

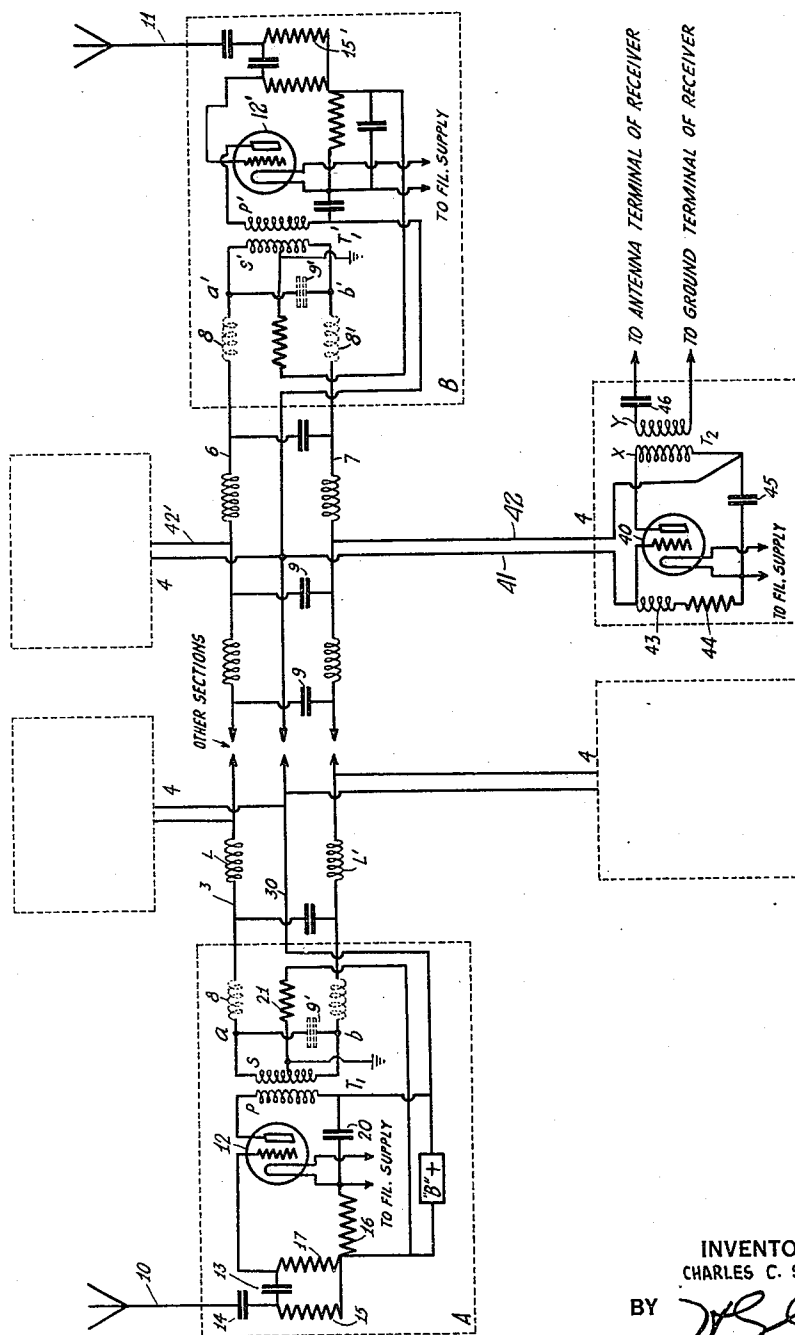
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CENTRALIZED RADIO SYSTEM

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CENTRALIZED RADIO SYSTEM

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My present invention relates to radio receiving systems, and more particularly to systems of the centralized type.

