

Nov. 20, 1962

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3,064,534

REFLECTOR FOR SPACE VEHICLE

Filed April 13, 1960

3 Sheets-Sheet 1

FIG. 1

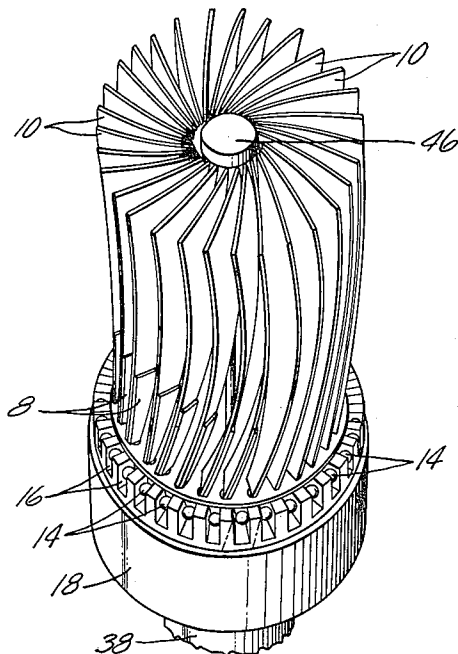
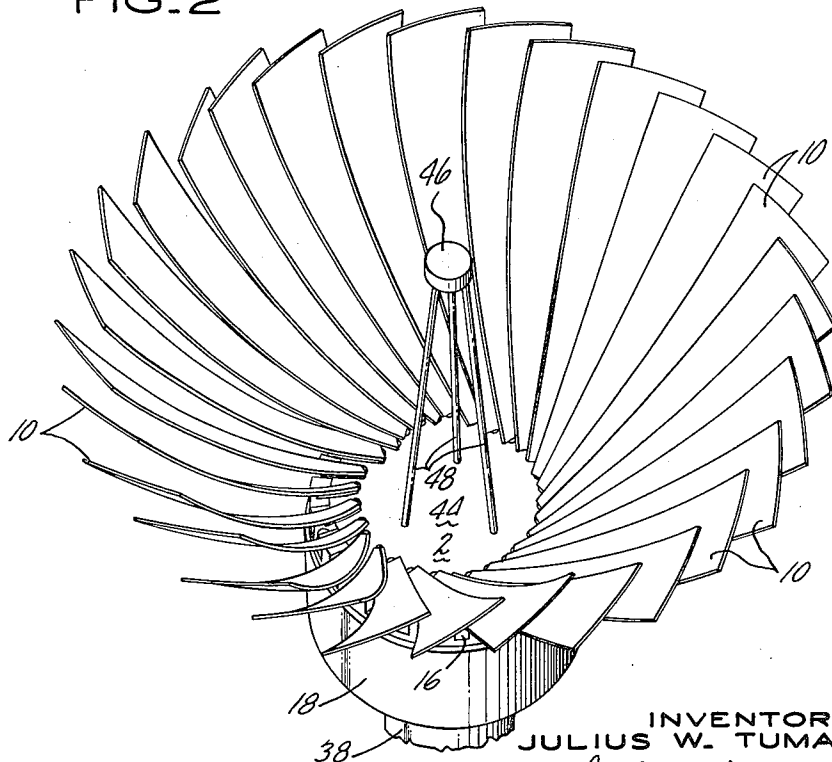


