July 15, 1930. F. SHORT 1,770,675

MOORING DEVICE

Filed Dec. 27, 1926 2 Sheets-Sheet 1

FIG. 1

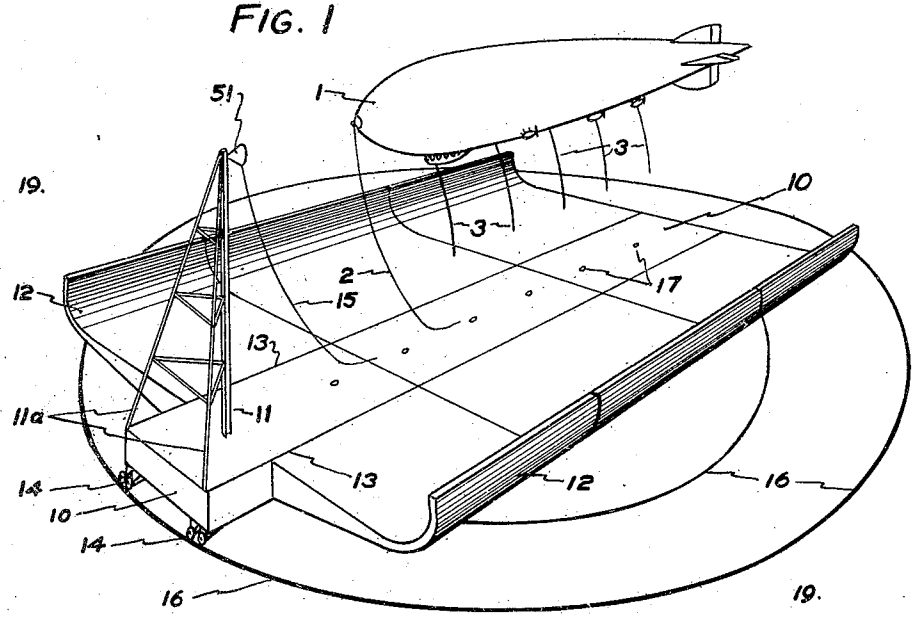


FIG. 5

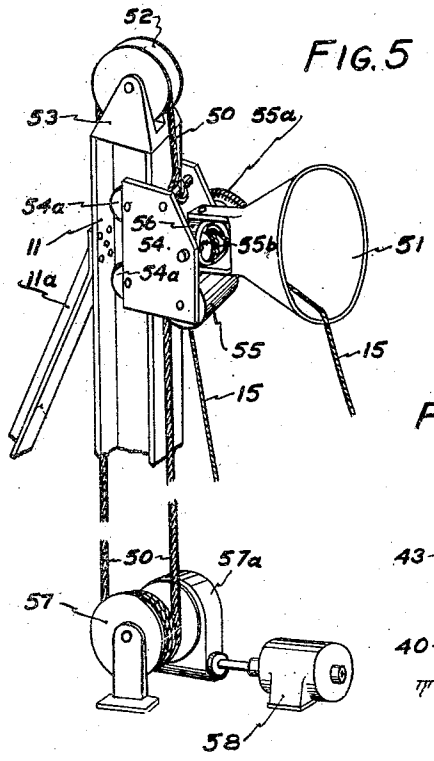


FIG. 2

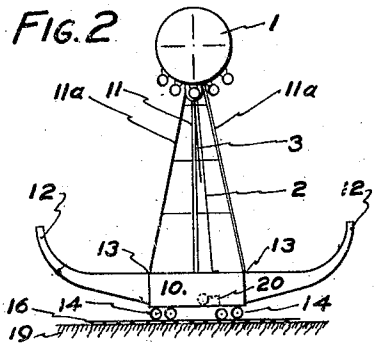


FIG. 4

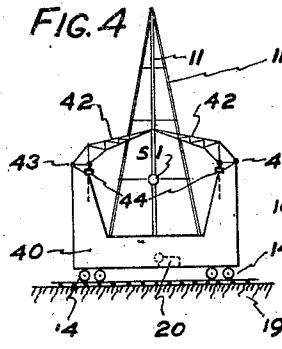
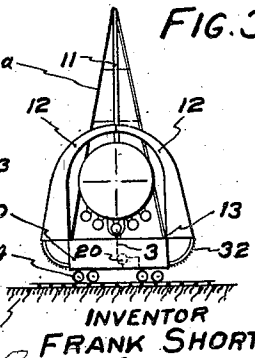


