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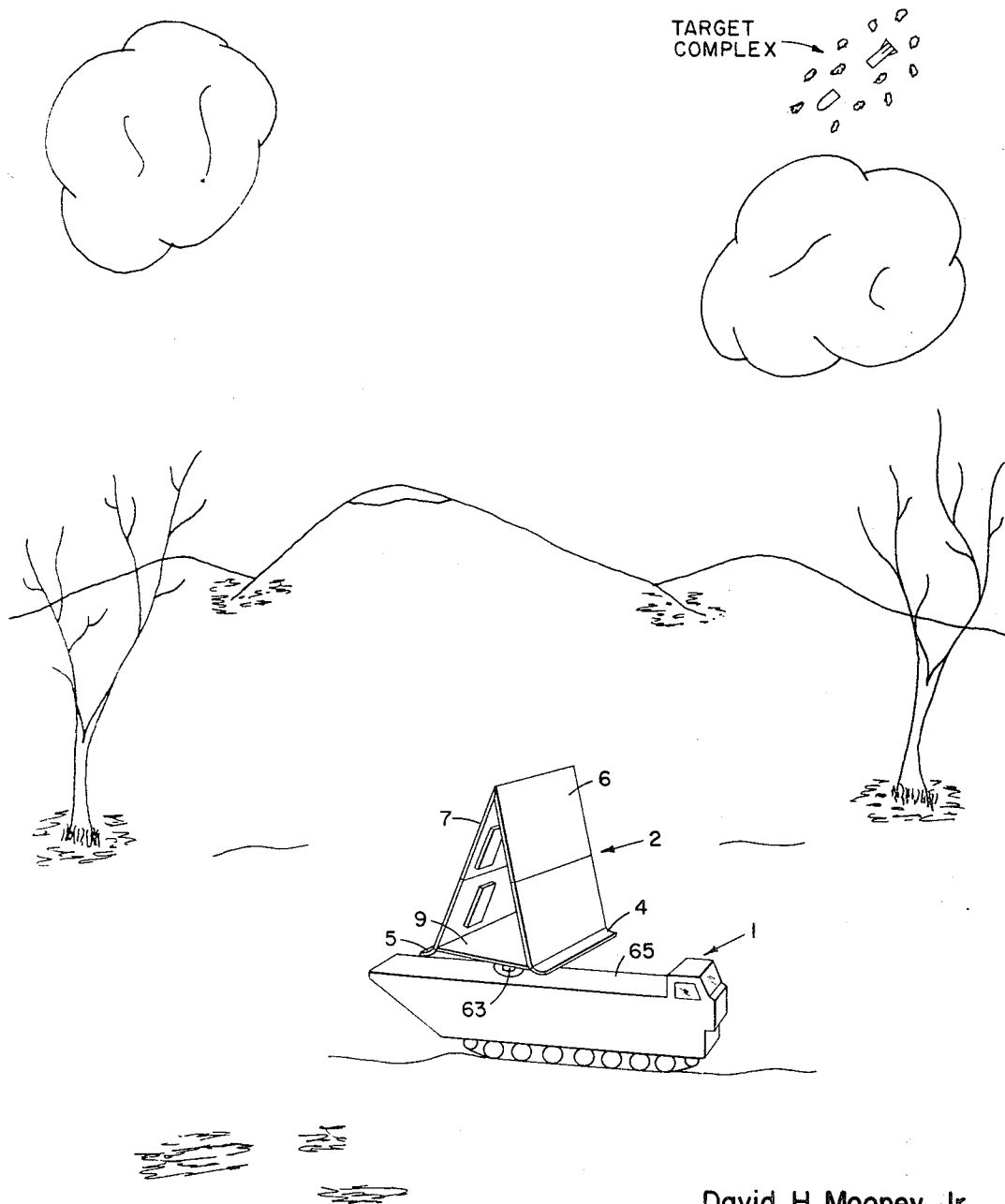
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COMPACT ANTENNA FOLDING FOR SEARCH ANTENNA

