July 12, 1960 D. J. DRISCOLL 2,945,234

COLLAPSIBLE REFLECTING STRUCTURE FOR ELECTRIC WAVES

Filed May 5, 1958 4 Sheets-Sheet 1

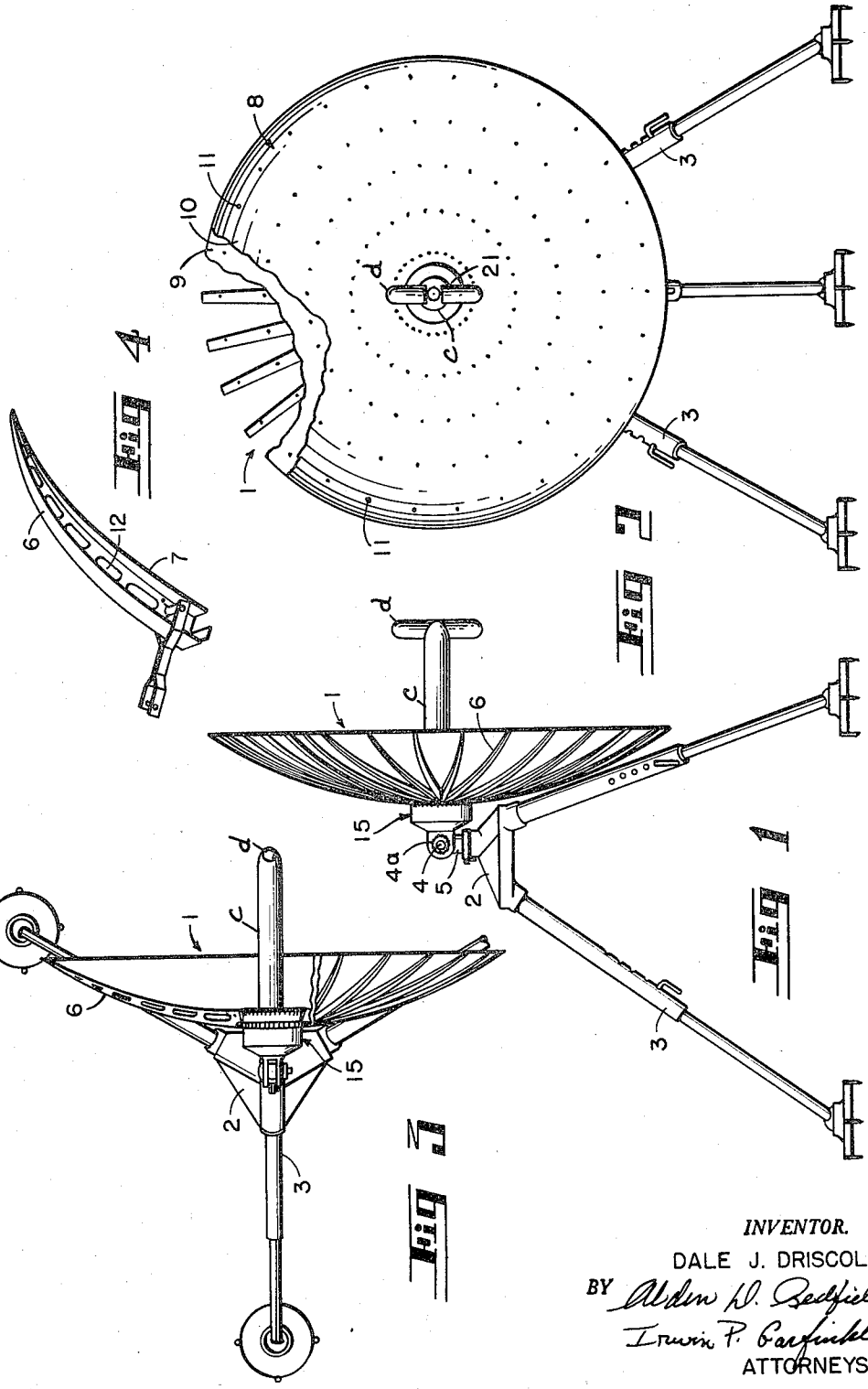


Fig. 4

Fig. 5

Fig. 1

Fig. 2

