

Sept. 15, 1959

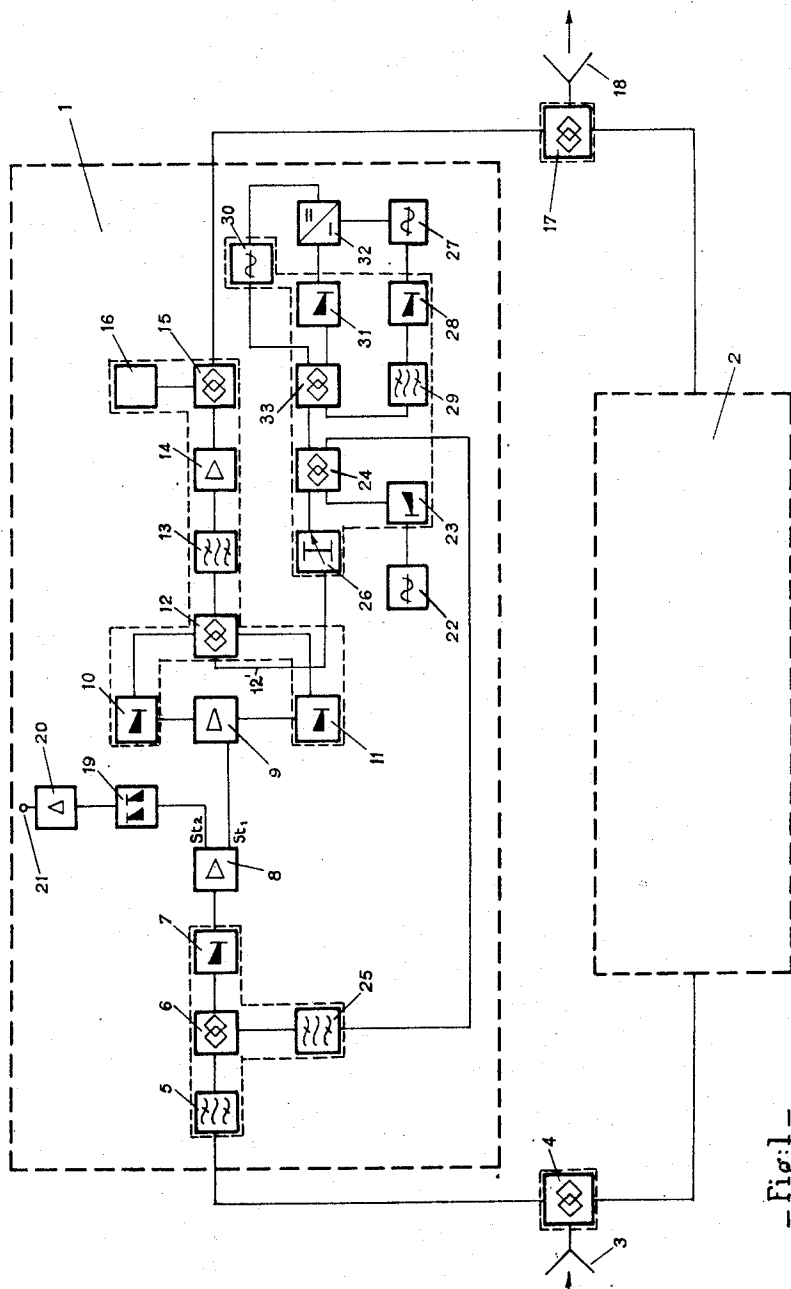
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2,904,725

