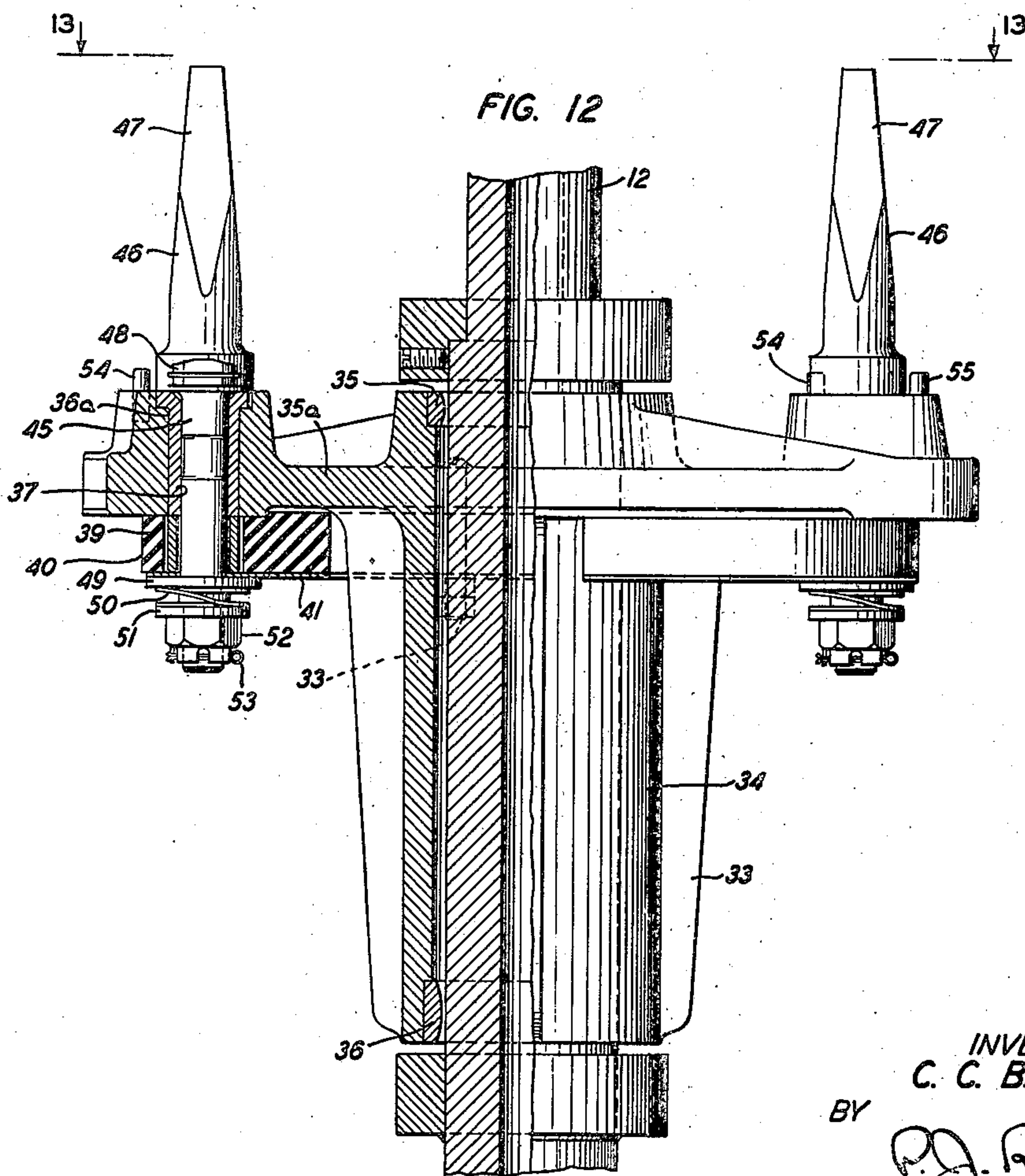
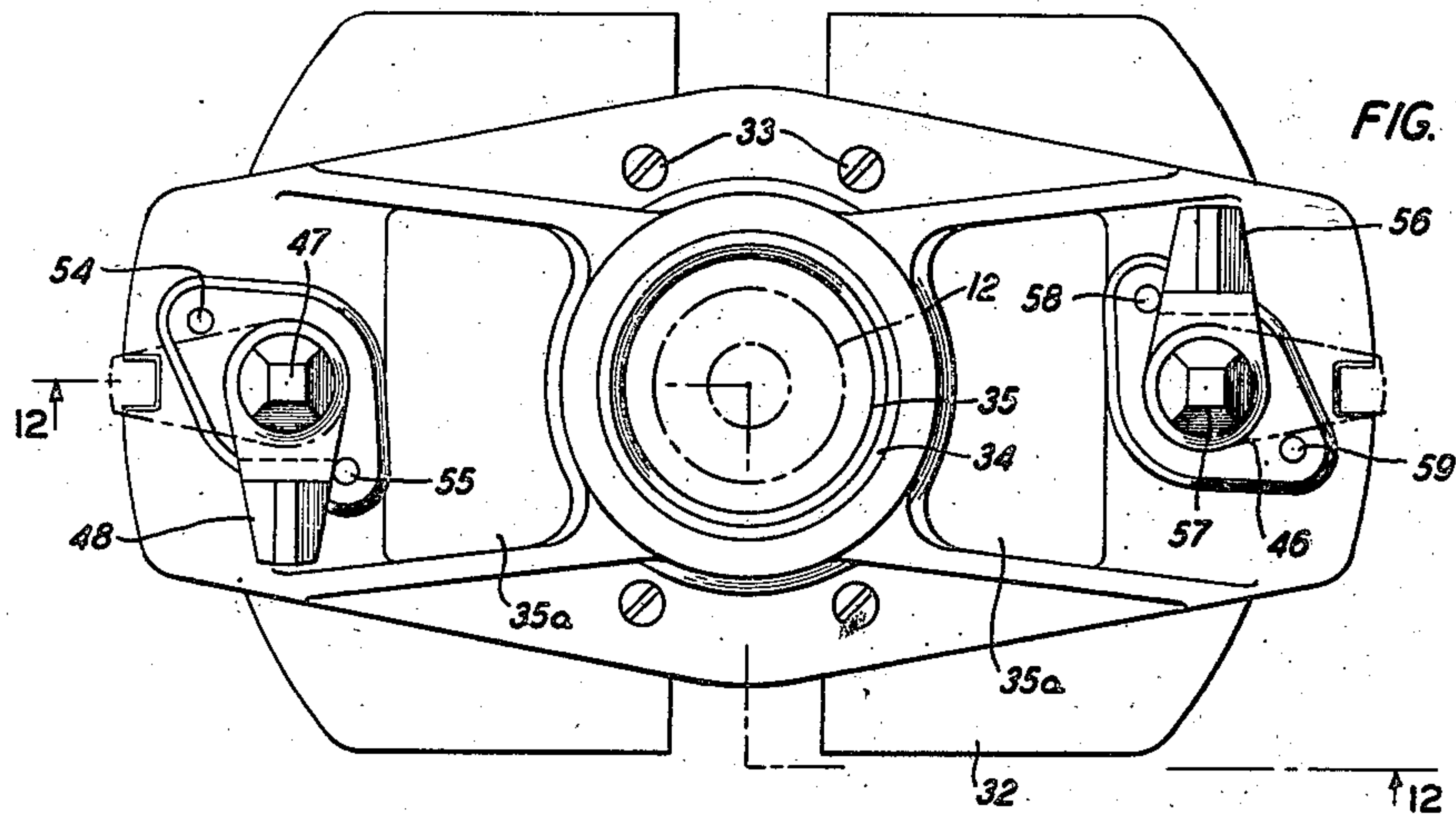


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INVENTOR  
C. C. BARBER  
BY  
P. J. Roche  
ATTORNEY