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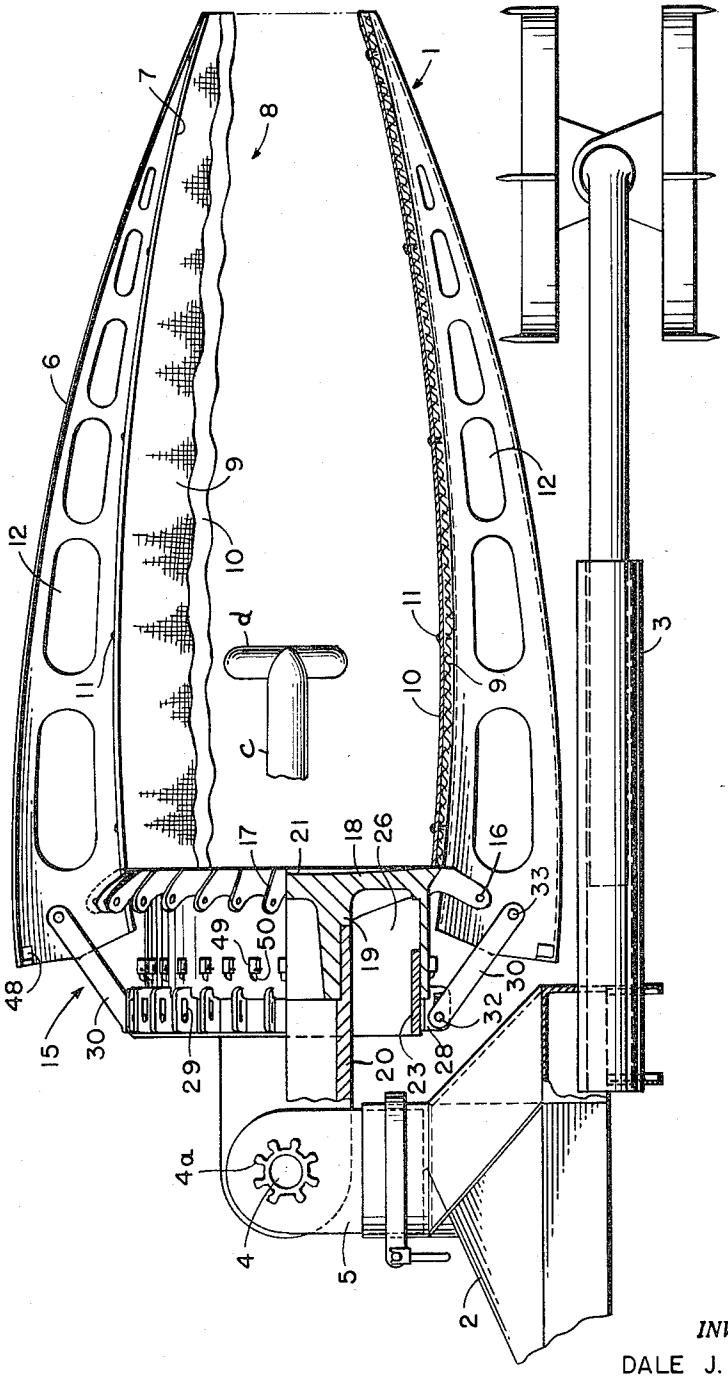


Fig. 1

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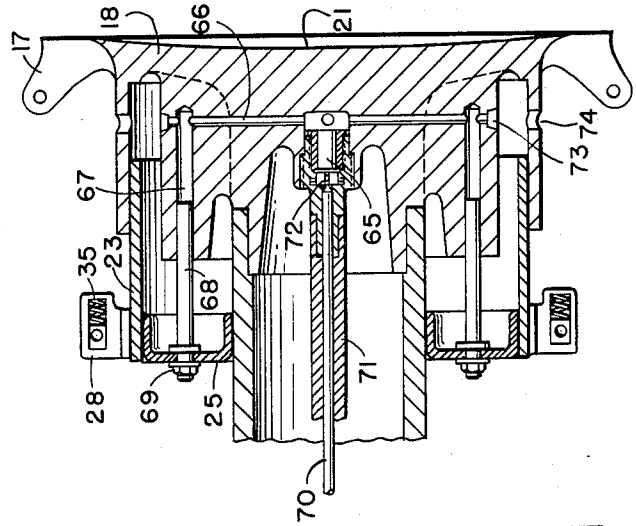


