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2,432,984

ELECTROMAGNETIC WAVE REFLECTION SYSTEM

Filed April 5, 1940

FIG. 1

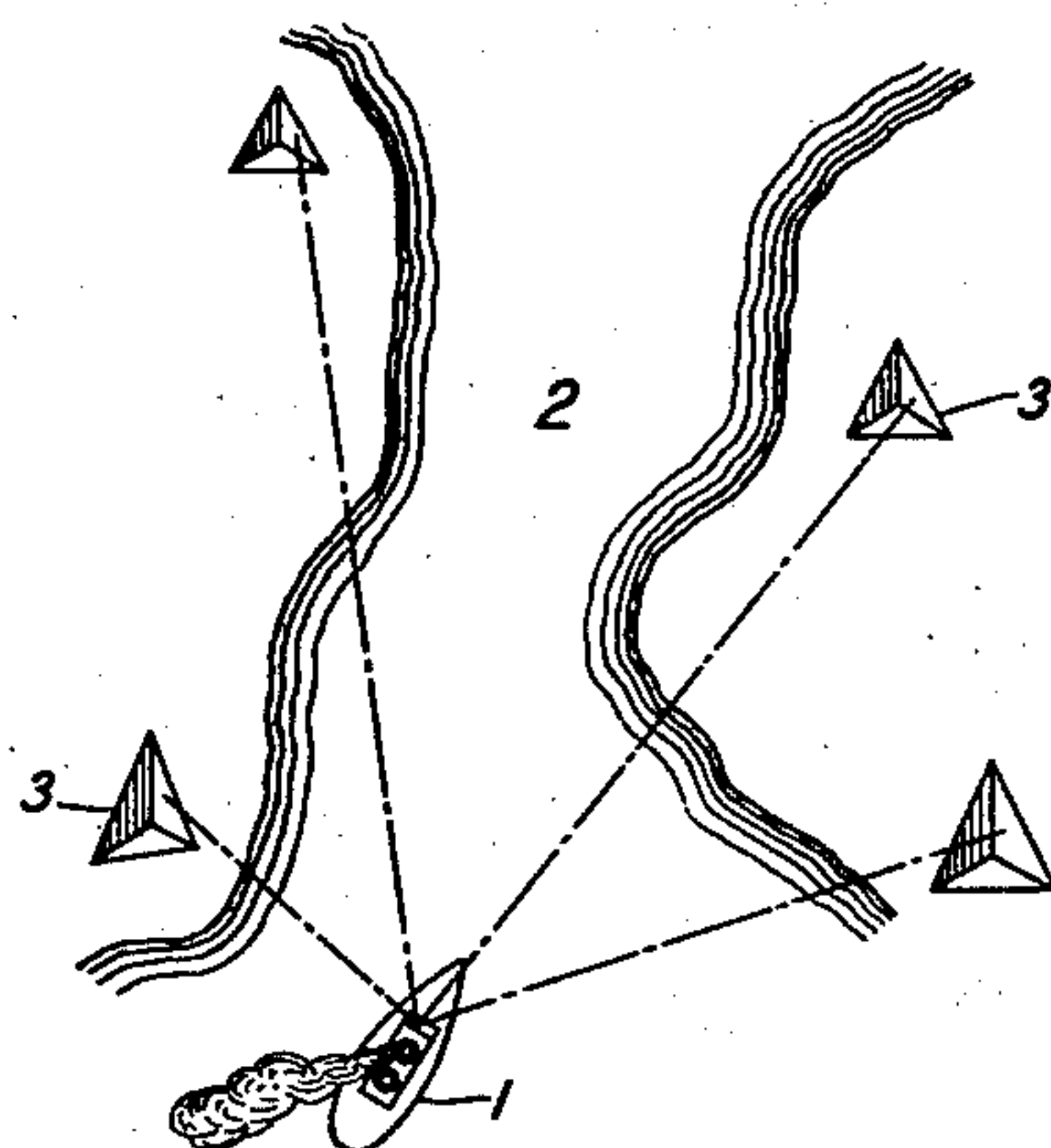


