TELEVISION ANTENNA

Filed Sept. 20, 1950 2 SHEETS—SHEET 1

Fig. 1

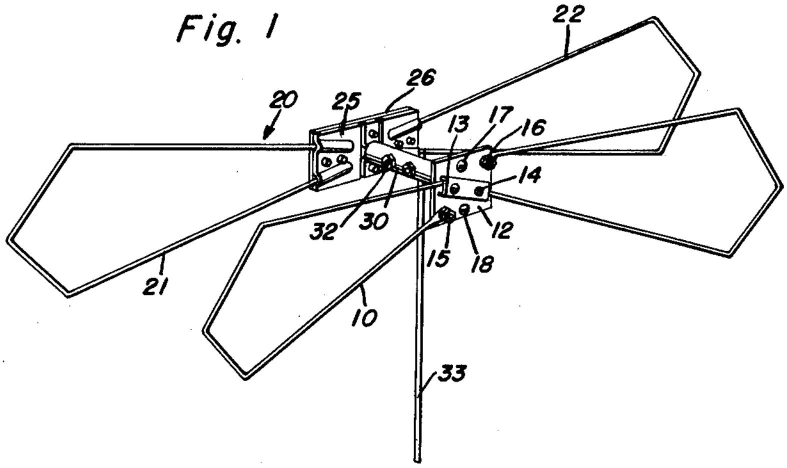


Fig. 2

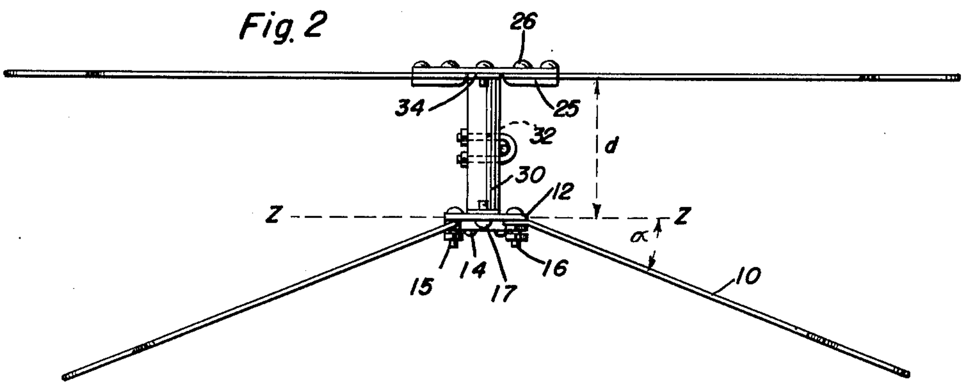
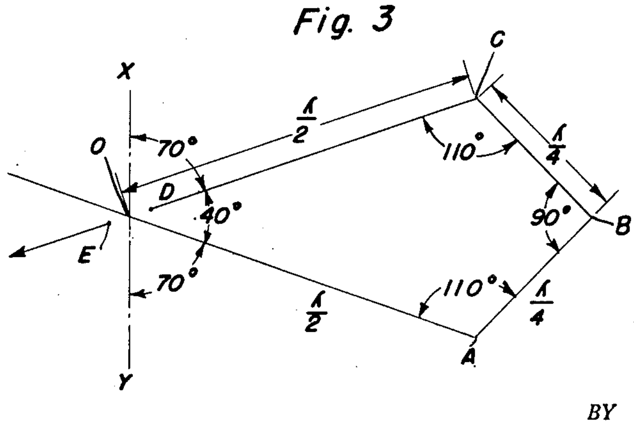


Fig. 3



Henry A. White
INVENTOR.