Fig 8

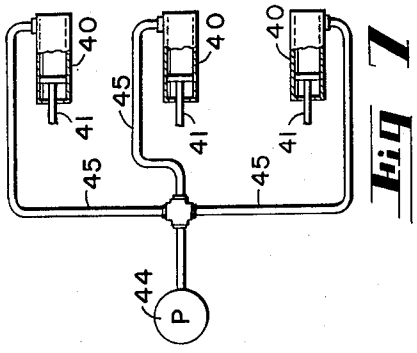


Fig 7

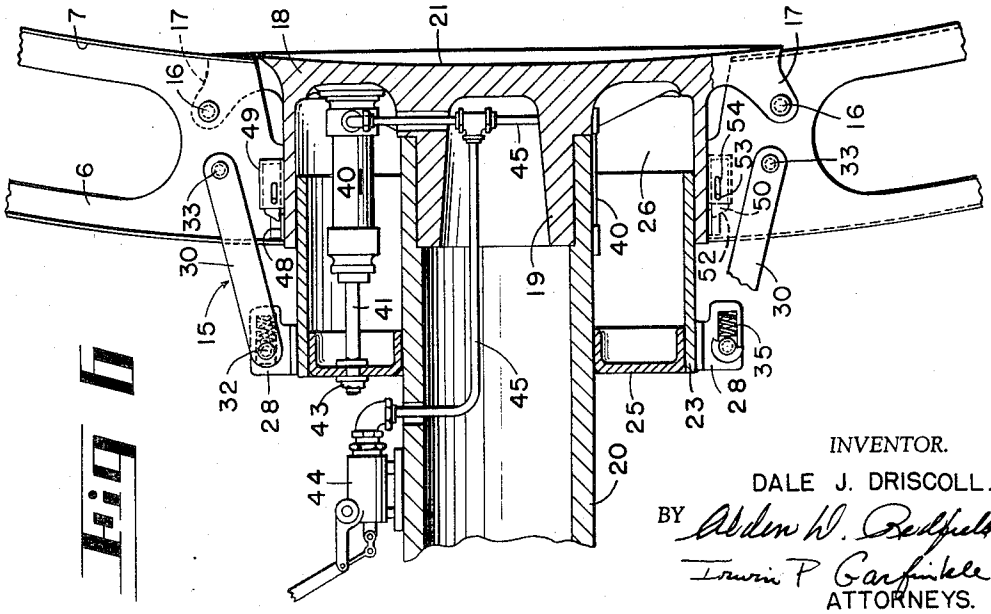


Fig 6

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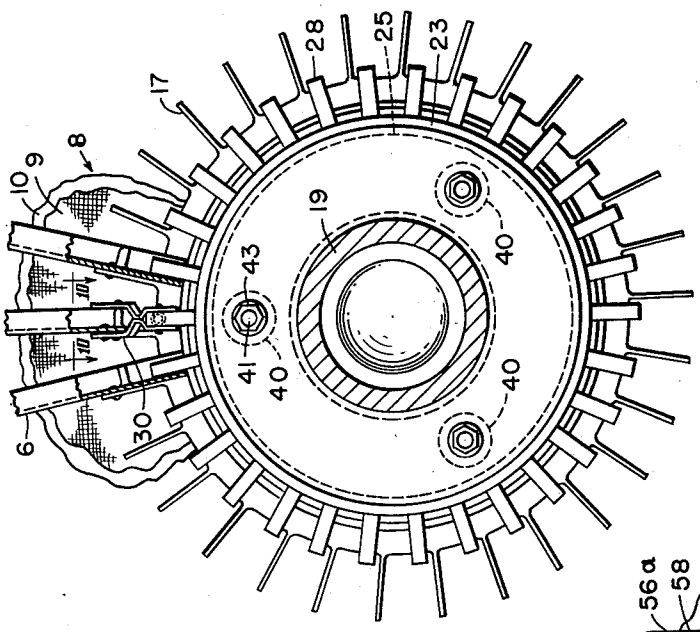


