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POWER CORD TYPE ANTENNA SYSTEM FOR A WAVE-SIGNAL RECEIVER

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Fig. 1

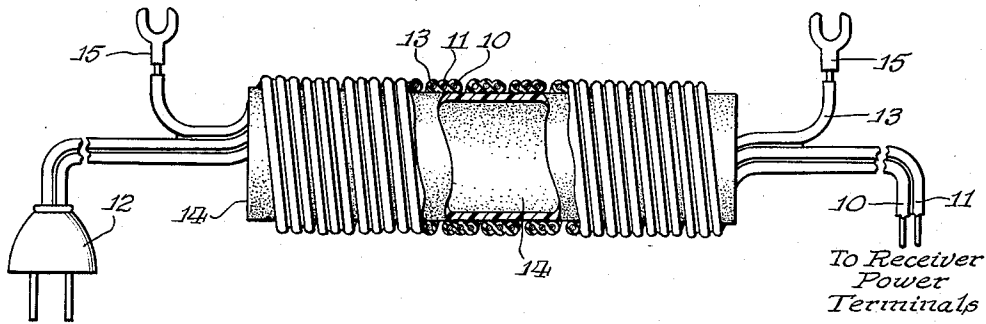
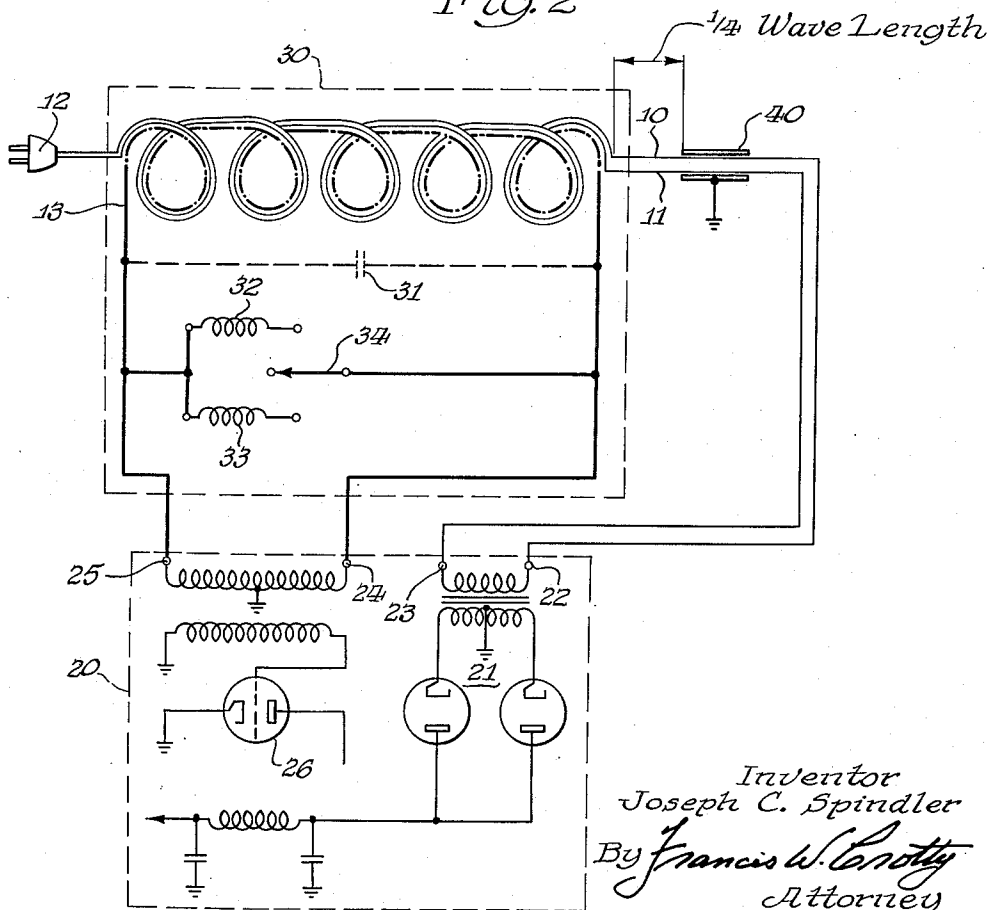


Fig. 2



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POWER CORD TYPE ANTENNA SYSTEM FOR A WAVE-SIGNAL RECEIVER

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The present invention relates to antenna systems for wave-signal receivers in general and is more particularly directed to systems intended to receive wave signals within a wide range of frequencies. It is especially suited for use with television receivers to facilitate reception of television broadcasts within the so-called VHF, or very high frequency band.