FIG. 2



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FIG. 3

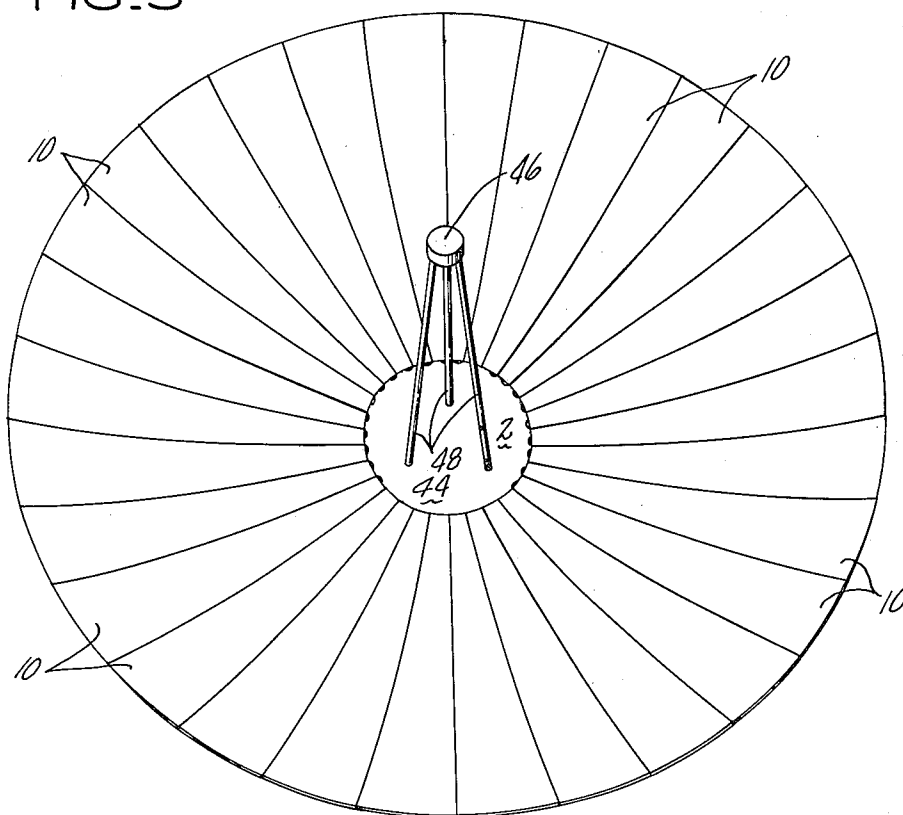


FIG. 8

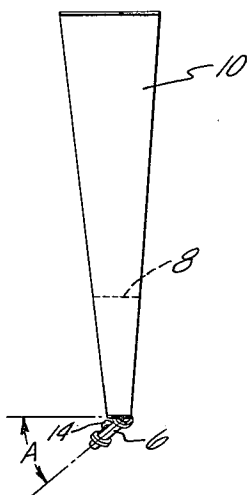
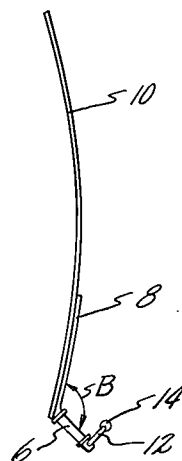


