Sept. 2, 1969 J. F. BRYAN 3,464,466

MOORING SYSTEM FOR TANKER VESSELS

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FIG. 1

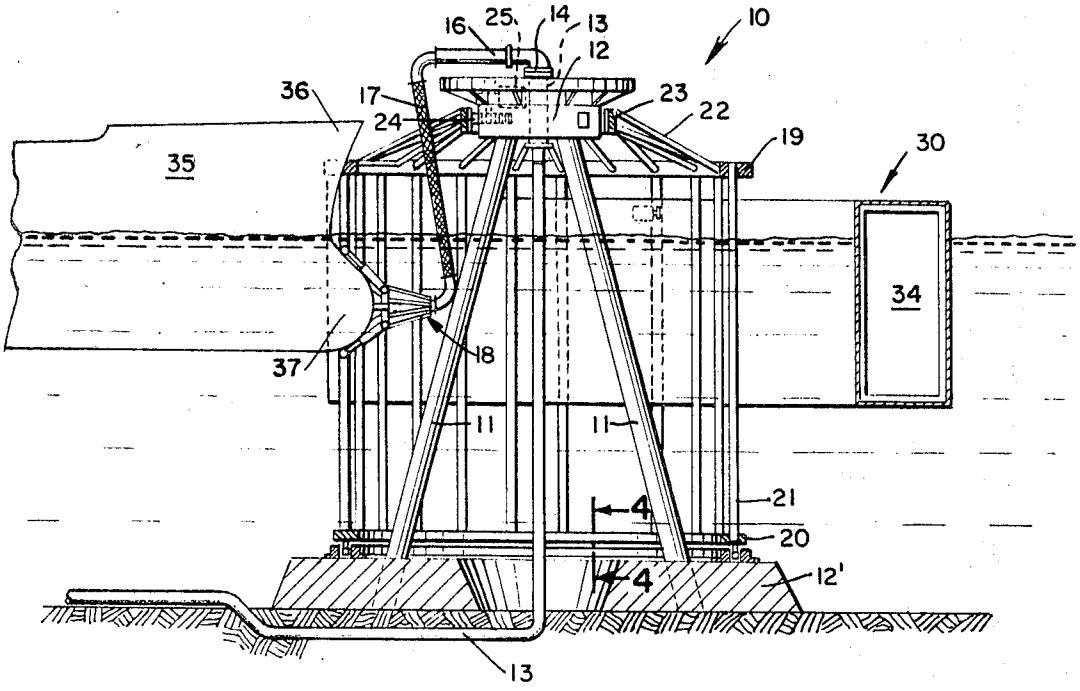
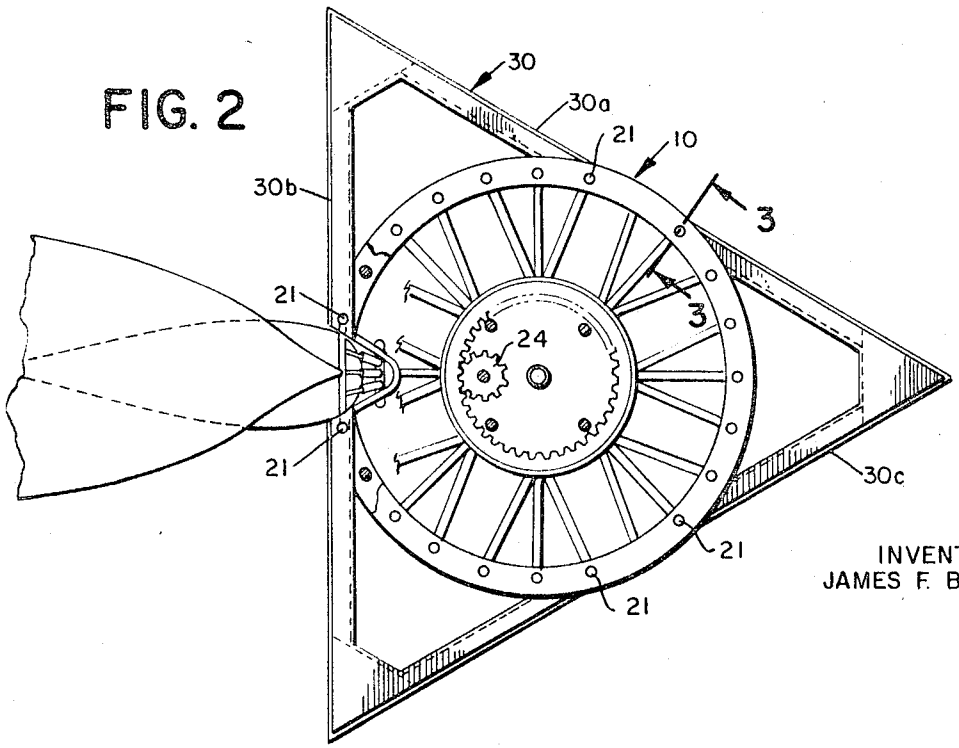


