

Jan. 26, 1954

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2,667,577

ANTENNA

Filed July 14, 1951

2 Sheets-Sheet 1

Fig. 1.

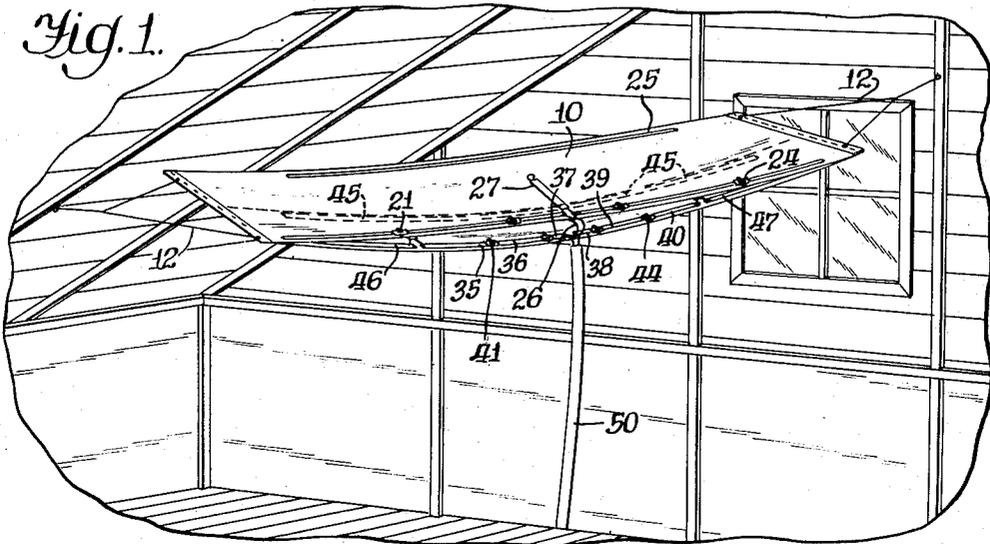


Fig. 2.

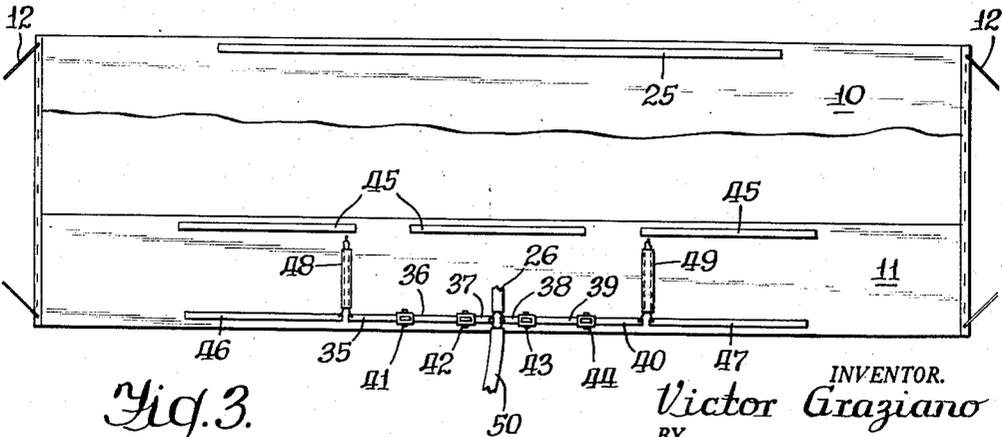
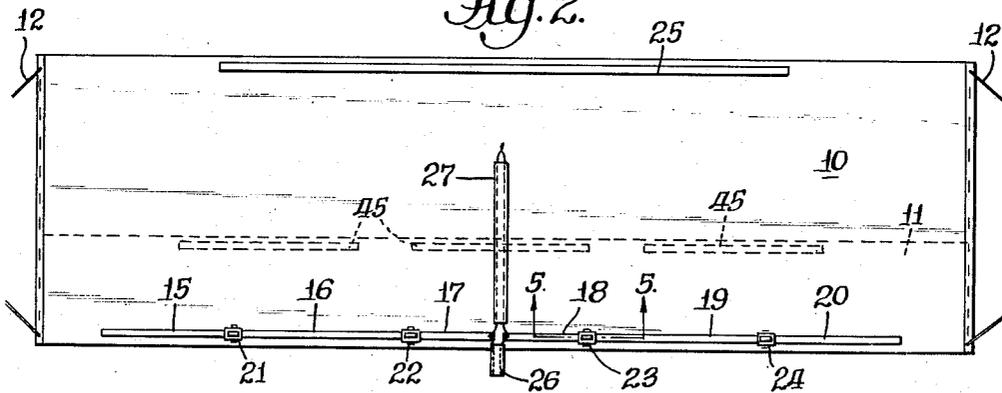


Fig. 3.