BY Clarence A. O'Brien
and Harvey B. Jacobson
Attorneys

Oct. 21, 1952 H. A. WHITE 2,615,005

TELEVISION ANTENNA

Filed Sept. 20, 1950 2 SHEETS—SHEET 2

Fig. 4

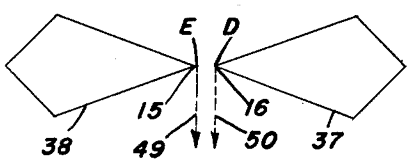


Fig. 5

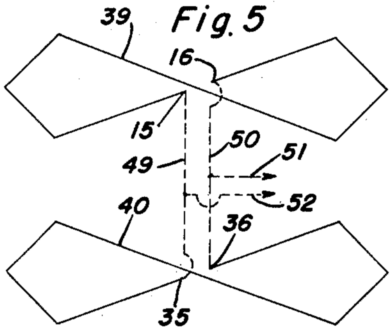


Fig. 6

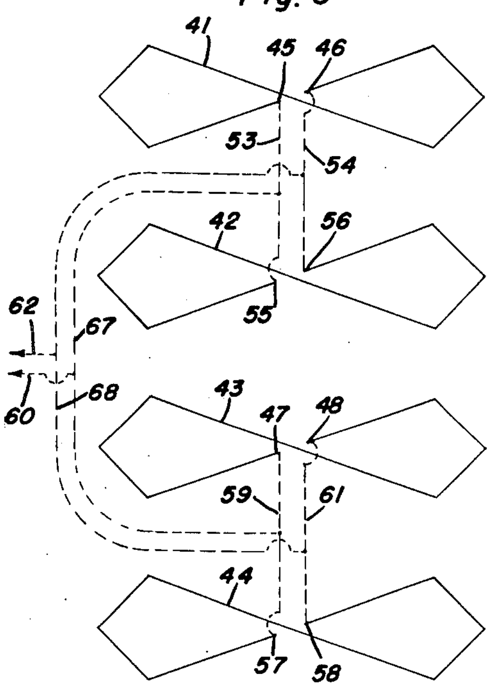
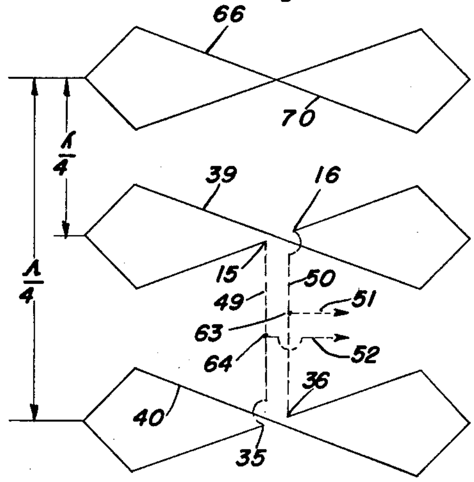


Fig. 7



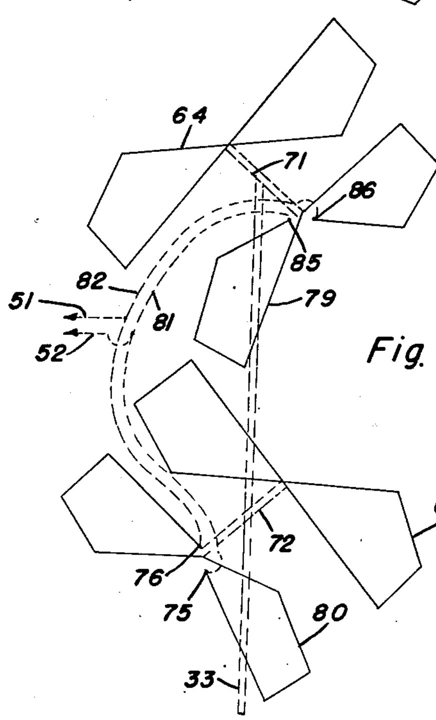


Fig. 8

Henry A. White
INVENTOR.

BY Clarence A. O'Brien
and Harvey B. Jacobson
Attorneys

Patented Oct. 21, 1952 2,615,005

UNITED STATES PATENT OFFICE

2,615,005

TELEVISION ANTENNA

Henry A. White, Brockton, Mass.

Application September 20, 1950, Serial No. 185,861

8 Claims. (Cl. 250—33.57)

1

This invention relates to short wave and ultra short wave antenna arrangements and more particularly to antennae of the type primarily used for the reception of television signals.