FIG. 2



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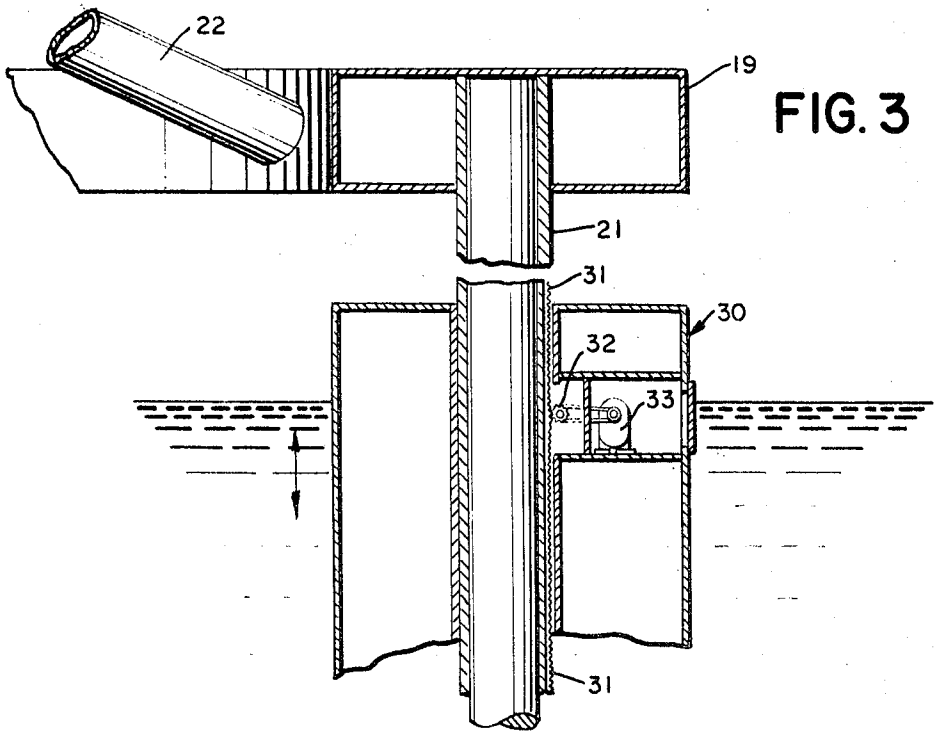
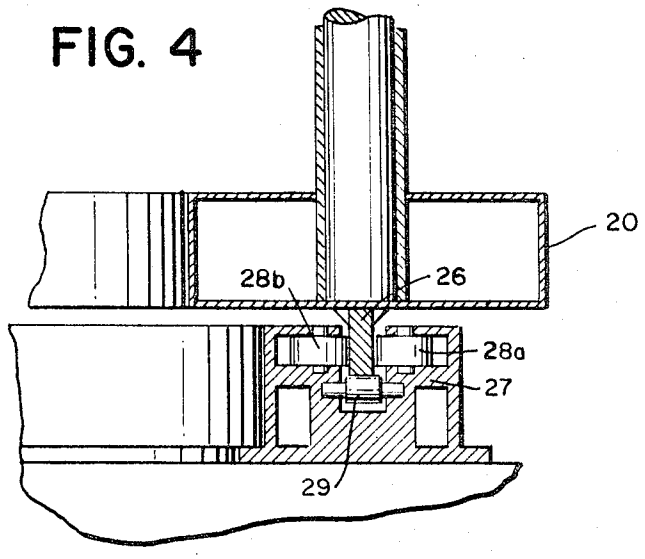