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Fig. 5.

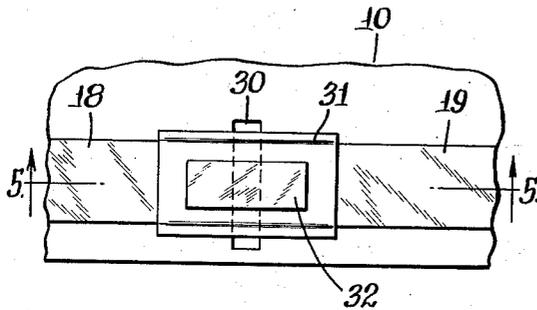
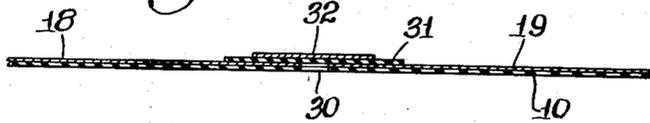


Fig. 4.

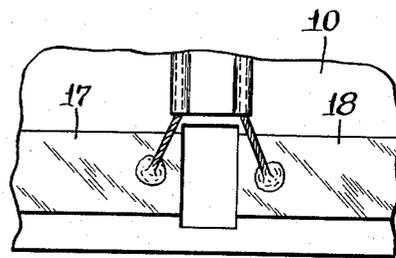


Fig. 6.

Fig. 7.

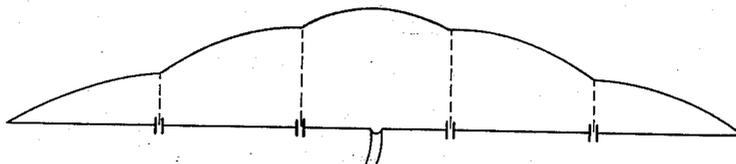
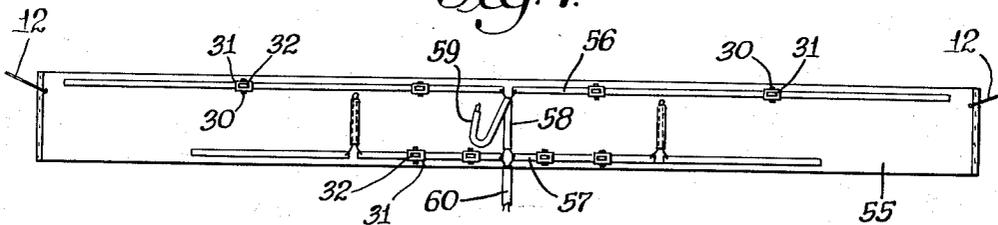
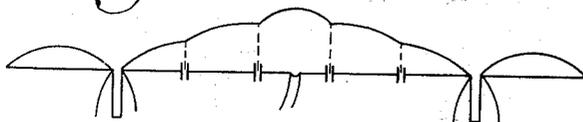


Fig. 8.

Fig. 9.



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# UNITED STATES PATENT OFFICE

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## ANTENNA

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8 Claims. (Cl. 250-33)

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This invention relates generally to antennas and more particularly to television antennas of simple construction which provide high gain on signals in two non-contiguous frequency ranges.

Television antennas have been relatively complicated mainly because television signals have been broadcast in two non-contiguous frequency ranges in the very high frequency band. In order to provide good signal pickup, television antennas must include arms of relatively long lengths and to provide an antenna which is sufficiently rigid and which at the same time present an attractive appearance, has resulted in structures which are quite expensive. Because of the very high frequencies involved, it is necessary to provide line of sight between the transmitting and receiving antennas and accordingly it is necessary to mount the antenna at a high elevation, such as on the roof of a house. This has made the large and complicated antennas which have been used further objectionable.

Although indoor antennas have been used to a considerable extent, such antennas have provided relatively low gain and are therefore satisfactory only in areas having strong signals. In many cases such antennas have required adjustment as the receiver is tuned from one station to another in order to provide optimum pickup. This is obviously objectionable. Indoor antennas of such construction to be positioned outside the receiver cabinet have been undesirable because of their appearance and the space required to extend the arms thereon.

It is therefore an object of the present invention to provide an efficient television antenna of simple construction.

A further object is to provide a television antenna which may be conveniently supported in an attic or the like and which provides high signal gain.

