June 11, 1946. R. E. HERSEY 2,401,759

DIRECTIONALLY SELECTIVE RADIO COMMUNICATION SYSTEM

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FIG. 1

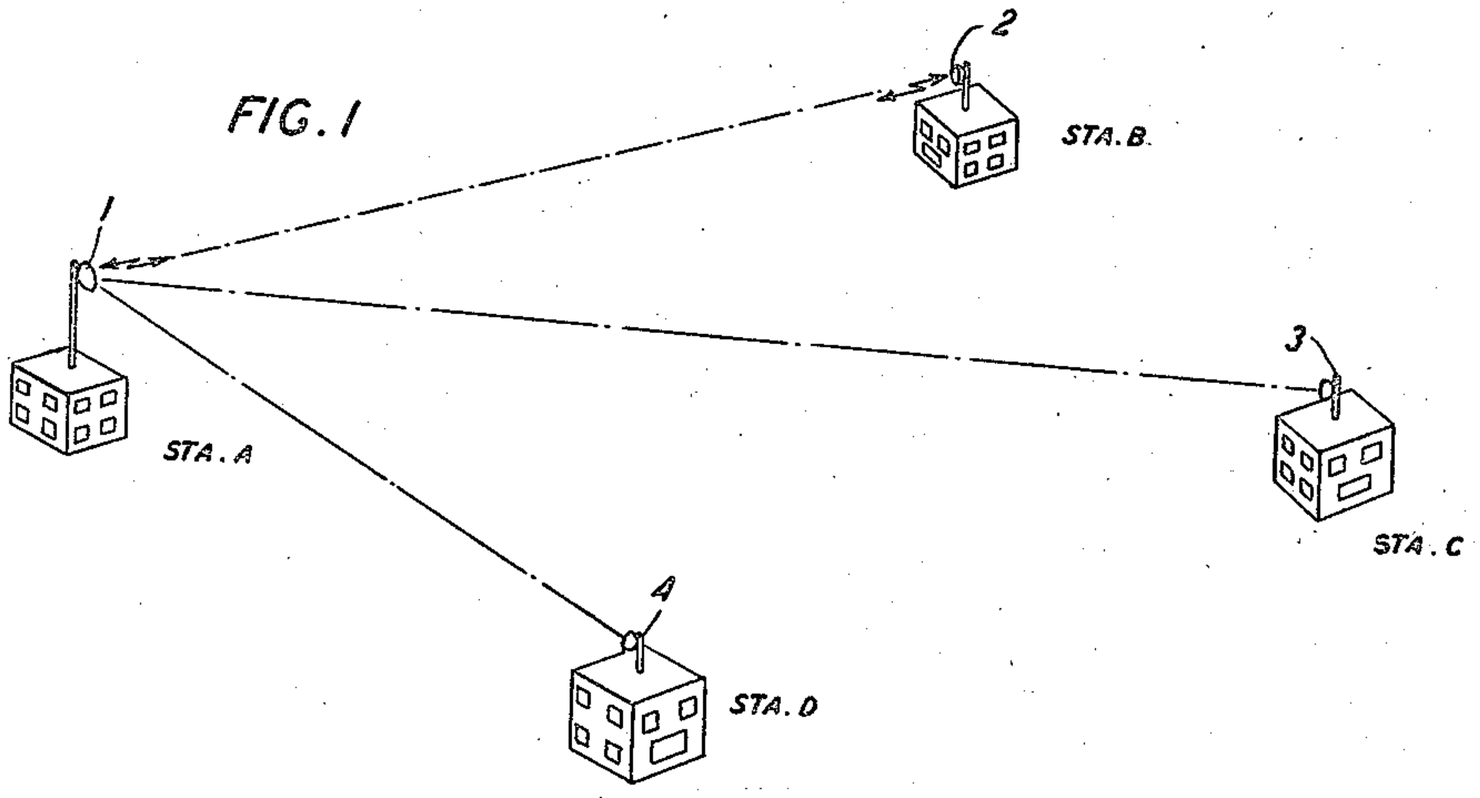

FIG. 2

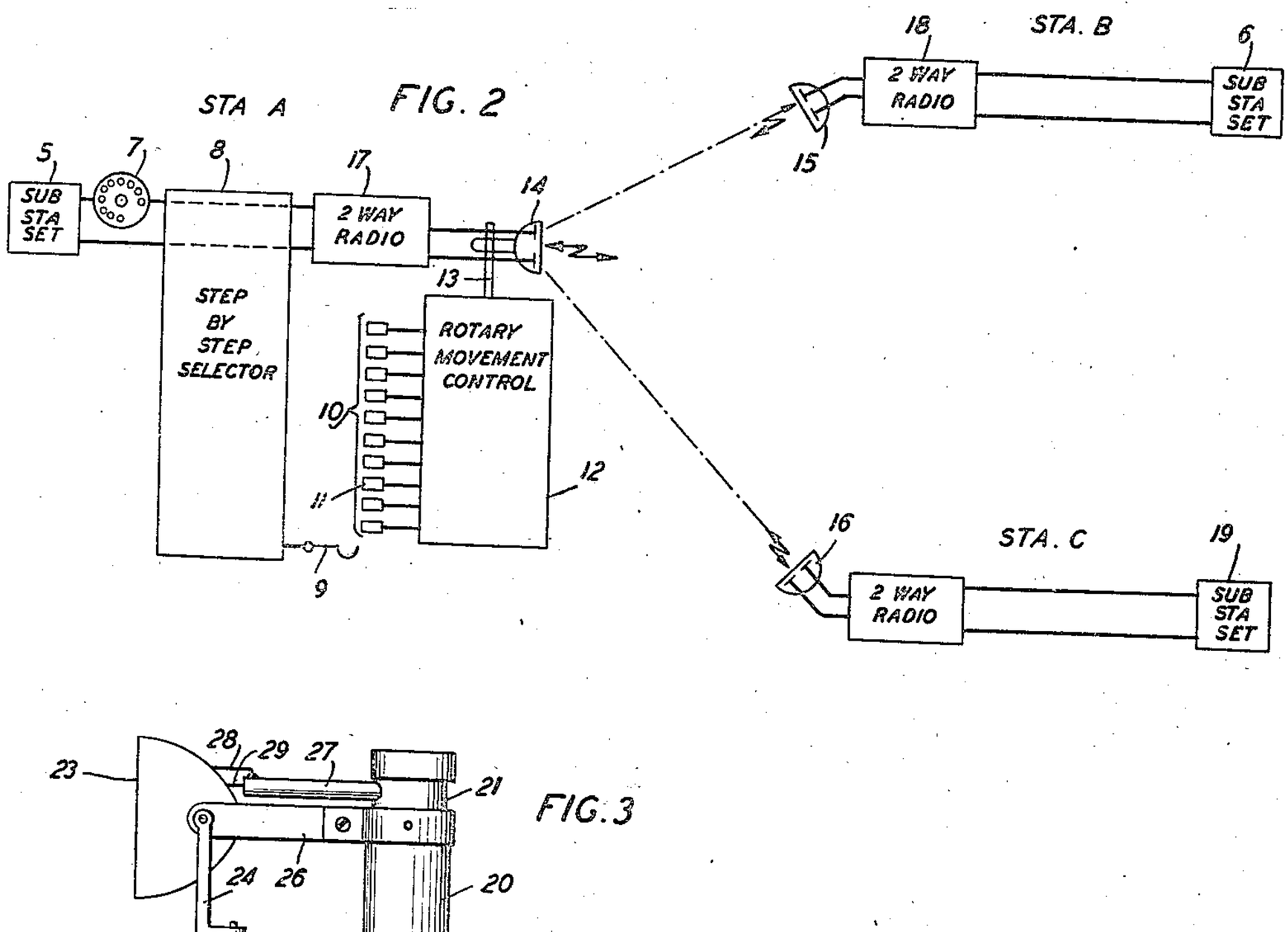

FIG. 3

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FIG. 4

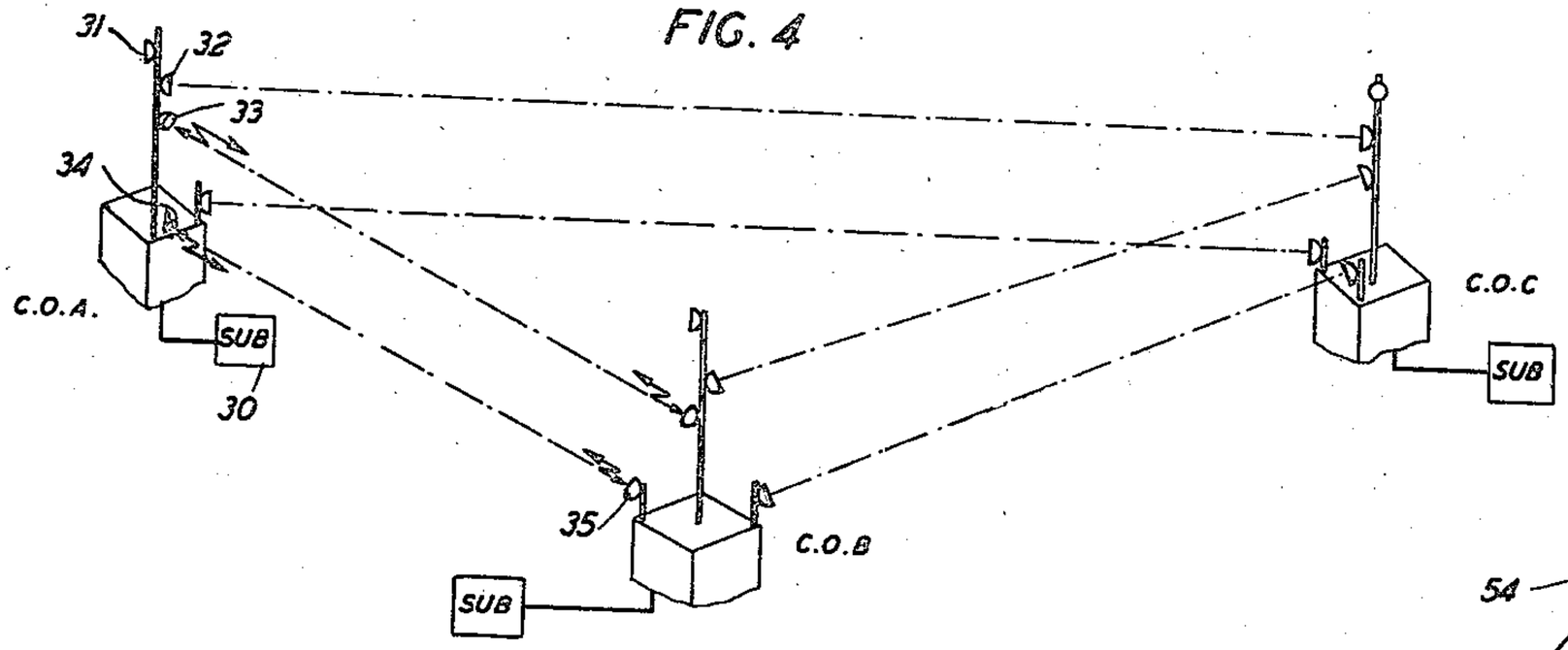

FIG. 5

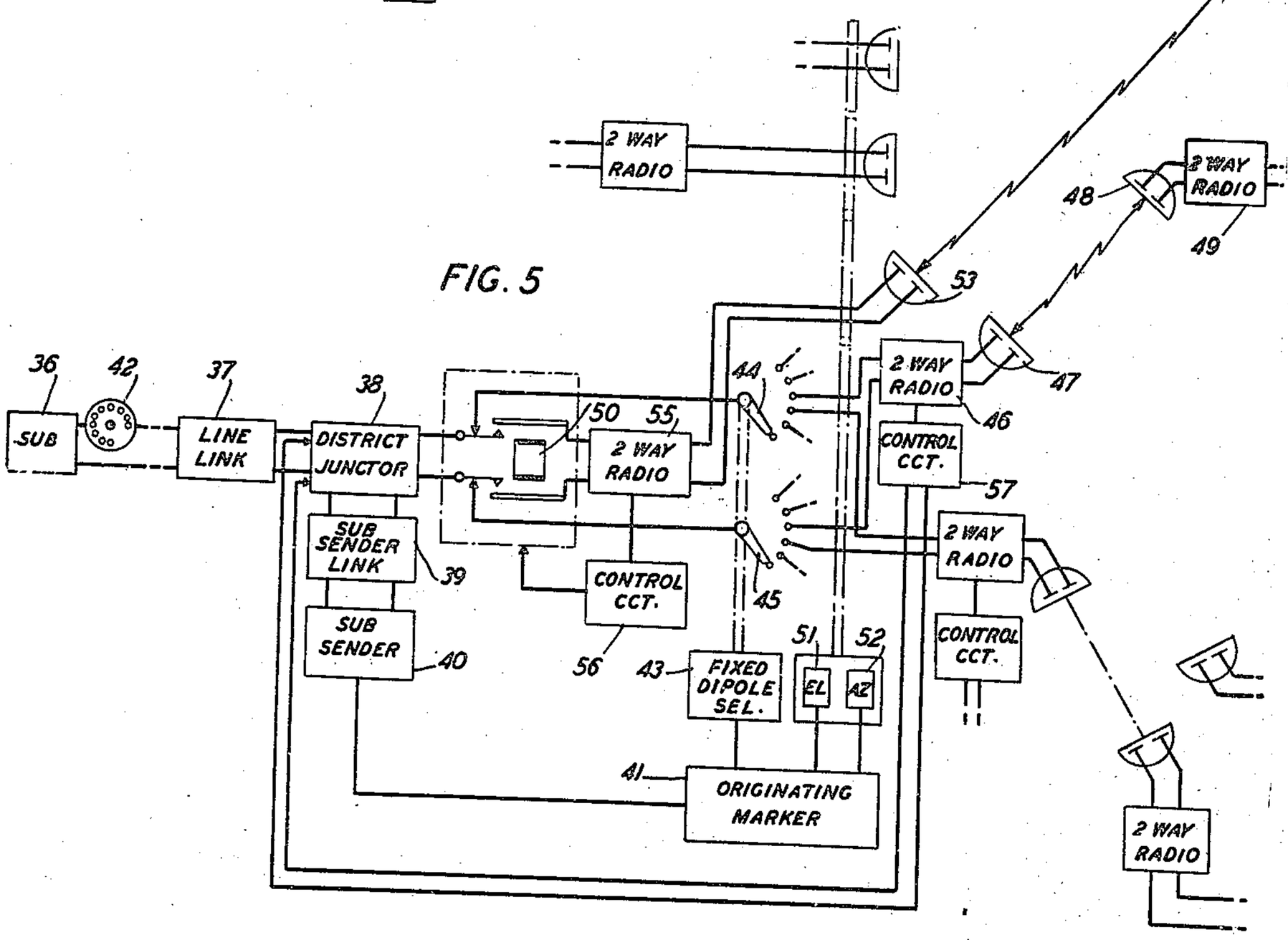

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FIG. 6

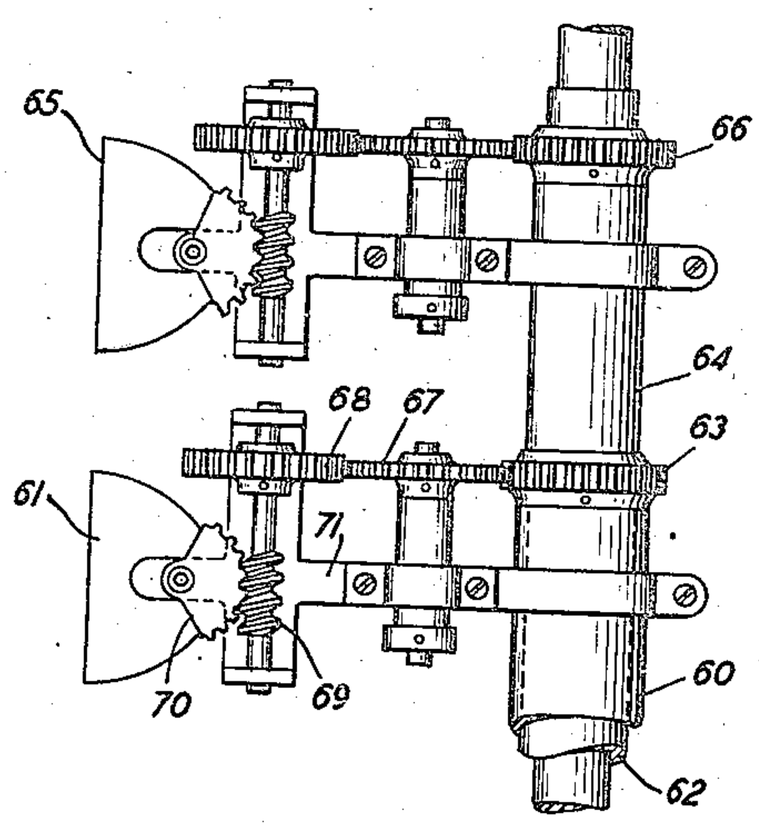
