April 27, 1965 TSOY K. MOY 3,180,222

SIMPLIFIED SYSTEM TO CONTROL POST-LAUNCH FLOODING

Filed Sept. 24, 1962

3 Sheets-Sheet 1

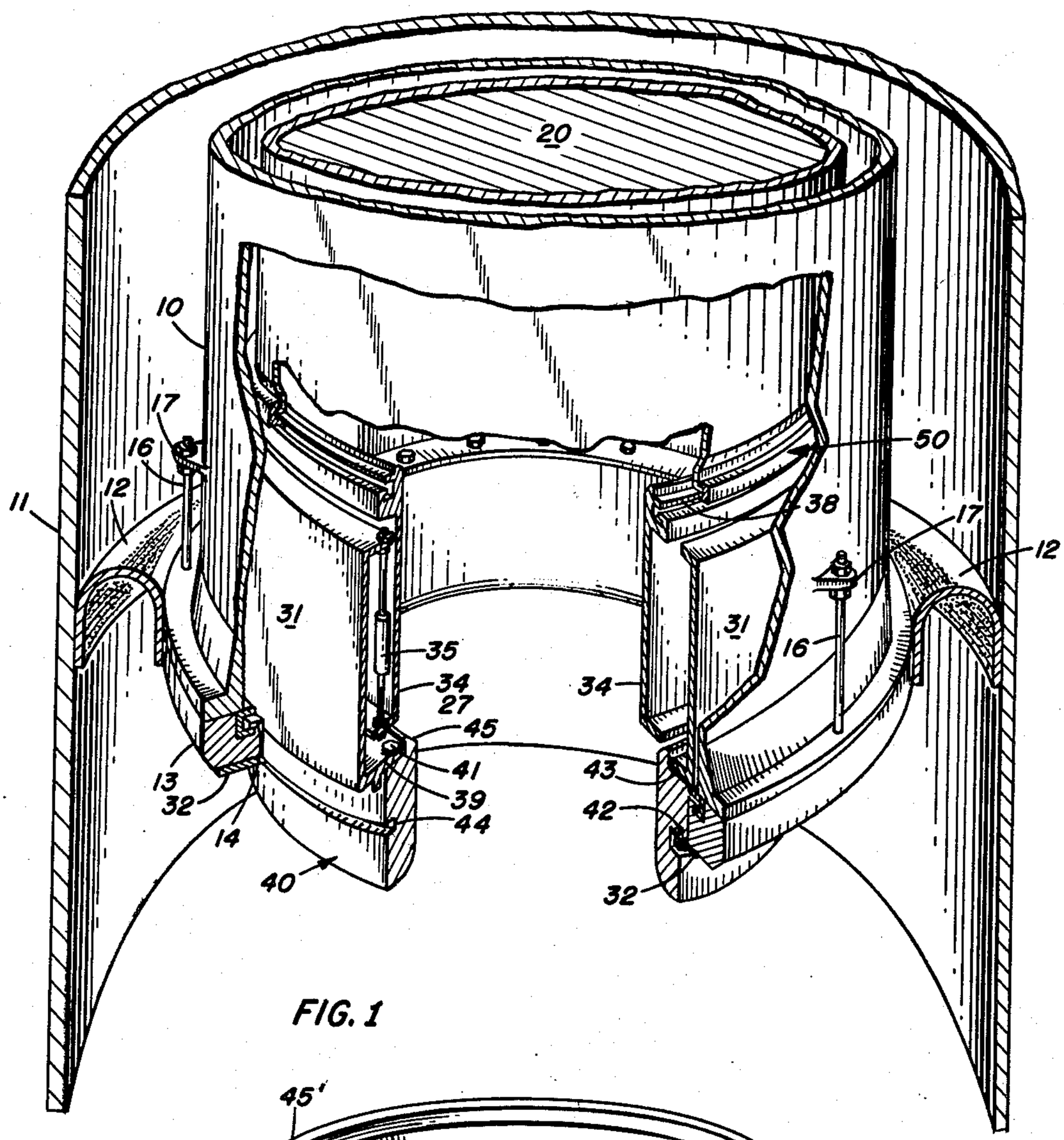

FIG. 1

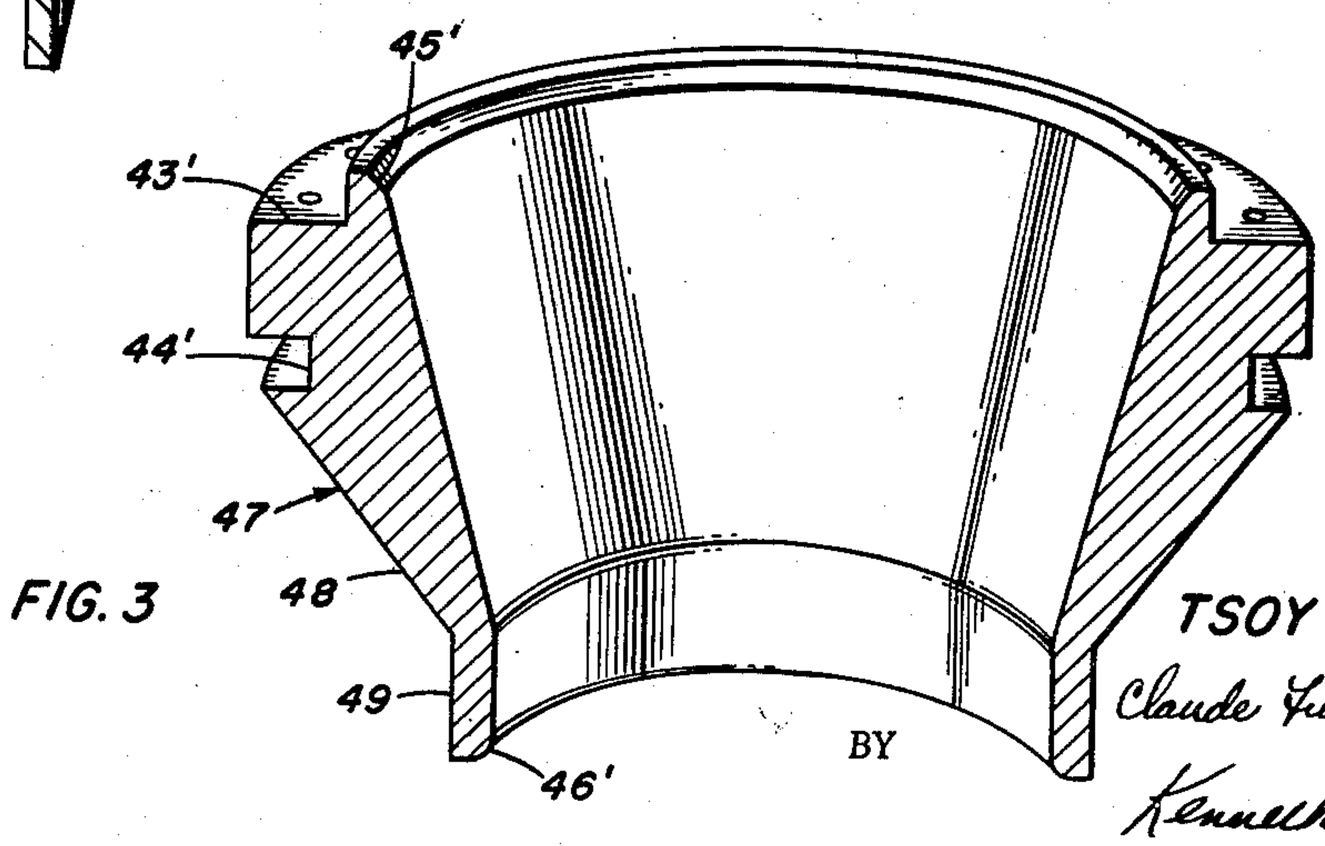

FIG. 3

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SIMPLIFIED