A still further object is to provide an antenna system of very inexpensive construction which provides high gain on both the high and low frequency television bands.

A feature of this invention is the provision of an antenna formed by conducting layers placed on an insulating web.

A further feature of this invention is the provision of a bi-resonant antenna system including a first web having thereon an antenna for operation on one frequency band, and a second web having thereon an antenna for operation on a second frequency band, with the two webs being secured together at the ends and supported in the form of a hammock.

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Another feature of this invention is the provision of a bi-resonant antenna system in which each antenna section is formed by an overlong dipole having the arms thereof sectionalized by condensers. The unit may be formed by conductors placed on an insulating sheet, with the capacitors being provided by insulating and conducting layers over the conductors at gaps therein.

Further objects and features, and the attending advantages of the invention will be apparent from a consideration of the following description when taken in connection with the accompanying drawings in which:

Figure 1 illustrates the antenna as installed in an attic;

Figure 2 is a top plan view of the antenna of Figure 1;

Figure 3 is a top plan view of the antenna of Figure 1 with a portion of the top web broken away;

Figure 4 is an enlarged plan view of the capacitor construction;

Figure 5 is a cross-section along the lines 5-5 of Figures 2 and 4;

Figure 6 illustrates the connection of a transmission line to the conductors;

Figure 7 illustrates a second embodiment of the invention;

Figure 8 shows the current distribution in the low band antenna; and,

Figure 9 illustrates the current distribution in the high band antenna.

In practicing the invention an antenna system is provided including antenna sections operating on the high and low band, each being an overlong dipole with the arms thereof sectionalized by condensers. Each antenna may be placed on a web which is supported substantially horizontally, with the two webs being connected at the end so that they can be supported as a unit. The lower web is longer than the upper web so that the lower antenna is spaced from the upper one. The webs may be of sufficient width that reflectors may be provided thereon properly spaced from the antenna elements. Alternatively, the two elements may be positioned on a single web arranged to be positioned vertically as a banner. To increase the response in the high band, additional half-wave elements may be connected at the ends of the overlong dipole by phase reversing stubs. The capacitors used in sectionalizing the arms may be provided by cutting portions from the conducting strips and placing insulators and conductors thereon. Therefore, the entire

structure may be formed very inexpensively from paper or other inexpensive web material, conducting strips, and sections of transmission line. Connection is made directly to the high band antenna, and to the low band antenna through a quarter wave line at the high band, with a half wave shorted stub also being connected across the low band antenna.

Referring now to the drawings, in Figures 1, 2 and 3 there is illustrated an antenna in accordance with the invention which is of the hammock type. In Figure 1 this antenna is shown strung up in an attic, and it is obvious that such an antenna can also be supported along a wall or between any two supports. The antenna is formed by a top web or sheet 10 and a bottom web or sheet 11 which are connected together at the ends, from which they are supported by cables or the like 12. The antenna elements are formed by conducting portions on the webs which may be provided by depositing a layer directly thereon as by sputtering or the like, or may be provided as tape having an adhesive coating which is easily fastened to the web.

In Figure 2 the top web 10 is shown more in detail with conducting portions 15, 16, 17, 18, 19 and 20 being placed on the web 10 to form an antenna element. The over-all length of the conducting elements is between  $\frac{1}{2}$  wave length and one wave length at the frequencies involved. Condensers 21, 22, 23 and 24 separate the various sections. Each of the sections 15, 16, 19 and 20, and the sections 17 and 18 together, are slightly less than a quarter wave length long at the highest frequency to be received. A conducting portion 25 is provided at the back of the strip which is approximately one-half wave length long and serves as a reflector for the antenna to thereby increase the gain in the usual manner. Connection to the antenna is made at the junction of sections 17 and 18 by a section of transmission line 26, and a shortage stub 27 is also connected to the junction for a reason to be explained more in detail hereinafter.

The antenna provided on the top web 10 is for reception on the low television band extending through the range from 54 megacycles to 88 megacycles, and to provide proper response in this range, the sections 15 and 16, 19 and 20 are each approximately 30 inches long, and the sections 17 and 18 are each approximately 15 inches long. The capacitors 21, 22, 23 and 24 are each of the order of ten micromicrofarads. The reflector 25 is approximately ninety five inches long and is spaced from the antenna by about 44 inches.