FIG. 3

FIG. 4

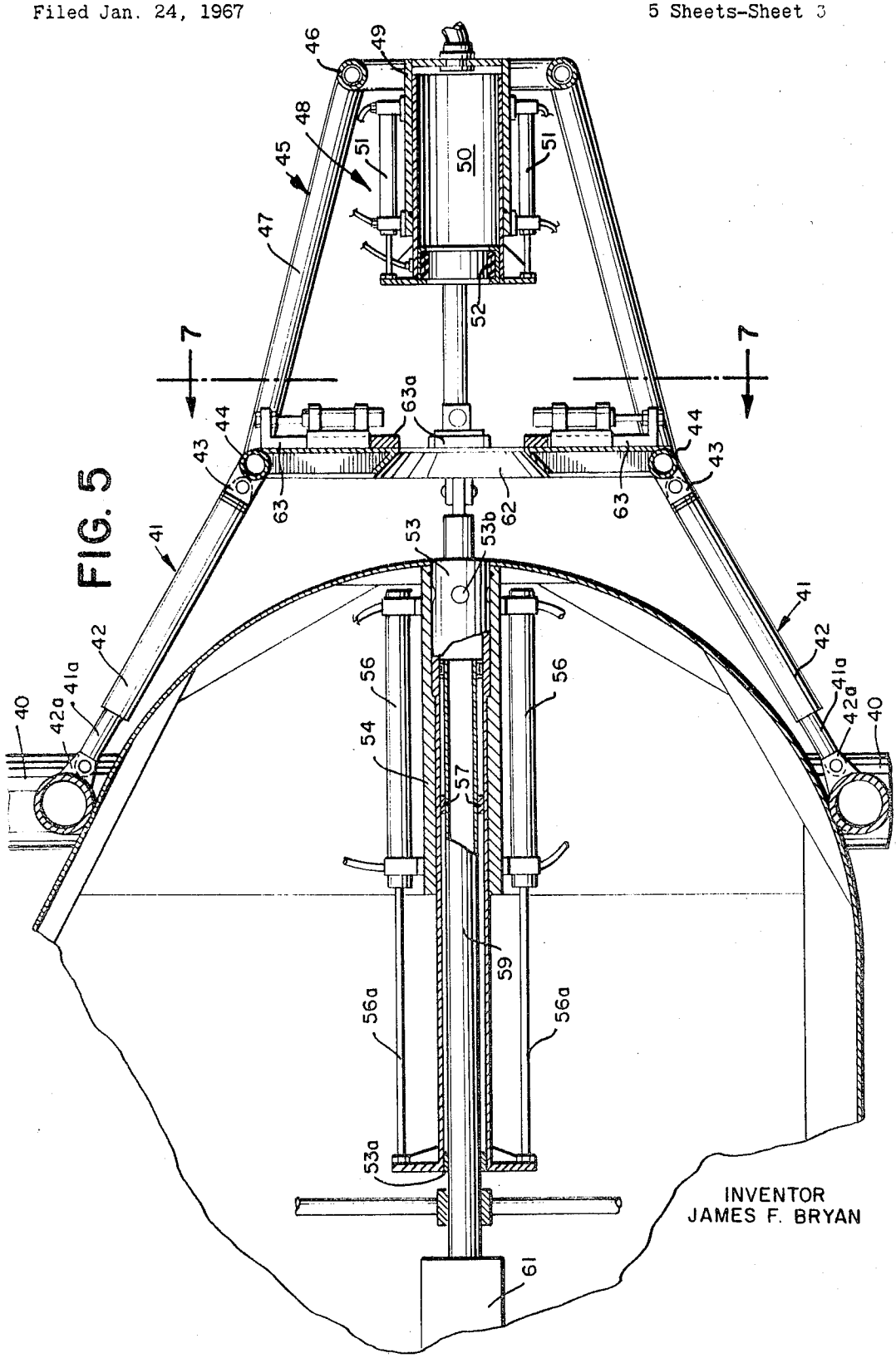


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MOORING SYSTEM FOR TANKER VESSELS