Filed Jan. 17, 1967

2 Sheets-Sheet 1



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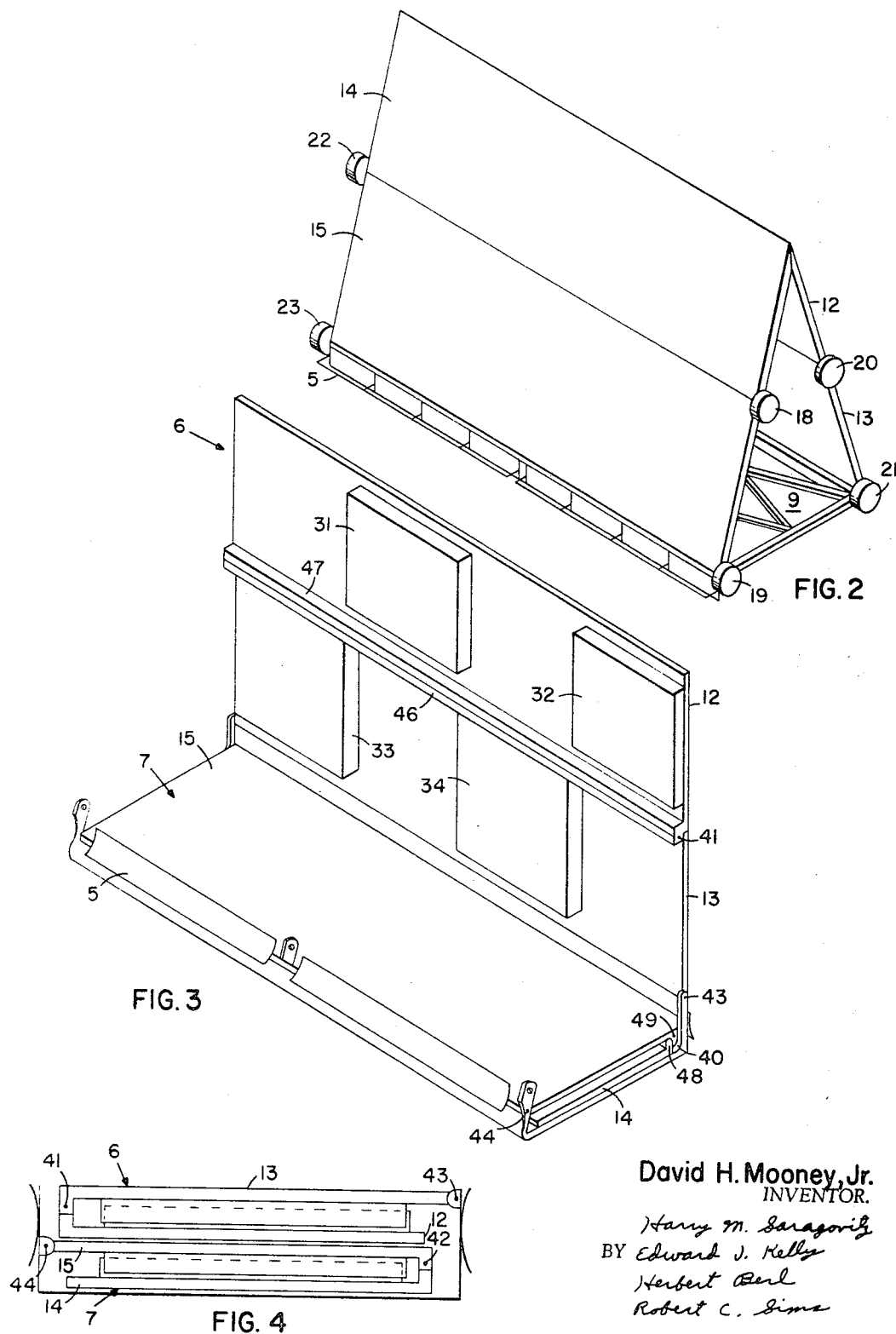
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1

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COMPACT ANTENNA FOLDING FOR SEARCH ANTENNA

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8 Claims. (Cl. 343-713)

ABSTRACT OF THE DISCLOSURE

A transportable folding antenna system including a pair of receiver antenna elements each having a transmitting antenna mounted adjacent thereto. The antennas are supported on a rotatable pedestal carried on a vehicle. The receiver antenna elements are comprised of a plurality of members hinged together to permit folding of the elements for the transporting thereof. The receiver elements are mounted on a common base in back-to-back relation and extend upward therefrom, in inclined relation, for mating engagement of the receiver elements at the top portions thereof, in its operating position.