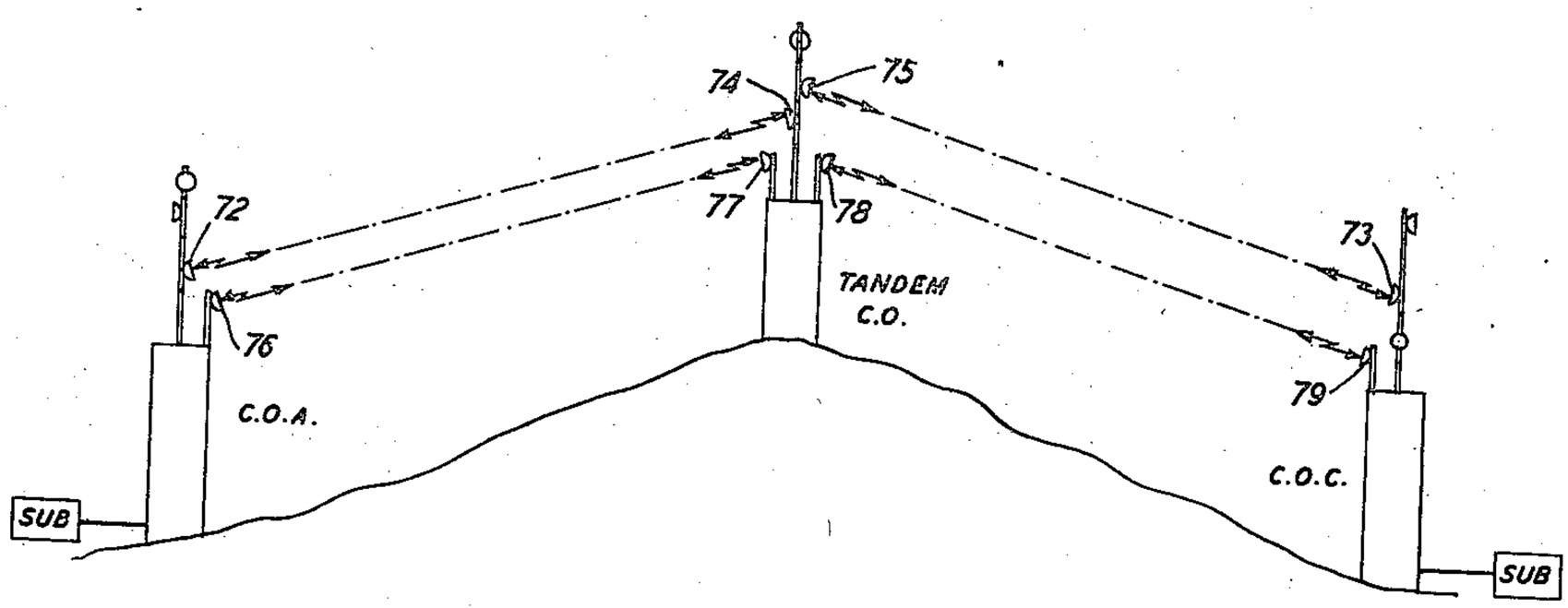


FIG. 7



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UNITED STATES PATENT OFFICE

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DIRECTIONALLY SELECTIVE RADIO COMMUNICATION SYSTEM

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Application March 22, 1944, Serial No. 527,604

2 Claims. (Cl. 250—6)

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This invention relates to telephone systems and particularly to machine switching systems employing radio links, the object being to employ an antenna transmitting a highly directive beam and to mechanically orient the beam by machine movement under dial control.

In accordance with this invention, a radio link is used in establishing a telephone channel. A transmitting antenna will be rotatable so that the channel may be selectively beamed to cooperate with any particular one of a number of receiving antennae in accordance with the location of the wanted party.

In a simple embodiment of the invention, a small telephone system may employ a radio link for communicating with a number of surrounding points relatively inaccessible to land lines, as for instance for interisland communication. In such a case the antenna may be rotated under dial control. If the number of surrounding points is ten or less, then the setting of the directive antenna may be directed in accordance with a single digit of the called telephone number. Means will also be provided to adjust the elevation of the beam to care for differences in elevation of the cooperating receiving antennae. In the simple case above mentioned, a camming arrangement may be employed so that the elevation is automatically adjusted for each azimuthal position directly reached.

The invention may be employed in more complex systems—as for instance in the cross bar telephone system—where such a directive transmitting antenna is associated with each district junctor and is set to a given azimuthal and elevational position under control of the originating marker.