As shown in Figures 4 and 5, these condensers are formed by cutting a slot in the web and conductor and providing insulating and conducting layers thereacross. Figures 4 and 5 illustrate the condenser coupling the portions 18 and 19, with the gap in the sections being formed by cutting a slot 30 in the web 10 and also in the conductor to separate the same into the portions 18 and 19. Placed on top of the ends of the portions 18 and 19 is an insulating section 31 which may be a suitable tape having adhesive thereon. On top of the tape 31 there is applied a conducting strip 32 which has the dimensions required to provide the desired capacity between the adjacent antenna portions. This may also be an adhesive conducting layer which may be easily applied, or a conducting layer deposited directly on the insulating layer 31.

In Figure 3, in which the top web is broken away, the high band antenna section is shown

more in detail. As previously stated, this is provided on a web 11 longer than the web 10 so that it hangs below the web 10 and is thereby spaced therefrom. The antenna is formed by conducting portions 35, 36, 37, 38, 39 and 40 which form an overlong dipole in the high frequency band in generally the same manner as the antenna for the low frequency band. The various sections are separated by condensers 41, 42, 43 and 44 which may be constructed in the manner shown in Figures 4 and 5 previously described.

For operation in this frequency band, which extends from 174 to 216 megacycles, the sections 35, 36, 39 and 40 are of the order of 10 inches long and the sections 37 and 38 are each 5 inches long. The gain in the high band can be increased by the use of reflectors 45, and by the addition of half wave dipole elements connected to the ends of the units as indicated at 46 and 47. These elements are connected to the ends of the overlong dipole by shorted quarter wave stubs 48 and 49. Three reflectors 45 are used, each being 30 inches long and spaced from the high band antenna section by 16 inches. The elements 46 and 47 are of the order of 27 inches long and the stubs 48 and 49 may be formed by sections of 300 ohm transmission lines 12 inches long.

Referring again to Figure 1 it is seen that the transmission line 26 connects the low band antenna on the web 10 directly to the high band antenna on the web 11. Connection to the entire unit then is made by a transmission line 50 connected to the high band antenna. Figure 6 illustrates the manner in which connection of the transmission lines may be made to the conducting portions of the antenna. By making the line 26 of a length equal to a quarter wave on the high band, and by the use of the shorted half wave stub 27, the low band antenna is completely isolated from the high band antenna. When operating with the frequencies previously referred to, the transmission line 26 may be a 300 ohm line 12 inches long, and the stub 27 may be a 300 ohm line 24 inches long. On the low band, the shorted stub 27 and the high band antenna are both high impedances and therefore have substantially no effect on the operation of the low band antenna.

Figures 8 and 9 show the current distribution in the antenna sections for the two bands. The antenna system as shown has provided substantial gain over tuned half-wave dipoles with the system showing a gain in the low band of 1.7 to 1 without a reflector and 2.4 to 1 with a reflector, and a gain in the high band of 1.4 to 1 without a reflector and 2.5 to 1 with a reflector.

In Figure 7 there is illustrated a simplified embodiment wherein the two antenna elements are provided on a single web arranged to be supported vertically as a banner. This web 55 has the low band antenna 56 at the top thereof, and the high band antenna 57 at the bottom. The antenna elements themselves may be exactly identical to those shown in Figures 1 to 3 inclusive with the two antennas being spaced vertically in substantially the same manner. The antennas 56 and 57 are connected by a transmission line 58, and a shorted stub 59 is connected to the antenna 56. The signals picked up in the antennas may be applied to a receiver through the transmission line 50 connected to the high band antenna 57.

It is apparent from the foregoing that the antenna system of the invention may be constructed very simply and inexpensively from readily available materials. The structure is made up of insu-

lating webs which may be paper or cloth, and conducting strips thereon which may be either deposited directly on the web or applied thereto by adhesive. The capacitors connecting the sections are simply provided by insulating layers bridging adjacent ends of the conducting elements, and other conducting strips over the insulating layers to form condensers which connect the interrupted portions of the strips. The stubs required may be provided simply from 300 ohm transmission line such as is used for the lead in from the antenna so that the very few different materials are required and a very simple assembly process thereof is possible.

The antenna is of such configuration that it can be easily installed in a space such as an attic having limited head room. The over-all length of the unit is of the order of 12½ feet so that sufficient room would be available in the attic of most houses. As previously pointed out, however, the antenna is not limited to installation in attics but may be installed between any two supports, and may be so constructed that it is suitable for outside installations.

Although certain embodiments of the invention have been described which are illustrative thereof, it is obvious that various changes and modifications may be made therein without departing from the intended scope of the invention as defined in the appended claims.