FIG. 3



INVENTOR
FRANK SHORT
BY George A. Gleason
ATTORNEY

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MOORING DEVICE

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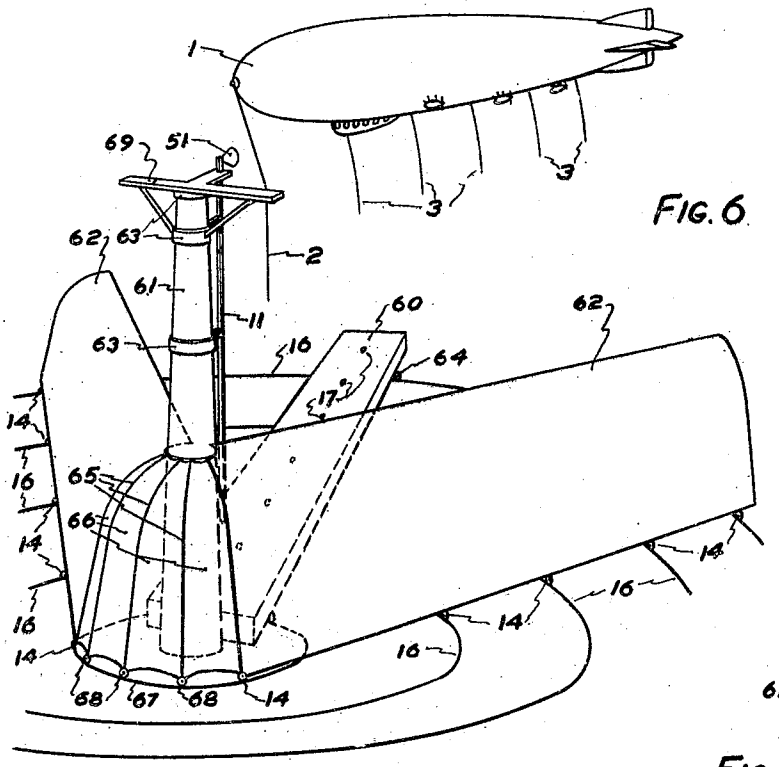