The invention also comprehends means for directing a pair of antennae to line up on the same line extending therebetween so that where both are adjustable, a communication channel between the two may be established by machine switching movement control.

The invention further comprehends the use of relay antenna stations so that if a path is desired which is optically poor because of interfering objects or distance the antenna may be pointed toward a relay or tandem point in order that the beam may be redirected to avoid the obstruction.

A feature of the invention is a movable antenna in a radiotelephone system which may be directively pointed in a wanted direction under dial control.

Other features will appear hereinafter.

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The drawings consist of three sheets having seven figures, as follows:

Fig. 1 is a perspective and schematic representation of one manner in which the present invention is employed;

Fig. 2 is a schematic circuit diagram of the means for controlling the elements of the present invention;

Figure 3 is a side view of a mechanism that may be used for pointing a transmitting antenna;

Fig. 4 is a view similar to that of Fig. 1 showing the use of a plurality of antennae atop each of a plurality of central office buildings;

Fig. 5 is a schematic representation of the means including circuits employed for controlling the devices of Fig. 4;

Fig. 6 is a side view of the mechanisms which might be employed to point the antennae of Fig. 4; and

Fig. 7 is a schematic representation of the employment of a tandem or relay point.

One embodiment of the invention is shown in Fig. 1. Here are shown four buildings marked Sta. A, Sta. B, Sta. C and Sta. D, respectively. Mounted atop the building Sta. A is an antenna 1 which may be moved into cooperative relationship with any one of the fixed antennae 2, 3 or 4 mounted atop the buildings marked Sta. B, Sta. C. or Sta. D, respectively. It will be understood that these antennae may be of any conventional and convenient form for establishing a very narrow beam communication channel, and that they will be connected to circuits for two-way transmission.

The operation of the system may be seen through a consideration of the system as illustrated in Fig. 2. Let us say that a subscriber at station 5 wishes to establish communication with a subscriber at station 6. The subscriber at station 5 by methods indicated by the dial 7 will set up a connection to a machine switching element 8 which may be a step-by-step selector having a brush 9 operable under dial control to move over a row of contacts 10 and to come to rest in connection with any one of them such as 11. Each of the contacts, such as 11, is connected to means in the rotary movement control 12 whereby through the movement of shaft 13 the antenna 14 may be selectively pointed to establish communication over paths controlled by distant fixed antennae such as 15 and 16. Let us say that when the brush 9 is set on terminal 11, the antenna 14 is moved to cooperative relationship with antenna 15. Thereupon the two-way radio sets 17

and 18 will be enabled and communication will be established between substation 5 and substation 6. In the same manner communication may be established to other substations such as substation 19. The essentially new operation in this arrangement is that the subscriber sets up the connection to the wanted subscriber in the conventional manner through the manipulation of his dial 7 and that in response to at least one operation of the dial the antenna 14 is rotated and oriented into cooperative relationship with a distant antenna leading to the wanted substation.

Fig. 3 shows a mechanical arrangement which may be mounted atop a building for orienting an antenna. The device is made of a pair of hollow concentric sleeves 20 and 21. The outer sleeve 20 has a cam 22 affixed thereto which is found to tilt the antenna represented by its reflector 23 by an appropriate amount at each azimuthal position thereof. The reflector is mounted to move about a horizontal axis under control of an arm 24 which carries a roller 25 bearing on the surface of the cam 22. The reflector 23 is primarily mounted on a bracket 26 which is fixed to the inner sleeve 21 so that by rotation of this inner sleeve the antenna may be rotated to any desired azimuthal position. A coaxial connection to the antenna is represented by the element 27 and the two conductors 28 and 29, the conductor 29 being connected to the centrally located conductor and the conductor 28 being connected to the sheath 27.

Fig. 4 shows another embodiment of the present invention in which it is employed on a much more elaborate basis. In this arrangement the movable antennae may be used atop central office buildings so that communication channels replacing interoffice trunks may be established. There may be a plurality of antennae functioning as either transmitting or receiving antennae. Thus central office A, serving a large plurality of subscriber stations, such as the substation 30, may have mounted thereon the antennae 31, 32 and 33, representing a great number of such devices. It is contemplated that a plurality of antennae may be mounted on each support and that there may be a plurality of such supports. Likewise central office B and central office C are each shown with similar arrangements.