Fig 9

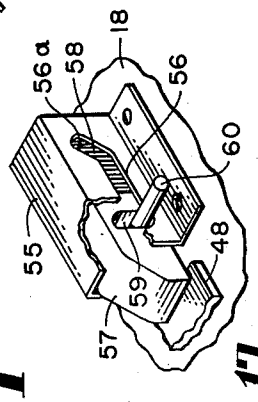


Fig 12

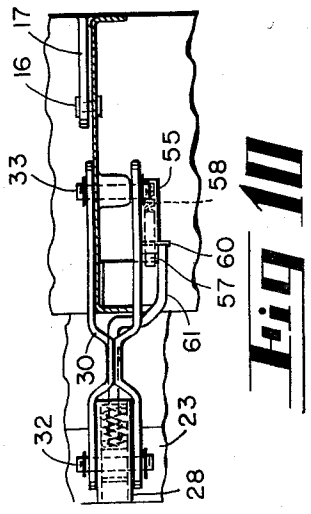


Fig 10

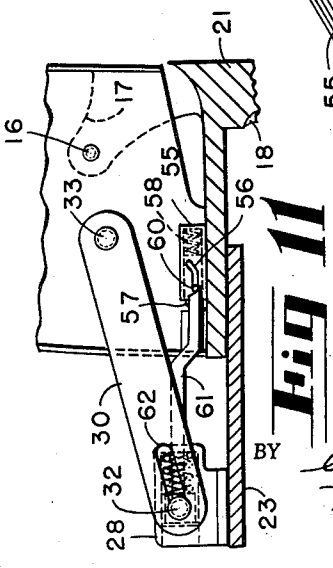


Fig 11

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COLLAPSIBLE REFLECTING STRUCTURE FOR ELECTRIC WAVES

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Filed May 5, 1958, Ser. No. 732,948

8 Claims. (Cl. 343—915)

This invention relates to a device for reflecting microwave radio energy and, more particularly, to a highly mobile, collapsible type reflector suitable for reflecting radar waves.

Highly mobile reflectors are required, particularly for military applications where reflectors may be set up in remote areas accessible only on foot or in small trucks or by parachute drop from aircraft. Since it is not unusual that a portable radar reflector requires a diameter of from 12 feet to 15 feet or more, the desirability of having a collapsible, lightweight reflector can be understood readily.

The prior art teaches the use of many types of folding reflectors, but generally these have been unsatisfactory. Among the many disadvantages of the prior art reflectors is the fact that the shape of the reflector does not conform to the requirements for maximum reflection, i.e., the reflector does not conform to a true parabola or other shape required for the particular application. Moreover, in many types of collapsible reflectors the entire structure is distorted or destroyed in the event of minor damage. Further, with large reflectors only partial collapsibility has been achieved, and this amount of collapsibility has added excessive weight.

The primary object of this invention is to provide a portable, lightweight reflector which is collapsible into a package of a size and shape suitable for convenient transportation.

Another object of this invention is to provide a parabolic reflector comprised of a plurality of centrally pivoted, self-supporting, rigid spars to which a metallized cloth covering is secured.

Still another object of this invention is to provide a collapsible reflector that is self-supporting in its open position, that requires no additional apparatus to maintain its reflective surface, that is substantially unaffected by minor damages, and that is sufficiently rigid to resist contour changes due to positioning movements.

For further objects and for a more complete understanding of the nature and advantages of this invention, reference should now be made to the following detailed description and to the accompanying drawings, in which:

Figs. 1–3 represent side, front and top elevations, respectively, of the preferred form of my invention;

Fig. 4 is a perspective view of a spar used in accordance with the invention and the linkage associated therewith;

Fig. 5 is a view illustrating the reflector in a collapsed position;

Fig. 6 is a view showing the reflectors in an open position, and shows a hydraulic mechanism for actuating the spars;

Fig. 7 is a diagrammatic representation of the hydraulic mechanism illustrated in Fig. 9;

Fig. 8 illustrates a modification of the actuator in which a cartridge is employed for automatically operating the reflector;

Fig. 9 is an enlarged view showing a central portion of the reflector with certain portions broken away and only three spars in place;

Figs. 10, 11 and 12 are views of a modified form of latching mechanism.