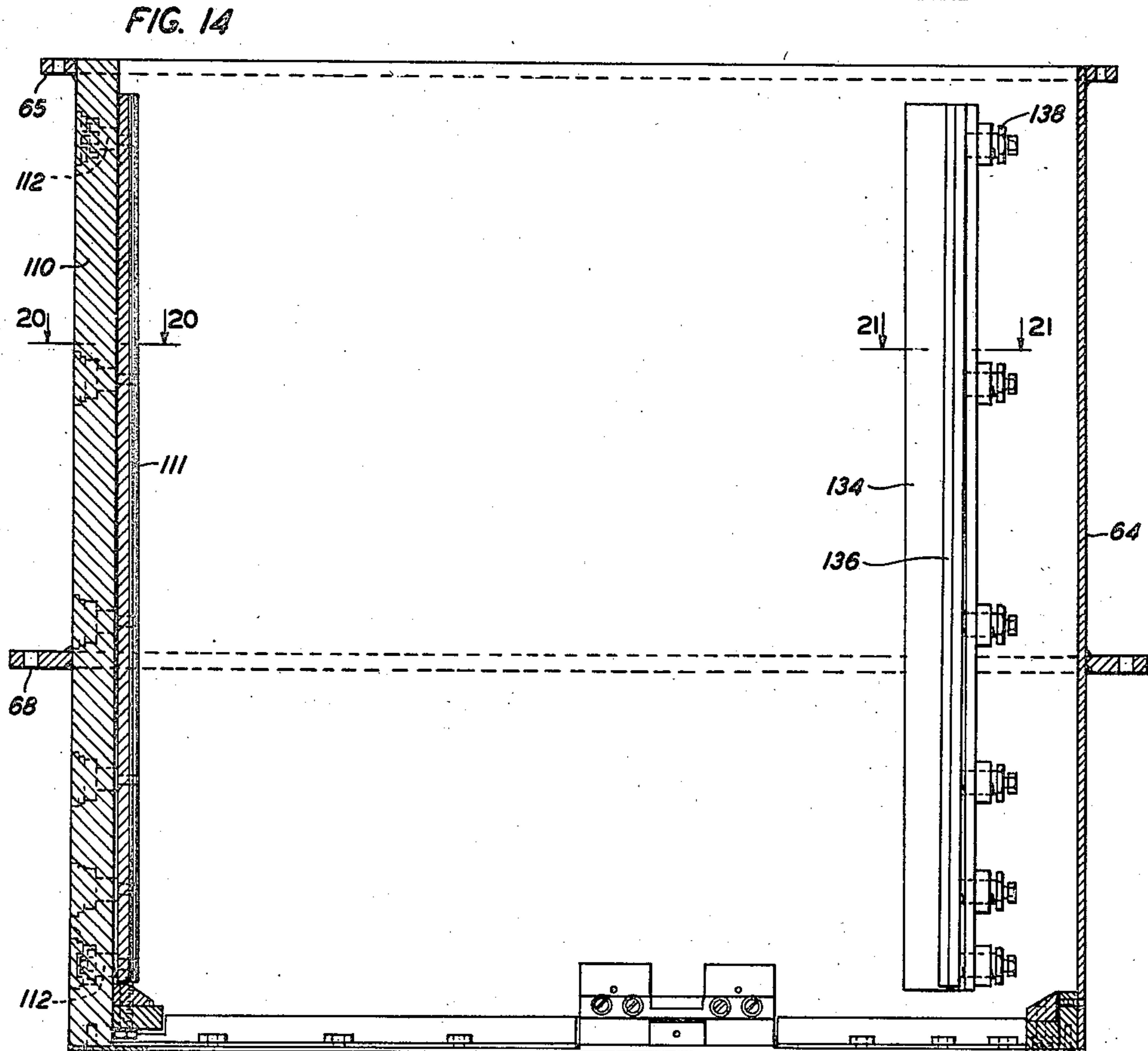
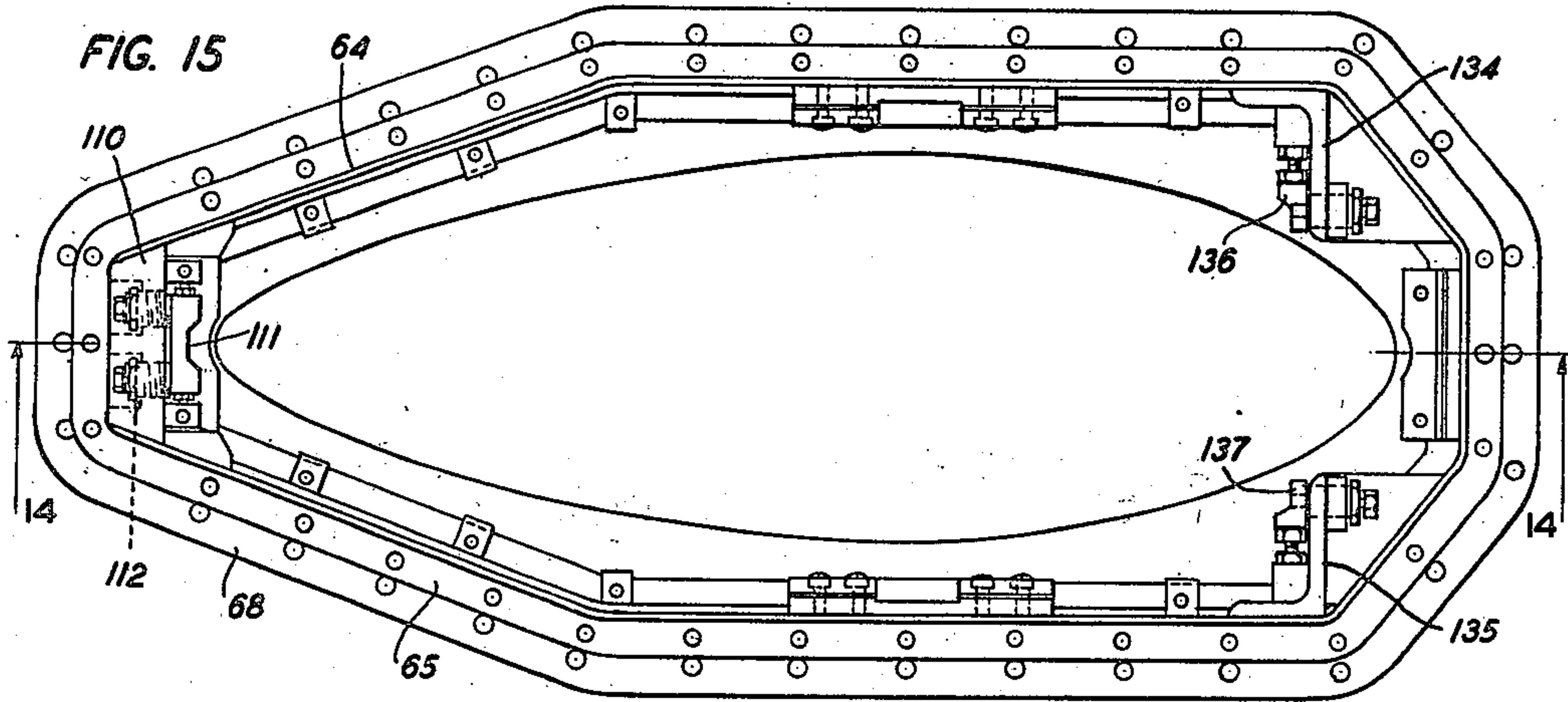


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C. C. BARBER  
BY P. J. Roche  
ATTORNEY

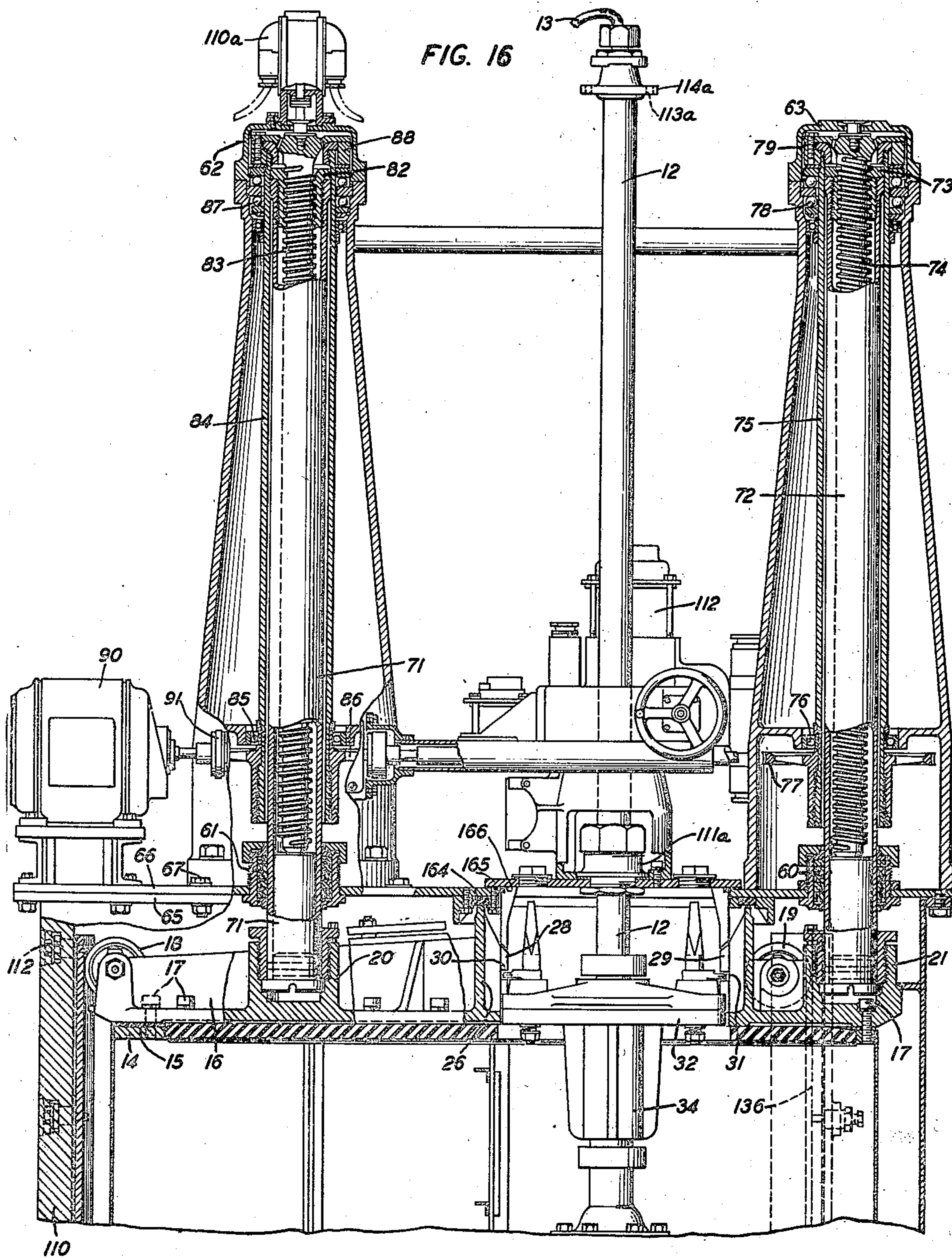


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INVENTOR  
C. C. BARBER  
BY  
P. J. Roche  
ATTORNEY