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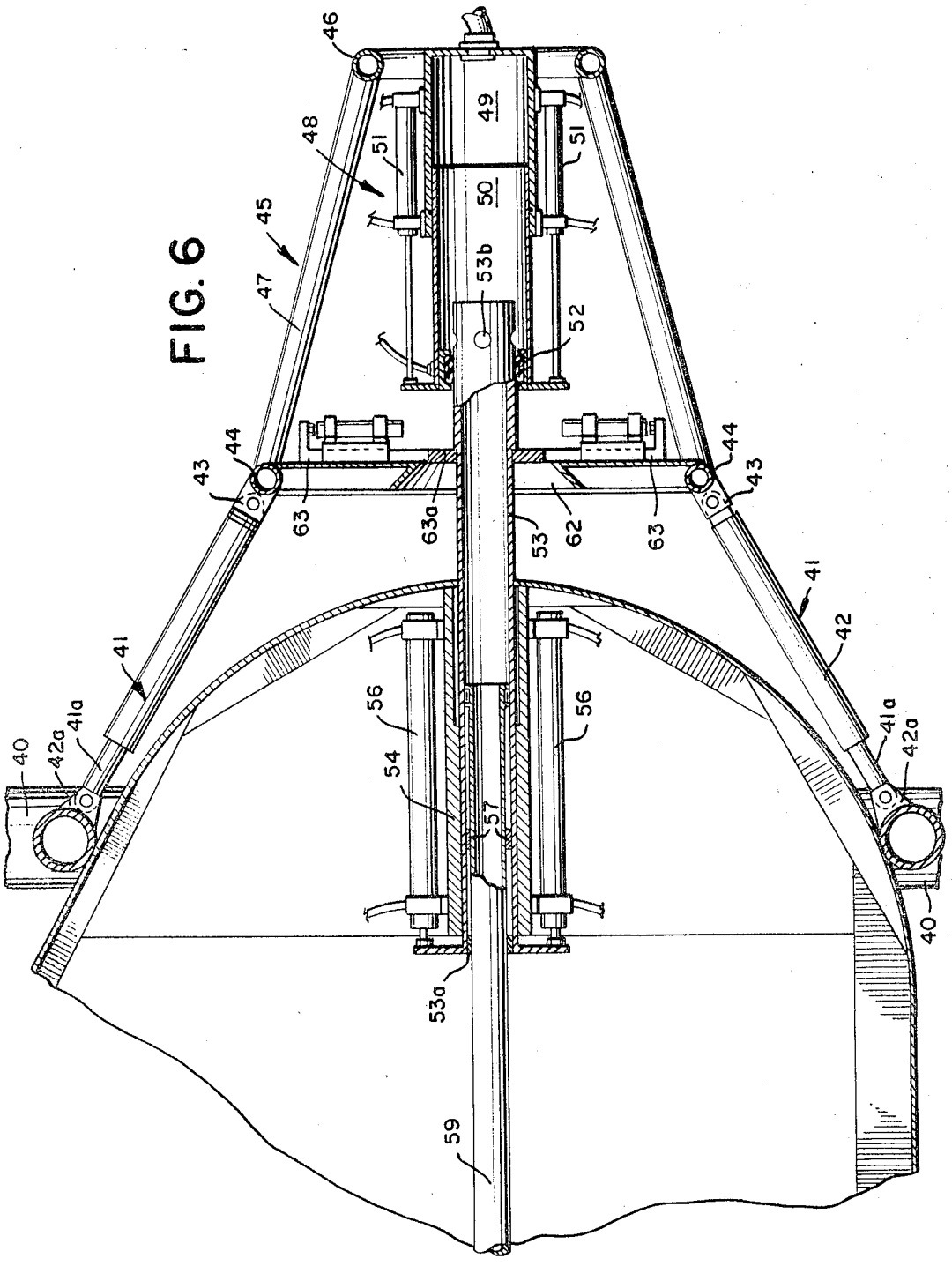
FIG. 5



