Aug. 26, 1958 F. J. KLANCNIK, JR 2,849,712

ANTENNA STRUCTURE

Filed Dec. 31, 1956

Fig. 1

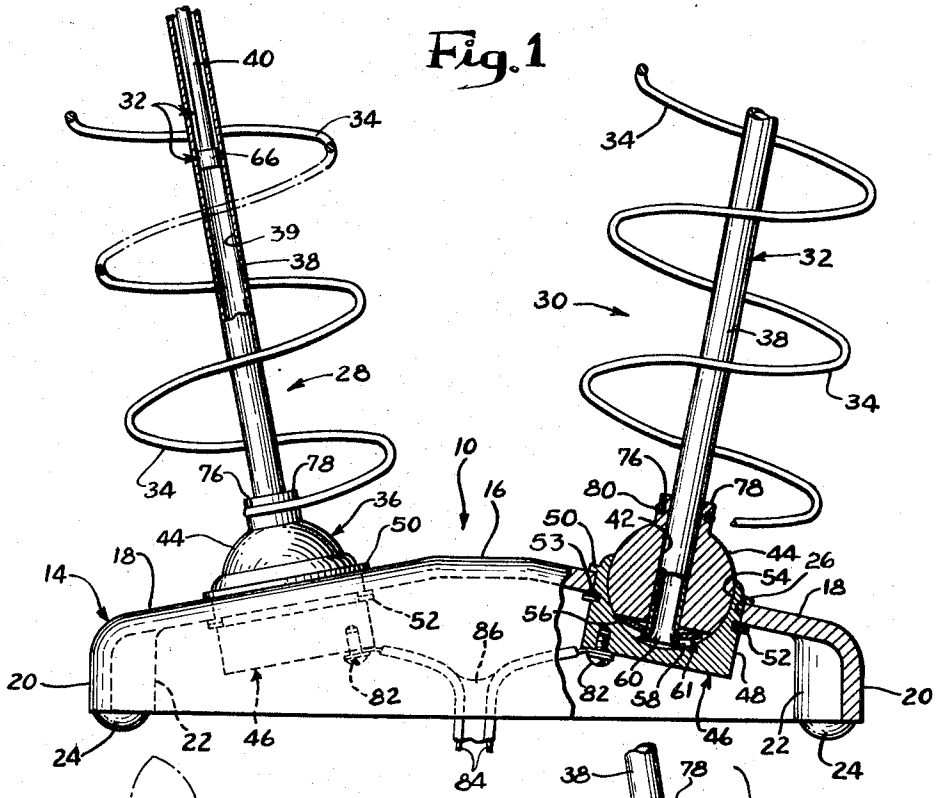


Fig. 2

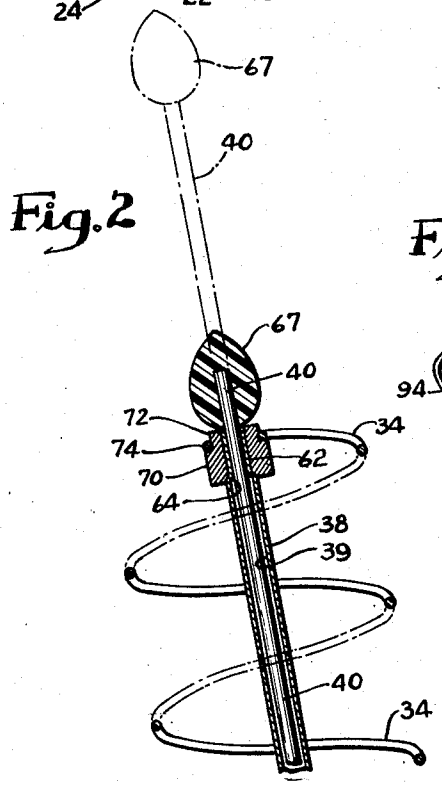


Fig. 3

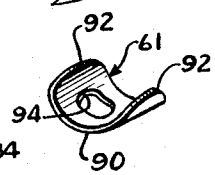
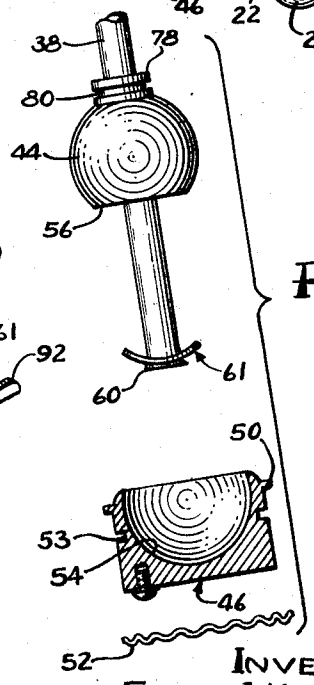


Fig. 4



INVENTOR
FRANK J. KLANCNIK, JR
By Fred Gerlach
ATTY.

United States Patent Office 2,849,712 Patented Aug. 26, 1958

2,849,712

ANTENNA STRUCTURE

Frank J. Klancnik, Jr., Chicago, Ill., assignor to Hi-Lo TV Antenna Corp., Chicago, Ill., a corporation of Illinois

Application December 31, 1956, Serial No. 631,815

6 Claims. (Cl. 343—805)

The present invention relates to antenna structures and more particularly to such structures which are designed for use in the reception of short wave electrical radiation of unlike frequency in the broad high frequency radiation area of television reception. The present invention is specifically concerned with antenna structures which are designed primarily for use as an indoor antenna in connection with television receivers which are installed in the home, for example, in dwelling houses, apartment buildings and the like. Still more particularly, the invention is directed to antenna structures of the type shown and described in my co-pending application, Serial No. 630,637, filed on December 26, 1956, for Antenna Structure.

The antenna structure disclosed in the above mentioned application is of the dipole type and, briefly, it comprises a principal antenna component in the form of a pair of extensible rod-like members the inner ends of which are swivelly connected to a base member of insulating material at spaced points thereon by means of ball and socket connections. Encompassing each rod-like member is a cage member in the form of a few turns of helically wound spring wire material, the two coils constituting a secondary or auxiliary antenna component. The two components are thus inductively coupled and the primary component has a resonant frequency which differs from the resonant frequency of the auxiliary component. The inner ends of the rod-like members are electrically connected through a transmission line to the input of the television receiver and thus signals to which the primary component is responsive are fed directly to