I claim:

1. An antenna system for receiving wide band signals in two non-contiguous frequency ranges including in combination, web means formed of insulating material, conducting portions on said web means forming first and second dipole antennas for individually receiving signals in said two frequency ranges, each of said dipole antennas having two opposed arms each including a plurality of spaced conducting portions and conducting means spaced from adjacent conducting portions forming condensers which interconnect said adjacent conducting portions, each of said arms having a length greater than one-half wave length and less than one wave length of the highest frequency to be received thereby, each of said conducting portions having a length less than one-quarter wave length of the highest frequency to be received thereby, and means interconnecting said antennas and including terminals for receiving signals picked up by said antenna system.

2. An antenna system for receiving wide band signals in two non-contiguous frequency ranges including in combination, web means formed of insulating means, conducting portions on said web means forming first and second dipole antennas for individually receiving signals in the higher and lower of said frequency ranges respectively, each of said dipole antennas having two opposed arms each including a plurality of spaced conducting portions and capacitors interconnecting the same, each of said antennas having a length greater than one-half wave length and less than one wave length of the highest frequency to be received thereby, each of said conducting portions having a wave length less than one-quarter wave length of the highest frequency to be received thereby, a pair of additional conducting portions having a length substantially equal to one-half a wave length in said high frequency range extending from said opposed arms of said first antenna, stubs having a length substantially equal to a quarter wave length in said high frequency range connecting said additional conducting portions to

said arms of said first antenna, and means interconnecting said antennas and including terminals for receiving signals picked up by said antenna system.

3. An antenna system for receiving television signals including in combination, a web of insulating material, a conducting layer on said web including portions forming a dipole antenna, said dipole antenna having two opposed arms each including a plurality of spaced conducting portions and conducting means spaced from adjacent conducting portions forming capacitors which connect said adjacent conducting portions, said antenna having a length greater than one-half wave length and less than one wave length of the highest frequency to be received thereby, each of said conducting portions having a wave length less than one-quarter wave length of the highest frequency to be received thereby, additional conducting portions having a length substantially equal to one-half wave length extending from said opposed arms, and quarter wave stubs connecting said additional conducting portions to said arms.

4. An antenna system for receiving television signals in two wide non-contiguous frequency ranges, including in combination, a first elongated web of insulating material having conducting portions thereon forming a first antenna and a first reflector for the lower frequency range, a second elongated web of insulating material having conducting portions thereon forming a second antenna and a second reflector for the higher frequency range, each of said antennas including a plurality of spaced elongated portions and conductor means providing condenser means interconnecting said spaced portions, said webs being secured together at the ends thereof, with one of said webs being longer than the other and said shorter web being positioned above said longer web, and means interconnecting said first and second antennas.

5. An antenna system for receiving television signals in two wide non-contiguous frequency ranges, including in combination, a first elongated web of insulating material having conducting material thereon forming an antenna and a reflector for the lower frequency range, a second elongated web of insulating material having conducting material thereon forming an antenna and a reflector for the higher frequency range, said webs being secured together at the ends thereof, with one of said webs being longer than the other and said longer web being positioned below said shorter web so that the center portion thereof is spaced from said shorter web, and means interconnecting said antennas on said first and second webs and isolating the same from each other so that each of said antennas has substantially no effect on the other in the frequency range thereof, said interconnecting means including single terminal means for providing signals from said antennas on both said first and second webs.

6. An antenna system in accordance with claim 1 wherein said web means includes a first web for supporting said first dipole antenna and a second web for supporting said second dipole antenna, said first and second webs being secured together at the end thereof with one of said webs being longer than the other, said webs being supported in a generally horizontal position with said longer web being below said shorter web so that the center portions of said webs are spaced from each other.

7. An antenna system in accordance with claim

1 wherein said web means includes a sheet positioned generally vertical with said dipole antennas positioned generally horizontally thereon, one above the other.

8. An antenna system for receiving wide band signals in two non-contiguous frequency ranges including in combination, a first elongated web of insulating material having thereon a plurality of electrically interconnected conducting portions forming a first dipole antenna for operation in the lower frequency range, a second elongated web of insulating material having thereon a plurality of electrically interconnected conducting portions forming a second dipole antenna for operation in the higher frequency range, said webs being secured together at the ends thereof with one of said webs being longer than the other, said webs being positioned generally horizontal with said longer web below said shorter web so that the center portion thereof is spaced verti-

cally from said shorter web, and means electrically interconnecting said antennas on said first and second webs and substantially electrically isolating the same from each other so that each of said antennas has substantially no effect on the other in the frequency ranges thereof, said interconnected means including single terminal means for providing signals from said first and second antennas on said first and second webs.

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