MOORING SYSTEM FOR TANKER VESSELS

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FIG. 6



MOORING SYSTEM FOR TANKER VESSELS

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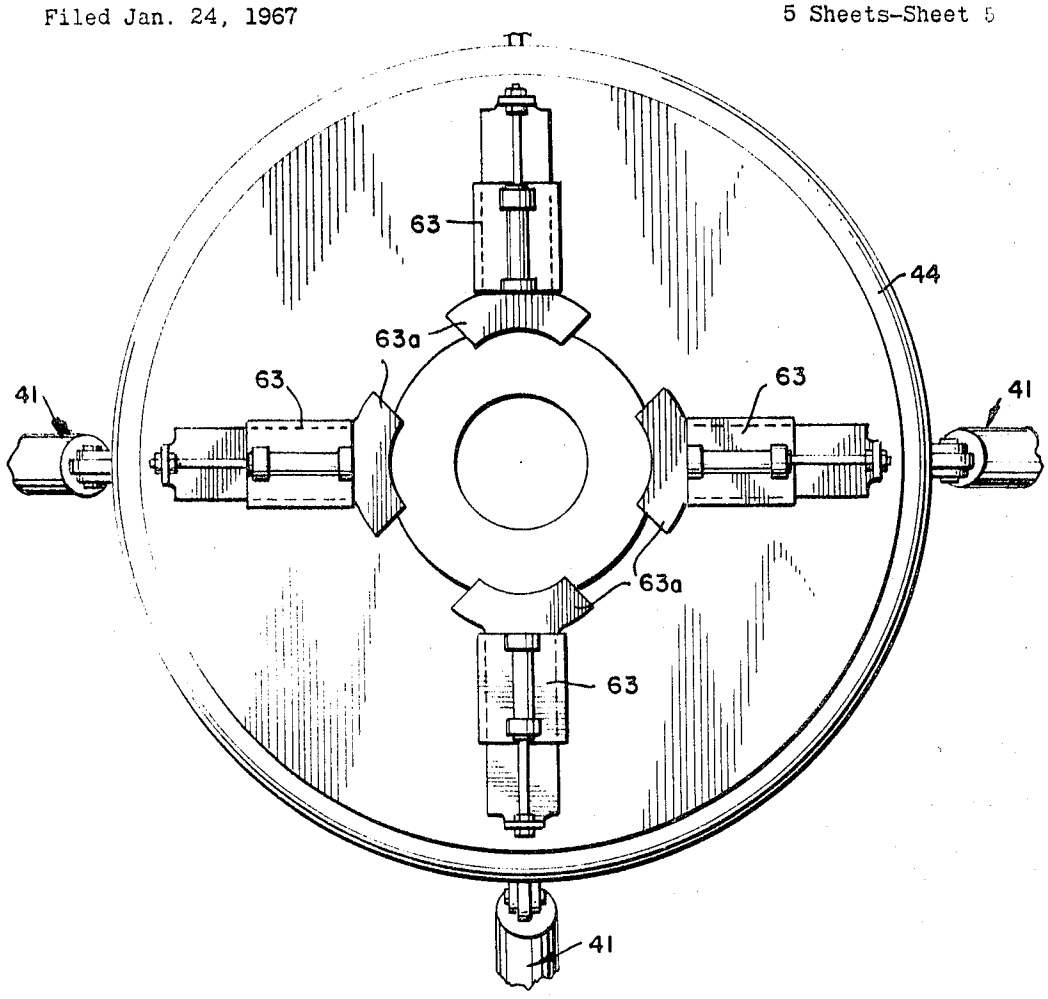


FIG. 7

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3,464,466

MOORING SYSTEM FOR TANKER VESSELS

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Int. Cl. B63b 21/00
U.S. Cl. 141—346 9 Claims

ABSTRACT OF THE DISCLOSURE

The disclosure shows a fixed mooring station having fluid coupling means which can be rotated, raised or lowered suitably to position the coupling means relative to corresponding means installed in the bulb bow portion of a tanker vessel. Means are provided for positive engagement of the bulb within a housing in the mooring.

Background of the invention

This invention relates to improvements in mooring, loading and discharging systems for marine tanker vessels and the like, and more particularly, to a mooring adapted to receive bow portions of a tanker vessel therein for the combined purpose of mooring the vessel and for loading and discharging cargo.

Heretofore many mooring systems have been devised for securing tanker vessels off-shore to permit the loading or discharge of cargo through fluid conduits interconnecting the shore and the vessel. In one currently used system the vessel is moored by its bow lines to a mooring station and cargo discharge or loading is effected through a submerged arm extending to the midship section of the vessel. Another arrangement requires the use and handling of buoyant hoses from the mooring to the vessel's midship section.

Summary of the invention

It is a major purpose of the present invention to eliminate extensions of fluid conduits of the type described by providing means at the bow of the vessel to load and discharge cargo. It is a further aspect of the apparatus disclosed that the means for mooring the vessel and the fluid loading and discharge means are the same.