Radio receiving systems of the centralized type are now well known. These systems may be broadly classified in two groups. One group employs a radio frequency signal transmission path from the common antenna to each tunable receiving circuit; while, the other group utilizes an audio frequency signal transmission path from a common antenna and one or more tunable receivers to each reproducer arranged for switching in any one desired program selected by the receivers. An example in the prior art of a centralized audio frequency system is found in U. S. Patent 1,733,609 issued on October 29th, 1929, to J. J. Kuhn. A centralized system of the radio frequency type is disclosed by J. Weinberger in application Serial Number 350,869, filed March 29th, 1929.

Regardless of which of these systems is employed, they both have certain features in common, viz; a common energy collecting means, one or more distribution paths, and one or more signal responsive means connected with each path. When a centralized system is employed in a physically fixed structure, as a hotel, no particular reception problem arises, save those inherent in the system itself. However, when a centralized system is installed on a mobile structure, as for example a train, an operating difficulty occurs which becomes a serious obstacle to ideal reception.

To illustrate, assume an antenna mounted on one of the cars of the train, say the last one. If the centralized radio frequency system is being employed, the antenna is connected by means of an audion tube, connected as an untuned radio frequency amplifier, to a low loss transmission line, consisting of wave filters. This line is connected through all the cars of the train, and an untuned radio frequency amplifier coupling stage connected to the line at each point, in each car, where reception is desired.

The antenna and ground terminals of a complete receiving apparatus would then be coupled to the output of the coupling stage at

each of said car positions, thereby enabling the user to select any program for himself.

In the centralized audio frequency system, of course, as many complete receivers would be installed in the antenna car as stations desired. The program of a station would then be sent over a line to speakers, or headphones, situated at several points in each car. Thus, as many lines as there are programs, would be used; each speaker, or phone, would necessarily have associated with it a switch for connecting the device to any one of the lines.

Now, it will be apparent, and actual test and experience on train installation has shown, that on both the radio and audio frequency systems, the antenna must be collecting the maximum amount of radiated energy from all stations within its range, to assure ideal reception within the cars. In actual test work, as already stated, such ideal antenna operation was found practically impossible of attainment for a number of reasons.

In the first place, it was found that the antenna had a shielding effect exerted on it, whenever the train was passing a steel, or other metallic structure. The same effect was observed in the vicinity of metallic deposits, trees, power or other electrical guiding lines. Again, directional changing effects were observed as the train passed around curves. The net result of these observations was that a single common antenna was subject to being rendered inoperative, thus greatly detracting from the enjoyment of a program. Variations in signal intensity were marked whenever the train approached and passed over bridges, through tunnels, and the like.

After considerable experimentation, an arrangement was devised for practically eliminating interference with radiant energy collection. Briefly, the principle of the new arrangement, and one of the main objects of this invention, depends upon the use of more than one antenna, the antennae being physically separated and arranged in such a manner relative to the common signal responsive means that substantially constant energy collection is accomplished at all times, regard-

less of the environment or direction variations of the mobile structure in which the receiver system is installed.

Another important object of my invention is to provide a centralized receiving system, either of the audio frequency or radio frequency type, especially adapted for use on mobile transportation structures, although readily adapted for utilization in connection with fixed structures, which system consists in collecting signal energy at physically separated points, and feeding the collected energy from both points to a common signal responsive element, the physical separation being of such a nature that antenna directional effects, and shielding effects of structures external to the mobile structure, are effectively minimized.

Still another object of the invention is to provide an antenna system for centralized receiving system employing radio frequency transmission lines, which system is particularly adapted for use on trains, and in which system each of two radio frequency amplifiers has its input circuit actuated by the energy obtained from its individual antenna, or other input, the output of each amplifier being coupled through its coupling transformer to the same transmission line, the latter including wave filter sections, individual complete receivers being operated at distinct points in each car from potentials generated in the transmission line by coupling each of the receivers individually to the transmission line through a coupling amplifier tube.

Another object of the invention is to provide an antenna system for a common signal responsive means mounted in a mobile structure, the system comprising two or more antennae, physically independent of one another and separated, both being connected to the same signal responsive means, the arrangement of the antennae being such that if one antenna is inoperative due to temporary shielding, the other acts as a source of energy to actuate the responsive means; or, if the direction of one antenna is different from that of the other, a low signal strength on one may be counter-balanced by a relatively high signal strength on the other, due to different directional effect of the antennae.