EQUIPMENT FOR TELECOMMUNICATIONS BY MEANS OF HERTZIAN BEAMS

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6 Sheets-Sheet 1



- Fig. 1 -

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FIG. 2

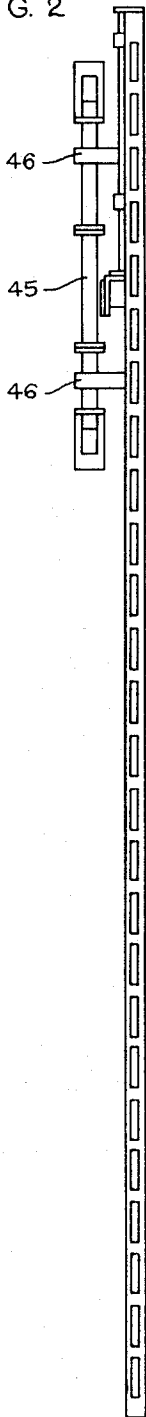


FIG. 3

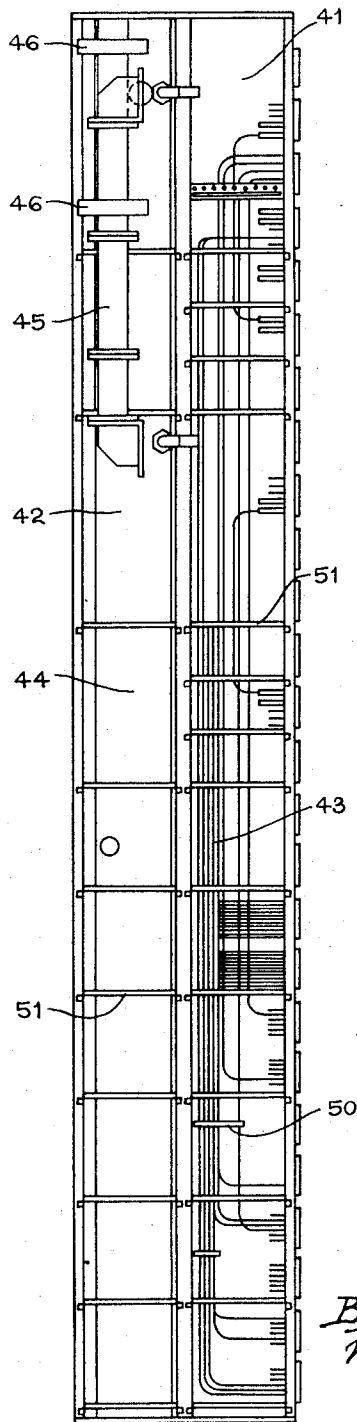


FIG. 4

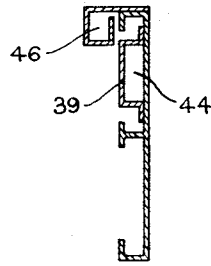


FIG. 5

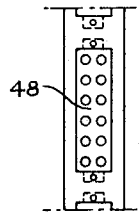


FIG. 6

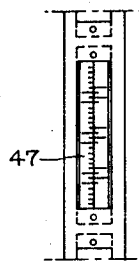
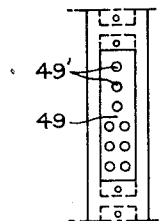


FIG. 7



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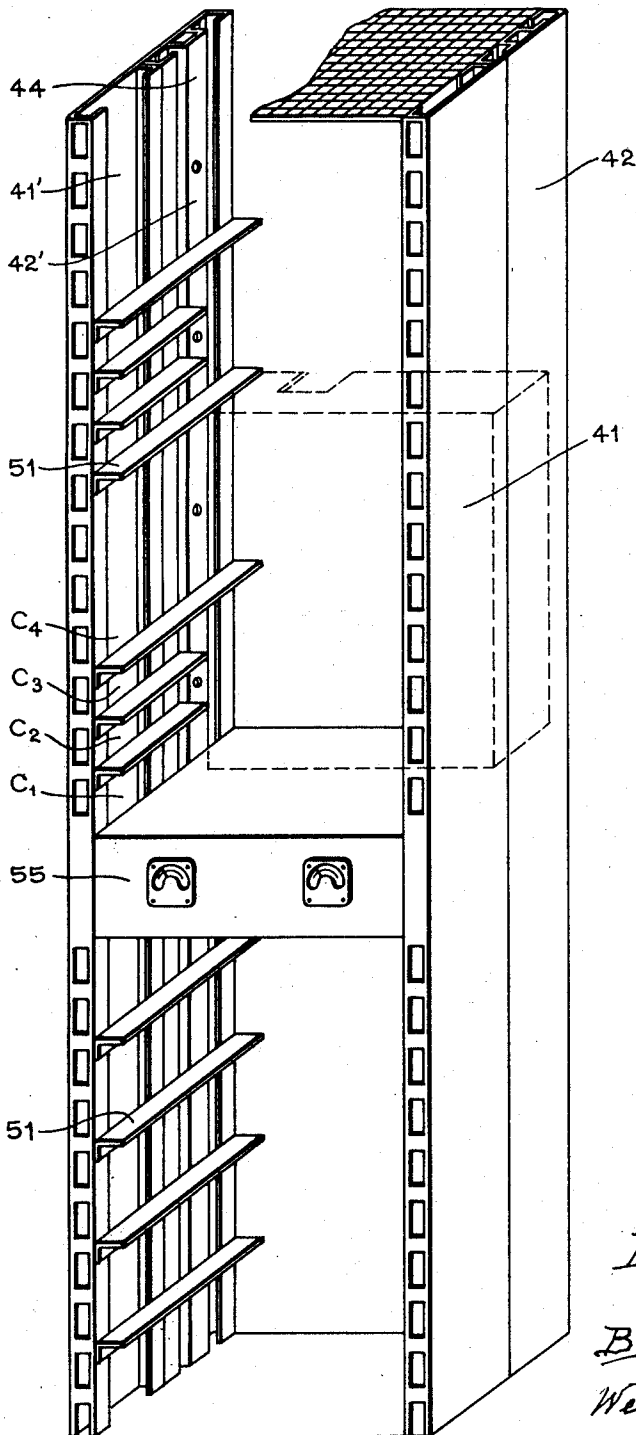