The arrangement to be described herein represents a further development and improvement of the antenna system disclosed and claimed in a co-pending application of Joseph C. Spindler, entitled "Antennas," Serial Number 656,677 filed September 2, 1957, now Patent No. 2,915,627 and assigned to the same assignee as this application. The antenna structure of the co-pending application is of the class known in the art as "line-cord antennas." Such antennas are characterized by the use of a power cord, through which a power supply is connected to a wave-in signal receiver, in the role of a wave-signal interceptor, taking advantage of the known fact that the power cord does, in a great many installations, concurrently serve as an efficient wave signal interceptor.

The structure shown in the co-pending application, in one particular embodiment, employs an electrical conductor inductively and capacitively coupled to the power cord as a vehicle for transferring wave signals intercepted by the power cord to the input terminals of an associated receiver. In manufacturing that structure, the conductor takes the form of a stranded wire, or metal braid, ensheathing a length of the power cord. The effective electrical length of the sheath is particularized in the application and if the specifications recited for the structure are followed, results are obtained which are at least the equivalent of that realized with the well-known "rabbit ear" antenna.

As disclosed in the reference application, the section of the power cord encompassed within the metal braid may be formed into a coil with a relatively wide separation between turns in order to avoid short-circuiting the braid upon itself. Coiling permits the braided section of the power cord to be conveniently encased within a container which may be housed within the cabinet of the receiver with obvious advantages. While that structure performs well, the arrangement described herein is even more simple in construction and even less costly to fabricate.

It is, accordingly, an object of the present invention to provide an improved and simplified antenna system for use with a receiver intended to receive wave signals within a band of frequencies.

It is a specific object of the invention to provide an improved antenna system for a television receiver for the purpose of efficiently receiving wave signals within the entire VHF band.

The antenna system of the present invention is for a receiver which is to receive wave signals within a predetermined frequency range and which has power input as well as wave-signal input terminals. Structurally, the antenna comprises a pair of conductors for coupling the power input terminals to a source of energizing power and also for intercepting wave signals within the aforementioned frequency range. Means are provided for transferring such wave signals from the conductor pair to the input terminals. That means comprises a third conductor, mechanically and electrically coupled to and

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coiled with a section of the conductor pair, to constitute an inductor which is self-resonant at a frequency within the aforementioned frequency range. The thusly formed trifilar conductor section is formed to constitute a coil having negligible interturn spacing, and the self resonant frequency approximates the mid-point of the lower one of two portions of the overall frequency range to be received. The wave-signal input terminals of the receiver are individually connected substantially across opposite ends of the coiled third conductor.

The features of the present invention which are believed to be novel are set forth with particularity in the appended claims. The organization and manner of operation of the invention, together with further objects and advantages thereof, may best be understood by reference to the following description taken in connection with the accompanying drawing, in several figures, of which like reference numerals identify like elements, and in which:

FIGURE 1 represents a structure embodying the present invention; and

FIGURE 2 schematically shows an installation of the antenna of FIGURE 1 upon a wave-signal receiver, such as a television receiver.

Referring now more particularly to FIGURE 1, the antenna structure there represented is intended for use with a receiver expected to accept wave signals within a predetermined or known frequency range which receiver, of course, would have a pair of power-input terminals as well as a pair of wave-signal input terminals. The antenna, which is of the power cord type, includes a pair of conductors 10 and 11 of any convenient length terminated at one end in a conventional power plug 12 for coupling the power input terminals of an associated receiver to a source of energizing power which, in most cases, is a wall outlet or similar power receptacle. In the installation contemplated, this conductor pair concurrently serves to intercept wave signals to which it is desired to tune the associated receiver. The intercepted wave signals are, of course, to be transferred from the power cord to the signal-input terminals of the receiver and, for that purpose, the structure under consideration includes a transfer means, which is a third conductor 13.

Conductor 13 is mechanically and electrically coupled to and coiled with a section of conductor pair 10, 11 and, in its coiled form, constitutes an inductor which is self-resonant at some frequency within the range of signals to be intercepted. Preferably, resonance occurs at the mid-frequency of that range. It is convenient to employ a coil form 14 and to form the coil turns thereon. Any known method may be adopted for maintaining the coil in its desired configuration. It is quite simple, for example, to wind the three conductors about the coil form and secure them in place by lengths of vinyl tape (not shown) which pass longitudinally along the coil and are cemented or otherwise secured to the internal periphery of the coil form. Alternatively, the formed coil could be provided with a suitable coating of resin or the like to maintain the coil configuration.