In the transmission of television signals plane polarized waves are used, the plane of the polarized waves being regularly either a horizontal or a vertical plane. However, attention must be paid to the fact that the plane of polarization at the reception point is not perfectly vertical or horizontal. Horizontally polarized waves, for instance, are reflected by the layers of the atmosphere and by the ground and therefore the plane of polarization at the reception point is usually inclined with respect to the horizontal at an angle varying from about ten to twenty-two degrees. The antenna construction should therefore be so designed as to take full advantage of this fact.

For the reception of television signals, moreover, antennae with wide frequency band reception have to be used. Furthermore, the antenna system must be so chosen that it has a flat impedance versus frequency characteristic over a broad range as seen when looking towards the antenna from the receiver terminals.

The object of the invention consists of providing an antenna system of the type responsive to plane polarized radiant action which meets the above mentioned conditions, while picking up a maximum of energy from the desired direction.

A further object of the invention consists in providing an antenna which, in general, is of a simple construction, structurally more convenient and more inexpensive than the dipole type of antenna, in which the losses are however reduced to a minimum so that its efficiency remains high.

A further object of the invention consists of an antenna system of the above named type which has directional characteristics, such characteristics being necessary because ultra short waves of the type used for transmitting television signals are reflected from objects, such as houses, trees, hills and the like, and therefore reflected waves should be suppressed or attenuated and polarized waves propagated within the plane of the polarization should be received.

According to the invention the antenna system essentially consists of a double deltoid or diamond shaped structure of bilateral and central symmetry with the feed line connected in the central point. The two deltoids or diamonds are connected at the center while the feed points

2

are located close to said center at two points preferably at a short distance from each other on both sides of the connection between the deltoids or diamonds. The currents at corresponding points of the deltoids or diamonds are therefore in phase with the radiation in the transmitting direction. Experiments have shown that in this way an antenna of high efficiency with the above described characteristics may be obtained.

A further and more detailed object of the invention will be apparent from the following detailed specification.

The invention is illustrated in the accompanying drawings showing several modes of application of the invention. It is however to be understood that the systems which have been illustrated diagrammatically are shown by way of example only in order to explain the principle of the invention and the best modes of applying said principle. The examples shown do not intend to give a complete survey of all the modifications by means of which the principle of the invention may be carried into effect. A departure from the examples illustrated in the drawings does therefore not necessarily involve a departure from the principle of the invention.

In the drawings:

Figure 1 is a perspective view of an antenna primarily designed for the reception of television signals;

Figure 2 is a plan view of the antenna shown in Figure 1;

Figure 3 is a diagram illustrating the construction of the antenna;

Figures 4 to 8 are diagrams illustrating the various ways in which the deltoid shaped antennae are connected with each other and with the feed wires;

Figure 4 illustrating the use of two separate deltoids;

Figure 5 illustrating diagrammatically the connection of two double deltoid antennae;

Figure 6 illustrating the use of two stacked double deltoid antenna;

Figure 7 illustrating a stacked double deltoid antenna with a reflector, and

Figure 8 illustrating a plurality of antennae with reflector in cooperation and connected with the same feed lines.

The principle of the antenna construction is best explained with reference to Figures 1 to 3, showing an antenna construction with a reflector, but it must be emphasized that the antenna is usable with or without a reflector.

The antenna as illustrated in Figures 1 to 3 consists of a wire 10 or rod preferably of aluminum in the shape of a double deltoid. Each component of the double deltoid is arranged in a vertical plane. Each single deltoid, as shown in Figure 3, formed by suitably bending the wire 10, runs from a center O outwardly for a distance which is equal to one-half of the wave length

$$\left(\frac{\lambda}{2}\right)$$

to a point A and from this point A to a point B the length A—B being equal to

$$\frac{\lambda}{4}$$

From the point B which is located on an axis of symmetry passing through the center O, the antenna wire runs through the point C which is again at a distance from point B equal to

$$\frac{\lambda}{4}$$

From the point C the wire runs back to the center point O but ends before reaching the point O at the point D the distance C—D being again

$$\frac{\lambda}{2}$$

The configuration is the same on the other side of the plane of symmetry which is indicated at X, Y.