FIG. 8

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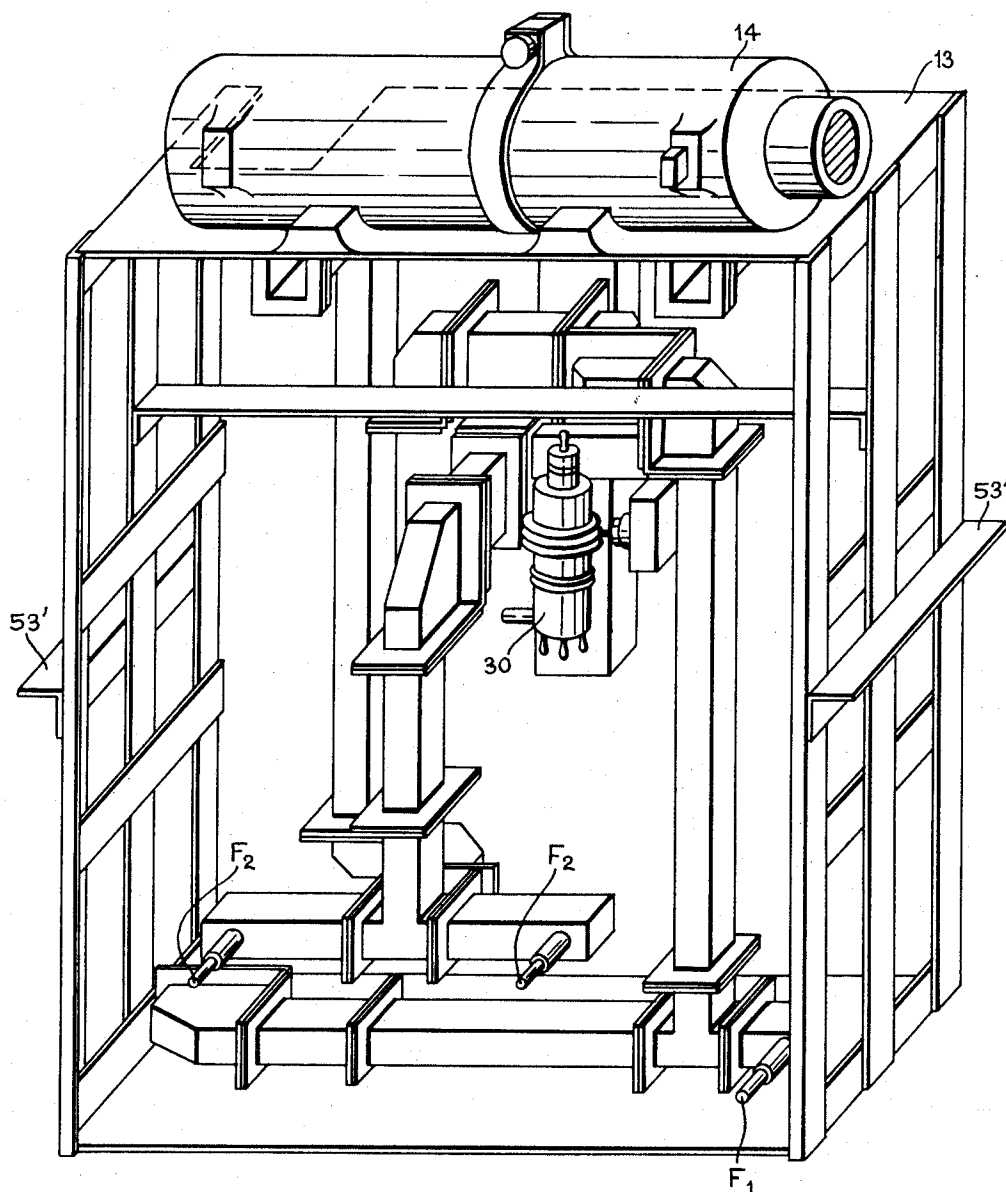