Still other objects of the invention are to improve generally the efficiency of centralized receiving systems, and to provide a system, particularly useful on mobile structures, which is reliable in operation and yet economically installed.

The novel features which I believe to be characteristic of my invention are set forth in particularity in the appended claims, the invention itself, however, as to both its organization and method of operation will best be understood by reference to the following description taken in connection with the

drawing in which I have indicated diagrammatically one circuit organization whereby my invention may be carried into effect.

Referring to the accompanying drawing, there is diagrammatically shown a centralized receiving system, of the radio frequency transmission type (hereinafter termed "centralized radio system", as distinguished from "centralized audio system", for the sake of simplicity). This system is particularly adapted for use on mobile structures, as for example a train. Accordingly, while the system will be, hereinafter, described as installed in a train, it is to be clearly understood that the use of the arrangement is not so limited.

Assuming, then, that the box A, in broken lines, is either the first or last car of the train, say the first, and the box B the last car, two antennae 10, 11 are shown mounted on the cars A, B respectively. Thus, antenna 10 can be considered as mounted on the roof of car A, while antenna 11 is mounted on the roof of car B. Antenna 10 is connected to the input circuit of a coupling amplifier tube 12, the grid of which tube is connected in series with capacities 13, 14.

Collected signal energy is applied across the resistor 15, the latter being connected in series with a resistance 16, between the grid and cathode of the tube 12. A resistor 17 is connected in shunt with the resistor 15, and is arranged immediately in the input circuit of the tube 12. The anode circuit of the tube 12 is energized from a source of potential "B", the current from the said source being fed to the anode through the primary P of a coupling transformer T₁.

One leg of the tube cathode is connected to the resistance 16, and to the anode circuit through a capacity 20. The other leg of the cathode is connected to the filament current supply, as is the first leg. The secondary S of the coupling transformer T₁ is connected at points a, b, to a transformation line made up of several filter sections. The transmission line is particularly designed to distribute radio frequency energy with very slight losses. The coil S is tapped and connected through a resistance 21 to the negative side of the source of anode potential "B".

As explained heretofore the antenna 11 is mounted on the roof of car B. It is connected to the input circuit of a coupling amplifier tube 12' the circuit connections in this car from the antenna to the terminals a' b' of the secondary S' of the coupling transformer T'₁, being exactly the same as to the connections in the car A. Thus, the signal energy collected by the antenna 11 is applied across the resistor 15', the latter being connected across the input circuit of the tube 12'.

However, potential is applied to the anode of tube 12', from the source of anode potential called "B" located in the car A. A line 30

is connected from the positive terminal of the source "B" to the anode of the tube 12', the anode current being fed through the primary of the coupling transformer in car B.

The transmission line for feeding the collected radio frequency energy is connected between the cars A, B. The terminals at one end of the transmission line being connected to the points a, b , in car A, while the terminals at the end of the transmission line are connected to the points a', b' in car B. The transmission line generally denoted by the numeral 3 is made up of iterative pi sections with only practical limitations as to the number of sections employed. Thus, I have designated one side of the transmission line by the reference numeral 6, this side being connected between the points a and a' and including a plurality of inductances L in series, there being shown in dotted lines at each end of the said line inductances 8, which inductances represent leakage reactances.

The other side of the transmission line is designated by the reference numeral 7 and, as in the case of the side 6, is made up of a plurality of inductances L' mounted in series between the points b and b' . In this case, also, the leakage reactances on this side of the line are designated in dotted lines as inductances 8'. Between each pair of inductances there is connected a capacity 9, the reflected capacity at each end of the line being shown in dotted lines and being designated by the reference numeral 9'.