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FIG. 17

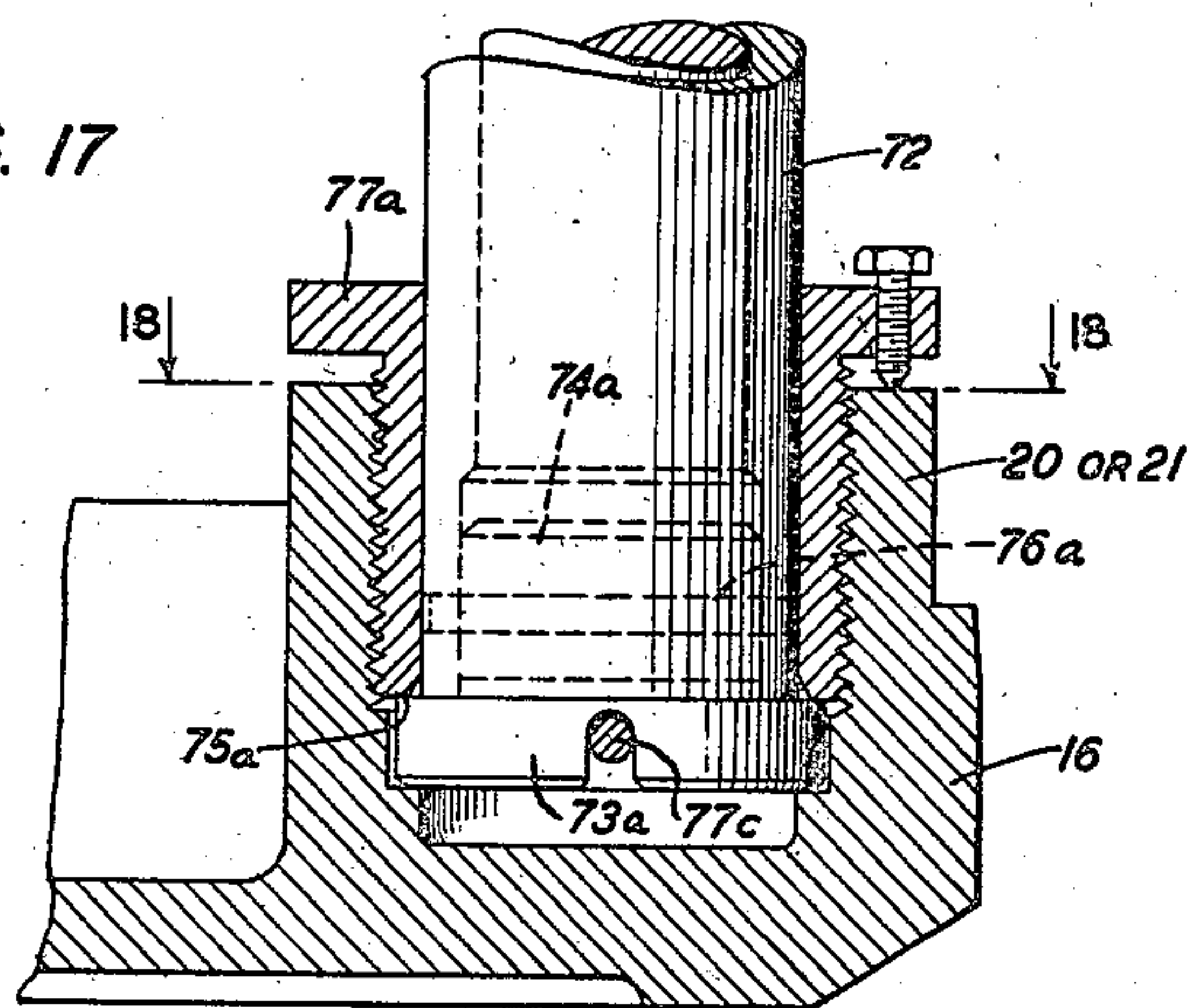


FIG. 18

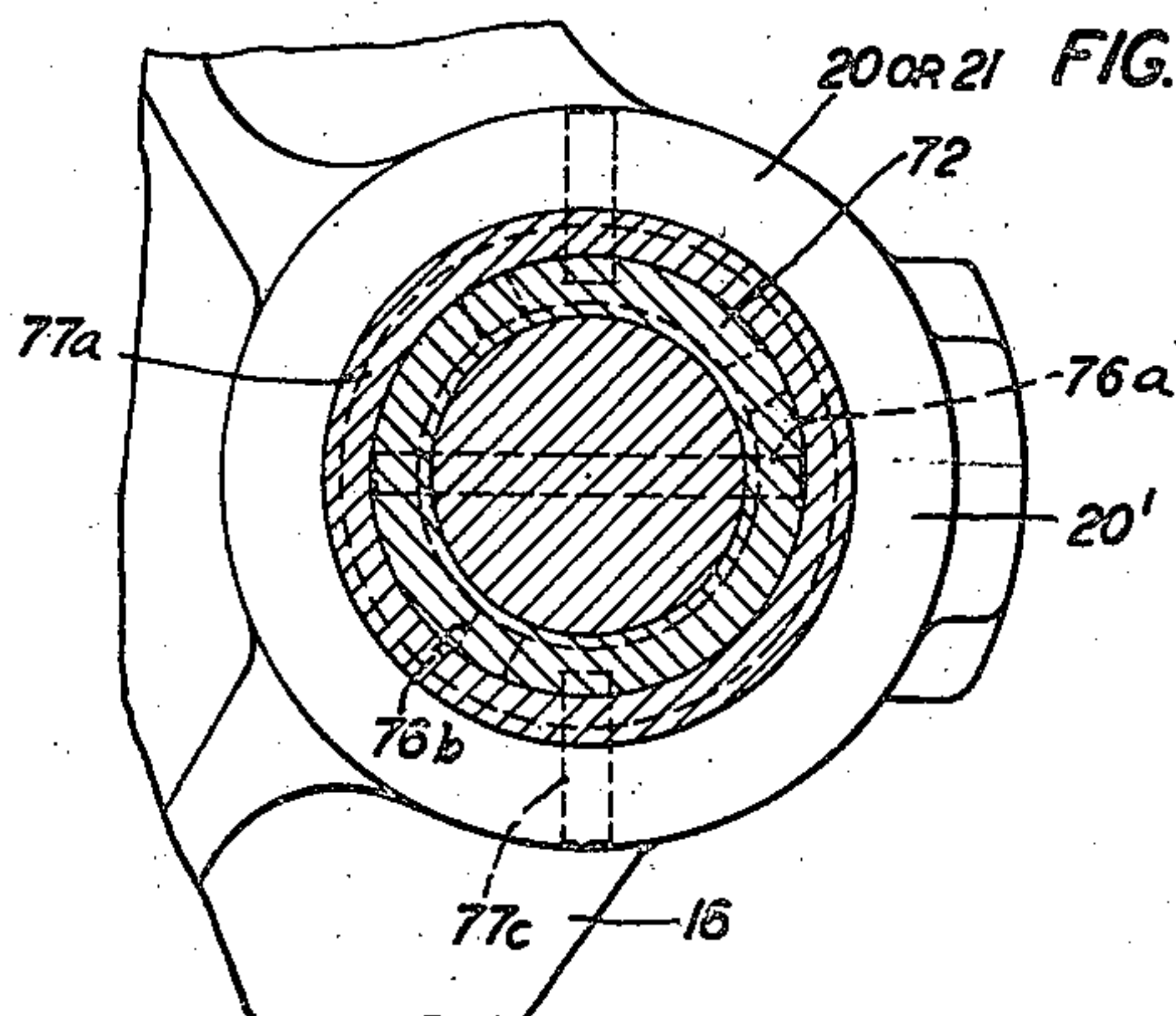
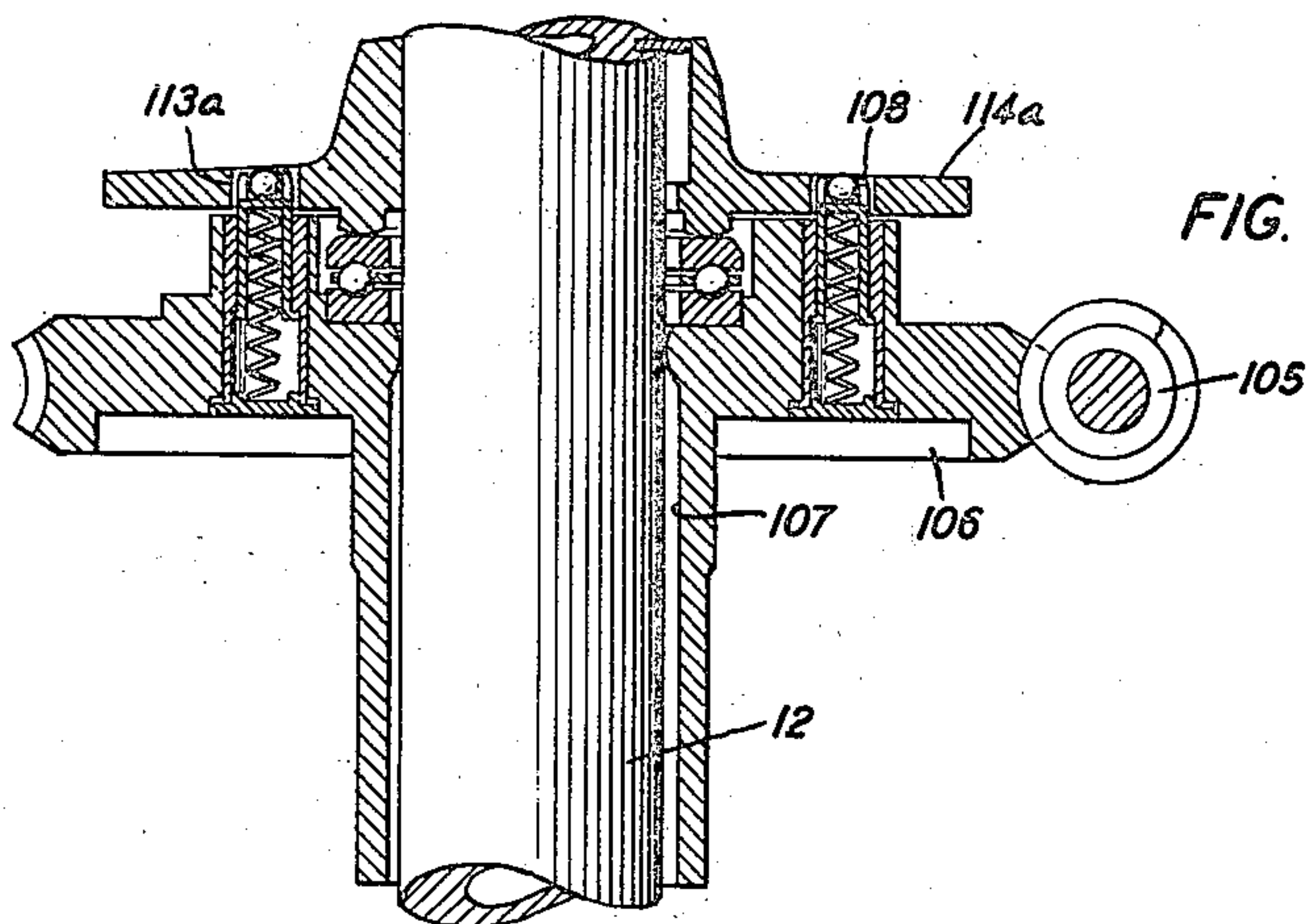