FIG. 6

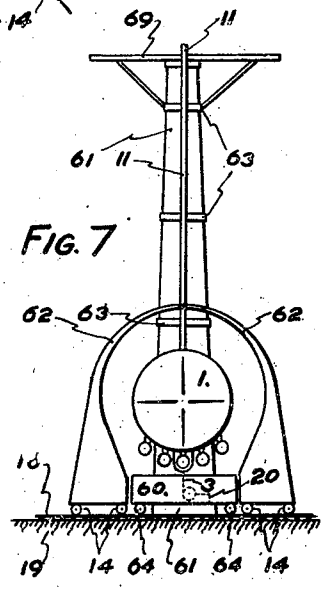


FIG. 7

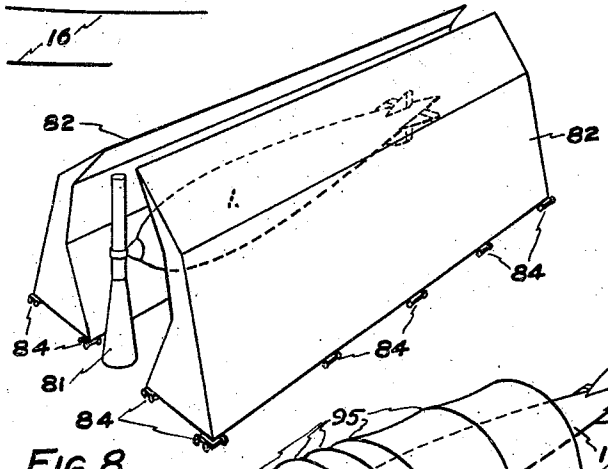


FIG. 8

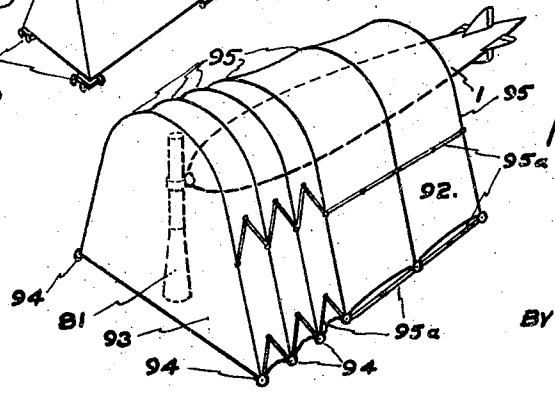


FIG. 9

INVENTOR
FRANK SHORT
BY Gingell & Dean
ATTORNEY

Patented July 15, 1930 1,770,675

UNITED STATES PATENT OFFICE

FRANK SHORT, OF POUGHKEEPSIE, NEW YORK

MOORING DEVICE

Application filed December 27, 1926. Serial No. 157,054.

My invention relates to improvements in mooring devices the broad objects of which are to make mooring of an airship safer, more expeditious and more convenient for the transfer of passengers or freight and the like to and from the airship. It has for further objects the protection of the airship from the deteriorating effects of sun and weather while moored, the danger of destruction from excessive winds and the constant wracking of the airship structure by wind when secured to any stationary object. It has for a further object the economy of landing space permitted by certain features of the invention, thus enabling a smaller landing field to be utilized and often thereby making it practicable to land at considerably closer proximity to large centers of population.

With these and other objects in view, I have shown in the appended drawings, described in the following specification and claimed in the claims hereto the preferred embodiment of my invention. In the drawings:

Fig. 1 is a perspective view taken from slightly above one form of the invention. showing an airship about to be moored thereto;

Fig. 2 is another view of the invention as shown in Fig. 1, the view being taken from the astern of the airship, which is in the same position as in Fig. 1;

Fig. 3 is a view taken from the same point as in Fig. 2 but with the airship moored;

Fig. 4 is a view of a modified form of the invention, taken from approximately the same viewpoint as are Figs. 2 and 3, but without the airship;

Fig. 5 is a perspective view, with parts cut away, of the upright member or mooring mast of Figs. 1 to 4, inclusive;

Fig. 6 is a perspective view of another form of the invention, showing an airship in the initial stages of mooring;

Fig. 7 is a view of the mooring device shown in Fig. 6 taken from the astern of the airship, which is moored;

Fig. 8 is a perspective view slightly from above of a further form of the invention, showing the airship in the final stages of mooring; and

Fig. 9 is a perspective view taken slightly from above showing a still further form of the invention.

In order to accomplish the objects of the invention, the airship is preferably first made fast to an upright member or special mooring mast that is adapted to raise or lower the airship while attached to a movable fitting on said mast. When lowered, the shelter for the airship is placed about the airship in one of several ways, and so avoids the dangers of attempting to run the airship into a shelter, especially with wind conditions not altogether favorable. In this manner, although the airship may be made fast to the mooring mast under turbulent weather conditions, there is no danger of its striking the shelter, because the latter is opened up wide and hence entirely out of the way. As the airship is lowered, the shelter may be used as a windbreak to ameliorate air conditions about the airship. And as the shelter is finally closed about the airship, more and more complete shelter from wind and weather is afforded.

The form of mooring device shown in Fig. 1 is particularly advantageous as far as compactness and small landing space required is concerned. The airship, 1, may have appended to its nose the nose cable 2, which is sufficiently long to drag on the platform 10 of the mooring device. The platform 10 is normally kept oriented in the direction of the wind, so that the upright member or special mooring mast, 11, is directly upwind, and the airship approaches it along the platform 10, and hence, directly into the wind. The mast cable, 15, is already in position as shown, lying on the platform 10 in a position convenient for quick use. As the airship approaches slowly toward the mooring fixture, 51, on the mast 11, the landing crew on the platform 10 secure the end of the nose cable 2 and fasten it to the end of the mast cable 15. This done, the cables 15 and 2 are wound in through the mooring fixture 51, by means such as shown in Fig. 5, and the airship 1 is brought slowly up to the moor-

ing fixture 51; in the process, the motors of the airship 1 may be reversed or inoperative, or under some wind conditions, still helping to propel the airship forward.