The angle between A—B and B—C is approximately ninty degrees. The angle between the two sides of the deltoid D—C and O—A and therefore also the angles O—A—B and B—C—D are dependent on the frequency which is to be received and which determines the wave length λ for which the antenna is constructed. The example shown in Figure 3 with an angle of forty degrees between the two sides of the deltoid which converge on point O and with an angle of seventy degrees between O—A and the axis of symmetry X, Y is an example for a definite frequency.

It will be noted that the end D of the antenna wire or rod which is close to the center O in one of the two deltoids faces the point E of the second deltoid and that the two points E, D are located on a straight line which passes the center O. This line E—D therefore crosses the line A—O and the corresponding section of the other deltoid runs from the point O to the left in Figure 3. This is one of the main features of the double deltoid construction. These points D and E are those points at which the feed wires of the receiver are connected with the antenna. Across these points an impedance is developed which must be matched with the surge impedance of the feed line to obtain the best results.

From Figure 2 it will be seen that the two deltoids on both sides of the plane of symmetry are not co-planar but that the vertical plane of each deltoid is inclined towards the vertical plane Z—Z which is at right angles to the plane of symmetry X—Y. The angle α may vary according to conditions between ten and twenty-two degrees.

As has already been explained an antenna of this type has directional characteristics. Ultra short waves of the type used for transmitting television signals are reflected from objects to be found in the vicinity of the antenna and should be suppressed or attenuated. These reflected waves have no definite plane of polarization. On the other hand, the polarized waves on account

of reflection on the ground or on the layers of the atmosphere has a certain angle varying from ten to twenty-two degree from the theoretical plane of polarization. It has been found by actual tests that the above mentioned angle at which the deltoids are set allows to take advantage of this fact.

The construction of the antenna, when provided with a reflector is seen from Figures 1 and 2. The double deltoid antenna formed by the wire or rod 10 is mounted on an insulated plate 12 which holds that portion of the wire 10 which connects the two deltoids by means of a suitable channel piece 13 fixed on the insulated plate by means of screws or rivets 14. The two free ends of the wire or rod 10 corresponding to the points D and E in the diagram (Figure 3) are held by means of bolts 15, 16 on the said insulated plate. These bolts form terminal posts which are connected with the feed wires (not shown in Figure 1).

Two further bolts 17, 18 with suitable heads are located near the channel arm 13 and wire or rod 10 on both sides of these elements, the distance between said bolts 17, 18 and the wire or rod 10 being so small that the bolt heads may serve as lightning arresters or may serve for carrying off static charges which may have accumulated on the wire. The bolts must be grounded for the purpose described in a manner which is described below.

The reflector is generally indicated at 20 and consists of wires 21, 22 each of which is bent in the shape of a deltoid, a shape which conforms itself to the shape of the antenna. Substantially the size and configuration of the deltoid forming the reflector are the same as that of the deltoids forming the antenna wire. However, the deltoids forming part of the reflector need not be closed as the wires 21, 22 may be held between two conducting aluminum plates 25, 26 by means of tubular or half cylindrical half sleeves which project from the plate 25 and which serve as holders for the ends of the said wires 21, 22. The aluminum plates 25, 26 together with the wires 21, 22 therefore form a single grounded reflector system.

The insulating plate 12 and the plate assembly consisting of the two plates 25, 26 are joined by a spacer bar 30 of a suitable length, properly selected to space the antenna from the reflector. The spacer bar 30 usually comprises a tube carrying a U-bolt 32 by means of which it is joined to the mast 33.

At the end of the tube two end plates 34 are provided which are screwed or riveted to the two plates 12 and 25. The bolts 17, 18 which pass through the insulated plate 12 also pass through the two end plates 34 and are fixed in the said end plates of the spacer tube 30. As the spacer bar 30 and its end plates 34 may be grounded by means of the mast 33 the bolts 17, 18 are also held at ground potential. The grounding of the spacer bar 30 also holds the plate assembly 25, 26 of the reflector 20 at ground potential.