FIG. 24



INVENTOR  
C. C. BARBER  
BY P. J. Roche  
ATTORNEY



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FIG. 19

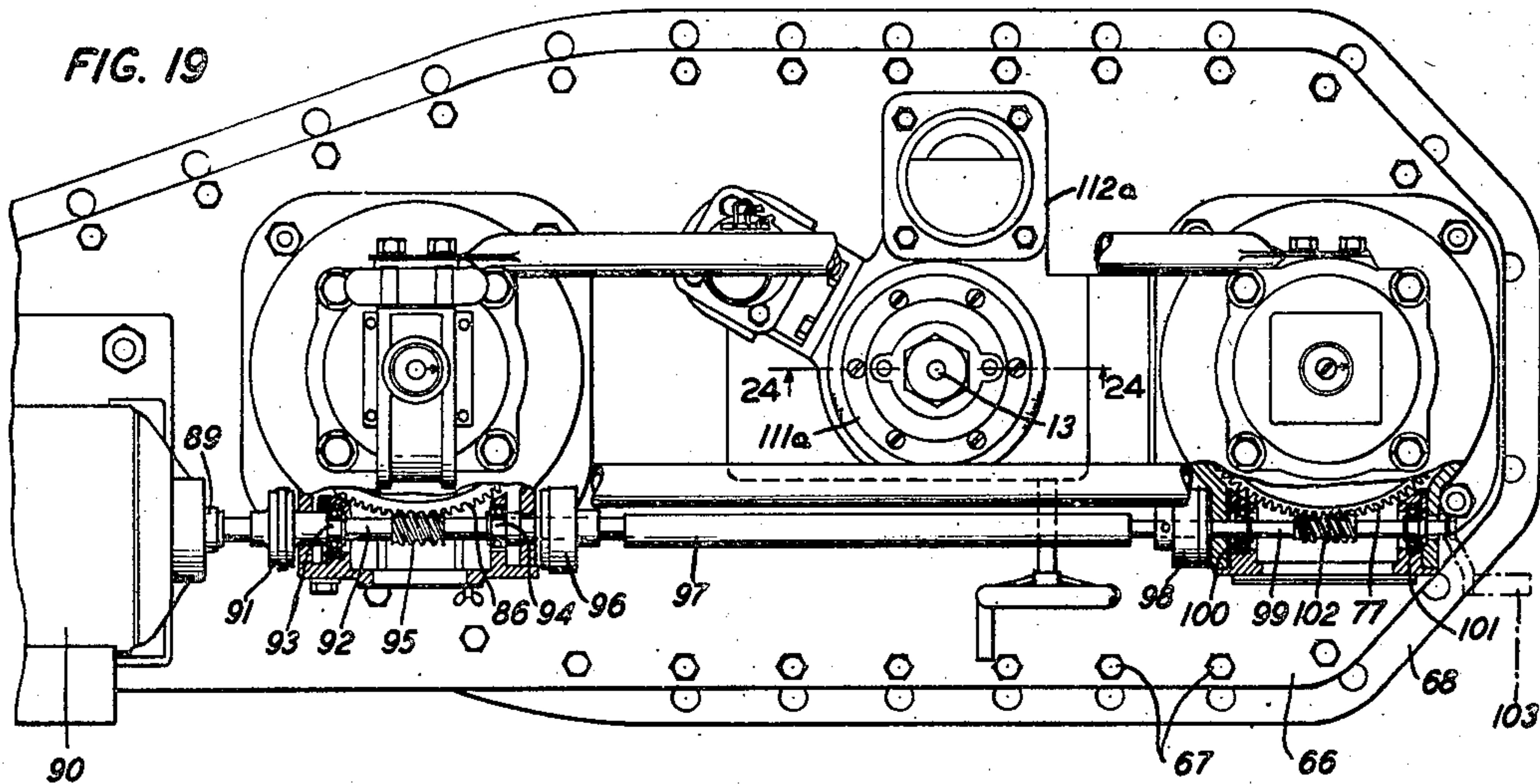


FIG. 20

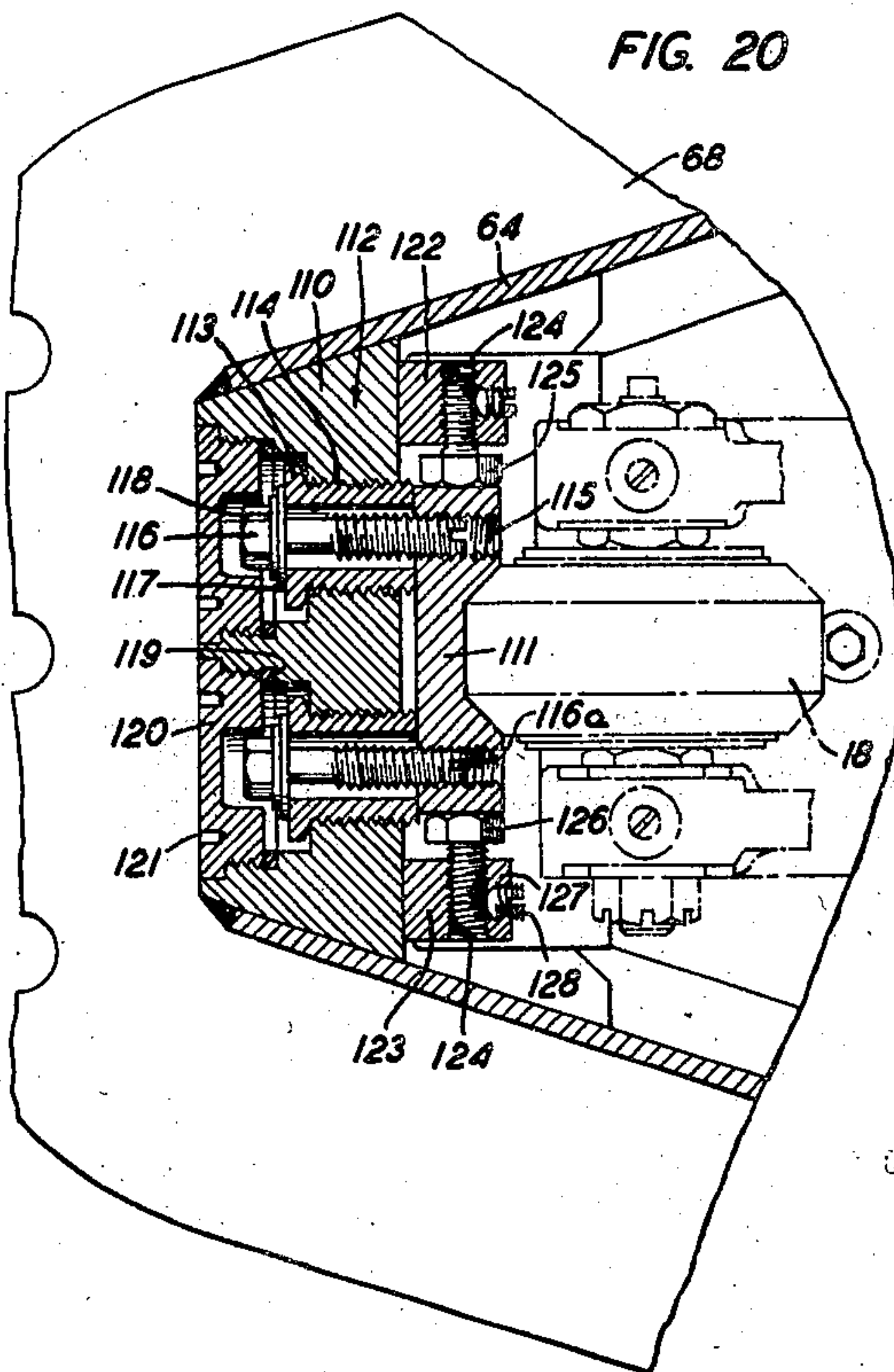
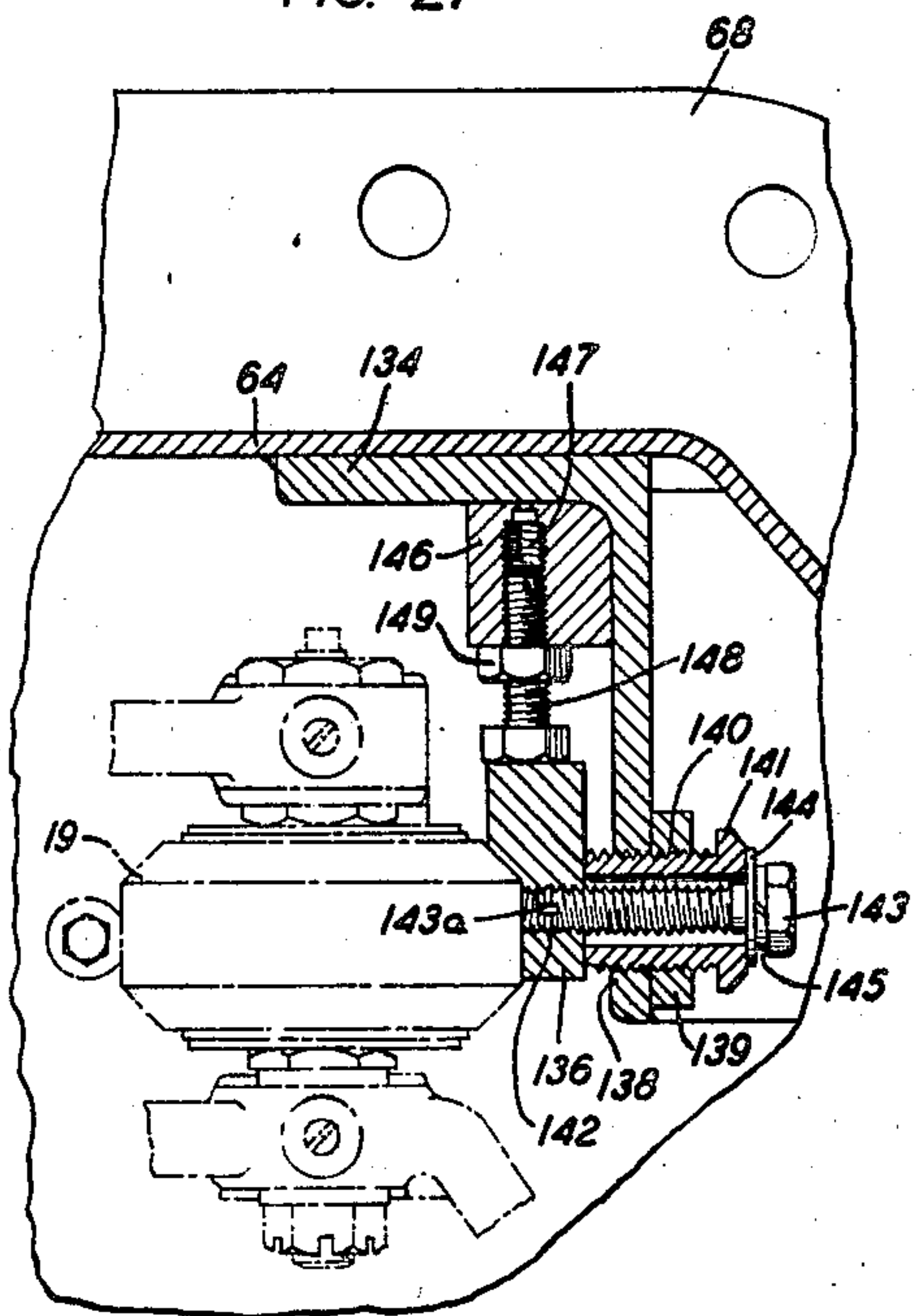