FIG. 9

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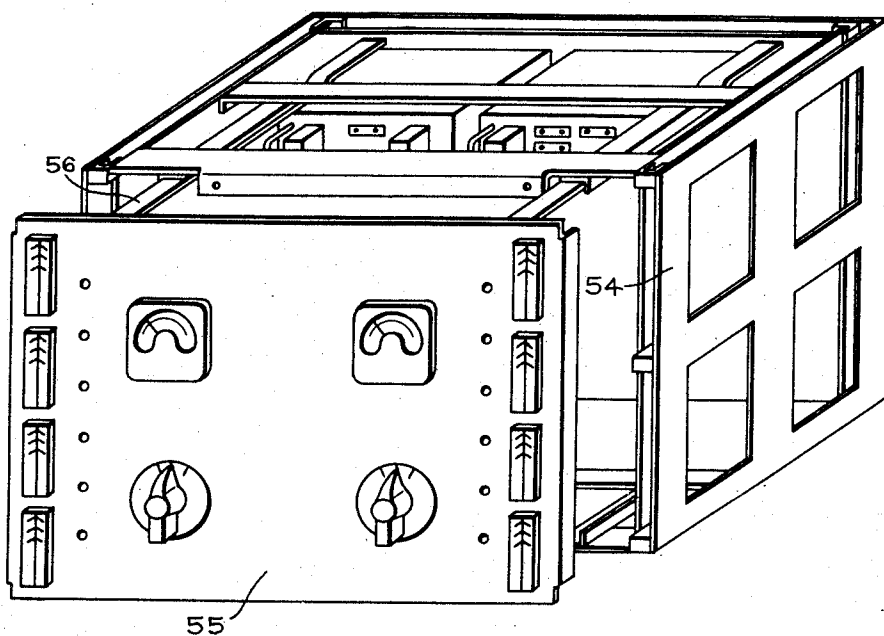