SYSTEM TO CONTROL POST-LAUNCH FLOODING

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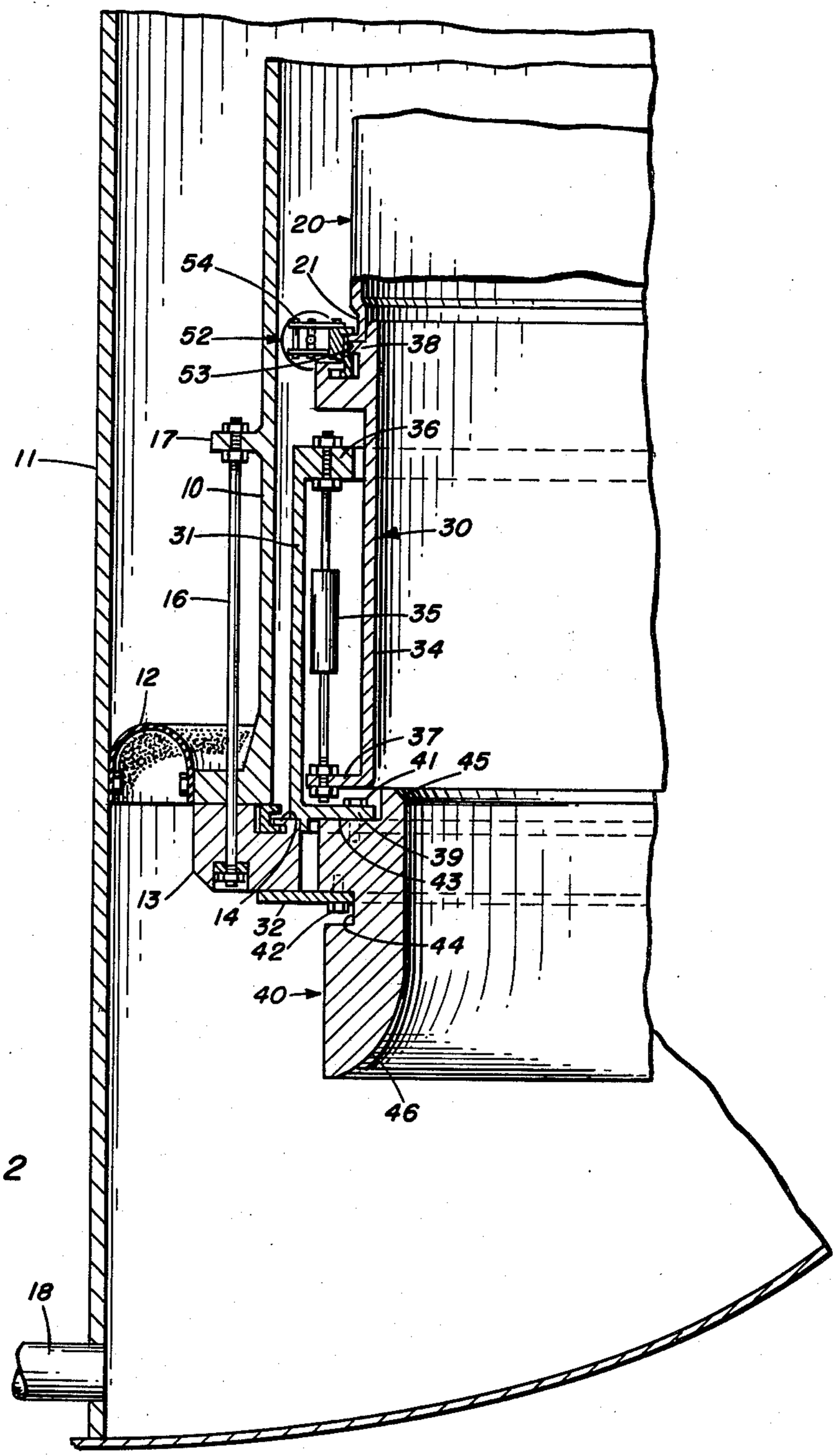