FIG. 21



INVENTOR  
C. C. BARBER  
BY  
P. J. Roche  
ATTORNEY



## UNITED STATES PATENT OFFICE

2,407,240

## PROJECTING AND RETRACTING MECHANISM FOR UNDERWATER SIGNAL SOURCES

Charles C. Barber, Rockville Centre, N. Y., assignor to Bell Telephone Laboratories, Incorporated, New York, N. Y., a corporation of New York

Application December 18, 1943, Serial No. 514,778

13 Claims. (Cl. 116—27)

1

This invention relates to submarine sound translating apparatus, and more particularly to a mechanism for mounting the sound translating apparatus on a ship's keel such that the sound translating apparatus may be projected from the ship into the sea water for locating objects submerged therein and such that the sound translating apparatus may be retracted from the sea water into the ship.

Under-water sound systems used on ships are known for simultaneously indicating the direction and distance of submerged objects such as wrecks, floating mines, icebergs, submarines, shore line, and the like. In addition, under-water telephone and telegraph systems are known for communicating between ships via the sea water as the transmitting medium. Such under-water systems employ sound translating apparatus which may be automatically projected from the ship into the sea water through a suitable opening provided in the bottom of the ship when the under-water sound system is arranged for operation, and which may be automatically retracted from the sea water into the ship when the under-water sound system is shut down. This projection and retraction of the sound apparatus requires a mechanism which is capable of expeditious operation so as to avoid undue time delay, particularly in an emergency.

One type of mechanism used heretofore was designed such that cooperating parts were machined to fit, after certain parts were welded into position. As the mechanism was relatively large in size, such machining required special cutting devices together with highly skilled operators therefor. As tolerances were extremely small, rejections were high unless a high degree of care was exercised by the operators. In the event the mechanism became fouled for any reason, such as exposure to an explosive discharge, scraping a sandbar, striking a submerged log or the like, it was found difficult, and in some cases impossible, to operate the mechanism thereby causing the sound apparatus to remain in a fixed position. To render the mechanism operative after such fouling, it was necessary to send the ship to drydock. The present invention is concerned with a mechanism adapted for lowering the sound translating apparatus of a ship's under-water sound system from the ship into the sea water and retracting the sound translating apparatus therefrom into the ship, and designed to obviate precision machining operations, permit replacement of parts, and com-

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pensate for irregularities in the size of the replacement parts.

The present invention contemplates a mechanism arranged to project sound translating apparatus into the sea water and to retract it therefrom and capable of assembly into an operative condition by means of parts adjustably fitted together.

The main object of the invention is to provide a mechanism for expeditiously lowering a ship's sound translating apparatus into the sea water, and retracting it therefrom.

Another object is to provide a lowering and raising mechanism embodying adjustable parts.

A further object is to provide a raising and lowering mechanism embodying compensation for irregularities in the size of replacement parts.

In a known type of under-water sound system for a ship having an opening in its keel and including a sound translating device for projection into the sea water and retraction therefrom through the keel opening, a housing having an opening at one end is secured to the keel such that the housing opening aligns with the keel opening. Positioned interiorly of the housing for lowering and raising movements therein is a support carrying the sound apparatus. A motor mounted on the top of the housing is arranged to lower and raise the support and thereby to project the sound apparatus into the sea water, and to retract it therefrom.

In a specific embodiment, the invention provides an adjustable arrangement for controlling the position of the sound-apparatus support relative to the interior of the housing during its raising and lowering movements, and comprises three individual rails mounted vertically in spaced relation on the interior surface of the housing and adapted individually for adjustment in forward, aft, port, starboard and rotary directions; three rollers mounted in spaced relation on the sound apparatus support such that each roller engages one rail and such that individual rollers are adapted for adjustment in directions corresponding to those in which the rails are adjustable. Thus, in effect, the rails and associated rollers constitute a three-point suspension for the sound-apparatus support interiorly of the housing such that the force of the engagement between each rail and associated roller varies as the support is lowered from its uppermost position to its lowermost position, and vice versa; such force being substantially a maximum when the support attains its lowermost position at which the sound apparatus is fully projected



into the sea water, and being substantially a minimum when the support attains its uppermost position at which the sound apparatus is substantially entirely retracted from the sea water.

Features of the invention are: (1) compensates for dimensional variations of component parts; (2) obviates need for special machines for precision milling of tracks in their relative locations interiorly of the housing so as to accommodate readily the associated rollers on the sound-apparatus support; (3) speeds up manufacturing as precise milling operations are avoided; (4) virtually prevents junking due to violations of tolerances in dimensional variations; (5) avoids welding of carbon steel to stainless steel; (6) allows relatively greater welding tolerances; (7) permits replacement of individual rails and rollers; (8) and provides firm structure to withstand forces exerted by the sea water acting on the dome enclosing the sound apparatus, when in its lowermost position, during the forward motion of the ship; as well as the forces acting on such dome, when in its lowermost position during the turning motion of the ship, all of which forces vary with the speed of the ship.

The invention will be readily understood from the following description taken together with the accompanying drawings in which:

Fig. 1 is a perspective view of a ship showing the location of its sound room, and the projection of the sound translating apparatus into the sea water substantially to its full extent;

Figs. 2 and 3 are cross-sectional views taken along the line 2—2 of Fig. 1 and showing the assembly of the raising and lowering mechanism for the sound apparatus, and the sound apparatus fully projected into the sea water and entirely retracted therefrom, respectively;

Fig. 4 is a side elevational view taken along the line 4—4 of Fig. 2;

Fig. 5 is a plan view taken along the line 5—5 of Fig. 4 and showing the streamline of the lower portion of the dome;

Fig. 6 is an enlarged view of Fig. 4;

Fig. 7 is an end view taken along the lines 7—7 of Fig. 6;

Fig. 8 is a plan view of the raft shown in Figs. 6, 7, 9 and 16, including the annular member which serves as a sealing crown;

Fig. 9 is an enlarged view of a fragment of Fig. 6 showing the raft positioned substantially in its lowermost position;

Fig. 10 is a partial elevational view taken along the lines 10—10 of Fig. 8, and showing the annular sealing crown;

Fig. 11 is a plan view taken along the lines 11—11 of Fig. 6;

Fig. 12 is a partial cross-sectional view taken along the lines 12—12 of Fig. 13 and shows the steady bracket mounted on the raft as shown in Figs. 6, 11 and 16;

Fig. 13 is a plan view of the steady bracket taken along lines 13—13 of Fig. 12;

Fig. 14 is a cross-sectional view of the housing taken along lines 14—14 of Fig. 15;

Fig. 15 is a plan view of the housing taken along the lines 15—15 in Fig. 6, with the raft and associated parts removed;

Fig. 16 is an enlarged cross-sectional view of the upper portion of Fig. 6 showing the raft and the mechanism for effecting the lowering and raising thereof, including the raft positioned substantially in its uppermost position;

Fig. 17 is an enlarged cross-sectional view

showing the arrangement for attaching of individual lifting tubes to the raft as illustrated in Figs. 9 and 16;

Fig. 18 is a plan view taken along the lines 18—18 of Fig. 17;

Fig. 19 is a plan view taken along the lines 19—19 of Fig. 6 and showing the drive for actuating the mechanism for lowering and raising the raft as shown in Fig. 16;

Fig. 20 is an enlarged fragmentary view of Fig. 11, showing the assembly of the left-hand rail together with the roller in engagement therewith;

Fig. 21 is an enlarged fragmentary view of Fig. 11 showing the assembly of the upper of the two right-hand rails together with the roller in engagement therewith;

Fig. 22 is a cross-sectional view taken along the lines 22—22 of Fig. 8;

Fig. 23 is a partial elevational view taken along the lines 23—23 in Fig. 8; and

Fig. 24 is a partial cross-sectional view taken along the lines 24—24 in Fig. 19, showing the suspension and connection of the shaft carrying the sound device to its driving mechanism.

In the following description the same reference numerals are employed to identify the same elements appearing in the several figures of the drawings.

Referring to the drawings, the submarine sound translating apparatus shown in Figs. 1, 2, 3 and 4 comprises a streamlined dome 10, Figs. 5, 6, 7 and 9 within which is positioned a quartz-crystal sound translating device 11 attached to the lowermost end of a hollow vertical shaft 12. This shaft is driven to rotate the sound apparatus and thereby to train it on objects submerged in sea water in a manner that will be subsequently mentioned. The electrical conductors for connecting the sound device with a suitable sound detecting device, not shown, are embodied in electrical cable 13 extending through the interior of the shaft 12. A more complete description of the dome and sound translating device may be had by referring to the copending application of A. C. Keller, Serial No. 493,177, filed July 2, 1943.