The apparatus of the invention includes a fixed mooring station having equipment for receiving bow portions of the vessel. The receiving equipment may be operated remotely from the vessel as it makes its approach toward the mooring station. Means are provided for rotating and for raising or lowering the fluid receiving equipment of the mooring station, such that discharging and loading bow portions of the tanker may be received by the mooring station.

In order to form a greater appreciation of the invention, including more specific aspects thereof, attention is invited to the following specification describing a preferred embodiment as illustrated in the accompany drawings.

Brief description of the drawings

FIGURE 1 is a side elevation of a mooring station constructed according to the invention as it may receive the forebody of a tanker vessel for discharging or loading thereof;

FIGURE 2 is a top view of the structure shown in FIGURE 1;

FIGURE 3 is a sectional view taken in the direction of arrows 3—3 of FIGURE 2 illustrating a motorized portion of the mooring station for elevating or lowering the tanker receiving equipment;

FIGURE 4 is a sectional view taken in the direction of arrows 4—4 of FIGURE 1 showing the means permitting rotation of the outer mooring station structure;

FIGURE 5 is an enlarged fragmentary cross-section of the receiving equipment provided in the mooring station and the forward or bulb portion of the tanker, including tanker discharging and loading apparatus;

FIGURE 6 is a view similar to that of FIGURE 5 showing the fluid conduit means of the tanker and mooring station in coupling engagement; and

FIGURE 7 is a view taken in the direction of arrows 7—7 of FIGURE 5 illustrating opposed clamping means about the fluid coupling conduit of the tanker which permits the coupling additionally to act as a mooring device.

Description of the preferred embodiment

Proceeding now to describe the particular embodiment of the invention illustrated in the drawing, a mooring station **10** has been illustrated generally in FIGURE 1 as it might receive a tanker vessel for loading and discharging cargo. The mooring station (hereinafter referred to as a "mooring" or "station") is of the fixed variety in that it comprises a central anchored tripod having legs **11**, two of which appear in FIGURE 1. The legs **11** are firmly anchored to a concrete base **12** secured in the ocean floor. At their upper end the legs **11** are rigidly connected to a circular frame **12**. Through the frame **12** passes fluid conduit means **13**, which extends downwardly beneath the ocean floor as shown, for connection to a shore receiving installation. The upper end of conduit **13** joins a swivel joint **14**, permitting 360° rotation of a horizontal conduit **16** about conduit **13**. Conduit **16** is further connected to a flexible hose **17** of variable length which is joined at its lower end to tanker receiving equipment, indicated generally by reference numeral **18**.

The mooring **10** further comprises a cylindrical cage having upper and lower rings **19**, **20**, with interconnecting piles **21**. Ring **19** supports a plurality of shock-absorbing members **22** which are connected at their inner ends to a drive annulus **23**. Thus, it will be observed that ring **19**, annulus **23** and shock-absorbing members **22** comprise a fending system capable of absorbing an impact from a vessel brought into the mooring **10**.

Drive annulus **23** has a ring gear about its inner periphery, and this gear is in meshing engagement with a drive gear **24**. Rotation of gear **24** may be caused by a motor **25** to produce rotation of the drive annulus **23**, and, through members **22**, rotation of the entire cage consisting of rings **19**, **20** and piles **21**. Such rotation is permitted at the lower end of the cage by having a downwardly-projecting base support **26** (see FIGURE 4) enter within the multiple bearing housing **27**. Within housing **27** are side opposing roller bearings **28***a* and **28***b*, while support **26** rests upon a second series of bearings **29**.

As best seen in FIGURE 4, a shield **30** in the form of a tetrahedron having sides **30***a*, **30***b* and **30***c* is disposed about the periphery of the mooring **10**. The apices of the shield form tanks **34** which provide neutral buoyancy. The shield **30** engages and rides upon six of the piles **21** to accommodate movement of the shield in vertical directions. Referring to FIGURE 3, one of the piles **21** has been shown having a worm **31** engaging a pinion **32** which is connected to the structure of the shield **30**. The pinion **32** is driven by an electric motor **33** to cause movement in vertical directions of the shield **30**. It will be understood that each of the six piles **21** (shown in FIGURE 2) is associated with a shield actuating mechanism identical to that shown in FIGURE 3, and that energization of each of the respective driving motors **33** will be synchronized to raise or lower the shield **30**. It will be further understood that such actuation of the motors **33**, as well as rotation of the drive annulus **23** and thus the cage connected thereto, may be accomplished by electrical signals sent remotely from a vessel as it ap-

proaches the mooring. Therefore, by the means and structure described, it will be possible for the shield **30** to be placed in prepositioned relation to a tanker both as to its degree of submergence and angular direction.