When the airship is clear up to the mooring fixture 51, it is secured there, preferably with means for quickly letting go in case of emergency, and the mooring fixture and airship are lowered toward the platform 10. When within reach, the auxiliary cables, 3, on the airship are secured by the crew on the platform 10, and may be held manually, or preferably are passed through the hatches, such as 17, to power-operated winding drums or winches, 20 (see Figs. 2, 3, 4, and 7). When these are secured so that the airship may be held from lateral swinging, the shelter walls 12 are raised by power-operated means, which may act on the gear sectors 32 (Fig. 3) and thus cause the shelter walls, 12, to rotate about the horizontal hinges, 13, until they meet over the airship 1. The final lowering and securing of the airship to the platform 10 and the raising of the shelter walls, 12, progress together; the higher the walls are at any instant, the more shelter from wind they afford, hence the nearer the platform it is safe to bring the airship. Until finally, when the walls are closed over the top of the airship and any desired end shelter such as curtains is in place, the airship may be made solidly secure onto platform 10, and passengers and freight, as well as fuel and other supplies, may be transferred to or from the airship cars in much the same manner as is done in the case of railway trains and the like. This eliminates the tedious process of having to transfer passengers, freight and supplies from the top of a high mooring mast to a swinging airship, and then carrying along a considerable length of passageway within the airship to their final destination. It further makes it unnecessary to be constantly on the alert in regard to the buoyancy of the airship, due to change of load, change of gas pressure or temperature and possible rain or snow loads.

In addition to the facility gained in handling passengers, freight and supplies, much greater confidence would be felt by passengers boarding the airship cars in much the same manner as they would the cars of a railway train, to which they are already accustomed. Further, the airship itself is protected from sun, wind and weather excepting when in actual flying service—the sun is known to have a marked deteriorating effect on airship fabrics, the wind causes stresses on the airship structure when moored to a mooring mast which approach those of flying service, and in some cases probably are more severe than normal flight, thus depreciating the airship unnecessarily. Protection from weather is not only beneficial for the airship and the load, including passengers alighting therefrom or boarding it, but also, it permits the thorough inspection of all parts of the airship and the making of minor repairs during the lay-over between flights.

The upright member or special mooring mast, 11, is preferably supported or strengthened by auxiliary members such as the slanting brace 11^a and the necessary tie members. In this form of the invention, the mast 11 is mounted at one end of the platform 10, which in turn is pivoted about a point in about the center of its length, and mounted on wheels, 14, which run on the series of concentric circular tracks, 16. Thus, the whole sweeps out an area not much greater than the circle whose diameter is the length of the platform 10, which latter is determined by the length of the longest airship to be accommodated. As it would be structurally difficult and unnecessarily costly in most instances to make platform 10 in a single rigid unit, Fig. 1 shows this platform sub-divided into sections, as well as the shelter walls 12. Platform sections are preferably driven about their respective tracks by electric motors, and it is a simple matter for one skilled in the art to proportion the driving forces and controlling devices therefor in such a manner that relatively small intersection stresses will have to be cared for by the couplings between sections. The fact that the whole structure is normally kept aligned with the wind direction makes it possible to reduce wind forces on it, and thus to make a lighter and less expensive structure than would be required in a fixed hangar.

In special cases, such as where the mooring device of the above type is to be mounted on the roofs of buildings in a city, the platform 10 may have to be one unit.

In general, the upright member 11 will be made sufficiently tall so that the airship may fly over obstacles in the immediate neighborhood of the landing field and still be on the level of the top of upright 11, where the airship is first brought to the mooring fixture 51. Thus it would be possible to utilize a space even entirely surrounded by buildings or trees, which would shelter the whole structure to a considerable extent from winds, and which would also permit of the location of the landing field in a built-up section of a city. The numeral 19 therefore may represent the ground or the top of a building or other suitable place.

Fig. 2 shows the mooring process from the viewpoint of an observer following behind the airship 1. The nose cable 2 is seen dragging on the platform 10, ready to be picked up by the landing crew. The auxiliary cables, 3, are seen still out of reach. The location of the series of winches, 20, is seen below the landing stage of the platform 10,

and so out the way of crew and airship. Other elements are as described for Fig. 1.