FIG. 9



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FIG. 4

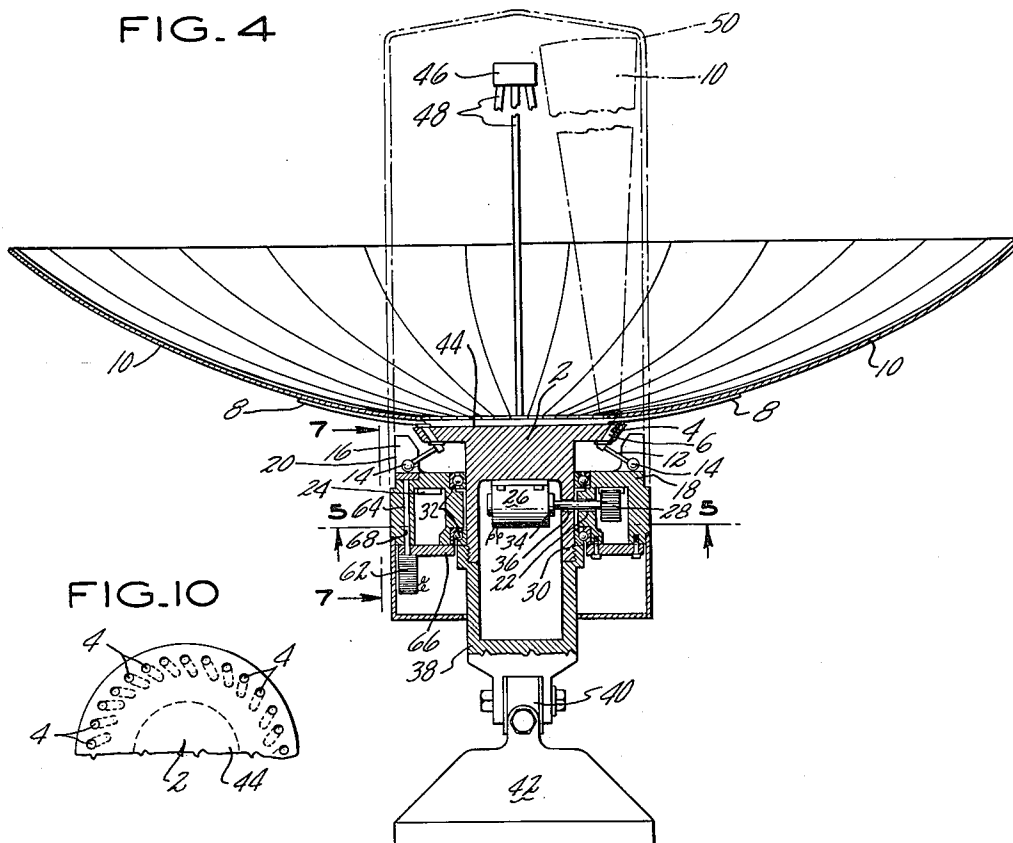


FIG. 10

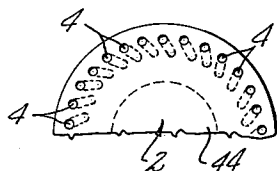


FIG. 5

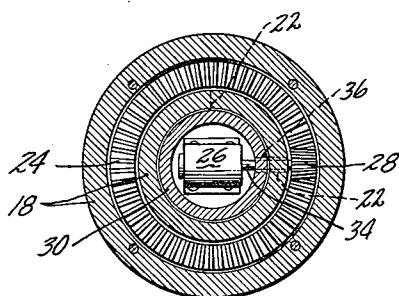


FIG. 7

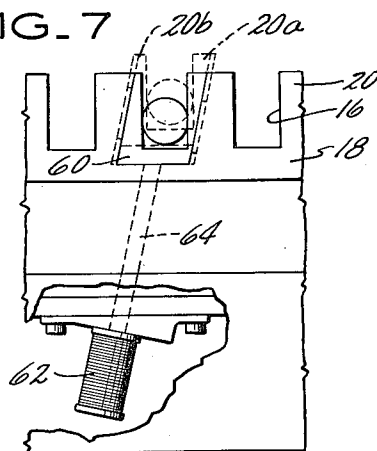
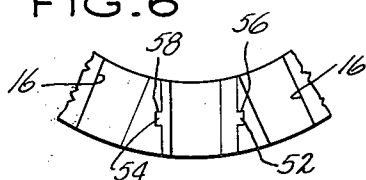


FIG. 6



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REFLECTOR FOR SPACE VEHICLE

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3 Claims. (Cl. 88-84)

The present invention relates to a reflector device. More particularly it relates to a reflector device which can be retracted into a small package for transportation.

In many situations it is desirable to transmit signals, originating at a common point, along parallel paths. Conversely, it may also be desirable to collect signals traveling along parallel paths and concentrate them at a common point. In order to accomplish these aims a reflector device is used. A parabola has the distinguishing characteristic that it will reflect all parallel impinging signals to a common focal point and is probably the most desirable shape. Also, any signals originating at that point and impinging on the reflector will leave the reflector along parallel paths.

One situation in which such a device is applicable is a solar heater for space vehicles. A boiler can be placed adjacent to the focal point of the parabola and the rays of the sun will be reflected from the parabolic surface to provide a concentrated heat source at the boiler.

In many situations it may be desired to transport the reflector from place to place. For instance, if the reflector is to be used in space vehicle applications it must be launched by suitable means to its desired location in space. Since the reflecting parabola is rather large and is difficult to transport through the atmosphere in its operative condition, it is necessary to collapse the parabola during flight.

One feature of this invention is a construction whereby a reflector of revolution is divided into sectors which can be retracted into a small package for transportation and extended into operating position at its destination.

Another feature of this invention is a retractable parabolic reflector which has a true parabolic reflecting surface when the reflector is extended.

Another feature of this invention is a collapsible parabolic reflector in which the amount of reflection can be controlled by moving part of the reflector out of focus.

Other features and advantages will be apparent from the specification and claims and from the accompanying drawings which illustrate an embodiment of the invention.

FIG. 1 is a perspective view of the reflector in its closed position.

FIG. 2 is a view showing the reflector in an intermediate position between open and closed.

FIG. 3 is a view showing the reflector in its extended position.

FIG. 4 is a sectional view of the extended reflector, including the actuating mechanism.

FIG. 5 is a view taken on line 5-5 of FIG. 4.

FIG. 6 is a plan view of an enlarged detail of the actuating cam.

FIG. 7 is a view taken on line 7-7 of FIG. 4.

FIG. 8 is a view of one of the reflector sectors.

FIG. 9 is a side view of one of the reflector sectors.

FIG. 10 shows a detail of the base on which the reflector sectors are mounted.

Referring to FIGS. 4, 8 and 9, base plate 2 contains a plurality of holes 4 around its periphery. Each hole houses a shaft 6 which rotates in the hole. An arm or finger 8 extends from each shaft 6 and is fastened to the reflector sector 10 to support the sector. An arm 12 extends from each shaft 6 and a ball 14 is attached to each arm. The balls 14 are positioned in the grooves

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16 of a cam 18 as is best shown in FIG. 7. Cam 18 is cylindrical and is composed of lands 20 and substantially radial grooves 16. As best shown in FIG. 5, a gear 24 is mounted on cam 18 and the cam is rotated by a motor 26 and a gear 28 in contact with gear 24. Cam 18 is mounted on the centrally extending portion 30 of base plate 2 by bearings 32. Motor 26 is mounted in a cavity in centrally extending portion 30 and gear 28 is mounted on a shaft 34 which extends through an opening 36 in centrally extending portion 30 and a slot 22 in the body of cam 18. The centrally extending portion 30 of base plate 2 is threaded to a sleeve 38 and sleeve 38 is connected by a universal joint 40 to a plate 42 which is mounted directly on a vehicle. As shown in FIG. 10, holes 4 are inclined toward the axis of base plate 2, and are also angled with respect to the face 44 of base plate 2. As was stated above, shafts 6 are mounted in holes 4 which act as bearings for the shafts and define the axis of rotation of reflector sectors 10.