FIG. 2

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SIMPLIFIED SYSTEM TO CONTROL POST-LAUNCH FLOODING

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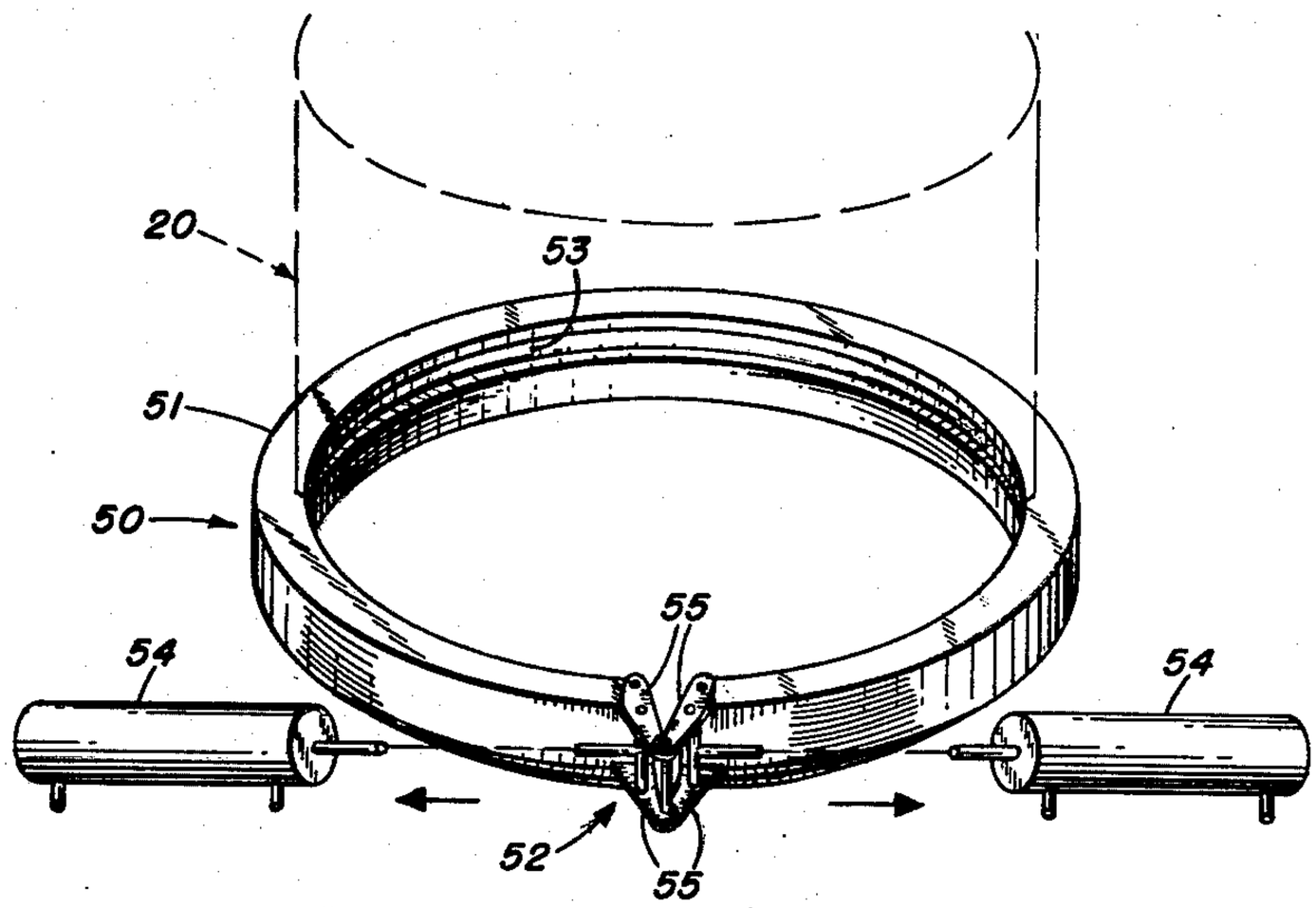