the receiver input while signals to which the secondary component is responsive are induced in the primary component for subsequent feeding to the receiver input. Adjustment of the antenna structure for tuning purposes is attained by varying the orientation of the rod-like primary component members and their encompassing helical coils within the wide solid angle range of adjustments of which they are capable by virtue of their ball and socket connection with the base member, or by varying the effective length of these extensible rod-like members, all in a manner which has been fully set forth in my co-pending application above referred to. Reference may be had to this application for a full disclosure of the principles involved in the operation of this type of antenna structure. The present invention is directed specifically to an improved means for establishing electrical contact between the inner end of the extensible rod-like members and the transmission line through the ball and socket joint involved and by means of which limited universal swinging movement may be imparted to the two dipole assemblies.

Accordingly, it is among the principal objects of the present invention to provide an antenna structure of the character shown and described in my co-pending application having associated therewith an improved form of ball and socket connection for permitting limited swinging movement of the rod-like primary antenna component sections relative to the base support and whereby a positive and efficient path for the flow of current through the ball and socket joint is attained.

A similar and related object of the invention, in an antenna structure of this character, is to provide a ball and socket connection between the rod-like primary antenna component sections and the base support which will be effective to positively maintain the various parts involved in their selected positions of adjustment against shifting and dislodgment.

These being the principal objects of the invention, other objects and advantages thereof, not at this time enumerated, will become more readily apparent as the following description ensues.

In the accompanying single sheet of drawing forming a part of this specification a preferred embodiment of the invention has been shown.