The submarine sound translating apparatus is located in a compartment 9 located at the bottom of and forward of the ship, Figs. 1, 2, 3 and 4. Such location tends to minimize interference from noise effects generated by the ship's propeller. When the sound translating apparatus is fully projected to its working position, the lowermost surface of the dome is approximately 44 inches below the under surface of the ship's keel, Figs. 2, 4 and 6. When the sound translating apparatus is fully retracted to its non-working position, the lowermost surface of the dome is substantially flush with the under face of the ship's keel, Fig. 3.

Referring to Figs. 8, 9 and 16, the uppermost portion of the dome carries a peripheral member 14 and a gasket 15 whereby the dome is attached to the under surface of a raft 16 by a plurality of machine screws 17. The gasket 15 tends to render the interior of the dome substantially free from sea water. The raft is substantially streamlined, and is provided with a roller 18 positioned at the left-hand or aft end of its horizontal axis, and a pair of spaced rollers 19, 19 disposed on an axis which is normal to the right-hand or forward end of its horizontal axis. Also, on the horizontal axis of the raft in proximity of its left-hand end is formed an integral tubular member 20 provided with an internal thread, and on the same axis at its extreme right-hand end is a



similar integral tubular member 21 provided with an internal thread.

In proximity of the right-hand end of the raft but to the left of the transverse axis of the rollers 19, 19 is positioned an integral annular member 26, Figs. 8 and 10, which is opened at its uppermost end and which serves as a sealing crown in a manner that will be hereinafter pointed out. At the lowermost end of this annular member are two pairs of oppositely disposed projections 27, 27 formed integral with the raft for partially enabling the attachment of the dome to the under surface of the raft as previously mentioned. Integral with the inner surface of the annular member 26 are two pairs of spaced projections 28, 28 and 29, 29 which are oppositely disposed along the horizontal axis of the raft, Figs. 8 and 10. Intermediate each of these pairs of projections are the respective openings 30 and 31. The functions of these projections and openings will now be described.

Positioned interiorly of the annular member 26, Figs. 9, 11 and 16, is a steady bracket 32, Figs. 12 and 13, which is rigidly fastened to the raft in a manner that will be presently pointed out. Referring to both latter figures, the steady bracket comprises an elongated tubular member 34 at the opposite ends of which are disposed integral metallic bearings 35 and 36 whose functions will be subsequently identified. Extending on diametrically opposite portions of the tubular member 34 and integral therewith is a pair of transverse extensions 35a of which the ends are individually provided with an opening 36a. Located in the opening 36a on the end of the left-hand extension 35a is a bushing 37 which has positioned therebelow in alignment therewith a further bushing 39. Disposed on the bushing 39 adjacent the under surface of the raft is the upper surface of an acoustic pad 40 whose lower surface engages the upper surface of a retaining plate 41.

Positioned in each vertically aligned pair of bushings 37 and 39 is an axle portion 45 of elongated locking member 46 whose integral uppermost end comprises a tapered rectangular portion 47 and a toe 48. Disposed in sequence on the lowermost end of the axle portion 45 is a washer 49 engaging the retaining plate 41, a coiled spring 50, a further washer 51, a nut 52 and a cotter pin 53. A plurality of screws 33 aid in further securing the acoustic pad to the under surface of the raft. Located on diametrically opposite sides of the locking member 46 are a pair of stop pins 54 and 55. From the structure just described it is clear that the locking member 46 may be rotated in a clockwise direction by placing a suitable wrench, not shown, onto the rectangular portion 47 and actuating the wrench in the clockwise direction, Fig. 13. This serves to rotate the locking toe 48 until it engages the stop pin 54. Now, the locking toe is disposed in its locking position, as indicated by the dot-dash line. A counter-clockwise actuation of the wrench will cause a corresponding rotation of this locking toe until it engages the stop pin 55. Now, the locking toe is disposed in the non-locking position as shown by the unbroken line. Locking toe 56 on the right-hand locking member 57 is actuated between locking pins 58 and 59 for disposal in the non-locking and locking positions which are indicated by the broken and dot-dash lines, respectively, in Fig. 13. It is understood that the right-hand locking member 57 is mounted in the right-hand extension 35a in a manner similar to that

used for the left-hand locking member 47 as above described.

As the steady bracket is now positioned in the annular member 26 as previously pointed out, it is understood that the steady bracket may be firmly locked therein by individually actuating both locking toes 48 and 56 to their respective locking positions in the manner hereinbefore mentioned. This means that both locking toes 48 and 56 are disposed in the openings 30 and 31, Fig. 10, and occupy the positions indicated by the dot-dash lines in Fig. 13.

As shown in Fig. 11, a housing 64 substantially encloses the raft and streamlined dome attached to the under surface thereof when the latter, including the sound device, is fully retracted to its non-working position as indicated in Figs. 3 and 16; and serves to guide the raft as it is actuated to move the sound device and dome from the non-working position to the working position as represented in Figs. 2 and 6, and vice versa. Referring to Figs. 6, 14 and 15, the housing 64 embodies an upper peripheral flange 65 which is attached to a cover 66 by a plurality of suitable bolts 67. Immediately below the horizontal center of the housing 64 is a further peripheral flange 68 which is suitably secured to the ship's structure 69 in the sound room shown in Figs. 2, 3, 4 and 6. A gasket 70 is interposed between the flange 68 and the ship's structure so that the sound compartment is rendered substantially water-tight with reference to the sea water.

A lifting tube 71 is positioned in the tubular member 20 of the raft, and a lifting tube 72 in the tubular member 21, Figs. 8, 9, 11 and 16. The lower end of each of these tubes is rigidly secured to the raft as shown in Figs. 17 and 18. Referring to both latter figures, an annular plug 73a comprises a portion 74a inserted internally of the lower end of each lifting tube and a shoulder portion 75a disposed in the particular tubular member 20 or 21 of the raft. A transverse pin 76a and a plurality of welded fillets 76b serve to secure firmly the engagement between the plug portion 74a and the lifting tube. A threaded bushing 77a is positioned in the tubular member of the raft so that the lowermost portion of this bushing engages the upper surface of the shoulder 75a on the plug 73a. A pair of key pins 77c integral with the individual tubular members 20 and 21, Fig. 8, prevent the respective lifting tubes from turning.

Referring to Fig. 16, a left-thread pillar assembly 63 mounted on the cover 66 comprises a left-hand lifting nut 73 suitably secured internally of the upper end of the lifting tube 72 whose lower end passes through a suitable stuffing box 60 provided in the cover 66. This nut is provided with an internal left-hand worm thread to accommodate the left-hand thread on the lifting screw 74 which is positioned internally of the lifting tube 72. Disposed externally of the lifting tube 72 is a hollow driving shaft 75 having its lowered end mounted in a suitable bearing 76 and keyed to a left-hand worm wheel 77. The upper end of the driving shaft 75 is mounted in a suitable bearing 78, and keyed to a suitable mechanism 79 for coupling the upper end of this driving shaft to the upper end of the lifting screw 74 such that rotary movement of the driving shaft 75 is effectively transmitted to the lifting screw 74.

Referring to Fig. 16, a right-thread pillar assembly 62 mounted on the cover 66 comprises a right-hand lifting nut 82 suitably secured inter-



nally of the upper end of the lifting tube 71 which passes through a suitable stuffing box 61 provided in the cover 66. This nut is formed with an internal right-hand worm thread to accommodate the right-hand thread on lifting screw 83 which is positioned internally of the lifting tube 71. Disposed externally of the lifting tube 71 is a hollow driving shaft 84 having its lowered end mounted on a suitable bearing 85 and keyed to a right-hand worm wheel 86. The upper end of the driving shaft 84 is mounted in a suitable bearing 87, and keyed to a suitable mechanism 88 for coupling the upper end of this driving shaft to the upper end of the lifting screw 83 such that rotary movement of the driving shaft 84 is effectively transmitted to the lifting screw 83.

Referring to Figs. 16 and 19, motor 90 mounted on the cover 66 has its armature connected through coupling 91 to the left-hand end of a shaft 92 mounted intermediate its opposite ends on suitable bearings 93 and 94 and carrying a worm 95 meshing with the worm wheel 86. The right-hand end of the shaft 92 is extended through a coupling 96 to one end of a shaft 97 whose opposite end is joined by coupling 98 to one end of a shaft 99. This shaft is mounted intermediate its opposite ends on a pair of bearings 100 and 101, and carries a worm 102 meshing with the worm wheel 77. The extreme right end of the shaft 99 is adapted for use with a hand crank 103 shown in dot-dash lines. It is understood that the motor 90 serves to actuate the worm wheels 77 and 86 via the shaft structure just previously described; and further that the hand crank 103 is to be employed when the motor 90 is deenergized.

A limit switch 110a of suitable structure is mounted on the uppermost end of the right-thread pillar assembly 62, Fig. 16, in engagement with the lifting screw 83, and serves to control automatically the disconnection of electric power from the motor 90 when the raft has reached predetermined positions in its raising and lowering movements which will be hereinafter pointed out. Although not shown in detail in the drawings, it will be understood by those familiar with the art that the lifting screw 83 is adapted, under control of a preselected number of revolutions, to actuate individual sets of contacts in the limit switch whereby the aforementioned power disconnection is accomplished.

Referring to Fig. 12, bearings 35 and 36 on the steady bracket 32 serve to support the shaft 12 carrying the sound device 11 against lateral movement, except to the extent of a slight misalignment of the shaft 12. Such support is advantageous when the sound device is fully extended to its operating position, Fig. 6. A stuffing box 111a of suitable structure is mounted on the cover 66, Figs. 16 and 19, to permit the shaft 12 to pass therethrough in slidable fashion as the raft is lowered and raised in a manner which will be presently explained, and tends to keep the sea water from entering the sound compartment.