FIG. 4

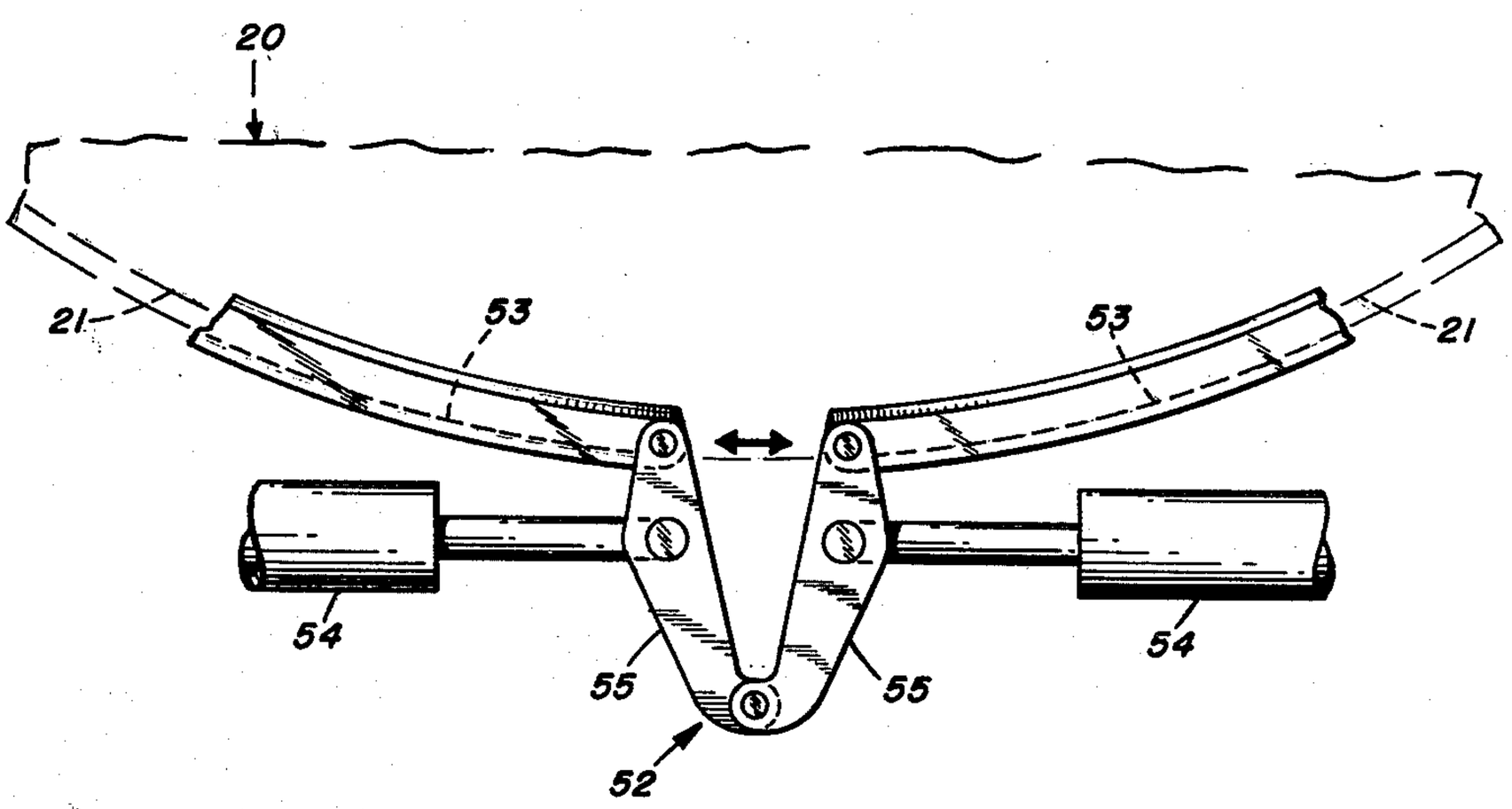

FIG. 5

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SIMPLIFIED SYSTEM TO CONTROL POST-LAUNCH FLOODING

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3 Claims. (Cl. 89—1.7)