As seen in the drawings, and particularly in Figs. 1–3, the preferred form of my invention consists of a parabolic radio wave reflector, indicated generally at 1, suitably mounted for rotation on both a horizontal and a vertical axis for permitting proper orientation. The support for the parabolic reflector 1 is conventional and includes a base member 2 from which three telescoping legs 3 are pivotally mounted to form an adjustable tripod. The reflector 1 is supported from the base 2, and proper orientation of the reflector axis is provided by means of shafts 4 and 5 which are rotatable on both the horizontal and the vertical axes, respectively. Where the reflector is used for focusing high frequency radio waves, a conventional dipole radiator *d* positioned at the focal point of the reflector may be installed in any conventional manner and connected to a transmitter (not illustrated) by any conventional transmission line *c*. Any conventional locking mechanism, such as is shown at *4a*, may be employed for fixing the reflector position.

The parabolic reflector 1 is made up of a plurality of rigid, self-supporting ribs or spars 6, each of which is provided with a contoured inner edge 7 to which is secured metalized fabric 8 comprised of canvas or other heavy cloth material 9 on which a metal coating 10 of aluminum, silver, or other conductor has been applied. The metallized fabric may be secured in any convenient manner, as by screws 11, care being taken to assure conformation of the fabric to the contoured edge 7 of each of the spars 6. Since each spar 6 is pivoted (in a manner to be described) it will be seen that the rotation of the spars from a closed position (Fig. 5) to an open and operative position (Figs. 1–3) is permitted. As best seen in Fig. 4, each spar or rib 6 is constructed of a channeled, lightweight metal, preferably aluminum. For the purpose of reducing the weight of the structure, lightening holes 12 are spaced along the length of each spar.

The actuating mechanism for moving the spars 6 from a closed to an open position is indicated generally at 15, and is best seen in Figs. 5, 6 and 7. Each of the spars 6 are pivotally secured by means of pins 16 to a plurality of tongues 17 radially projecting from an annular hub 18. Where a dipole *d* is employed, it conveniently may be supported from the annular hub 18 or from such other structure as may be available. However, since the specific mounting of the dipole forms no part of this invention no specific mounting is illustrated, and the showings of the dipole *d* and the transmission line *c* are intended to be merely suggestive of the many mounting arrangements known and available to the prior art. The hub 18 includes a central portion 19 which is welded or otherwise fixedly secured to a support shaft 20 which, in turn, is pivotally secured to the shaft 4. The hub 18 also includes a dished, reflecting surface 21 which, as will be seen, forms the middle of the reflector. In addition, there is also provided a cylindrical sleeve 23 to which is secured or made integral therewith an annular thrust ring 25. As best seen in Fig. 6, the thrust ring 25, along with the sleeve 23, is slidable within an annular channel 26 formed by the shaft 20 and the inner periphery of the hub 18.

Evenly distributed about the outer periphery of the sleeve 23 and integral therewith are a plurality of tabs 28, each having an elongated slot 29. Each of the spars 6 is connected to one of the tabs 28 by means of a linkage 30 secured at one end to a pin 32 extending through a slot 29, and at the other end to a pin 33 fixed on each of the spars 6. A spring 35 is positioned in each slot 29

to maintain the pin 32 under pressure, and to permit manufacture of the apparatus with wide tolerances.

The thrust ring 25, along with the sleeve 23, is adapted to slide under the influence of three pistons 40 suitably supported from the hub 18 within the channel 26, and spaced 120 degrees apart. As illustrated in Fig. 6 and as represented in Fig. 7, each piston is provided with a conventional piston rod 41 mechanically connected to the thrust ring 25 by a nut 43, and all three pistons may be acted upon by the fluid pressure from a single hand-operated pump 44 connected to the piston by flexible hoses 45. Thus, when the spars 6 are in the closed position shown in Fig. 5 and the pump 44 is operated to actuate the pistons 40 and piston rods 41, the head 25 along with the sleeve 23 and the tabs 28 will be moved from a forward position to a rear position, and each of the spars 6 will be rotated about the pins 16 to the open position of Figs. 1–3 and 6. Because of the play permitted by the springs 35, the apparatus will not be jammed in the event one or more of the spars is positioned before the others.