Also mounted on the cover 66 in proximity of the stuffing box 111a is a mechanism 112a, Figs. 16 and 19, for rotating the shaft 12 and thereby training the sound device 11 on objects submerged in the sea water in the familiar manner. Although not shown in detail in the drawings, this driving mechanism is a well-known structure and includes an electric motor, a shaft suitably connected to its armature and carrying a worm 105, Fig. 24, meshing with a worm wheel 106 having an axial opening 107 through which the shaft 12

may pass. On the upper surface of such worm wheel are disposed a plurality of spring-controlled vertical projections 108 which are accommodated in corresponding openings 113a provided in the lower surface of an annular plate 114a firmly fastened to the uppermost end of the shaft 12, Figs. 16 and 24. When these projections are seated in the openings, the rotary movement of the worm wheel is transmitted to the shaft and thereby to the sound apparatus 11. Although not shown in the drawings, the shaft is operatively connected to a suitable stop whereby the clockwise and counter-clockwise training of the sound device are limited to prevent damage to the cable 13.

In accordance with the present invention, an arrangement for guiding the movement of the raft for projecting the sound translating apparatus from its non-working position to its working position, and for retracting the sound translating apparatus from its working position to its non-working position, as the ship moves in the water, will now be explained. Referring to Figs. 14, 15 and 20, a staunch member 110 is vertically positioned at the extreme left-hand or aft end of the housing 64 so as to constitute substantially the left-hand wall thereof. Disposed interiorly of the housing 64 in alignment with the member 110 and spaced from the longitudinal edges thereof is a rail 111 which is attached at its top and bottom to the member 110 by a pair of adjustable supports 112. Each adjustable support 112 comprises a pair of exteriorly threaded bushings 113 positioned in a pair of horizontally spaced openings 114 formed with threads to accommodate the bushings and disposed oppositely to and in substantial alignment with a pair of horizontally spaced threaded openings 115 formed in the rail 111. In Fig. 20 it will be noticed that the right-hand end surfaces of the individual bushings 113 engage the left-hand or rear surface of the rail 111. Positioned in the opening of each bushing 113 aligned with its associated opening 115 is a screw 116 whose shank has an outside diameter which is substantially less than the diameter of the internal openings in individual bushing 113 for a purpose which will be hereinafter pointed out.

Underneath the head of the screw 116 in engagement with the left-hand surface of the bushing 113 is a washer 117; and interposed between the latter and the under face of the head of the screw 116 is a lock washer 118. A gasket 119 and plug 120 serve to render water-tight the outer end of individual openings 114. A plurality of recesses 121 located in the outer surface of plug 120 accommodate a suitable tool, not shown, whereby this plug may be inserted into and removed from the opening 114. Secured suitably to the surface of the member 110 located interiorly of the housing 64 and in substantial alignment with the openings 114 is a pair of spaced and aligned blocks 122 and 123, each of which embodies a threaded opening 124. In the opening 124 of block 122 is a screw 125 and in the opening 124 of block 123 is a screw 126, each of which screws is positioned such that its head engages a portion of the surface of the rail 111 opposite to that engaged by the other screw.

Referring to Figs. 14, 15 and 20, it is apparent that, relative to the ship, the rail 111 may be actuated in forward, aft, and effective rotary (that is, top in forward direction and bottom in aft direction, and vice versa) directions by suitable adjustment of proper individual bushings 113 and screws 116 in individual supports 112;



and the rail 111 may be actuated in port, starboard, and effective rotary (that is, top in port direction and bottom in starboard direction, and vice versa) directions by suitable adjustment of proper individual screws 125 and 126 in individual supports 112. Due to the difference in the diameters of the internal opening of the bushing 113 and the shank of the screw 116 as above specified, the rail 111 is rendered capable of such directional actuations. Obviously, the rail 111 may be actuated in any combination of such directions. In each of the blocks 122 and 123 is a threaded opening 127 disposed transversely to the opening 124 therein and provided with a set screw 128. These set screws serve to lock the respective screws 125 and 126 in position after the hereinbefore described adjustments of the rail 111 have been made for a purpose that will subsequently appear. A slot 116a in the end of each screw 116 enables staking to prevent its turning in the rail 111, after the screw 116 has been tightened in position.

Referring to Figs. 14, 15 and 21, angle irons 134 and 135 are oppositely disposed in vertical alignment in proximity of the right-hand end of the housing 64 such that the parallel legs of both angle irons are suitably attached to substantially opposite portions of the inner surface of the housing 64. Disposed in front of the left-hand face of the other leg of angle iron 134 is a rail 136, and in front of the left-hand face of the angle iron 135 is a rail 137. These rails are attached to the respective angle irons at a plurality of points by an adjustable support 138. Each adjustable support 138, Fig. 21, comprises a block 139 suitably secured to the rear face of the free leg of angle iron 134. In a threaded opening 140 formed in the combined angle iron 134 and block 139 is positioned an exteriorly threaded bushing 141 whose left-hand end surface engages the right-hand or rear surface of the rail 136. In the rail 136 at a point opposite to the bushing 141 and in alignment therewith is formed a threaded opening 142. Positioned in the aligned bushing 141 and opening 142 is a screw 143 whose shank has an outside diameter which is substantially less than the diameter of the internal opening of the bushing 141 for a purpose which will appear subsequently. Intermediate the right-hand end surface of the bushing 141 and the head of the screw 143 are a washer 144 and lock washer 145. A block 146 is suitably secured to both inner surfaces of the angle iron 134 at a point opposite to the opening 142 in the rail 136. A threaded opening 147 provided in this block accommodates a screw 148 whose head engages a portion of one surface of the rail 136. A lock nut 149 positioned on the screw 148 serves to lock the latter in position. A slot 143a in the end of each screw 143 enables staking to prevent its turning in the rail 136, after the screw 143 has been tightened in position.

Referring to Figs. 14, 15 and 21, it is apparent that, relative to the ship, the rail 136 may be actuated in forward, aft, and effective rotary (that is, top in forward direction and bottom in aft direction, and vice versa) directions by proper adjustment of the bushing 141 and screw 143 in individual supports 138; and the rail 136 may be actuated in port, starboard, and rotary (that is, top in starboard direction and bottom in port direction, and vice versa) directions by proper adjustment of the screw 143 in individual supports 138. Due to the difference in the diameters of the shank of the screw 143 and the internal

opening of the bushing 141 as above pointed out, the rail 136 is rendered capable of the movements just mentioned. Obviously, the rail 136 is also capable of any desired combination of such movements. As the rail 137 is mounted similarly to the track 136, it is understood that the rail 137 is also capable of adjustment in all directions aforeidentified with the rail 136.

In connection with Fig. 8, it has been hereinbefore explained that the raft carries a roller 18 at its left-hand end and a pair of rollers 19, 19 in proximity of its right-hand end. The roller 18 is mounted on a shaft 150, Fig. 22, extending between the two projections of an associated U-shaped support 151, Fig. 8. Each of rollers 19, 19 is mounted on a shaft 146 extending between a U-shaped support 147, Fig. 8, which shafts and U-shaped supports are substantially identical with the shaft 150 and U-shaped support 151, respectively. The mounting of the roller 18 on its associated shaft and U-shaped support will now be explained.

Referring to Fig. 22, a pair of externally threaded bushings 152 and 153 are oppositely disposed in the legs of the U-shaped support 151 such that the collars of the respective bushings are disposed toward each other and such that the shaft 150 is positioned therein. Intermediate these bushings on the shaft 150 is disposed an eccentric bushing 154 which is keyed to this shaft at 149. On the outer periphery of the eccentric bushing is positioned a ball bearing 155 carrying the roller 18. Intermediate the shoulder of each of the bushings 152 and 153 and one surface of the ball bearing is a shield 156. Near the lower end of the shaft 150 is a washer 157, a nut 158 held in place by a cotter pin 159 extending through a suitable opening in the lowermost end of the shaft 150.

Referring to Fig. 22, the upper end of the shaft 150 carries an integral head 160 whose periphery is formed with a plurality of scoops which are numbered from 1 to 12 as shown in Fig. 23 for a purpose that will be later explained. A set screw 161 is positioned in the U-shaped support 151 at a point directly beneath the screw head 160, and is accommodated in individual scoops thereof.

When the screw 161 is entirely removed from the U-shaped support 161 and the cotter pin is also detached from the shaft 150 to enable a loosening of the nut 158 thereon, the shaft 150 may be rotated in either a clockwise or counter-clockwise direction. Such rotation may be continued until a desired scoop in the screw head 160 is positioned directly above the screw 161 whereupon the latter is re-inserted into the U-shaped portion 151 together with a tightening of the nut 158 on the shaft 150 and replacement of the cotter pin 159 to lock the shaft 150 in the desired position. As a consequence, the eccentric bushing 154 has also been rotated in either a clockwise or counter-clockwise direction. The effect of such clockwise rotation is to move the roller 18 a predetermined distance in a forward direction relative to the raft and ship; while the effect of such counter-clockwise rotation is to move the roller 18 a predetermined distance in an aft direction relative to the raft and ship. Each of the scoops 1 through 12 represents a predetermined distance, and the effective distance depends on the number of scoops passing the screw 161. For example, in one illustration of Fig. 23, the roller 18 was adjustable from 0.001



to 0.010 inch, and locked in any one of twelve positions through such adjustable distance.

Also, it is apparent in Fig. 22 that the bushings 152 and 153 may be rotated in the respective legs of the U-shaped support 151 in such relative directions that the roller 18 may be caused to slide on its associated shaft 150 in either port or starboard directions relative to the raft and ship. As the individual rollers 19, 19 are mounted on the raft in a manner which is substantially identical with that of the roller 18, it is understood that the individual rollers 19 may be moved relative to the raft and ship in the directions just described for the roller 18. From the foregoing it is clear that when the rollers 18 and 19, 19 are moved in the port direction, the raft is effectively moved in the starboard direction relative to the ship; and when the rollers 18 and 19, 19 are moved in the starboard direction, the raft is effectively moved in the port direction relative to the ship.