This invention relates generally to a compact antenna folding system for a search antenna. Specifically, the invention is concerned with the hinging and folding of an antenna so as to save space when the antenna is in the folded state.

Mobile radar units have to not only be light in weight but also have to be small in their transportable size. This size limitation is due to many factors such as tunnels, power lines, trees, cargo aircraft size, etc. One of the biggest elements in any radar system is the antenna. The antenna is extra big when it is a receiver array and transmit array antenna combination such as used for search operations. This size problem is compounded when the search radar consists of a back-to-back pair of antennas.

It is an object of the invention to provide a compact folding antenna.

A further object of the present invention is the provision of hinging panels of a back-to-back search radar antenna and folding one on top of the other.

A still further object of this invention is the provision of arranging equipment on a folding antenna so as to save space when the antenna is in its folded state.

The present invention accomplishes these objects by hinging each antenna of a back-to-back antenna unit. The equipment units required to be mounted on the antennas are mounted such that when one antenna is folded on itself, the equipment units will interleave with each other and allow the antenna to fold to a thickness of about the size of the thickness of two antennas plus the thickness of just one of the equipment units. This is done for both antennas and then one antenna is folded on top of the other to form a compact unit.

The invention further resides in and is characterized by various novel features of construction, combinations, and arrangements of parts which are pointed out with particularity in the claims annexed to and forming a part of this specification. Complete understanding of the invention and an introduction to other objects and features not specifically mentioned will be apparent to those skilled in the art to which it pertains when reference is made to the following detailed description of a specific embodiment thereof and read in conjunction with the appended drawing. The drawing, which forms a part of the specification, presents the same reference characters to repre-

2

sent corresponding and like parts throughout the drawing, and wherein:

FIGURE 1 shows a back-to-back search antenna mounted on a vehicle;

FIGURE 2 shows the antenna in its erected position;

FIGURE 3 shows the antenna in a partially closed position; and

FIGURE 4 shows the antenna in a closed position.

FIGURE 1 shows a vehicle 1 having a back-to-back antenna 2 mounted thereon. The antenna consists of two transmitting antennas 4 and 5 and two receiving antennas 6 and 7. These are mounted on a common revolving pedestal 9. The transmitting antennas 4 and 5 will transmit a fan pattern having its thin dimension in azimuth. The receiver antennas 6 and 7 are two plane-arrays mounted back-to-back on the vehicle. The plane of each array is tilted 20° from the vertical. The antennas are mechanically scanned in azimuth. The receivers are to form a stacked set of pencil beams which are formed in elevation.

FIGURE 2 shows the structure of the antenna in greater detail. The receiver antennas are each divided up into two panels 12 and 13, and 14 and 15. These panels are hinged horizontally at the base of each array and at the junction of the panels of each receiver array. Eight rotary hydraulic actuators 18-25, one located on each end of the four hinge axes, provide the power for erecting the antenna. Solenoid valves control the actuators to provide the proper erection sequence. Having two actuators for each rotating array panel adds to system reliability as each actuator is capable of erecting its panel alone and under maximum windloading conditions if necessary. The time required to erect the antenna is dependent on the capacity of the pump, not shown.

The pedestal 9 seen in FIGURES 1 and 2 is designed to support the antenna under adverse environmental loading conditions. It consists of a non-rotating, hollow shaft 63 fastened securely to the platform 65 of the vehicle at one end and supporting the antenna through two roller bearings, not shown, at the other end. Slip rings, not shown, which carry the multi-channel received signal from the arrays, and a high power R.F. rotary joint to carry the transmitted power occupy the space between the two bearings. In FIGURE 2, it can be seen that the pedestal utilizes I-beams for bending members and tubing for compression members. FIGURE 1 shows the pedestal 9 with fabricated aluminum fastened atop it to provide a mounting base for the antenna.