The completed mooring operation is shown in Fig. 3. The shelter walls, 12, have closed over the airship 1, which is secured by the auxiliary cables 3 and winches 20 (and such other means as my seem desirable) to platform 10, and it is convenient for the transfer of passengers, freight, supplies and the like. It will be noted that in the final pulling down of the airship 1 to platform 10, it is desirable to back the former away from the mooring fixture 51, and to allow ample slack on nose cable 2. The airship is then free to swing laterally about the auxiliary cables, 3, without inducing severe stresses at the nose.

Fig. 4 shows a form of mooring device very similar to that of Figs. 1, 2 and 3, the principal difference being that the platform 40 has upwardly extending walls of a fixed nature along its sides, and that the horizontal hinges for the roof members 42 are at a height comparable with the height of the airship 1 (as hinges 43). Screw-jack means, 44, are here shown for manipulating the shelter roof members 42, though any convenient means may be used for this purpose. The mooring fixture 51 is here shown in what is normally its lowest position, such that the airship cars would be close to the platform 40.

Fig. 5 shows a detail of a preferred form of mooring fixture, 51, and the elements of the special mooring mast, 11, which co-operate with it. The upright member 11 is surmounted by a cap, 53, which serves to hold pulley 52 and permit it to revolve about a substantially horizontal axis. Cable 50 passes over pulley 52, being secured at one end to the top of carriage 54, the other passing down and around winch drum 57, thence up again to a point of attachment at the bottom of carriage 54. Thus, motor 58, through the non-reversible gear members, 57^a, can drive carriage 54 up or down, and when at rest, carriage 54 will not be able to move up or down because of the non-reversible feature of the gear members 57^a. The ordinary worm and worm gear combination will fulfill this requirement, and is the preferred means. Thus elevation control of the carrage 54 is secured positively, and the height of the airship when in process of mooring is consequently positively controlled. Wheels, 54^a, may be used to facilitate sliding of the carriage 54 when under the pull from the attached airship. Any other equivalent constructon would be satisfactory.

The mooring fixture 51 is preferably conic in shape, of size adapted to permit the entry of a member on the nose of the airship, which may be a ball-like structure on an extending arm, and this fixture 51 is preferably universally mounted as by means of the gimbal ring 56. One of the gimbal ring pivots (preferably the horizontal pivot) is extended clear through both faces of the frame of the carriage 54, and is provided with a gear, 55^a, which meshes with the pinion on the shaft of motor 55. Mounted on this through-pivot is the winding drum 55^b, which serves to pull in or to let out the mast cable 15 as required in the mooring of the airship.

In this manner, means are provided for drawing the airship up to the special mooring mast 11, of holding it there as desired, and of moving the fixture 51 up or down with the airship thus held, in order to fulfill the desirable functions of this invention.

A form of the invention which is particularly suited to places where extent of area is not of such importance as would be the case near large centers of population, is shown in Fig. 6. Herein, the mooring mast 61 is used as the pivot point of the system, the other major elements being adapted to revolve about it. Since the length of the platform 60 is determined by the length of the longest airship to be accommodated, the system will sweep out an area a little larger than the circle whose diameter is twice the length of platform 60; hence, this form of mooring device will require roughly four times the ground area of the type shown in Figs. 1, 2 and 3. On the other hand, the structure would probably not be as costly as the former.

The mooring mast 61 is built to withstand thrust in any direction, and is preferably approximately circular in section to permit of the application of revolvable holding bands 63. At the top of mooring mast 61 and mounted on two of the revolvable holding bands 63 is mounted the T-shaped platform 69. The upright member 11 is secured to and extends slightly above the middle or shorter end of platform 69, thus permitting the mooring fixture 51 to come somewhat above the level of said platform. A railing may be provided around platform 69 for the safety and convenience of the crew stationed there. Bands 63, platform 69 and upright member 11 are caused to revolve as a unit about mooring mast 61, preferably under control of an operator stationed on platform 69.