In this drawing:

Fig. 1 is a fragmentary side elevational view partly in longitudinal section of an antenna structure constructed in accordance with the principles of the present invention;

Fig. 2 is a fragmentary sectional view taken substantially longitudinally and centrally through the outer region of a composite dipole assembly employed in connection with the present antenna structure;

Fig. 3 is a perspective view of a spring thrust washer employed in connection with the present invention; and

Fig. 4 is an exploded view of a ball and socket joint employed in connection with the invention.

Referring now to the drawing in detail, an antenna structure manufactured in accordance with the principles of the present invention has been designated in its entirety at **10** and is of the "indoor" type capable of being mounted on the top wall of a television receiver or on any other suitable supporting surface in the vicinity of the receiver. The structure **10** involves in its general organization a base member **14** which may be formed of a suitable insulating material such as Bakelite or other similar durable plastic material having the necessary strength and rigidity to perform its supporting function in the antenna assembly. The base member **10** is in the form of a shallow inverted cup-shaped body which is preferably of generally rectangular design in horizontal cross section and is formed with an upper dome-like portion having a narrow flat apex portion **16** from which there slopes downwardly and outwardly a pair of flat inclined portions **18**. A depending apron **20** extends around the base structure and constitutes the side walls thereof. At the four corners of the base structure there are provided internal ribs **22** which may be drilled to accommodate reception therein of the shank portion of conventional rubber or other anti-friction feet members **24**.

Formed substantially centrally in each of the two flat portions **18** of the base member **14** is a circular hole or opening **26** and supported on the base member **14** within the openings **26** are a pair of composite antenna assemblies **28** and **30**, respectively, the two assemblies being substantially identical in construction and design but being separately designated for facility of description. Since the two assemblies are identical, it is thought that a description of one will suffice for the other.

The antenna structure proper comprises a principal two-part dipole component consisting of two composite rod-like elements **32**, the effective length of which may be varied by means subsequently to be described, an auxiliary antenna component consisting of two helical spring wire coils **34**, one of which coils is associated with each of the assemblies, together with a ball and

socket connection 36 whereby each assembly is operatively mounted on the base member 14 for independent limited universal swinging movement relative to the latter.

Each part or section of the principal antenna component includes a hollow tubular proximate rod-like member 38 having a central bore 39 formed therein and an outer or distal member 40 which may be in the form of a solid rod and which is telescopically slidable within an end of the proximate or lower member 38 so as to be adjustably extensible therefrom. The lower end of the hollow tubular member 38 extends through and is slidable in a radially extending bore 42 provided in a frustospherical ball member 44 carried in a metal socket member 46 fixedly supported within the opening 26. The socket member 46 is in the form of a cup-shaped casing having a cylindrical outer wall 48 fitting snugly within the opening 26 and having an annular flange 50 formed thereon adjacent the upper rim thereof. A split wave spring washer 52 is seated within an annular groove 53 formed in the socket member 46 beneath the flat portion 18 of the base member 14 and serves to retain the flange 50 seated on the base member so as to fixedly secure the socket member 46 within the opening 26. The socket member is formed with a hollow spherical socket 54 in which the ball member 44 is snugly disposed for limited universal turning movement therein. The socket 54 encompasses a major portion of the ball member so that the latter is permanently retained within the socket against dislodgment. Initial insertion of the ball member 44 into the socket 54 may be effected in any suitable manner as for example by beading the rim of the socket over the ball, or by thermal contraction of the metal socket member 46 on the ball member.

The retaining ball member 44 is truncated in the lower regions thereof as indicated at 56, thus providing a clearance space or pocket 58 at the bottom of the socket. The extreme lower end of the tubular rod 38 is formed with an enlargement 60 thereon which may be formed by a flaring operation which is performed on the rod at its lower end. Surrounding the rod 38 and positioned between the enlargement 60 and the truncated portion 56 of the ball member is a thrust washer 61, the nature and function of which will be set forth presently and the incorporation of which in the ball and socket assembly 36 constitutes one of the principal features of the present invention.