It will be apparent that three separate conductors may be employed in fabricating the structure of FIGURE 1, or the usual two-conductor power cord plus a separate third conductor may be utilized. Most conveniently, however, the structure is formed from a three-wire A.C. power cord, modified by cutting one conductor to correspond to element 13 of the described structure. The length of that conductor would be the length required to form the coil plus the necessary length for connecting to the signal-input terminals of the receiver. Its overall length may be significantly different from that required for conductors 10, 11 to make the power connection. In this preferred construction, use is made of a trifilar conductor, and the coiled section is then of the trifilar

type represented in the drawing. The three conductors are molded together and have a common covering of insulation, such as rubber. This covering establishes the necessary mechanical and electrical coupling of third conductor 13 to conductor pair 10, 11. Also, for convenience, it is well to terminate conductor 13 in spade lugs 15, which facilitate connecting to the input terminals of the receiver.

The described antenna structure is shown in FIGURE 2 installed to supply a wave-signal receiver 20 with both power and radio-frequency signals. Where unit 20 is a television receiver, conductor pair 10, 11 connect to the primary winding of a power transformer associated with the usual full wave power rectifier 21. The power-input terminals for the receiver are designated 22, 23.

The signal-input terminals are designated 24, 25 and where the input circuit of the receiver is of the balanced type, these terminals connect to opposite ends of the primary winding of an input transformer included in the first stage, or radio-frequency amplifier 26 of the receiver. Obviously, the antenna may be applied with equal facility to a receiver that has an unbalanced rather than a balanced input. In this installation, spade lugs 15 of the third conductor 13 connect directly to signal-input terminals 24, 25. To simplify the illustration, the coil form 14 has been omitted and conductor 13 has been shown in dash-dot construction to distinguish it readily from the members of conductor pair 10, 11.

The trifilar coil is housed within a suitable container represented by broken-line rectangle 30. It may be fabricated from metal, molded or fiberboard, with provisions for mounting it within the cabinet of the receiver to which it is to be connected. Details of a container structure that can be conveniently adapted are enclosed in the co-pending application referred to above.

For the particular installation under consideration, wherein the antenna is to intercept wave signals within VHF range, the trifilar coil, which is tuned by its distributed capacitance 31, is resonant at the mid-frequency of the low band of that range. More particularly, the VHF frequency range is constituted of two bands. One extends from 54 to 88 megacycles and the other from 74 to 216 megacycles. The trifilar coil, in this case, is self-resonant at mid-frequency of the lower band and, preferably, has a sufficiently broad resonance characteristic to be an effective signal transferring device throughout the lower band. In order to achieve adequate signal transfer throughout the high band as well, the effective electrical length of the trifilar section should be greater than one-half the length of any signal within the higher band.

Electrically, the trifilar coil represents a capacitive impedance throughout the high frequency band and, if necessary, more effective signal transfer in that band may be accomplished through the expedient of selectively coupling other inductive impedances across the coil. For that purpose, additional inductors 32 and 33 may be provided, having one terminal of each connected to one end of the coil and having the opposite terminal of each electrically connected to a contact of a switch 34. The blade of that switch, when brought in register with the appropriate terminal, completes the electrical connection of the selected inductor to the other side of the trifilar coil to which the switch blade is permanently connected. Where the added inductor is not required, and this is true for reception over the low band of the VHF range, switch 34 is in the position shown. An appropriate mechanical and electrical construction for this switching arrangement is also disclosed in the earlier Spindler application.

Electrically, the described antenna system, especially with reference to the transfer of radio-frequency energy from the power cord to the receiver, constitutes a transformer with a one-to-one turns ratio and extremely tight interturn coupling. The coupling results from the physi-

cal arrangement in which the coil turns are contiguous to one another with as little separation as possible. The impedance of conductor pair 10, 11 is in the neighborhood of 70 to 300 ohms over the frequency range of the two bands and the latter impedance value is usually presented at signal-input terminals 24, 25. The impedance across the secondary of the transformer is higher than that of the primary since the co-efficient of coupling is less than unity and provides a sufficient impedance match for effective signal transfer. Where the structure is made of the usual three-conductor A.C. power cord, in which a 32-inch length is coiled about a coil form of 1½ inch diameter, the maximum mismatch is less than two to one and efficient energy transfer is accomplished throughout the VHF range.