Since the metalized fabric 8 is firmly secured along the length of the parabolically contoured edge 7 of each of the spars 6 and since, in the preferred embodiment, individual spars are spaced every 6 degrees, the reflecting surface provided by the coating 10 together with the dished, reflecting surface 21 of the hub 18 very closely approximates a true parabola. It is to be understood, of course, that in applications where a precise, parabolic shape is not required, a lesser number of spars may be employed. Also, other shapes, such as hemispheres, etc., may be obtained by varying the contour of the edges 7 and the surface 21.

For firmly latching the spars 6 into an open position, a projecting lip 48 is welded or otherwise affixed to the base portion of each of the spars. Also, around the outer periphery of the hub 18 are mounted a plurality of latches 49 of the type used in a conventional door latch mechanism. Each latch 49 is positioned so that its spring-loaded tongue 50 has a cammed surface 52 in the line of travel of the edge of a lip 48 and, thus, each tongue 50 will be forced back into the housing of the latch under the influence of a lip 48 as the spars move from the closed to the open position. When the spars reach the fully open position, the lips 48 lie flush with the hub, and the spring-loaded tongues 50 are permitted to withdraw from the latch housings, slide over the lips 48, and firmly latch the spars in position.

For the purpose of releasing the lips 48 to permit closure of the spars 6, each latching mechanism may be provided with a pin 53 extending through an elongated slot 54. It will be readily observed that this system for permitting the closure of the spars after they have been moved to the open or operative position is quite inconvenient, since it requires many separate and time-consuming manual operations (in this case, thirty). However, for those applications in which the reflectors are considered expendable after a single use, apparatus as disclosed to the point will be very suitable. Expendable-type reflectors may be used to great advantage for many military applications where the addition of apparatus permitting closure might only add unnecessary expense and weight.

If the apparatus is required for re-use, then a preferred modified latching mechanism, such as illustrated in Figs. 10, 11 and 12, may be employed. It will be observed that the cooperation between the lip 48 and the modified latch 55 is the same as described before, when the spars 6 are moved from the closed to the open position; however, the elongated slot 56 of this latch is provided with an outwardly extended portion 56*a*. In addition, the tongue 57, loaded by a spring 58, is provided with a transverse slot 59 in which a pin 60 is free to ride.

For operating the latch, a cam actuator 61 may be welded or otherwise secured at one end to a tab 28, and its cammed surface is positioned to cooperate with the pin 60. In addition, each linkage 30 is provided with an elongated slot 62 through which the pin 32 extends. Thus, when the pump pressure on the piston 40 is reversed by a suitable valve (not shown) the thrust ring 25 is driven toward the hub along with the tabs 28, thereby driving the cam mechanism 61 against the pin 60. Under the action of the cam mechanism 61, the pin 60 will be guided longitudinally along the slot 56 and into extension 56*a*, thereby retracting the tongue 57 and also permitting passage for the cam mechanism 61. It will be noted that the withdrawal of the tongue is accomplished with no movement of the linkages 30 because of the elongated slots 62 which are provided. However, when the tongue is retracted the pins 32 will have traveled the entire length of the slots 62 and will then exert a force on the linkage 30 to drive the spars 6 into the closed position.

A modified form of the actuating mechanism 15 is shown in Fig. 8. In this embodiment a cartridge 65 containing an explosive is suitably secured to the hub 18 through which at least three ports 66 communicate with at least three bores 67 in the hub 18. Pistons 68 are slidably positioned at one end within the bores 67 and at the other end are secured by means of suitable nuts 69 to the thrust ring 25. A detonating mechanism, including a plunger 70, a plunger guide 71 and a firing pin 72, is suitably supported from the hub 18 and may be adapted for automatic or manual detonation of the cartridge 65. For the purpose of releasing the gas pressure on the pistons 68 after the spars have been moved from the closed to the open position, pop-out plugs 73 are provided in the bores 67, and the hub 18 contains a plurality of vents 74. Since this mechanism includes no means for a reverse force for returning the spars from the open to the closed position, a latching mechanism 49 of the type shown in Fig. 6 is suitable, and this arrangement is useful primarily in a reflector system considered expendable after a single use.