FIG. 10

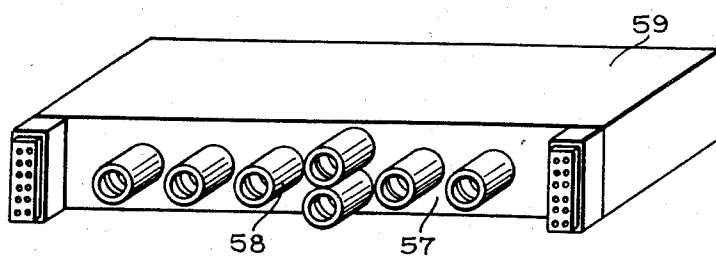


FIG. 11

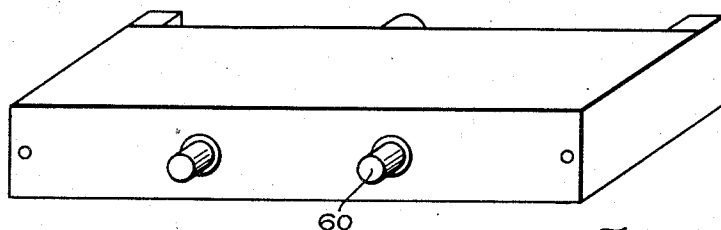


FIG. 12

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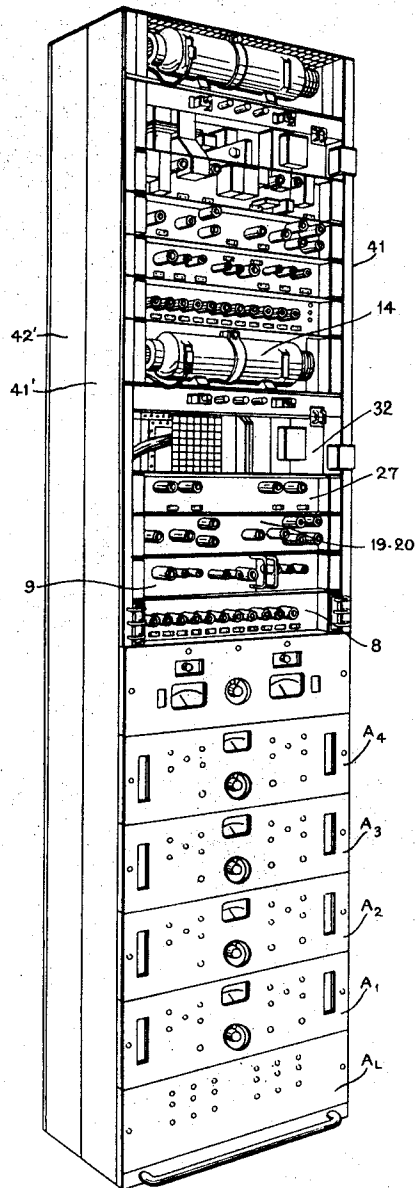
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FIG. 13



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EQUIPMENT FOR TELECOMMUNICATIONS BY
MEANS OF HERTZIAN BEAMS

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Application March 29, 1955, Serial No. 497,730

3 Claims. (Cl. 317—99)

The present invention relates to telecommunication equipment, particularly for intermediate or terminal relay-stations, for short-wave radio communications, which must be set in places from which there is a long clear view, for instance on iron towers or in high altitude situations to which usually no carriage road can lead.

Equipment of this type known up to now has included a heavy rack entirely factory assembled, wherein the rack is equipped in the factory with all its electronic apparatus and wave-guide elements and then is conveyed with great difficulty to the site where it is to be erected. Frequently, it is necessary to instal an aerial ropeway between the carriage road situated at the foot of a more or less high hill and the structure upon it which is to receive this equipment. This makes the transportation costs rather high.

Another drawback of this type of rack, equipped and adjusted in the factory is the difficulty arising in intermediate stations of connecting the wave-guides assembly with the feeders of the transmitter and the receiver aeriels; for the rack includes a part of the equipment constituting a wave-guide, namely an assembly of rectilinear elements, or T-shaped elements securely fixed upon the rack. As the angles of the cranked and T-shaped elements are made with rather wide tolerances, it often happens that the ends of this wave guide assembly, when the rack is set in position, will not exactly register with the ends of the feeder, also made as wave-guides and the connection will then require some fitter's work which can be carried out only by a qualified fitter.

And lastly, the type of equipment above described or rack, assembled in the factory and upon which the elements are permanently set, requires for the constant attendance at its rather deserted site of qualified workers for maintenance and repairs on the site.

Equipment according to the present invention obviates these drawbacks. The rack comprises two hollow pillars wired in the factory, the wiring terminating on strips of tags and/or in strips of sockets, both on the front faces of the pillars and these pillars are assembled on the site of the station to form shelves: the various electronic apparatus and wave-guides are contained in individual blocks which are inserted at the station in these shelves, and these blocks include sockets which can be joined by staples to complete the circuits required.

In one embodiment of the invention, the assembly of wave-guides is elastically suspended in a rigid frame, which allows it sufficient freedom to permit of connection with the lower end of the wave-guide feeder even if the end of this feeder does not exactly register with the corresponding end of the wave-guide assembly when the rack is assembled.

By way of example, a form of equipment for a relay station according to the invention is described hereinafter and illustrated in the annexed drawing:

Figure 1 is a block diagram of the equipment.

Figures 2, 3, 4 illustrate respectively the front face, the hollow or inner face and a section of a pillar.

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Figures 5, 6, 7 illustrate strips of sockets and strips of tags supported by the pillars.

Figure 8 is a perspective view of the assembled rack, showing the containers in which the blocks and the frame are inserted.

Figure 9 is a perspective view of a frame equipped with wave-guides.

Figure 10 is a perspective view of a measuring, signalling and commutation frame.

Figure 11 illustrates diagrammatically a block of electronic apparatus.

Figure 12 shows a back-view of the block of Figure 11.

Figure 13 shows a fully equipped rack.

As shown in Figure 1, the relay-station according to the invention includes two amplifying channels, 1, 2, mounted in parallel between the receiving aerial 3 and the transmitting aerial 18, through the switches 4, 17 by which either channel may be put in circuit. Each switch comprises a shunt T wave-guide, the side arms of which have shutters adjusted in position. A single drive actuates simultaneously the two shutters, so that the waves arriving through the shunt arm of the T are directed toward one only of the lateral arms and thereby to either the amplifying channel 1 or the identical amplifying channel 2.