As shown in Figs. 2 and 3, the outer or distal end of the tubular rod 38 is reduced as at 62, thus providing an internal shoulder or limit stop 64 designed for engagement with a cylindrical enlargement 66 formed on the lower end of the upper or distal rod 40 when the latter reaches the limit of its outward sliding movement relative to the tubular rod 38. The diameter of the enlargement 66 is such that it will have a sliding frictional fit within the inner bore 39 of the tubular rod to prevent shifting thereof under the influence of its own weight when the same is moved to any selected position of adjustment on the rod 38. Inward telescopic sliding movement of the upper or distal rod 40 within the bore 39 is limited by the provision of a cap member 67 which may be press-fitted on the outer end of the rod 40.

The auxiliary component of the antenna structure which comprises the two helical coils 34 has each section or coil thereof inductively coupled to its respective primary component section or tubular rod 38. Each coil 34 consists of a few coil turns of the wire material, eleven such turns being considered ideal although it will be understood that a greater or a lesser number of such turns may be employed if desired.

The opposite ends of the coil 34 are connected to the outer free end of the rod 38 and to the ball member 44 respectively in such a manner that the rod is at all times normally biased downwardly or inwardly of the ball structure and so that the flared end 60 is caused to frictionally bear against the wall of the socket 54 and establish good frictional and electrical engagement therewith. Accordingly, a cap member 70 (Fig. 2) of insulating material such as Bakelite or other suitable plastic is telescopically received over the outer end of the rod 38 and fits snugly around this end. The cap member 70 is formed with a reduced outer end 72 around which the outer end of the coil 34 is looped as at 74. The lower end of the coil 34 is similarly looped as at 76 around a protruding neck portion 78 formed on the ball member 44 and the looped portion thereof is seated within an annular groove 80 formed in the neck portion. The normal condition of the helical coil 34 is such that it is completely collapsed and, since the coil is formed of spring wire material, the coil, when in position on the rod 38 will serve to normally urge the latter inwardly of the socket member as previously described.

It is to be noted that since the cap member 70 is formed of an insulating material, the outer end of the coil 34 is effectively electrically insulated from the rod 38. The ball member 44 may be formed of metal or it may, alternatively, be formed of an insulating material. In either event, the cage-like helical coil 34 will be inductively coupled to the rod 38 inasmuch as in the former instance it is completely insulated therefrom and in the latter instance it is electrically connected thereto only at its extreme inner region where there is practically no voltage differential between the parts.

The socket members 46 of the two composite antenna sections 28 and 30 are each provided with a terminal screw 82 on the underneath side thereof whereby the same may be directly connected to the input of a television receiver or other receiving apparatus by means of electrical conductors 84 which may be embedded in the conventional flat lead-in tape conductor cable 86.

It has been found in actual practice that the frictional force developed between the flared end 60 of the rod 38 and the inner wall of the socket 54 cannot always be relied upon to establish a good electrical contact between the rod and socket member 46, nor can it be always relied upon to overcome the influence of gravitational forces acting upon the outer regions of the coil and rod assemblies 28 and 30 and prevent unwanted displacement of these assemblies. This is particularly true in instances where the ball member 44 is formed of an insulating material such as Bakelite or other plastic material having a hard surface finish which presents a low coefficient of friction to the surrounding wall of the socket 54 or where the helically wound coil has lost its resiliency due to tampering therewith or accidental damage thereto. It is particularly true where users of the antenna structure have introduced oil into the space existing between the ball and its confining socket for purposes of lubrication. According to the present invention, in order to insure a high degree of frictional contact between the lower or proximate end of the rod 38 and the wall of the socket 54, as well as a clean electrical contact between these elements, the spring washer 61, previously referred to, and which encircles the rod 38 is formed from a high grade of spring steel and is in the form of an annulus which has been bent into generally U-shape configuration in side elevation so as to provide a bowed medial portion 90 having upwardly and outwardly diverging side wings 92 as viewed in Fig. 3 extending therefrom. The washer 61 is formed with a central opening 94 therethrough, the diameter of which is less than the overall diameter of the enlargement or flared portion 60 of the rod 38. The difference between the axial linear extent of the enlargement 60 and the depth of the pocket 58 is less than the overall thickness of the spring washer 61 so that when the flared end 60 of the rod 38 is confined within the pocket 58 in the assembled ball and socket structure 36, the bowed medial portion 90 will bear downwardly against the flared end 60 of the rod 38 while the side wings 92 will bear upwardly against the truncated portion 56 of