It will be recognized that variations in conduction of the receiver power rectifier 21 may reflect a variable impedance into the antenna transformer and, hence, to the receiver. Specifically, there may be an impedance variation at the rate of 120 cycles per second where the power frequency is the customary 60-cycle, and this variation may manifest itself as an undesirable bar pattern, particularly during the reception of a strong but unmodulated television signal, that is, a condition in which the image would otherwise be a white field. In order to overcome any adverse effect of such impedance variations, it is preferred that a conductor sleeve 40 be placed around, and therefore capacitatively coupled to, conductor pair 10, 11 and connected to receiver ground. If the spacing of the sleeve from the adjacent end of the trifilar coil is approximately one-fourth wavelength at the mid-frequency of the high VHF band, it will, in effect, constitute no loading of the transformer and the desired signal balance will be maintained over this band. The balance condition for the low VHF band is less critically disturbed and the inductive transformer action is adequate for preserving the desired condition of the balance. It is also preferable that the conductive sleeve have an effective electrical length which is one-eighth wavelength or less at the lowest frequency of the high VHF band. As a practical matter, it is convenient to form sleeve 40 from aluminum-coated cardboard and it may be secured in place by a turn of tape. Electrically, it is in the nature of a short circuit to the receiver chassis, but its one-fourth wavelength spacing from the antenna transformer preserves the conditions essential to signal transfer, as described.

The antenna system is of extreme simplicity and, at the same time, is effective both as a wave-signal interceptor and as an R-F energy transferring device for feeding the signal-input terminals of the receiver. The use of an ordinary rubber-covered three conductor lamp cord for the antenna structure permits a maximum reduction in cost and has the further distinct advantage of compactness of the entire assembly. The protection afforded by the insulation of the cord is especially desirable if the antenna is to be included in the cabinet of the receiver.

It has been convenient to show discrete input terminals 22, 23 and 24, 25 for receiver 20. Physically, these may take the form of solder connections and, particularly where the receiver has an unbalanced R-F input, at least one such connection may be a connection to ground.

While a particular embodiment of the invention has been shown and described, it will be obvious to those skilled in the art that changes and modifications may be made without departing from the invention in its broader aspects, and, therefore, the aim in the appended claims is to cover all such changes and modifications as fall within the true spirit and scope of the invention.

I claim:

1. For a receiver receptive of wave signals within a pair of frequency ranges and having a pair of power input terminals and a pair of wave-signal input terminals, an antenna system comprising: a pair of conductors for coupling said power input terminals to a source of ener-

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gizing power and for intercepting said wave signals; and means for transferring said wave signals from said conductor pair to said wave signal input terminals comprising a third conductor mechanically and electrically coupled to a portion of said conductor pair to form there-
 5 with a section of trifilar conductor, said trifilar conductor section constituting a coil having negligible interturn spacing with said third conductor, in such coiled form, being self-resonant at a frequency approximating the mid-
 10 point of the lower one of said ranges, said wave-signal input terminals being individually connected substantially across opposite ends of the coiled third conductor.

2. For a receiver receptive of wave signals within a pair of frequency ranges and having a pair of power input terminals and a pair of wave-signal output terminals, an
 15 antenna system comprising: a pair of conductors for coupling said power input terminals to a source of alternating-current energizing power and for intercepting said wave signals; means comprising a third conductor elec-
 20 trically coupled to and coiled with a section of said conductor pair to constitute therewith a transformer, for transferring said wave signals from said conductor pair to said input terminals; and conductive means, capacitively
 25 coupled to said conductor pair between said transformer and said power input terminals at a point spaced from said transformer by a distance of one-fourth wavelength at the mid-frequency of the higher of said ranges, and
 30 connected to the ground plane of said receiver for establishing a low impedance path from said point to ground at a frequency related to that of said power source.

3. For a receiver receptive of wave signals within a pair of frequency ranges and having a pair of power input

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terminals and a pair of wave-signal output terminals, an antenna system comprising: a pair of conductors for
 coupling said power input terminals to a source of alternating-current energizing power and for intercepting said
 wave signals; means comprising a third conductor electrically coupled to and coiled with a section of said conductor
 pair to constitute therewith a transformer, for transferring said wave signals from said conductor pair to said
 input terminals; and a conductive sleeve having a length
 10 less than one-eighth wavelength at the lowest frequency of the higher of said ranges, capacitively coupled to said
 conductor pair between said transformer and said power input terminals at a point spaced from said transformer
 15 by a distance of one-fourth wavelength at the mid-frequency of said higher range, and connected to the ground plane of said receiver for establishing a low impedance path from said point to ground at a frequency related to
 that of said power source.

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