While certain preferred embodiments of this invention have been illustrated, it is to be understood that other types of actuating mechanisms, such as manually driven screws or spring-loaded pistons, may be used for moving the spars from the closed to the open position. Furthermore, the tripod stand for the reflector may be modified so as to make the entire structure self-erecting, or pontoons or other types of apparatus may be used to support the reflector on water. Furthermore, if the spars are closely positioned when in the open or radially extending position, the need for the metalized fabric may be avoided altogether. Moreover, while the apparatus is described as a reflector of radio waves, it may also find application as an optical reflector. Many other modifications will also be apparent to persons skilled in the art, and it is intended, therefore, that this invention be limited only by the annexed claims as read in the light of the prior art.

What is claimed is:

1. A mobile reflector comprising: a cylindrical hub having a dished surface at an end thereof comprised of a conducting metal to provide a reflecting surface; means mounting said hub for directionally orientating the axis of reflection of said surface in space; a plurality of rigid, self-supporting elongated spars, each of said spars being pivoted at one end from a point on said hub at the periphery of said surface for rotation in a plane parallel to said axis, said elongated spars being rotated for storage to a position substantially parallel to said axis; actuating means mounted on the other end of said hub for rotating said spars for operation to a position substantially perpendicular to said axis whereby said spars extend radially from said hub, each of said spars having an edge adjacent to and cooperating with said surface when in said radially extending position; means securing to said edges

of said spars a continuous, collapsible material comprised of a conducting metal, whereby said material and said surface form a substantially continuous reflector; and latching means mounted on said hub and on said spars for rigidly latching each of said spars in said radially extending position.

2. The invention as defined in claim 1, wherein said reflecting surface is a parabola, and the edges of said spars are parabolically curved.

3. The invention as defined in claim 1 wherein said actuating means comprises a thrust ring slidably mounted concentrically with said cylindrical hub, a linkage for each of said spars, each of said linkages being pivotally connected between said ring and a respective one of said spars, and means for imparting a thrust to said thrust ring parallel to said axis of reflection for sliding said ring and actuating said linkages and rotating said spars.

4. The invention as defined in claim 3, wherein the pivotal connection between said linkage and said ring includes a tab for each of said spars extending radially from said ring, an elongated slot in each of said tabs extending parallel to said axis of reflection, a pin secured to one end of each of said linkages, each of said pins extending transversely through each of said slots and a spring in each of said slots for transmitting thrust from said ring to each of said pins.

5. The invention as defined in claim 4 wherein said means for imparting thrust to said ring comprises rods positioned on an axis parallel to said axis of reflection and connected to said ring at a plurality of points, and means for axially driving said rods.

6. The invention as defined in claim 5 wherein said rods are driven by fluid pressure.

7. The invention as defined in claim 1 wherein said latching means comprises a lip on said one end of each

of said spars, each of said lips extending substantially perpendicular to said spars, whereby said lips lie flush with said hub when said spars are rotated to said radially extended position; an axially slidable, radially restrained tongue for each of said lips, said tongues being mounted around the periphery of said hub, each of said tongues having a lower surface parallel to, but spaced from the surface of said hub by a distance equal to the thickness of said lips, and also having a cam surface in the line of travel of said respective lips as said spars travel from said parallel position to said radially extending position whereby said tongues are displaced from said lips until said spars are radially positioned and said lips are lying flush with said hub; and a spring for each of said tongues for axially biasing said tongues into a position securing said lips between said tongues and said hub.

8. The invention as defined in claim 7 wherein means are provided for simultaneously unlatching all of said tongues from said lips when said spars are returned from said radially extending position to said parallel position.

References Cited in the file of this patent

UNITED STATES PATENTS

2,072,262	Herzog et al.	Mar. 2, 1937
2,450,417	Bossi	Oct. 5, 1948
2,534,710	Golian et al.	Dec. 19, 1950
2,572,430	Balton	Oct. 23, 1951
2,604,644	Tilton	July 29, 1952
2,639,426	McAuley et al.	May 19, 1953
2,674,693	Millett et al.	Apr. 6, 1954
2,763,002	Fitzgerald et al.	Sept. 11, 1956

FOREIGN PATENTS

5,028	Great Britain	July 24, 1902
329,461	France	July 30, 1903