This invention relates generally to missile launching systems and more particularly to the control of post-launch flooding of submerged launching tubes.

The launching of missiles from within submerged vessels or platforms presents the problem of controlling the stability of the vessels due to the variation in the weight-volume relationship of the vessel before and after missile launching. Immediate post-launch flooding of the container from which the missile was ejected has been viewed as a satisfactory solution to the problem if such flooding may be controlled to limit the weight of flooding water to that of the ejected missile. Lack of suitable control would permit the launch tubes to be rapidly filled with water thus causing a marked change in the buoyancy of the submerged vessel.

One solution to the problem of flooding control is a movable check valve within the launch tube as described in application Serial No. 165,050, entitled "Post Launch Flooding Control Apparatus," filed January 8, 1962 by Tsoy K. Moy, now U.S. Patent No. 3,100,421, and assigned to the United States Government. However, the requirement of an effective seal between the valve and the launch tube in addition to the requirement for locking means positioned at various locations along the tube for selectively holding the valve at predetermined levels prompted the desirability of a simple, stationary, foolproof control.

Accordingly, an object of the present invention is to provide a simple, economic apparatus for controlling the post-launch flooding of submerged missile launch tubes thereby maintaining a stable weight within the tube before and after launch, which apparatus may be easily installed and readily varied to accommodate missiles of varying sizes and weight.

Another object of the invention is to provide means for limiting the post-launch flooding to that amount equal in weight to any one of a variety of missiles selected for launching.

Other objects and many 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 in which like reference numerals designate like parts throughout the figures thereof and wherein:

FIG. 1 is a perspective view of a portion of a missile launching tube assembly with portions broken away;

FIG. 2 is a vertical sectional view of a portion of a missile launching tube assembly and a missile supported therein;

FIG. 3 is a perspective sectional view of another embodiment of the flex rod stool skirt;

FIG. 4 is a perspective view of the missile hold-down clamp; and

FIG. 5 is a plan view of a portion of the missile hold-down clamp showing the actuator.

A launching system embodying the present invention anticipates initially a launching capability of two types of missiles of different weights. Since the change of weight of the vessel after missile ejection, without flooding control, would vary depending upon whether a normal weight or light missile was launched, the operation of weight compensation in the vessel is complicated. The present

invention contemplates the creation of a cavity for trapping air within the launch tube thus reducing the amount of flooded water in the tube when a light weight missile has been ejected. By means of this arrangement, the weight of the flooded water is controlled and limited to approximately that of the ejected missile.

Referring to FIGS. 1 and 2 the missile launching tube **10** is supported within an outer tube **11** by any suitable means (not shown) and the space between the tubes is isolated by a bottom seal **12** and a top seal (not shown). Normally, the tubes are carried within the hull of a vessel, e.g., a submarine, in vertical orientation.

A missile support ring assembly **13** is centered beneath the launching tube **10** and is attached thereto by flexure rods **16** suspended from pads **17** welded to the lower outer surface of the launching tube. The flexure rods **16** suspend the support ring **13** in the manner of a pendulum so that when the missile **20** is subjected to a side load, flexing of the rods allows the missile to move laterally within limits imposed by storage/launching adapters (not shown) positioned between the missile **20** and the tube **10**. Bending stresses on the missile and missile skirt **21** are thus minimized. Vertical movement of the support ring, relative to the launching tube, is restrained. The support ring supports and holds down a normal weight and normal length missile in stowed position by clamping the missile skirt to the missile support flange **14** of the support ring.