Further, it is apparent in Fig. 22 that the bushings 152 and 153 associated with the roller 18 and similar bushings associated with individual rollers 19, 19 may be rotated in the legs of the respective U-shaped supports 147, 148 and 151, Fig. 8, in such relative directions that the roller 18 is caused to move in a port direction while both rollers 19, 19 are caused to move in a starboard direction to impart to the raft an effective counterclockwise rotation in a horizontal plane; or the roller 18 is caused to move in a starboard direction while both rollers 19, 19 are caused to move in a port direction to impart to the raft an effective clockwise rotation in a horizontal plane. The utility of such effective rotary movement of the raft will become clear later on.

In explaining the operation of the invention, which will be done presently, it will be assumed that the apparatus hereinbefore described is assembled in the ship's sound room such that the raft is so positioned interiorly of the trunk that the rollers 18 and 19, 19 engage the respective rails 111, 136 and 137; and such that the motor 90 through the pillar assemblies 62 and 63 actuates the lifting tubes 71 and 72, respectively, to lower the raft approximately to its lowermost limit as shown in Fig. 9 and to retract the raft approximately to its uppermost limit illustrated in Fig. 16. As the raft carries the sound translating apparatus as above described, it will be understood that such apparatus is also moved between its lowermost and uppermost limits. Consequently it is apparent that when the raft is in its uppermost position, the sound device 11 is also in its uppermost position. Hence, the sound device 11 may be removed for inspection from the dome by disconnecting the steady bracket from the raft in the manner hereinbefore pointed out, detaching plate 165 from the cover 66, Fig. 16, and lifting, through a suitable opening 166 formed in the cover 66, the steady bracket and the sound device 11, both of which are secured to the lower end of the shaft 12. In such case, the upper portion of the annular member 26 engages resilient member 164 for preventing sea water from entering the ship's sound compartment.

The operation of the invention is such that the position of the raft relative to the housing may be adjusted by adjusting individual rails 111, 136 and 137 and/or individual rollers 18, and 19, 19 as hereinbefore explained. Thus, relative to the trunk, the position of the raft may be adjusted in forward, aft, port, starboard, and rotary directions to compensate for any irregularities of

alignment between the housing and raft which irregularities may be occasioned during manufacture or the ship's tour at sea. In positioning the raft in the housing initially, the engagement between the individual rails and associated rollers is accomplished with varying amounts of force such that the effective force of such engagement is a maximum when the raft attains approximately its lowermost position for fully projecting the sound apparatus into the sea water in order that the dome will be rigidly supported to resist movement tending to be caused by the force of the sea water as the ship is propelled therein as hereinbefore mentioned and such that the effective force of such engagement decreases progressively as the raft is moved towards its uppermost position, and is substantially a minimum when the raft attains approximately its uppermost position for retracting the sound apparatus substantially entirely from the sea water. In the event any of the rails and/or rollers become fouled, the fouled parts may be replaced by adjustment of the proper elements hereinbefore mentioned. This will also serve to compensate for irregularities in the sizes of the replacement parts.

Although the invention is described in connection with three rails and associated rollers, it is not necessarily limited thereto, and may be used with one or more rails depending on individual installations.

What is claimed is:

1. In combination, in an under-water sound system, apparatus for mounting on a ship having an opening below its water line and for transmitting sound waves into the water and receiving sound waves from the water, a housing for said apparatus, said housing having an opening at one end and allowing said apparatus to move interiorly thereof such that said apparatus is capable of being lowered into the water through said one housing opening and of being retracted from the water through said one housing opening, said housing having said one end mounted on said ship at said ship's opening such that said housing opening aligns substantially with said ship opening and such that said housing projects interiorly of said ship, means positioned horizontally in the interior of said housing and capable of lowering and raising movements interiorly of said housing for supporting said apparatus in said housing and imparting corresponding lowering and raising movements to said apparatus, means for actuating said supporting means in said lowering and raising movements and thereby lowering said apparatus into the water and retracting said apparatus from the water respectively, and adjustable means interposed between said housing and said supporting means for maintaining the horizontal position of said supporting means in the interior of said housing.

2. The combination according to claim 1 in which said adjustable means comprises a plurality of elements positioned at each of at least three spaced points on said housing and supporting means and cooperating thereat for maintaining the horizontal position of said supporting means in the interior of said housing, certain of said elements at individual points being adjustable relative to others of said elements at the same points for effectively moving said supporting means to maintain the horizontal position of said last means in the interior of said housing.

3. The combination according to claim 1 in which said adjustable means comprises a pair of



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means positioned at each of a plurality of spaced points on said housing and supporting means and cooperating thereat for maintaining the horizontal position of said supporting means in the interior of said housing, at least one of said means of each of said pairs at one or more of said points being adjustable relative to the other of said means of the same pair at the same point for effectively moving said supporting means to maintain the horizontal position thereof in said housing.

4. The combination according to claim 1 in which said adjustable means comprises a pair of means positioned at each of a plurality of spaced points on both said housing and supporting means and cooperating thereat for maintaining the horizontal position of said supporting means in the interior of said housing, each means of said pair of means at individual points being adjustable relative to the other means of the same pair at the same points for effectively moving said supporting means in a port direction relative to said housing and ship and thereby maintaining the horizontal position of said supporting means in said housing.

5. The combination according to claim 1 in which said adjustable means comprises a pair of means positioned at each of a plurality of spaced points on both said housing and supporting means and cooperating thereat for maintaining the horizontal position of said supporting means in the interior of said housing, each means of said pair of means at individual points being adjustable relative to the other means of the same pair at the same points for effectively moving said supporting means in a starboard direction relative to said housing and ship and thereby maintaining the horizontal position of said supporting means in said housing.

6. The combination according to claim 1 in which said adjustable means comprises a pair of means positioned at each of a plurality of spaced points on both said housing and supporting means and cooperating thereat for maintaining the horizontal position of said supporting means in the interior of said housing, each means of said pair of means at individual points being adjustable relative to the other means of the same pair at the same points for effectively moving said supporting means in a forward direction relative to said housing and ship and thereby maintaining the horizontal position of said supporting means in said housing.

7. The combination according to claim 1 in which said adjustable means comprises a pair of means positioned at each of a plurality of spaced points on both said housing and supporting means and cooperating thereat for maintaining the horizontal position of said supporting means in the interior of said housing, each means of said pair of means at individual points being adjustable relative to the other means of the same pair at the same points for effectively moving said supporting means in an aft direction relative to said housing and ship and thereby maintaining the horizontal position of said supporting means in said housing.

8. The combination according to claim 1 in which said adjustable means comprises a pair of means positioned at each of a plurality of spaced points on both said housing and supporting means and cooperating thereat for maintaining the horizontal position of said supporting means in the interior of said housing, each means of said pair of means at individual points being

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adjustable relative to the other means of the same pair at the same points for moving said supporting means substantially in a rotary direction interiorly of said housing and thereby maintaining the horizontal position of said supporting means in said housing.

9. In combination, in an under-water sound system, apparatus for mounting on a ship having an opening beneath its water line and for transmitting sound waves into the water and receiving sound waves from the water, a housing having an opening at one end and allowing said apparatus to move interiorly thereof such that said apparatus may pass into and out of said housing, said housing being fixedly attached to said ship at said ship opening such that said housing opening aligns substantially with said ship opening and such that said housing projects interiorly of said ship, means positioned horizontally in the interior of said housing for supporting said apparatus and capable of raising and lowering movements for actuating said apparatus into and out of said housing, means for actuating said supporting means in the lowering and raising movements to project said apparatus into the water and to retract it therefrom, and adjustable means for maintaining said supporting means in the horizontal position and simultaneously therewith establishing engagement between said housing and supporting means with varying amounts of force at each of a plurality of spaced points on said housing and supporting means during the lowering and raising movements of said last means such that the effective force is substantially a maximum when said supporting means is lowered approximately to its lowermost position in said housing, at which position said apparatus is projected into the water substantially to its fullest extent, and such that the force of the engagement progressively decreases as said supporting means is raised towards its uppermost position, and is substantially a minimum when said supporting means is raised approximately to its uppermost position, at which position said apparatus is substantially entirely withdrawn from the water.

10. The combination according to claim 9 in which said adjustable means comprises at individual points a pair of elements, one of which is mounted on said housing and the other of which is mounted on said supporting means, each element of individual pairs being adjustable relative to the other element of the same pair at the same point for varying the force of the engagement between said housing and supporting means.

11. The combination according to claim 9 in which said adjustable means comprises at individual points a pair of elements, one of which is mounted on said housing and the other of which is mounted on said supporting means, said elements on said housing being adjustable relative to said elements on said supporting means for varying the force of the engagement between said housing and supporting means.

12. The combination according to claim 9 in which said adjustable means comprises at individual points a pair of elements, one of which is mounted on said housing and the other of which is mounted on said supporting means, said elements on said supporting means being adjustable relative to said elements on said housing for varying the force of the engagement between said housing and said supporting means.



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13. In an under-water sound system for a ship having an opening in its keel, including apparatus for transmitting sound waves into the water and receiving other sound waves from the water, means for lowering said apparatus into the water through said keel opening and retracting said apparatus from the water through said keel opening, comprising a housing for said apparatus, said housing having an opening at one end for allowing the passage of said apparatus from said housing into and out of said water, said housing being positioned on said ship at said ship opening so that said housing opening aligns substantially with said keel opening and so that said housing projects interiorly of said ship, means positioned longitudinally in the interior of said housing and capable of lowering and raising movement in said housing for supporting said apparatus and imparting such movement to said apparatus, means mounted on said housing for lowering and raising said supporting means so that said apparatus is lowered into the water and retracted from the water respectively, and adjustable means positioned at each of a plu-

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5 rality of spaced points on said housing and supporting means for maintaining said supporting means in the horizontal position by providing multipoint engagement between said supporting means and housing, comprising a plurality of individual rails positioned vertically in spaced relation on the interior surface of said housing, means for adjustably mounting individual rails on said housing such that individual rails are 10 capable of longitudinal, transverse and rotary movements relative to said housing, a plurality of rollers positioned in spaced relation on said supporting means such that each roller engages one of said rails, means for adjustably mounting each of said rollers on said supporting means 15 such that individual rollers are capable of longitudinal and transverse movements relative to said supporting means and such that said supporting means is capable of rotary movement relative to said housing, each rail and associated roller constituting one of said adjustable means 20 at each of said plurality of points.

CHARLES C. BARBER.