It is believed unnecessary to show the derivation of this filter section, it being merely noted that a transmission line made up of iterative pi sections produced best results. It will thus be seen that each antenna is coupled to the same wave filter transmission line through an untuned, radio frequency amplifier coupling tube. The transmission line 3 is, of course, carried in a single conduit, the inductances and capacities being disposed at predetermined lengths along the line for producing the wave filter sections as shown. The line will extend through the length of the train, and will necessarily be disposed in each of the cars between the car A and car B.

For the sake of simplicity, and to avoid undue repetition I have shown the line 6, 7 broken at intermittent points thereof and merely noted on the drawing that other sections are inserted between the arrows at the said intermediate points. In order to utilize the radio frequency energy transmitted through the line 3, the line is coupled through extension units 4, the extensions being to as many radio outlets as is desired. While I have only shown four extension units it is to be understood that as many extension units, as is desired, may be tapped from the line 3, in each of the cars between the car A and car B. I will, therefore, only describe in

detail the circuit connections in one of the extensions 4, it being understood that the arrangements to be described are the same, in each of the other extensions 4. Each extension includes a tube 40, the grid of which tube is connected by a lead 41 to the neutral wire 30, it being observed that only one plate and grid voltage source "B" is employed, and that, further, the line 30 is tapped by all extension tubes.

It should be noted that the lines 6 and 7 are used as the power lead for the direct current from the source "B", except from the antenna coupling unit at which the source is located. The filament of the tube 40 is connected by a lead 42 to the line 7. Of course, extensions which are situated on the side of the line 3, in opposite position from the extension hitherto described in detail, have their cathode leads connected to the side 6 of the transmission line through leads 42'.

One leg of the cathode of tube 40 is connected to the grid through an inductance 43 in series with a resistance 44, the leg also being connected to the primary of the coupling transformer T₂ through a capacity 45. The other leg of the cathode is connected to a source of filament current, as is the first leg of the cathode. The secondary Y of the coupling transformer T₂ has its terminals free and connected to contact points serving as radio receiver outlets. A capacity 46 is disposed between one end of the secondary and its terminal. Each outlet provides antenna and cathode connections for one receiver. I have not shown such a radio receiver on the drawing in order to maintain a simplicity of disclosure, it being understood that the receiver to be employed may be any one well known to those skilled in the art.

It is to be pointed out that the general features of this system with regard to transmission line and the coupling unit construction, and the extension tube construction has been disclosed by J. Weinberger in the application referred to heretofore. It should be pointed out that as many as ten radio outlets can be coupled to a single transmission line 3. Thus if there are ten cars in a train each car could be equipped with a single receiver which would be connected to the transmission line by merely plugging into the radio outlets at its extension 4 provided in each car.

A single loud speaker would thus entertain all the people in the single car. It is not to be understood, however, that each car is limited to only one extension unit, for a plurality of extension units can be tapped to the transmission line in each car, and thus a plurality of receivers used in each car where head phones are to be used by the persons listening to the program, enabling a person to sit in a car without having to listen to a loud speaker when he does not desire to do so.

It will be seen that as one end of a train

equipped with an antenna system as described heretofore traverses a curve, and therefore the antenna at the front end of the train has its directional characteristics varied, the antenna at the rear end of the train is still maintaining the desired directional characteristic, and thus antenna directional effects are minimized. Again, if the antenna 10 is inoperative due to temporary shielding, as by metallic structures, trees, bridges, tunnels and the like, the other antenna 11, at the rear of the train, if unshielded, acts as a source of energy to actuate the receivers coupled to the radio outlets of each extension unit 4.

It should also be observed that advantage can be taken of the arrangement herein disclosed, whether employed on transportation mediums, such as trains and ships, or on physically fixed structures, as regards the use of antenna with different directional characteristics. On a physically fixed structure, one antenna could be erected in one direction and the other antenna in another direction; there is thus obtained optimum directional effects for the general operation of the receivers which are coupled to the transmission line. The latter feature, for example, could well be used on a hotel, for example, in which centralized radio equipment was installed, two or more antennae being coupled as shown herein to the transmission line, the antennae being physically separated and so arranged relative to one another that ideal reception is approached as far as possible.