the ball member 44 and thus a powerful downward thrust will be applied to the rod 38 so as to force the flared end 60 thereof into firm frictional and electrical contact with the spherical wall of the socket 54. By such an arrangement, not only is a positive and unbroken electrical path provided between the rod 38 and the terminal binding or anchoring screw 82, but additionally sufficient resistance to universal turning or swinging movement of the two sections 28 and 30 relative to the base member 14 is offered that these sections will remain in any desired positions of adjustment despite the influence of gravitational forces acting thereon.

In the installation and use of the present antenna structure, the base member 14 may be positioned in the vicinity of the television receiver or other receiving apparatus with which it is associated, preferably on the top or table portion of the receiver cabinet. The terminal screws 82 are connected as hereinbefore described through the conductor cable 86 to the receiver input in the usual manner of connecting such antenna structures. With the two outer or distal primary component rods 40 fully received within the inner or proximate primary component rods 38, the structure will function substantially in the same manner as the antenna structure of my co-pending application wherein the rods 38 have a resonant frequency which is responsive to radio waves or signals in the high frequency range of signals allotted to commercial television broadcast stations and will receive such signals and transmit them directly to the receiver input through the transmission line to which they are electrically connected. The coils 34 which are inductively coupled to the rod 38 and which have a resonant frequency which is responsive to radio signals in the low frequency range of television broadcast signals will receive such signals and cause them to be induced in the rod 38 for transmission to the receiver input.

Inasmuch as the ball and socket mounting from the composite primary and secondary component sections of the antenna structure will permit limited swinging movements of the sections throughout relatively wide solid angles, limited tuning whereby the overall response of the antenna structure may be varied is made possible by the expedient of varying the angle of acceptance of either or both composite sections 28 and 30 between horizontal and vertical positions of the sections so that more accurate impedance matching in either the high or low frequency range may be attained. Directional tuning effects may be attained by causing the composite sections 28 and 30 to move through increments of horizontal swinging motion about respective vertical axes. Additional tuning effects may be attained by varying the effective length of either or both of the composite extensible rod-like elements 32. Such tuning effects may be accomplished by the simple expedient of engaging the end caps 67 manually and moving the distal rods 40 to any desired telescopic position of reception within the proximate tubular rods 38. Increasing or decreasing the effective length of the primary antenna elements 32 serves to vary the resonant frequency of the primary antenna component to render the same more responsive to reception of signals in the high frequency range. Changing of the length of the primary antenna elements 32 also has a limited effect on the inductance of the surrounding coils 34 and, as the inductance of these coils is increased or decreased, as the case may be, their resonant frequency is also altered so that the auxiliary antenna component may likewise be rendered more responsive to low frequency signals.

In compliance with Title 35, U. S. Code, Section 22, a preferred form of the invention has been shown in the drawings and described herein, but it should be understood that the invention is not limited to the specific disclosure made, and that the appended claims should be construed as broadly as the prior art will permit.

Having thus described the invention what I claim as new and desire to secure by Letters Patent is:

1. Antenna structure comprising in combination a base member formed of electrically insulating material, a pair of metal rods forming a dipole antenna component, ball and socket means swivelly connecting the proximate end of each rod to the base member at spaced points thereon whereby the rods may be individually swung throughout respective solid angles between positions of wide divergence and positions of parallelism, said connecting means comprising a metal socket member fixedly secured to the base and having a spherical socket formed therein, a spherical ball loosely mounted for universal turning movement in said socket, said ball being formed with a radial bore extending completely therethrough and opening into said socket, the inner end region of said rod projecting completely through said bore and being slidable axially therein, means providing a shoulder on said ball, means providing a shoulder on said rod, spring means interposed between said shoulders for normally urging said rod axially inwardly of the socket whereby the proximate end thereof frictionally engages the wall of the latter, and a terminal connection in electrical contact with said socket member.