FIG. 2

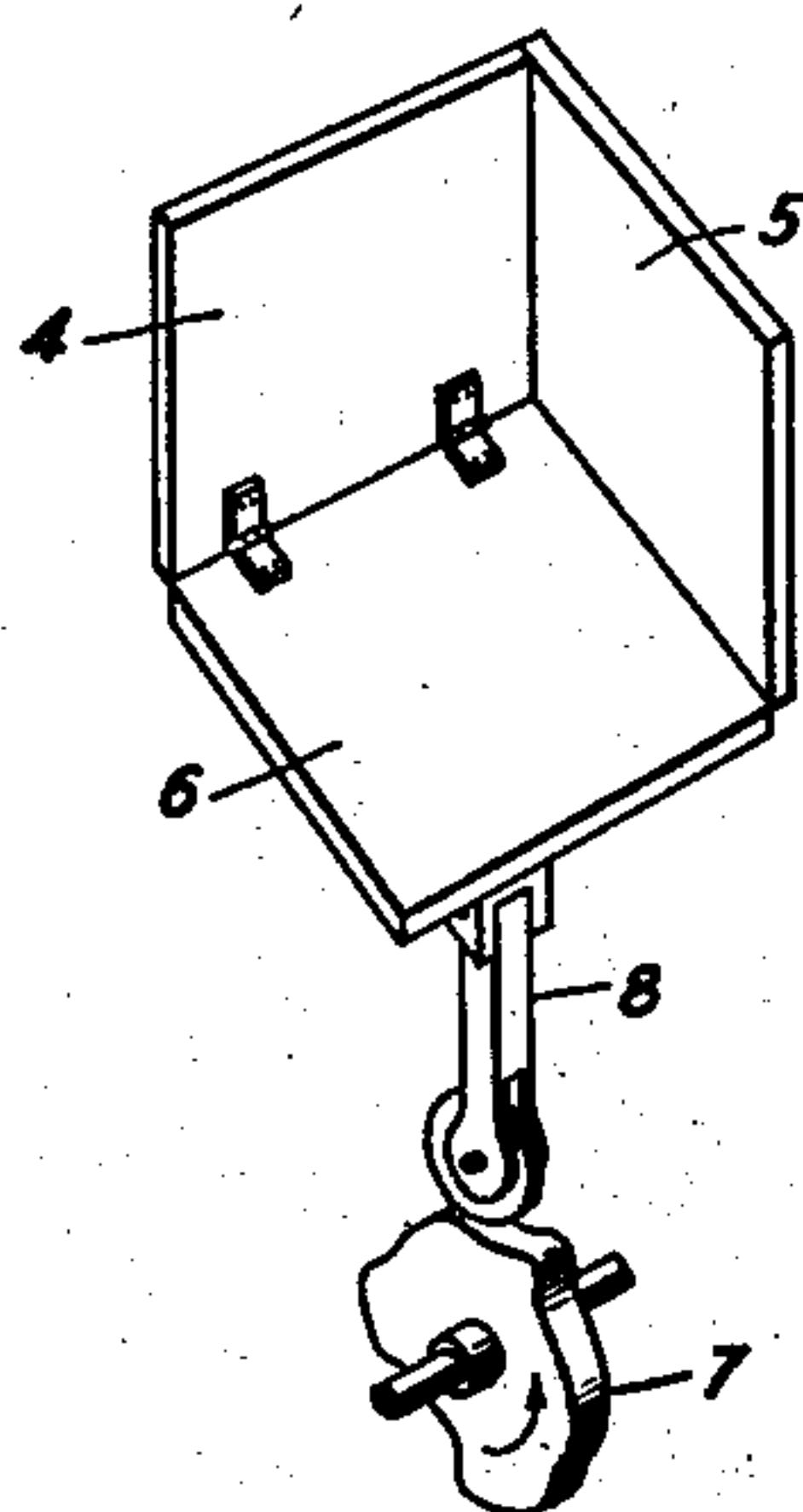


FIG. 3

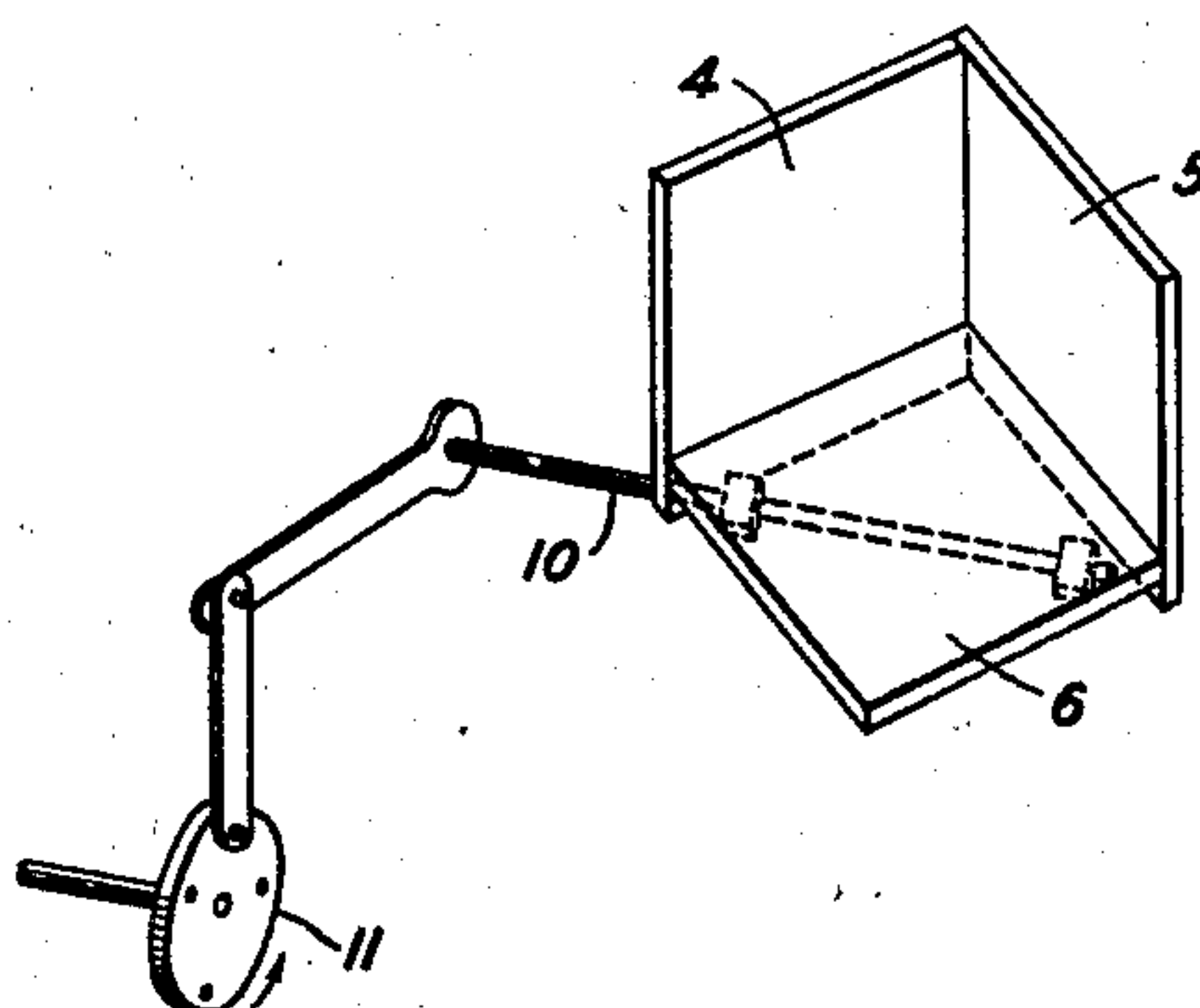
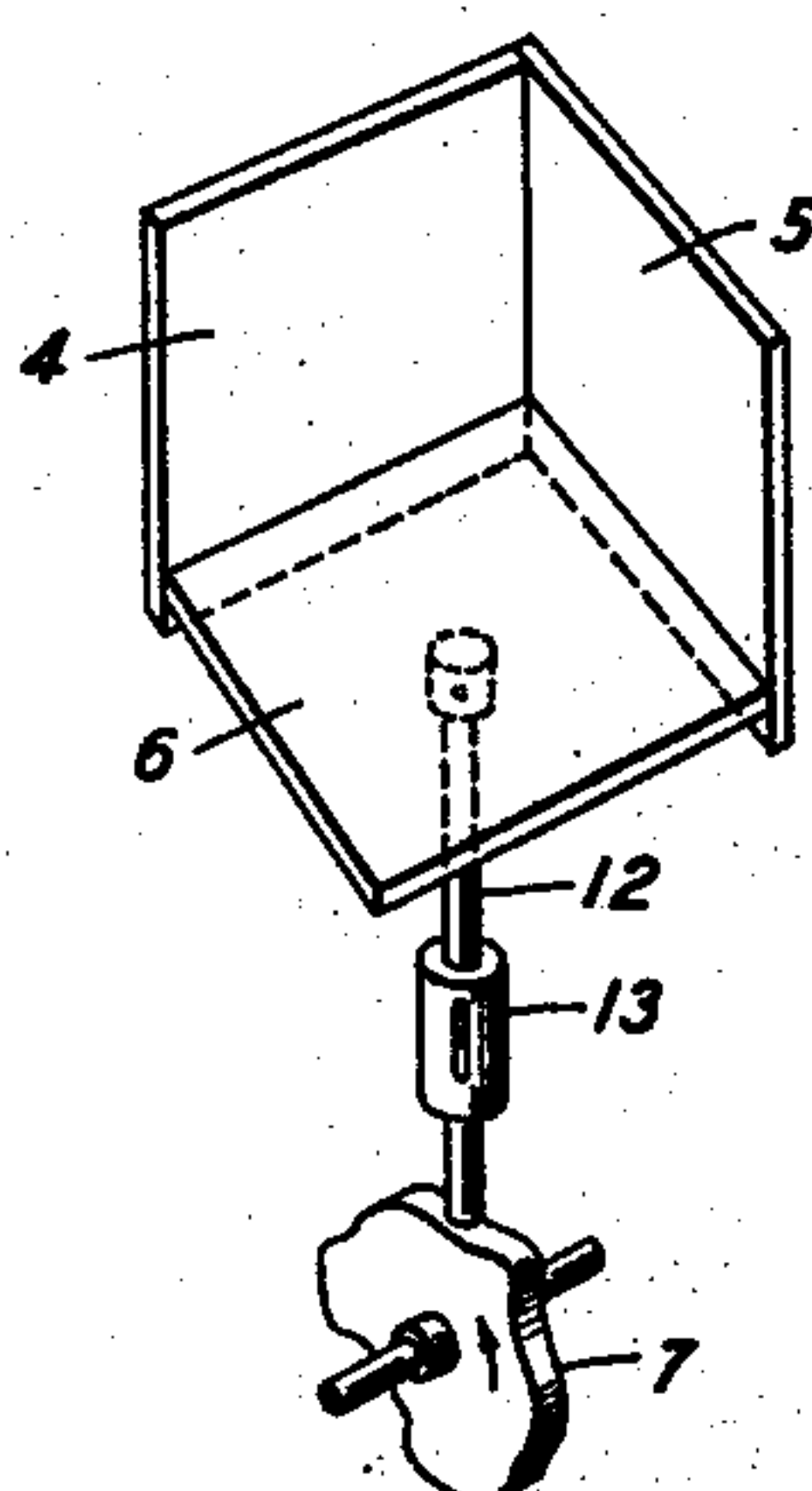


FIG. 4



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SYSTEM

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6 Claims. (Cl. 250—1.76)

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This invention relates to an improvement in radio reflector systems of the kinds disclosed in the copending application of G. C. Southworth Serial No. 281,537, filed June 28, 1939.