Figures 4, 5 and 6 show modified forms of the antenna wire.

The antenna shown in Figure 4 illustrates a shape of the antenna wire in which two completely closed deltoids with separate end points E, D are formed, the feed wires 49, 50 being joined to the said points at 15, 16 which also form the two end points of the deltoids. This type of antenna will function in a manner which is similar to the antenna above described. The double deltoid consisting of two completely closed deltoids may be provided with a reflector and may otherwise be constructed in a manner which is closely similar to the construction shown in Figures 1 and 2.

The modification shown in Figure 5 consists in two stacked antennae, each consisting of a double deltoid 39, 40 constructed exactly as described with reference to Figures 1 to 3. The two feed wire connections 15, 35 and 16, 36 of the two double deltoid antennae are however joined by the common connections 49, 50 which are connected with the feed wires 51, 52 running to the receiving apparatus to be supplied with the radiated energy. The two antennae are therefore connected in parallel. They may be used either when arranged in parallel planes or when arranged in two planes inclined with respect to each other and they may be arranged for instance for the reception of two different frequencies radiated from different stations.

In the arrangement illustrated in Figure 6 each antenna consists of two double deltoid antenna systems 41, 42 and 43, 44 respectively, as shown, the feeding points 45, 46 and 55, 56, and the feeding points 47, 48 and 57, 58 of which are joined by system feed connections 53, 54 and 59, 61 respectively, and these latter connections being joined by connections joining the two systems 67, 68. The feed wires 60, 62 leading to the receiver, are then joined to the last named connections joining the systems.

Again, as in the case already mentioned before, the two systems may be arranged for reception for different stations or channels. The antenna may be started for increased gain.

In the arrangement illustrated in Figure 7 a system of horizontally set antenna 39, 40 similar to the system shown in Figure 5 is provided with a single reflector 66, the two double deltoids being arranged and constructed for the reception of different frequencies and different channels. The double deltoid 39 is located at a distance

$$\frac{\lambda}{4}$$

from the reflector (this distance corresponding to the distance d in Figure 2), λ being the wave length of one channel for which the antenna is constructed. The double antenna deltoid 40 is located at a distance d equal to

$$\frac{\lambda}{4}$$

from the reflector λ being the wave length of another channel. When the antennae 39 and 40 are of the same dimensions, the receiver feed lines 51, 52 are best connected either with feeding points 15, 16 or with feeding points 35, 36. However when the two antennae are arranged for different frequencies and are of different dimensions, the receiver feed line is connected to intermediate points 63, 64 on the two system connecting lines 49, 50, the distance 16—63, 15—64, being proportional to

$$\frac{\lambda}{4}$$

while the distance 63—36; 64—35 is proportional to

$$\frac{\lambda}{4}$$

In this way the desired frequencies will be built up with maximum efficiency.

The connections in all other respects are the same as those already described.

In the antenna arrangement which is illustrated in Figure 8 each double deltoid antenna 79, 80 of the two systems has a separate reflector 64, 65 arranged at a distance d from its antenna which is proportional to a fraction of the wave length on which the antenna receives. The two double deltoid antennae 79, 80 are again joined by system connection lines 81, 82, joining the end terminals 75, 76 and 85, 86 of the deltoids. The feed wires 51, 52 of the receiver are joined to these connection lines. The spacing bars 71, 72 are both held on the mast 33 and are supporting the antenna and reflector system. The two systems may be arranged at different heights and at different angles with respect to a vertical plane for the reception of different transmitter stations.

As a matter of course also the systems shown in Figure 6 may be provided with reflectors and other combinations of stacked antennae will be possible without departing from the principle which has been explained.

It will also be clear that minor and unessential changes in the construction are not to be considered as a departure from the principle of the invention which is defined in the annexed claims.