In the initial stage of the mooring, the airship 1 approaches the mooring mast 61 approximately against the wind and at a slightly higher level than platform 69. It comes slowly forward and seeks to drag nose cable 2 against one of the laterally extending arms of platform 69, where it is secured by the crew and led into the winding mechanism of the mooring fixture 51. The airship will then back away and let itself be drawn slightly downward to the mooring mast. The approach is thus higher, clearance is possible over higher neighboring obstacles and less danger exists of injury, in case the airship

at first overshoots the mast—being at a higher level, it can go clear by and swing around for another attempt.

Once brought up to the mooring fixture 51, the airship 1 is lowered with said mooring fixture down the upright member 11 by means such as that shown in Fig. 5 or the equivalent, coming into the shelter of the open shelter walls 62. The platform 60 is revolved about mooring mast 61, being borne by wheels, 64, on the circular rails 67 and 16, until in alignment with the wind and airship, approximately, and when in reach of the landing crew, the auxiliary cables 3 on the airship 1 are caught and when weather conditions permit are passed through hatches, 17, to the winches 20, below the landing stage, which winches serve to draw the airship down and hold it in place. As the airship comes lower, the shelter walls 62 are gradually closed about it, giving progressively greater shelter and making it progressively safer to bring the airship closer to the landing platform 60. When finally the shelter walls 62 are completely closed about the airship 1, it will be safe to bring the airship down to the landing stage or top surface of platform 60, but in this final operation it is desirable to back away from mooring fixture 51, leaving a clear space between the nose of the airship 1 and the fixture 51, and allowing ample slack in the nose cable 2; this permits the airship a certain amount of lateral swing about the auxiliary cables 3 without causing severe stresses at the nose of the airship. Other attachments may be applied to the airship as required in the final or other stage of the mooring operation.

Whereas, in Fig. 1, end shelter is preferably provided by curtains which are preferably secured to the slanting brace members, 11^a, of the special mooring mast and to the near ends of the shelter walls 12 after the latter have closed over the airship 1, in the mooring device of Fig. 6 a plurality of frames 65 are movably attached to the mooring mast 61 at their tops and are mounted on wheels 68 at their bottoms and are thus adapted to revolve about the mooring mast 61 as an axis and be supported and guided at their bottoms by the inner circular rail 67. Between frames 65 is normally provided a pliable sheathing, 66, such as waterproofed fabric, which is loose enough in the figure to permit of revolving shelter walls 62 (to which said sheathing is also attached) to close about the airship and when closed to stretch the sheathing 66 to a reasonable degree of tightness. Thus it will be seen in the form of the invention shown in Fig. 6, there is always a continuous surface from one extreme end of one shelter wall to the extreme end of the other shelter wall, making a large dead air space for the reception of the airship, as opposed to the type shown in Fig. 1, wherein it is desired not to interrupt the flow of air past the lower mooring mast 11 in order not to introduce eddy currents which will affect the operation of mooring the airship originally to fixture 51.

Fig. 7 shows the airship 1 moored and sheltered by the shelter walls 62, which have closed about it. This stern view shows the normal relative positions of shelter walls 62 and platform 60, and it will be noted that in this position it is possible and desirable to link these elements together temporarily, so that in swinging with the wind, the whole may move as a unit. One of the circular tracks, 16, is shown resting on the ground 19, and supporting the shelter wall wheels, 14, and the platform wheels, 64. The moored position of the auxiliary cables 3 is also shown, held by the winches, 20.

It will be noted further, that in the above type of mooring device, the platform 60 may be eliminated, and the airship 1 be brought right to the ground 19 for loading or unloading. Man-power may be used for pulling the airship down and holding it; sand-bags may be hung on for holding down after landing, or water ballast pumped to the tanks of the airship itself for this purpose; electric or other power-driven tractors may be utilized for pulling and holding purposes; and other means may be substituted for the functions performed by platform 60 with a saving in first cost. On the other hand, the convenience of operation with platform 60, and the saving of time in landing an airship together with the reduction in handling personnel would tend to make the additional cost of platform 60 a good investment.