In the aforesaid Southworth application there is shown a radio system for marking a course for the guidance of ships, aircraft and other vehicles comprising a plurality of radio wave reflectors spaced along the course, each reflector being arranged to reflect an incident radio beam, launched from a vehicle passing within the angular range of the reflector, back toward its point of origin. Radio receiving means are provided on the vehicle for detecting the reflected wave so that the angular bearing of the reflector can be ascertained by observing the orientation of the beam launching means when reflected waves are detected in the receiver.

A principal object of the present invention is to enable differentiation between or identification of a plurality of radio wave reflectors from a distance. A more particular object is to provide a mechanically simple and reliable arrangement at each reflector for modifying the reflected wave in a preassigned manner individual to the several reflectors so that by observation of the reflected wave and of its said modification, the particular reflector from which it is returned can be determined.

In accordance with preferred embodiments of the present invention, the foregoing objects and others that will appear hereinafter are achieved by mechanical movement of one or more parts of the reflector such that the movement produces a corresponding variation in the reflected wave. The nature of the present invention will appear more clearly from a consideration of the specific examples of the invention illustrated in the accompanying drawing, in which:

Fig. 1 comprises a schematic outline of a reflector marker system to which the invention is applicable;

Fig. 2 shows a trihedral type of reflector with mechanical means for varying the angular relation of the several surfaces comprising the reflector; and

Figs. 3 and 4 show alternative modifications in accordance with the invention.

Referring now to Fig. 1 and to the course marking system outlined therein, a ship 1 is represented as traversing a river or channel 2 along the margins of which are arranged a plurality of radio wave reflectors 3. The ship may be presumed to be equipped with a radio beam transmitter, preferably one adapted for operation at

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radio wave-lengths of the order of centimeters, that can be rotated to move the beam in any desired horizontal direction. The ship is equipped also with a cooperative radio receiver, preferably one having a sharply directional or beam characteristic, that can be oriented in any horizontal direction to receive with maximum efficiency waves arising from reflection of the transmitted beam at a distant point.

Fig. 2 shows a preferred form of the radio reflector markers 3 in accordance with the invention. It comprises three metallic surface members 4, 5, 6 arranged in approximately mutually perpendicular relation to define an orthogonal trihedral or solid angle. With the three surfaces in strictly normal relation with each other, the reflector has the property of reflecting back toward its origin any incident radio wave entering the solid angle. This property is especially distinct when the radio wave-length is small compared with the dimensions of the component reflecting surfaces. For further details of the construction, application and properties of the trihedral reflector described and of the radio apparatus on the vehicle, reference may be made to the copending Southworth application, supra, the disclosure of which is to be deemed incorporated herein.

Two of the reflector surfaces in Fig. 2 are hinged together at their line junction, viz., the member 6 is hinged to the member 4 so that the angular relation between them can be changed. Controlling that angular relation is a mechanism comprising a rotatable cam 7 having spaced lobes around its periphery and a follower 8 which on rotation of the cam intermittently raises the edge of member 6 that is opposite the hinged edge, thereby modifying the angular relation between members 4 and 6. On disturbance of the mutually normal relation of the three surfaces, the hereinbefore described reflecting characteristic of the combination is impaired in greater or less degree, the reflected wave is directed not strictly toward its point of origin but diverted to some other direction, and the reflected wave power received on the ship is correspondingly substantially reduced or negligible.