One manner of operation may be controlled by an order wire arrangement whereby a pair of fixed antennae are employed for a common communication channel between each pair of central offices. Thus antenna 34 atop central office A and antenna 35 atop central office B are both fixed and provide a permanent communication channel between these two offices for a purpose which will now be described in connection with Fig. 5.

This arrangement is illustrated in schematic form as applied to a cross bar telephone system such as that generally described in an article entitled "Crossbar dial telephone and switching system" by F. J. Scudder and J. N. Reynolds in the Bell System Technical Journal, volume 18, January, 1939, pages 76 et seq. In accordance with this arrangement a subscriber at station 36 in removing his telephone from its cradle causes his line to be extended through the line link frame 37 to a free district junctor 38 and this in turn will be connected through the subscriber sender link 39 to a subscriber's sender 40. The subscriber at station 36 will now operate his dial 42 and register in the sender 40 the number of the called station. After this number has been

partially registered the originating marker 41 will control the fixed dipole selector 43 to establish a communication channel to the central office in which the wanted subscriber is located. Let us assume that under control of the marker 41 the fixed dipole selector 43 moves the brushes 44 and 45 into association with terminals leading to the two-way radio circuit 46 which feeds the fixed dipole 47 whereby a communication channel is established by way of the cooperating fixed dipole 48 and the two-way radio circuit 49. Thereupon the usual information is transmitted from the subscriber's sender 40 over the normal contacts of a relay 50, the brushes 44 and 45 the two-way radio circuit 46, fixed dipoles 47 and 48, the two-way radio circuit 49 to the usual incoming sender and terminating marker (not shown).

At the originating end the originating marker 41 controls devices 51 and 52 to orient the antenna 53 individual to district junctor 38 into cooperative relationship with another antenna such as 54 which will be similarly oriented by the terminating marker thereat. When a communication channel is thus established through the antennae 53 and 54 an appropriate signal translated by the two-way radio circuit 55 will cause an operation in the control circuit 56 which will result in the operation of relay 50. The common circuit established via antennae 47 and 48 will then be dropped off and returned to common use. By means of a control circuit an appropriate control may be exercised over the district junctor 38 so that the subscriber sender link and the other common apparatus in the system will be dismissed as soon as the wanted connection is established by way of antennae 53 and 54.

The mechanical arrangements whereby the elevational and azimuthal adjustments are made by the elements 51 and 52 under control of the marker 41 are not shown as any convenient mechanical device may be used. In Fig. 6 the mechanical arrangements on the support for orienting a plurality of antennae are shown.

The mechanical arrangements for making the elevational and azimuthal adjustments to point the transmitting antenna to different receiving antennae are fundamentally the same as shown in Fig. 3. Here, however, a larger number of concentric sleeves are provided, two for each antenna, such as a sleeve 60 for making an azimuthal adjustment of the reflector 61 and a sleeve 62 to which a gear 63 is affixed to make an elevational adjustment of reflector 61. Similarly a sleeve 64 to make an azimuthal adjustment of reflector 65 and a sleeve to rotate gear 66 to make an elevational adjustment of the reflector 65 are provided. The elevational adjustment of reflector 61 is made through a train consisting of gear 63, gear 67, gear 68, worm 69 and gear 70, the reflector being mounted on bracket 71 and being rotatable about a horizontal axis by the gear 70.

Fig. 7 shows an arrangement which may be used when a straight line optical path from an antenna 72 atop a central office A and an antenna 73 atop a central office C cannot be used. In this case the antenna 72 may be pointed to and aligned with an antenna 74 atop a relay or tandem central office and through appropriate circuits the communication channel may be further extended by antenna 75 which will be aligned with antenna 73 in the manner hereinbefore described. The fixed dipoles 76 to 79 may be used in the manner described in establishing such a complete relayed communication channel.

What is claimed is:

1. In a dial telephone system, means for establishing a telephone channel including a radio link under dial control, including a transmitting station and a plurality of surrounding receiving stations, a narrow beam transmitting antenna at said transmitting station and a cooperating receiving antenna at each of said receiving stations, dial controlled means for selectively rotating said transmitting antenna into cooperative relationship with any one of said receiving antennae and means for automatically adjusting the elevational position of said transmitting and receiving antennae.

2. In a dial telephone system including a plurality of central offices, means under dial control for establishing a plurality of telephone channels between substations in different central offices each including a radio link between the two central offices serving the calling and the called substations, including orientative narrow beam antennae at said central offices, and dial controlled means for selecting and orienting a pair of said antennae into cooperative relationship with each other.

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