It will be seen in FIGURES 1 and 2 that the side **30***c* of the shield **30** has been formed to receive bow portions of a tanker vessel **35**, including a portion of the upper bow **36**, and a lower protruding bulb **37**. As best seen in FIGURES 5–7, the fluid conduit receiving equipment **18** comprises an outer circular ring **40** adapted to engage the outer surface of the bulb **37** as the latter is driven toward and into the mooring. The ring **40** is secured to the structure of the shield **30** at side **30***c* thereof. Consequently, the ring **40** may be driven both in rotation and elevation to the approximate depth of the bulb **37** during the tanker's approach to the mooring. As mentioned, this prepositioning will be handled by the captain of the vessel, who will be aware of the vessel's draft and, allowing for trim, the degree of submergence of the bulb **37**. It is realized that pitching of the vessel (to some extent lessened by the shelter provided by shield **30**) will change the effective submergence of the bulb **37**. However, the arrangement is such that the engagement of any major portion of the bulb **37** within the ring **40** will operate to center the bulb **37** within the receptical thus formed. This result is aided by the neutral buoyancy of the shield **30** and by permitting the raising or lowering force imposed by the tanker to override the prepositioning action of the motors **33**.

Four self-adjusting struts **41** are connected by universal fittings **42** to the ring **40**. Each of the struts **41** comprises an inner piston arm **41***a* and outer cylinder **42** which are engaged telescopically, thereby allowing for lengthwise adjustment. A similar universal coupling is provided at **43** between the inner ends of the struts **41** and a second ring **44**. The ring **44** and a base ring **46**, together with intermediate struts **47**, define a frusto-conical shaped receiving housing **45** containing fluid conduit coupling means which will be described.

Base ring **46** mounts a telescopically-movable housing **48** comprising outer and inner sleeves **49** and **50**. The latter are telescopically engaged in sealed relationship. Mounted to the sleeve **49** are hydraulic rams **51** whose actuating arms are connected to the outer end of the inner sleeve **50**. Thus, by introducing hydraulic fluid under pressure into the ram **51**, the inner sleeve **50** may be extended from or retracted within the outer sleeve **49**.

Within the inner sleeve **50** adjacent to its outer end there is provided an inflatable annular seal **52** which, as best seen in FIGURE 6, may be actuated to sealingly engage the fluid conduit probe **53**, when the latter is extended for such engagement from the bulb **37**. Referring to the apparatus within the bulb **37**, it will be seen that the mechanism for advancing the probe **53** is located entirely therein and consists of an outer cylindrical sleeve **54** which is securely mounted within the cavity formed by the bulb **37**. Attached to the sleeve **54** are hydraulic rams **56** whose actuating arms **56***a* are connected at their ends to the inner end **53***a* of the probe **53**. The opposite end of probe **53** forms in effect a portion of the exterior of the bulb **37**. Fluid openings **53***b* permit flow from the end of the probe.

The arrangement is such that retraction of arms **56***a* within rams **56** will cause extension of the probe **53** from the bulb cavity toward and into the receiving housing **48** as illustrated in FIGURE 6. Probe **53** is in further telescopic relationship with an inner conduit **59** and is maintained in sealing engagement therewith by annular seals **57** and **57'**. Conduit **59** will be connected at its aft end with a manifold **61**, which will be in fluid connection with the cargo tanks of the vessel.

It will be observed that the ring **44** defines an opening **62** considerably larger in diameter than the probe **53** to permit misalignment of the probe **53** and receiving housing **45** upon initial entry of the probe within the housing. As best seen in FIGURES 6 and 7, attached to the inside of ring **44** are four hydraulically-actuated clamps **63**, whose ends **63***a* may be thrust inwardly to engage about the circumference of probe **53**. In the case of misalignment of the probe **53** with respect to the axis of the receiving apparatus **48**, the action of the clamps **63** will cause the entire receiving housing to be centered with respect to the axis of the probe **53** due to the relative movements permitted by struts **41** and universal couplings **42** and **43**.