2. Antenna structure comprising in combination a base member formed of electrically insulating material, a pair of metal rods forming a dipole antenna component, ball and socket means swivelly connecting the proximate end of each rod to the base member at spaced points thereon whereby the rods may be individually swung throughout respective solid angles between positions of wide divergence and positions of parallelism, said connecting means comprising a metal socket member fixedly secured to the base and having a spherical socket formed therein, a spherical ball loosely mounted for universal turning movement in said socket, said ball being relieved in the lower regions thereof to provide a clearance pocket defined by the relieved portion of the ball and the opposed inner wall of the socket, said bore being formed with a radial bore extending completely therethrough and opening into said pocket, the inner end region of said rod projecting completely through said bore and being slidable axially therein, the extreme inner end of the rod being disposed within said pocket, means providing a shoulder on said rod within said pocket, spring means interposed between said shoulder and the relieved portion of the ball for normally urging said rod axially inwardly of the socket whereby the proximate end thereof frictionally engages the wall of the latter, and a terminal connection in electrical contact with said socket member.

3. Antenna structure comprising in combination a base member formed of electrically insulating material, a pair of metal rods forming a dipole antenna component, ball and socket means swivelly connecting the proximate end of each rod to the base member at spaced points thereon whereby the rods may be individually swung throughout respective solid angles between positions of wide divergence and positions of parallelism, said connecting means comprising a metal socket member fixedly secured to the base and having a spherical socket formed therein, a spherical ball loosely mounted for universal turning movement in said socket, said ball being relieved in the lower regions thereof to provide a clearance pocket defined by the relieved portion of the ball and the opposed inner wall of the socket, said bore being formed with a radial bore extending completely therethrough and opening into said pocket, the inner end region of said rod projecting completely through said bore and being slidable axially therein, the extreme inner end of the rod being disposed within said pocket, means providing a shoulder on said rod within said pocket, a spring member surrounding said rod and interposed between said shoulder and the relieved portion of the ball for normally urging the rod axially inwardly of the socket whereby the proximate end thereof frictionally and electrically engages the

wall of the latter, and a terminal connection in electrical contact with said socket member.

4. Antenna structure as claimed in claim 3 wherein said spring member is in the form of an annular washer formed of spring steel the annlus of which is deformed at spaced regions out of the normal plane of the annulus.

5. Antenna structure as claimed in claim 3 wherein said spring member is in the form of a deformed annular washer having a central bowed portion bearing against said shoulder and diverging side wings bearing against the relieved portion of the ball.

6. Antenna structure comprising in combination a base member formed of electrically insulating material, a pair of metal rods forming a principal dipole antenna component, a ball and socket connection between the inner proximate end of each rod and the base member whereby the rods may be individually swung through respective solid angles between positions of wide divergence and positions of parallelism, each connection comprising a metal socket member fixedly mounted on said base member and having a spherical socket formed therein, a spherical ball loosely mounted for universal turning and swinging movement in said socket, said ball being formed with a radial bore extending completely therethrough, the inner end region of said rod projecting completely

through said bore and being slidable axially in the latter, a helical wire coil formed of spring material encompassing said rod axially and coextensively and through which the rod extends centrally, means for securing the outer end of said coil to the free outer end of the rod while maintaining the same electrically insulated from said end, means for securing the inner end of said coil to the ball whereby the coil is constrained to follow the swinging movements of the rod, said coil being inductively coupled to the rod and the two coils constituting an auxiliary antenna component, said coil being under tension and serving to normally urge the rod inwardly of the socket provided in said socket member whereby the inner end of the rod is forced into frictional engagement with the wall of the socket, means providing a shoulder on said ball, means providing a shoulder on said rod, spring means interposed between said shoulders for assisting the action of said coil in forcing the inner end of the rod into frictional engagement with the wall of said socket, and a terminal connection in electrical contact with said socket member.

References Cited in the file of this patent

FOREIGN PATENTS

489,037 Germany ---------- Nov. 6, 1927