I wish to emphasize the fact that the present invention is not necessarily limited to equipment of the centralized radio type, but that the principle of my invention is equally adapted to equipment of the centralized audio type. Thus, an arrangement as shown in the patent to J. J. Kuhn referred to heretofore, could be used in a mobile structure, such as a train or on a physically fixed structure, such as an apartment house or hotel, and the antenna system disclosed herein adapted for use therewith.

While I have indicated and described several systems for carrying my invention into effect, it will be apparent to one skilled in the art that my invention is by no means limited to the particular organizations shown and described, but that many modifications in the circuit arrangements, as well as in the apparatus employed, may be made without departing from the scope of my invention as set forth in the appended claims.

What I claim is:

1. An antenna system for multiple receivers, adapted to be used on mobile structures which comprises a plurality of physically separated and independent antennae mounted on widely spaced points of said mobile structure, a common transmission path, said antennae being coupled to said path,

and a plurality of signal responsive means coupled to said path.

2. In combination, with a mobile structure, centralized receiving equipment including a common transmission path and a plurality of signal responsive means coupled to said common path, at least two physically independent and separated radiant energy collecting means widely separated on said structure, said collecting means being connected to said transmission path, said collecting means being so relatively proportioned and spatially designed that directional effects are effectively minimized.

3. In combination with a train including a plurality of cars, an antenna mounted upon one of said cars, a second antenna mounted upon another car spaced from said first car by at least a plurality of cars, a plurality of signal responsive means disposed within the cars of said train, a common transmission path coupled to said responsive means and both of said antennae.

4. In combination a common transmission path composed of a plurality of wave filter sections, an untuned amplifier coupling tube connected to one end of said path, a second coupling tube connected to the other end of said path, an antenna connected to the input of one of said tubes, another antenna connected to the input circuit of the other of said coupling tubes, and a plurality of signal responsive means coupled to said transmission path.

5. In combination with a mobile structure, an antenna mounted at one point of the latter, a second antenna mounted at another point of the structure, said antennae being widely separated, at least one signal responsive device within the structure, a common low loss transmission path coupled to said device and antennae.

6. In combination with a mobile structure, an antenna mounted at one point of the latter, a second antenna mounted at another point of the structure, said antennae being widely separated, at least one signal responsive device within the structure, a common low loss transmission path coupled to said device and antennae and an amplifier tube between each antenna and said path.

7. In combination with a mobile structure, an antenna mounted at one point of the latter, a second antenna mounted at another point of the structure, said antennae being widely separated, at least one signal responsive device within the structure, a common low loss transmission path coupled to said device and antennae and an untuned amplifier tube between each antenna and said path.

8. In combination with a mobile structure, an antenna mounted at one point of the latter, a second antenna mounted at another point of the structure, said antennae being widely separated, at least one signal respon-

sive device within the structure, a common low loss transmission path coupled to said device and antennæ and an amplifier tube between said path and device.

5 9. In combination with a mobile structure, an antenna mounted at one point of the latter, a second antenna mounted at another point of the structure, said antennæ being widely separated, at least one signal responsive device within the structure, a common
10 low loss transmission path coupled to said device and antennæ, an amplifier tube between each antenna and said path, and an amplifier tube between said path and said device.

15 10. In combination with a mobile structure, an antenna mounted at one point of the latter, a second antenna mounted at another point of the structure, said antennæ being widely separated, at least one signal responsive device within the structure, a common
20 low loss transmission path coupled to said device and antennæ, an amplifier tube between each antenna and said path and a single anode potential source for said tubes.

25 11. In combination with a mobile structure, an antenna mounted at one point of the latter, a second antenna mounted at another point of the structure, said antennæ being widely separated, at least one signal responsive device within the structure, a common
30 low loss transmission path coupled to said device and antennæ, an amplifier tube between each antenna and said path, an amplifier tube between said path and said device,
35 and a single anode potential source for said tubes.

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