The sequence of operation of the foregoing is as follows: the probe **53** will first be projected from the bulb **37** through the opening **62** and into the receiving housing. Thereafter, clamps **63** will be operated to secure the probe **53** and center the receiving housing with respect to the probe. Next, rams **51** will thrust the inner receiving sleeve about the extended end of probe **53** and into the position of FIGURE 6. Finally, inflatable seal **52** will be actuated to seal the end of probe **53** within the receiving housing. At this time, the fluid control devices respectively in the tanker and in the mooring may be opened to effect loading or discharging of the fluid cargo. It will be apparent that a reverse sequence of operation will bring about disengagement of the parts described, permitting withdrawal of the tanker from the mooring.

It will be further observed that probe **53** has an enlarged diametrical section **53***c* immediately forward of the clamps **63**. Section **53** defines a shoulder permitting positive engagement of the clamps **61** behind section **53** and perventing withdrawal of the probe **53** from the housing **45**. This arrangement not only assures positive fluid coupling of the parts, but is intended as well to comprise a structural link between the tanker and the mooring for securing the tanker thereto. It will be understood that the structures involved are necessarily massive, it being contemplated, for example, that the diameter of probe **53** shall be in the order of 36 inches. Consequently, the probe **53** may be designed to comprise at the same time a structural link for mooring the vessel and will have sufficient volumetric capacity to allow loading or discharging of the vessel within the time limits usually assigned to this operation.

It will be understood that the foregoing description relates to a particular embodiment or embodiments and is necessarily merely representative of the principles and structures of the present invention. Accordingly, in order to ascertain more fully the nature and scope of the invention, attention is drawn to the following claims, in which I claim:

1. Fluid conduit discharging and loading apparatus for a mobile marine vessel comprising a station anchored to the sea bottom and capable of mooring said vessel, means in said station for receiving a bow portion of said vessel in nesting engagement, means for adjusting said bow receiving portion at predetermined vertical distances from said sea bottom, fluid conduit means in said vessel and in said station, respective coupling means associated with said conduit means located in the bow portions of said vessel and in the receiving portions of said station, and means for actuating said means to connect said conduit means in said vessel and station.

2. Apparatus according to claim **1** in which the bow portion of said vessel comprises a bulb, said bulb housing a telescopically-movable probe extendable into receiving apparatus located within said station.

3. Apparatus according to claim **2** in which said probe and receiving apparatus comprise a structural link sufficient to moor said vessel to said station.

4. Apparatus according to claim **1** in which the receiving means in said station includes means for moving said receiving means in rotation and in elevation to preposition said receiving means relative to said bow portions prior to said direct engagement.

5. Apparatus according to claim **4** in which said receiving means further includes apparatus for aligning

the respective coupling means after engagement of said receiving and bow portions of said station and vessel.

6. Apparatus according to claim 4 which further includes means for permitting universal movement of said receiving means relative to said station.

7. Apparatus according to claim 4 in which said station comprises a fixed base, a series of piles rising from said base and secured to a base ring, means including motor means for effecting rotation of said ring relative to said base, an upper ring rigidly secured to the upper ends of said piles, a shield secured to selected ones of said piles, means including motor means for effecting movement of said shield axially of said piles, said receiving means being connected for movement thereof to said shield when the latter is carried in rotation by said piles relative to said base and moved axially of said piles to lower or elevate said shield.

8. Apparatus for discharging or loading fluid from a mooring station for tanker vessels and the like comprising means adapted to receive a portion of said vessel in nesting engagement therein, fluid coupling means in said receiving means and means for actuating said coupling means, said receiving means being shaped to receiving the bulb portion of the bow of said vessel and said coupling means including motorized remotely-controllable means for aligning said coupling means with said bulb and corresponding coupling means therein and for actuating said coupling means.

9. Apparatus according to claim 8 wherein the receiving means is remotely controllable both in rotation and elevation to position said receiving means relative to said tanker.

References Cited

UNITED STATES PATENTS

2,308,743	1/1943	Bulkley et al.	61—46.5
2,849,200	8/1958	Person.	
3,093,167	6/1963	McCammon	141—387
3,349,816	10/1967	Mowell et al.	141—387

FOREIGN PATENTS

462,818	5/1937	Great Britain.

HOUSTON S. BELL, JR., Primary Examiner

U.S. Cl. X.R.

61—46.5; 114—5; 137—236; 141—383, 387