The amplifying channel includes a band rejection filter 5 constituted by a wave-guide provided with two shunt cavities, tuned to frequencies near the receiving heterodyne frequency and it allows the passage of the frequency band transmitting the signal. The band rejection filter is connected to a T shunt wave-guide 6 fed through the shunt arm and through a band-pass filter 25 by the heterodyne source (described in detail hereafter); the side-arms of the shunt T 6 are respectively connected with the output of the band-rejection filter or band elimination filter 5 and with the input of the receiving mixer 7. This mixer consists of a crystal mounted within wave-guide and it receives simultaneously the output signal of the filter 5 and the heterodyne frequency. The beat signal of 70 mc./s. obtained is fed to the mean frequency amplifier 8 by means of a coaxial socket provided on the wave-guide element which constitutes the receiving mixer 7. Into this socket is plugged the block containing the electronic apparatus constituting the mean frequency amplifier 8, including two coaxial outputs, St_1 , St_2 , mounted in parallel.

The output St_2 is connected with a receiving detector and a demodulator 19 with two limiting stages, and a discriminating assembly, and thence to a video amplifier 20.

The output St_1 of the mean frequency amplifier is connected with the transmitter mixing amplifier 9, 10, 11, consisting of two parallel channels, each including two clipping stages and a power stage. The coaxial outputs of the two channels supply two identical signals in opposite phases which are respectively applied to the terminals of the germanium crystals of the transmitting mixer 12.

This mixer is constituted by a magic T wave guide section, the shunt arm of which is connected by means of the coupling 12' to the transmitting heterodyne source (described hereafter) and the side arms are provided with germanium crystals (above mentioned), set in mountings into which plug the coaxial outputs of the transmitting mixer amplifier 9, 10, 11. The signal issues from the amplifier through the series arm of the T and enters the transmitter mixing filter 13 which is a filter with three wave-guide cavities, intended to select one of the lateral bands supplied by the transmitter mixer 12 and to transmit the selected band to the travelling wave tube 14 which gives an emission power of 1 watt

for an input power of about 25 milliwatts supplied by the mixer 12. The signal is then transmitted to the transmitting aerial 18 through the switch T 17, its shutter being correctly set, after having passed through a probe 15 through which, a signal may be injected into the input of apparatus for maintenance measures, connected with a power indicator.

The heterodyne frequencies for the transmitting mixer 12 and the receiving mixer 7 are produced from the same klystron 30, with which is associated a frequency stabilising device.

The waves supplied by the klystron 30 pass through:

(1) A first directional cross coupler 33 to stabilise frequencies, a second cross coupler 24 for mixing producer; a variable attenuating line, 26. The waves passing through this way reach, through the coupling 12', the shunt arm of the transmitter mixer 12.

(2) The energy taken out by the first directional coupler 33 (which, like the second directional coupler, is a cross coupler, the coupling between the principal arm and the secondary arm being made through circular holes, the diameter of which is a variable dependent on the desired coupling), passes through a reference cavity 29 and is reflected on a modulator crystal 28, modulated by a 18 kc./s. voltage supplied by the generator 27. The reflected energy comes back through the cavity and the coupler 33 to be detected by a crystal 31. By comparing on a discriminator 32 the voltage 18 kc./s. applied by the modulator crystal 28 and the voltage 18 kc./s. supplied by the detector crystal 31, a control D.C. voltage is obtained which is applied in the appropriate direction on the reflector of the klystron, so that the frequency of said klystron is brought back in the vicinity of the frequency of the cavity.

(3) The energy taken out by the second coupler 34 is reflected on a crystal 23 modulated by the quartz generator which supplies the transposition frequency of the relay. The modulated energy passes in the opposite direction through the coupler 24, through a low pass filter (not shown) to eliminate the high harmonics, and through the band-pass filter 25 which selects a modulation side band to be applied to the shunt arm of the switch 6.

In Figure 1, all the wave-guide elements in the amplifying channel 1, and the members such as klystron or travelling wave tube which are directly mounted in or on the wave-guide frame, are encircled by a dotted line. The other elements of electronic apparatus are made up in blocks which are plugged by coaxial sockets, upon coaxial tags provided on the wave-guide elements or are connected with said tags, by flexible coaxial cables. The equipment includes also a block containing the mean frequency amplifier 8, a block containing the receiving detector and amplifier 19, 20, a block containing the transmitter mixing amplifier 9, a block containing the transposition generator 22, a block containing the generator 27 of the frequency stabilisation system and a block containing the demodulator 32.