Using a platform such as 60, means may readily be adapted to the winches 20, such that the upward pull on each of the auxiliary cables 3 may be measured and the excess buoyancy of the airship adjusted properly in amount and in distribution, so that the airship, on being released, will rise at a predetermined rate and on a level keel. This would be more difficult of accomplishment without the platform, which would constitute a permanent housing for the landing equipment as well as for repair parts, supplies, handling equipment for passengers, baggage, etc., rooms for night crews, customs, and for many other purposes connected with transportation activities of the sort. Provision for friends of the passengers, visitors, etc., may profitably be made in the spaces within the shelter walls 62, thus keeping them separated from the landing platform 60 until it is desired to let them go onto the latter; whereas during the mooring process such locations would provide excellent views of the procedure while keeping the spectators entirely out of the way.

Provision would be made for the illumination of the elements of the mooring de-

vices described and the obvious and desirable location of the main illuminating device would be on the mooring masts or the platform 69, from which locations a strong top illumination of the platform 10 or 60, as the case may be, would be provided and would serve as a guide and wind direction index for an airship landing at night.

Although the mooring devices described above maintain certain space relations between the elements thereof, this space relation is not essential to the design of a mooring device involving the principles of the invention. Figs. 8 and 9 show perspective views, slightly from above, of two forms of the device in which the shelter element is independent of the mooring mast. In either case, the airship, 1, may be moored to a mast, 81, which preferably is provided with a lowerable mooring fixture such as 51 of previous designs.

When moored to the mast the airship 1 is inclosed by the shelter elements 82 (in Fig. 8), which are adapted to approach from the sides, independently, being mounted on a series of wheeled trucks, 84, which may be provided with motive power and interlinked steering arrangements.

In Fig. 9, the airship, 1, is provided with shelter after being moored to the mast 81, by a light hanger 92 which is run over the airship from the end, and would preferably inclose the mast 81 as well. This hanger 92 is preferably made somewhat collapsible and is shown constructed of the arch members, 95, and brace members, 95^a, with treated fabric between and at the end 93. Wheels, 94, provide easy means of moving the hangar to its position and are preferably power-driven individually. Brace members 95^a are articulated so that they may be bent as shown in the three sections near the end 93 and so bring the corresponding arches 95 closer together and reducing the length of the structure for convenience of handling. When straight, braces 95^a hold the frames 95 apart and stretch the connecting fabric to the proper tightness to provide a stable and effective shelter.

End curtains or doors may be provided for either end of any of the above mooring devices, such closing means being in standard use is not an essential part of this invention. In the figures, such standard closing means have been omitted for the sake of clarity. Other features of standard equipment may be used in conjunction with the principles of the invention, and modifications of the above described devices or equivalent means substituted therefore may combine to make up the mooring device of practice without avoiding the principles claimed as my invention in the appended claims. Electrical power devices and other motive power together with their control mechanisms and methods of application to the elements of the invention can readily be designed by one skilled in the art and are therefore not made a part of these specifications.

Although it is preferred that the airship be provided with nose cable such as 2 and auxiliary cables such as 3, any means of bringing the airship to the mooring mast fixture or attachment point which may be in use now or in the future may be considered the equivalent of nose cable 2; and any means such as standard handling ropes of airships of today or other means devised in the future may be considered the equivalent of auxiliary cables 3.

I claim:

1. In a hangar a landing platform, and a plurality of wall sections hingedly connected to the edges of said platform and adapted to be swung upwardly to house a dirigible on said platform.

2. A combined mooring mast and hangar including a platform, a mast on the platform, a nose cap anchoring member vertically adjustable on the mast and hangar wall sections hinged to the edges of the platform and adapted to be folded about a dirigible after it has been moored to the mast.

3. A mooring device for dirigibles including a landing platform, a mooring mast having a fixed location relative to the platform, means for securing an airship to the platform, nose cap anchoring means vertically adjustable on the mast and folding hangar sections hinged to the edges of the platform and swingable to position to cooperatively house a dirigible anchored on the platform.

4. A hangar including a landing platform and wall sections pivotally connected to the edges thereof adapted to cooperatively define a housing for a dirigible anchored to the platform.

5. Apparatus for anchoring and housing a dirigible including an elongated platform, a mooring mast at one end thereof and wall sections movably connected to the edges of the platform for enclosing a dirigible anchored to the mast.

Signed at Poughkeepsie, in the county of Dutchess and State of New York this twenty-third day of December, A. D. 1926.

FRANK SHORT.