The receiving arrays 6 and 7 consist of strip-line feeds radiating through slots in the ground plane. These are mounted in a sandwich-like structure which makes up the antennas 6 and 7. However, the parametric amplifiers, the mixers, and the electronics circuitry comprising the beam forming matrix have to be mounted in units 31-34, for antenna 6 and 35-38 for antenna 7. See FIGURE 3. These units are mounted on the back of the panels 12-15. These units have appreciable thickness which must be allowed for folding of the antenna.

The erection and folding of the antenna is best understood with reference to FIGURES 3 and 4. The antennas 6 and 7 are too wide to be directly folded one on top of the other and would present too wide of a load to be carried. The antennas are, therefore, hinged at horizontal axes 41 and 42. The ridges 46-49 at the hinge axis are wide enough to separate the panels 12 and 13, and 14 and 16 so that the units 31-38 will fit inside. The units 31-34 are positioned as shown in FIGURE 3 so that when panel 12 is folded on panel 13, the units will interleave. In this way, the final thickness of folded antenna 6 will only be increased by the thickness of one unit. The same construction is applied to the hinge and units of antenna 7.

3

The antennas are further hinged at their base along axes 43 and 44. The folding operation, therefore, consists of separating the antennas 6 and 7; folding panel 14 onto panel 15 along hinge axis 42; folding folded panels 14 and 15 onto pedestal 9 along hinge axis 44; folding panel 12 on panel 13 along hinge axis 41, folding folded panels 12 and 13 onto panel 15 along hinge axis 43. A reverse operation is followed for erection of the antennas. It should be noted that hinge axis 43 is higher than hinge axis 44 so as to allow for the thickness of folded antenna 7. Transmitting antennas 4 and 5 are mounted so as to be outside the folded antennas 6 and 7. The hydraulic actuators 18-25, FIGURE 2, provide the power for the folding and erection.

A preferred embodiment of the invention has been chosen for purposes of illustration and description. The preferred embodiment illustrated is not intended to be exhaustive nor to limit the invention to the precise form disclosed. It is chosen and described in order to best explain the principles of the invention and their application in practical use to thereby enable others skilled in the art to best utilize the invention in various embodiments and modifications as are best adapted to the particular use contemplated. It will be apparent to those skilled in the art that changes may be made in the form of the apparatus disclosed without departing from the spirit of the invention as set forth in the disclosure, and that in some cases, certain features of the invention may sometimes be used to advantage without a corresponding use of other features. It is, therefore, to be understood that within the scope of the appended claims, the invention may be practiced otherwise than as specifically described. Accordingly, it is desired that the scope of the invention be limited only by the appended claims.

I claim:

1. A folding transportable antenna system comprising:
 - (a) a pair of receiver antenna elements each of said elements including a plurality of members secured in hinged relation and disposed for displacement from a folded position for transportation thereof to an extended position for operation thereof;
 - (b) a plurality of electronic circuit units mounted on the sides of said members which are adjacent one another in said folded position, said units being mounted on said sides in spaced relation, whereby said units of one said adjacent side fit into the spaces

4

between said units of the other said adjacent side when the members are in the folded position;

(c) hinge means for securing said members together in the hinged relation.

2. An antenna system as set forth in claim 1, further comprising a vehicle upon which said antenna is mounted.

3. An antenna system as set forth in claim 2 including means for rotatably mounting said antenna on said vehicle.

4. An antenna system as set forth in claim 3, including a common base for said antenna elements, said antenna elements being mounted on said base in a back-to-back relationship.

5. An antenna system as set forth in claim 4 wherein said hinge means is secured to said members adjacent the edges thereof for hinging said edges together so that the members of a first of said antenna elements can be folded on said base and the members of a second of said antenna elements can be folded on top of said first folded antenna elements.

6. An antenna system as set forth in claim 5, further comprising a vehicle, and said common base being rotatably mounted on said vehicle.

7. An antenna system as set forth in claim 6, wherein said antenna elements are receiver array antennas and each said member is provided with a top and a base, each member being hinged at its base so as to allow the antennas to fold on top of the pedestal, and each element being divided into two parts whereby when said antenna means is folded on the pedestal the dimension of each antenna element above the pedestal is equal to four times the thickness of an antenna member plus two times the thickness of a unit.

8. An antenna system as set forth in claim 7, further comprising first and second transmitting array antennas mounted on said pedestal outside the bases of said receiver array antennas.

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