Having described the invention, what is claimed as new is:

1. An antenna array for the reception of television signals comprising a single, bent antenna wire structure shaped to form substantially two deltoids arranged symmetrically with respect to a plane of symmetry passing between said deltoids and also with respect to a plane bisecting the two deltoids, the two deltoids being joined at a common apex, located at the intersection of the aforesaid planes of symmetry, at which point two of the longer sides of the two deltoids are aligned and joined, the two ends of the wire running along the two deltoids being located near the common apex at a distance therefrom on the two other and longer sides of the deltoids.

2. An antenna array for the reception of television signals comprising an antenna wire structure shaped to form substantially two deltoids arranged symmetrically with respect to a plane of symmetry passing between said deltoids and also with respect to a plane bisecting the two deltoids, the two deltoids having two longer sides substantially equal to one half of the wave length of the radiation to be received, and two shorter sides substantially equal to one fourth of the wave length of the radiation to be received, two longer deltoid sides located on different sides of the plane of symmetry bisecting the two deltoids being joined, and the other two longer sides having end point located on opposite sides of the line of junction between the two first mentioned longer deltoid sides near the same, a line passing said end points intersecting the aforesaid junction line in the planes of symmetry.

3. An antenna array for the reception of television signals, comprising a single bent antenna wire running substantially along the configuration of two deltoids arranged symmetrically with respect to a plane passing between the deltoids and with respect to a plane bisecting the deltoids, said deltoids having a common apex at the intersection of the two planes of symmetry, the single antenna wire passing from one deltoid to the other along the two longer sides of the deltoids which are aligned on both sides of the com-

mon apex and a reflector arranged in a plane and consisting of a bent wire having substantially the shape of two deltoids joined at a common apex the longer sides of the two deltoids being aligned and said deltoids being arranged substantially symmetrically with respect to a plane of symmetry passing between the deltoids and with respect to a plane of symmetry bisecting the said deltoids.

4. An antenna array for the reception of television signals comprising a single bent antenna wire having substantially the shape of two deltoids arranged symmetrically with respect to a plane passing between the deltoids and with respect to a plane bisecting the deltoids, said deltoids having a common apex located at the intersection of the two planes of symmetry and being joined by a single connection between two longer aligned sides located on opposite sides of the last named plane of symmetry, an insulated carrier plate holding said connection between the two longer sides near the plane of symmetry passing between the deltoids, said bent antenna wire having end points fixed on said insulating plate and arranged on the two other longer sides of the deltoid in immediate vicinity of the apex, terminal posts for holding said wire end points and feed wires leading to the reception apparatus connected with said terminal posts.

5. An antenna array as claimed in claim 4, having in addition grounded bolts on said insulated plates arranged in immediate vicinity of said connection between the deltoids and substantially in the plane of symmetry passing between the deltoids, said grounded bolts being means for carrying off static charges.

6. An antenna array comprising a plurality of antenna wires as claimed in claim 1, and in addition apparatus feed lines and distribution lines running from the same points of the feed lines in parallel connections to the free end points of the two longer sides of the deltoids.

7. An antenna array comprising a plurality of antenna wires arranged and bent to form antenna systems as claimed in claim 1, said antenna systems being arranged with their planes of symmetry passing between the deltoids at an angle with respect to each other, parallel distribution lines joining the free end points of the antenna wires of two antennae, and feed lines connected with the center points of said distribution lines.

8. An antenna array comprising a group of antennae with bent single antenna wires as claimed in claim 1, antenna wire system distribution lines joining the free end points of the two antenna systems, a further group of antennae with bent single wires, with antenna wire systems distribution lines joining the free end points of two antenna systems, main distribution lines joining the centers of the aforesaid antenna wire system distribution lines of the two groups and feed lines connected with the centers of the main distribution lines.

HENRY A. WHITE.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
Re. 23,346	Ercolino	Mar. 20, 1951
2,175,253	Carter	Oct. 10, 1939
2,234,744	Thomas	Mar. 11, 1941
2,430,664	Bradley	Nov. 11, 1947

OTHER REFERENCES

Electronic Engineering, December 1946, page 382.

Television News, November 1949, page 25.