FIGS. 2 and 3 show a boiler 46 connected to base plate 2 by the struts 48. Struts 48 are hollow and also serve as conduits for the flow of fluid to and from the boiler.

Referring to FIGS. 8 and 9, it can be seen that shaft 6 extends at a compound angle to finger 8. That is, it has an angle A in the plan view and an angle B in the side view.

Referring to FIGS. 1 and 4, the sectors 10, which are of identical size and shape and are curved parabolically, are aligned across the face 44 of base plate 2 so that the sectors are axial along substantially radial lines of base plate 2 in the retracted position. The distance between corresponding points on any two neighboring sectors is the same for all pairs of neighboring sectors. The sectors form a sleeve or ring of width varying according to the width of any one sector, and boiler 46 is located adjacent to the focal point of the parabola which is formed when the sectors are extended. The closed reflectors can be encased for transportation in a container 50 of diameter substantially equal to the diameter of base plate 2.

Motor 26 is energized by a signal from a suitable control mechanism and rotates cam 18 through gears 28 and 24. Clockwise rotation of cam 18 rotates shafts 6 in holes 4 through movement of ball cam followers 14 and arms 12. Reflector sectors 10 connected to shafts 6 move in identical paths inclined to face 44 of base plate 2. The paths are, of course, determined by the compound angle of shaft 6 and the inclination of shaft 6 to base plate 2. The sectors move outward from the axis of base plate 2 and downward toward base plate 2 until they form a parabolic surface of revolution as shown in FIGS. 3 and 4. The sectors can be retracted by reversing the rotation of cam 18.

When the reflector is in its extended position, the rays of the sun which impinge on the parabolic reflector surface parallel to the axis of the surface are reflected to the focal point of the parabola thereby heating boiler 46 which is positioned by struts 48 adjacent to the focal point of the parabola. The axis of the parabola is made to coincide with the axis of base plate 2, and base plate 2 can be moved through universal joint 40 so that the reflecting surface will always be pointed directly at the sun.

A provision has been made for individual movement of several of the reflector sectors from the open position toward the closed position. Referring to FIGS. 6 and 7 parts 20a and 20b of adjoining lands 20 have been cut and made movable with respect to the remainder of cam 18. Raised portions 52 and 54 protruding from parts 20a and 20b, respectively, ride in tracks 56 and 58. The parts 20a and 20b are joined by a cut portion 60 of the base of groove 16, and are cut at an angle so that groove 16 becomes movable. The lands are cut at an angle so that axial movement of the movable groove 16 will,

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through ball 14 and arm 12, rotate a reflector sector 10 toward the closed position. Four such movable grooves are provided spaced 90° apart. Each groove is independently moved by actuating a solenoid 62 which moves a rod 64 attached to the movable groove. As seen in FIG. 4 the solenoids are mounted on a plate 66 which is connected to the body of cam 18, and the rods extend through holes 68 in the cam body. The solenoids are independently actuated by a suitable control mechanism to move one or more reflector sectors 10 toward the closed position to be out of focus. Movement of any one sector out of focus in this way will actually affect the amount of reflection from two reflectors, because the sector being moved is no longer part of the reflecting parabola, and an adjacent sector is at least partially covered by this movement.

It is to be understood that the invention is not limited to the specific embodiment herein illustrated and described but may be used in other ways without departure from its spirit as defined by the following claims.

I claim:

1. A collapsible reflector device, comprising: a base having an axis and a face, and a plurality of openings disposed in a circle about said axis, said openings being inclined toward the axis of the base and angled with respect to the face of said base; a plurality of reflector sectors; a plurality of compound angle shafts, each shaft connected with one of said reflector sectors and mounted for rota-

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tion in each of said openings, each compound angle shaft having a pair of arms, one arm extending outwardly from the openings and connected with a reflector sector; and means, connected with said other arm of each compound angle shaft, concurrently moving said reflector sectors.

2. A collapsible reflector device as defined in claim 1, including means for selectively rotating some of said reflector sectors.

3. A collapsible reflector device as defined in claim 1, in which the compound angle of each shaft and the inclination of each shaft to the base are such that said reflector sectors move in identical paths inclined to the face of the base from an open position, forming a parabolic surface of revolution wherein said sectors are disposed in edge-to-edge relationship, to a retracted position wherein said sectors are disposed axially along substantially radial lines of the base, and vice versa.

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