The rack receiving the equipment is essentially made up as shown in Figures 2 to 8, of four pillars 41, 42, 41', 42', assembled in pairs, having a profile in current use for the telecommunications material and an overall length of 2.640 mm., for instance.

The pillars are equipped at the factory as follows:

The front pillars 41, 41', are provided with a wiring 43 made of normal telephone wire, terminating in various connecting members corresponding to various parts of the equipment of the rack. The connecting members are strips of tags 47 and strips of sockets 48 fixed on the front part of the pillars 41, 41'. Some of the strips of sockets 49 bear coaxial sockets 49' (see Figure 7). The wiring is held in place by means of wire guides 50.

In the pillars 42, 42' are arranged U-shaped channel irons 39 constituting ventilating ducts, held in place by angle irons 51 which form slides for locating various or-

gans built up in drawers. The associated pillars 42—42' also support wave-guide feeders 45, fixed by collars 46 to the rear face of the pillars which are the beginning of the aerial feed.

Between the pillars, a frame 54 is fixed by screws: this frame contains a panel 55 on which are mounted the protection, signalling, measure and switching devices.

In the lower part of the rack, beneath the panel 55, the angle irons 51 delimit five spaces in which are placed, from below upwards, as seen in Figure 13, a block AL for the general feed, a block A₁ containing the members feeding the klystron of the amplifying channel 1, a block A₂ containing the members feeding the klystron of the amplifying channel 2, a block A₃ containing the members feeding the travelling wave tube of the amplifying channel 1 and a block containing the members feeding the travelling wave tube of amplifying channel 2. All these blocks are provided on their front face, near the pillars, with strips of sockets, to receive U-shaped connecting elements engaging said sockets and corresponding sockets provided for on strips fixed on the pillars, to make the necessary connections passing through the pillars to feed the electric apparatus.

Above the panel 55, the angle irons 51 delimit two superposed sets each of four spaces, C₁, C₂, C₃, C₄ and C₁', C₂', C₃' and C₄', the two lower angle irons in each set extending only half the depth from the front.

In the casings C₁ to C₄, are placed equipments for the amplifying channel 1 and in the casings C₁' to C₄' are similarly placed equipments for the amplifying channel 2.

In the rear part of the spaces C₁ to C₄ in the rack is placed the wave-guide frame, illustrated in Figure 9 and shown diagrammatically in Figure 8, in which frame are assembled all the elements encircled by a dotted line in the amplifying channel 1 of Figure 1.

The wave-guide elements are connected, according to a known technique, by their straps and this rigid assembly is elastically suspended, for instance by means of rubber dampers, in appropriately selected places on the frame 53. This type of suspension is not shown in Figure 9 to avoid overcharging the drawing. Such a suspension includes a damper in the shape of a rubber cylinder on a stem fixed at one end to an element of the frame and at the other end to a rigid stem screwed on a strap of an element of the guide.

This suspension provides during assembly a certain freedom for the coupling of the terminal strap of the wave-guide with the corresponding strap of the aerial feeder. A wave-guide element may with advantage be made flexible, thereby increasing this freedom.

The frame 53 has, in its top plate, a notch for the coupling with the feeder and the plate bears in front the travelling wave tube 14.

The frame 53 rests, by means of its side angle irons 53' upon the rear part of the third pair of angle irons 51. The wave-guide elements include coaxial plugs F₁, F₂, F₃ which can plug in the electronic apparatus above described, all designed according to the same principle.

A block of apparatus has been illustrated, by way of example, in Figures 11 and 12. It consists of a plate 57 upon which are mounted, in front, sockets 53 for valves, adjustment means and connection means; at the rear of the plate are mounted the elements constituting the apparatus. These elements are sheltered by a hood 59 screwed upon stirrup pieces, soldered at the rear of the plate. The hood has notches for the passage of sockets plugging on the coaxial plugs of the wave-guide elements. The blocks are removable and the junctions between them and with the wiring of the rack are carried out by means of U-shaped connecting elements, as shown in Figure 13 illustrating the rack with full equipment.

In this figure, are to be seen the pillars 41, 41', 42, 42'

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upon which is screwed the frame of Figure 10 and in which is slidably fitted the control panel 54.