As the cam 7 rotates therefore, the reflected wave received on the ship is normal or of maximum intensity with intermittent periods of reduced or zero intensity, the periods being fixed by the speed of rotation of cam 7 and the length and peripheral spacings of the cam lobes. The latter may conveniently be so arranged that the resulting amplitude modulation of the reflected

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wave conforms with a preassigned telegraphic code signal individual to and characteristic of the particular reflector so that from the ship the several reflectors of the system may be severally distinguished and identified.

In the modification of Fig. 2 that is illustrated in Fig. 3, one of the reflecting members 6 is so pivoted as to permit relative angular movement about the vertex of the reflector. More specifically the member 6 is attached to a rod 10 which is mounted along a diagonal and a mechanical linkage is interposed between the rod 10 and rotating disc 11 so that on rotation of the latter the rod 10 and plate 6 are oscillated back and forth through a small angle. In this case the intensity of the beam received by the ship varies at a frequency determined by the frequency of oscillation of the plate member 6. The amplitude modulation thus virtually impressed on the reflected wave may be translated into a tone wave or other low frequency vibration at the ship. Different modulating frequencies may be assigned to the several reflectors in the course marking system so that they may be severally identified by the preassigned frequency of modulation.

The embodiment of the invention that is illustrated in Fig. 4 makes use of the same trihedral type of reflector but in this case one of the reflecting surfaces 6 is subjected to a motion of translation normal to its plane rather than to an angular motion. Member 6 is supported at its mid-point at the upper end of a vertical drive rod 12 which slides in an appropriate fixed sleeve 13 and which is driven at its lower end by a rotating cam as in Fig. 2. As the member 6 rises and falls under the control of the driving mechanism, the intensity of the wave power redirected toward the source of the incident wave correspondingly rises and falls and the amplitude modulation thus introduced may be utilized in the manner described to identify the particular reflector.

It should be understood that the orientation of the reflector as a whole and of the particular surface or surfaces to be varied in position is to be determined with reference to the angular range over which the device is to be operative as a reflector, whether that range be substantially horizontal, vertical or otherwise as it may be in various applications of the reflector marker, and that the drawings are not intended to indicate a particular orientation.

Although the present invention has been described with reference to a particular type of reflector and to particular means for introducing characteristic amplitude modulation, it will be understood to those skilled in the art that the invention is capable of a variety of alternative embodiments within the spirit and scope of the appended claims.

What is claimed is:

1. In a reflector marker system or the like, an

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orthogonal trihedral angle reflector for radio waves, and means for displacing one of the reflecting surfaces thereof relative to another in a preassigned manner whereby the said reflector may be identified at a distance point by virtue of resulting variations in the reflected waves reaching said point.

2. In a reflector marker system or the like, an orthogonal trihedral angle reflector for radio waves, and means for periodically modifying the angular relation of the surfaces comprising said reflector.

3. In a reflector marker system or the like, an orthogonal trihedral angle reflector for radio waves, and means for modulating radio waves incident on said reflector comprising means periodically translating one of the surfaces comprising said reflector in a direction normal to its plane.

4. In combination in a system wherein electromagnetic waves are transmitted to a distant reflector and received after reflection therefrom, a reflector comprising three reflective plane surfaces disposed substantially normal to each other to form a trihedral angle whereby said reflector tends to direct an incident wave back to its point of origin, and means for controllably varying the intensity of the reflected wave returned to the said point of origin comprising means varying the relative positions of said reflective surfaces.

5. In a system wherein a beam of electromagnetic waves is directed to a distant reflector and received after being returned by reflection therefrom, a reflector comprising a reflective expanse shaped to reverse the direction of any beam incident upon it from directions within a restricted angular range, and means for varying the intensity of the said beam as received after reflection comprising means controllably distorting the shape of said expanse.

6. A reflector comprising three planar reflecting elements mounted normally in mutually perpendicular relationship, and means to vibrate one of said elements with respect to its normal position of perpendicularity.

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