A flex rod stool **30** may be used as a spacer between the missile support ring **13** and missile skirt **21** when a shorter missile **20** is to be launched. Such spacing is required to effect proper alignment of electrical and instrumentation cabling, umbilical connections and pneumatic lines from the launching tube to the missile.

The flex rod stool **30** comprises concentrically arranged inner and outer cylinders. The outer cylinder **31** rests on the support flange **14** of the missile support ring and is secured to the support ring by clamps **32** protruding from the stool skirt **40**. The inner cylinder **34**, to which the short missile is clamped, floats within the outer cylinder **31** on vertical flexure rods **35** suspended from the upper rim **36** of the outer cylinder. The lower ends of the flexure rods are secured to the bottom rim **37** of the inner cylinder. Under a side load, a missile is allowed the same pendulum-like lateral motion as are missiles that are clamped to the missile support ring **13**, thus minimizing the bending stresses on the missile and missile skirt.

A missile hold down clamp **50**, FIGS. 4 and 5, consisting of a clamp ring **51** and an actuator, locks the missile skirt **21** to the flex rod stool inner cylinder **34** when the hold down clamp is engaged. A support flange **38** is provided at the upper end of the inner cylinder in a manner similar to the flange **14** on the missile support ring **13**. The clamp ring **51**, a split-ring circular segment, is engaged by drawing the two ends together. When the clamp ring is engaged, a groove **53** on the inner face of the clamp ring mates with surfaces on the missile skirt and on the stool missile support flange, preventing vertical movement of the missile within the launching tube. The clamp structure is similar to that associated with the support ring **13** when normal missiles are used.

The actuator **52** contains two pneumatic or hydraulic cylinders **54** that control levers **55** attached to the two ends of the clamp ring. These levers are pivotally mounted to swing inwardly when the clamping ring is being engaged and outwardly when it is being retracted.

Associated with the clamp and stool are switches for indicating the condition of the clamp and for indicating the departure of the missile from the ring.

When the short, lighter weight missile is launched from the flex rod stool, it is necessary to provide means

for reducing the weight of water which floods the launch tube by an amount equal to the difference in weight between the normal and light-weight missiles. By so doing, the problem of weight compensation in the vessel is greatly simplified since the same compensation would be applicable after the firing of either of the above type missiles.

The instant invention accomplishes the reduction of post-launch flooding by the provision of a flex rod stool skirt 40 attached to an inwardly protruding flange 39 provided on the lower end of the flex rod stool outer cylinder 31. The skirt is formed in the shape of a hollow cylinder or funnel (FIG. 3) and, when secured to the flange by bolts 41, serves as an extension of the outer cylinder 31 below the missile support ring 13. As set forth hereinabove the stool and associated skirt are secured to the missile support ring by clamps 32 attached to the skirt by bolts 42 and extending outwardly therefrom in contact with the under surface of the missile support ring. The cylindrically-shaped skirt shown in FIGS. 1 and 2 has a generally straight-sided outer wall interrupted by an upper recess 43 for attaching the skirt to the outer cylinder and a lower recess 44 for receiving the clamps 32. The inner wall of the skirt is also a generally straight-sided wall having a beveled upper surface 45 and flaring outwardly at the bottom as at 46 to facilitate the flow of missile eject air from a source 18 through the skirt.

When the stool 30 is positioned on the support ring 13, the depending skirt 40 forms a cavity determined by the outer tube 11, seal 12, support ring assembly 13 and the skirt 40 within which missile eject air is trapped. The air so contained prevents post-launch flooding into the cavity thereby reducing the total weight of flooded water in the launch tube relative to flooding in the absence of the stool skirt. The size of the cavity and, therefore, the amount of post-launch flooding are substantially inversely proportional and may be readily varied by altering the height of the stool skirt.