Below this panel are the various feeding blocks, as above recited.

Above the panel are placed successively:

The block 8, containing the mean frequency amplifying elements plugged at the rear on the coaxial plug F₁.

The block 9 containing the transmitter mixing amplifier, plugged on the plug F₃ and, next to it, the block containing the transposition generator 22 plugged on the plug F₂.

The block containing the receiving detector 19—20 and above it, to the right:

The block containing the demodulator, having in its right side a ventilation aperture, at the height of the klystron.

The travelling wave tube 14, supported by the wave-guide rack.

This assembly forms the amplifying channel 1 and it is surmounted by an identical assembly forming the amplifying channel 2.

The blocks 8, 22, 19—20, 27 and 32 bear strips of sockets by means of which the connections illustrated in Figure 1 and the connections required for the feed are made through U-shaped connecting elements plugged also into sockets of the strips on the pillars.

The equipment of a station for short-wave radio, as above described, is thus made up by independent assemblies, mounted and adjusted at the factory or at the station, as the case may require, the assemblies being of small bulk and easy to fit together and to replace, which is a particular important feature for material which is of difficult access at the top of a high tower or on high altitude site.

What I claim is:

1. In an equipment for a station for telecommunication by short wave radio, including two hollow pillars, a parallelepipedic frame disposed between said pillars and screwed at about mid-height thereon, whereby said pillars are maintained in spaced parallel relationship to form with said frame a rack, angle irons fixed on the inner faces of the pillars and delimiting in the rack a number of compartments, strips of terminals on the front faces of the pillars opposite the compartments, a wiring arranged vertically within the pillars, in the front portion thereof, and terminating on said terminals, blocks of apparatus inserted in said compartments, strips of terminals being connected to the terminals on the front faces of the pillars to complete the circuit and U-shaped irons vertically disposed within the pillars in the rear half-portion thereof to provide ventilation ducts in the rack, and clamping collars for supporting wave-guide feeders to be connected to a terminal of an aerial, the improvement which consists in assembling in a single structure those elements of the signal circuits and heterodyne frequency circuits which are formed as wave-guides, in elastically suspending said wave-guide structure in a single frame to be removably mounted within the rack,

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whereby the connection of said wave-guide structure to the aerial is facilitated.

2. In an equipment according to claim 1 in which the removable frame occupies the rear half of the depth of the rack and in which the elements of the wave-guide structure bear connecting tags upon which plug, from bottom to top, a block containing a high frequency amplifier, a block containing a transmitter mixing amplifier and a block containing a transposition generator, both situated at the same level, a block containing a detector and a block containing a frequency stabilisation system.

3. Equipment for a station for telecommunication by short wave radio including two hollow pillars, a parallelepipedic frame disposed between said pillars and screwed at about mid-height thereon, whereby said pillars are maintained in spaced parallel relationship to form with said frame a rack, a first set of angle irons carried by the pillars below the parallelepipedic frame and delimiting thereunder five lower compartments, a second set of angle irons carried by the hollow pillars, above the parallelepipedic frame, and delimiting two superposed spaces, each of which being divided in four compartments, a removable frame inserted in the rear half portion of each of said spaces, a wave-guide circuit elastically suspended in each removable frame and carrying a number of connection tags, blocks inserted from the bottom to the top of the corresponding space in the said four compartments and plugged upon said tags, the said block consisting in a block containing the mean amplifying elements, a block containing a transmitter mixing amplifier and adjacent thereto, in the same compartment, a block containing a transposition generator, a block containing the receiving detector elements, a block containing a frequency stabilising system, a block containing a demodulator system, a travelling wave tube, a drawer inserted in the parallelepipedic frame and containing the maintenance, measuring and protection material for the equipment, and there below, in the lower compartments two drawers containing, each, members feeding the travelling wave tube, two other drawers containing elements for the general feed, strips of sockets on the front faces of the pillars opposite the blocks and the various drawers, a wiring disposed within the pillars for connecting together sockets on the pillars disposed at different levels, strips of sockets on the blocks and on the drawers whereby the circuits may be completed by inserting U-shaped connecting elements in sockets on the pillars and on the block and drawers.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

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September 15, 1959

Myron Lebedinsky

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

In the heading to the printed specification, between lines 7 and 8, insert -- Claims priority, application France April 9, 1954 --.

Signed and sealed this 7th day of June 1960.

(SEAL)

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