The volume of the cavity may also be varied by providing a funnel-shaped skirt 47 having outside walls 48 generally tapering downwardly and inwardly thus creating a larger cavity. The skirt 47 is provided at its lower extremity with a straight sided portion 49 and with beveled and flared portions, 45′ and 46′, at the top and bottom to facilitate the flow of missile eject air. The skirt is further provided with recesses 43′ and 44′ for attachment to the outer cylinder flange 39 and clamps 32. Obviously, varying the vessel depth at which missiles are launched will cause a variation in the volume of the trapped air due to the changing pressure exerted on the air mass. However, tests have shown that such variation in volume of air and associated post-launch flooding, within the range of depths reasonably contemplated for missile launching, are insignificant insofar as vessel compensation is concerned.

Therefore, it will readily be seen that the inclusion of the flex rod stool and skirt accomplishes the objectives of controlling post-launch flooding, when different size missiles are to be ejected from a missile launch tube, in a simple, efficient and effective manner. While the invention has herein been disclosed by reference to the details of a specific embodiment, it is understood that such disclosure is intended in an illustrative, rather than limited sense, as it is contemplated that various modifications in the construction and arrangement of the parts will readily occur to those skilled in the art, within the spirit of the invention and the scope of the appended claims.

What is claimed is:

1. In a missile launching system having at least one vertically extending launching tube assembly comprising an outer tube, an inner tube mounted within said outer tube, means disposed between and sealing said tube, a missile support disposed within said inner tube in spaced relation with respect thereto, ring means carried by said inner tube for supporting said missile support in spaced relationship with respect to the inner tube, an annular member secured to said support and cooperating with the outer tube, ring means and sealing means to provide a cavity for entrapping gas in the lower region of said tubes upon post launch flooding of said tube assembly thereby to control the amount of post launch flooding in such a manner that the weight represented by post launch flooding equals the weight of a launched missile, said missile support comprising an outer cylinder and an inner cylinder concentrically arranged therewithin, said outer cylinder having at its lower end, an inwardly directed flange and at the upper end thereof an additional inwardly directed flange, means securing said annular member to said lower flange, said inner cylinder having an outwardly directed flange at the lower end thereof and a missile supporting flange at the upper end thereof, rod means connecting said upper flange on the outer cylinder with the additional flange on the inner cylinder whereby when a missile is seated on said missile flange and secured to said inner cylinder longitudinal movement of said missile relative to said inner tube is prevented, and a hydraulically actuated split ring for securing the missile to the inner cylinder when the missile is seated in the missile flange.

2. In a missile launching system of the type having at least one vertically extending launching tube assembly having an outer tube, an inner tube suspended therewithin, sealing means disposed between said inner and outer tubes, a support ring secured to the bottom of said inner tube, a plurality of flexure rods carried by said inner tube in engagement with said supporting ring for securing the ring thereto, a missile support and post launch flooding control comprising a stool mounted on said support ring and having an inner cylindrical member and an outer cylindrical member, means on said inner cylindrical member for receiving and supporting a missile thereon, an annular member attached to said outer cylinder member in engagement with said supporting ring and extending downwardly therefrom beyond the lower extremities of said support ring, sealing means and cylindrical members thereby providing a cavity between said supporting ring, sealing means, annular member and outer tube whereby gas may be trapped in said cavity during post-launch flooding for controlling the amount of said flooding, flange means on the inner cylindrical member, complementary flange means on said outer cylindrical member, and flexure rods connecting said flange means on the cylindrical members for supporting the inner cylindrical member in a missile supporting and receiving position.

3. The system according to claim 2 including clamping means for securing said missile to said stool comprising a split-ring encircling said missile and the inner cylindrical member and having groove means engageable with flange means on the missile and flange means on the inner cylindrical member, pivotally connected lever means having the terminal ends thereof pivotally connected to the split ring, and hydraulic means connected to said lever means for engaging said grove means with the flange means on said missile and the inner cylindrical member.

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