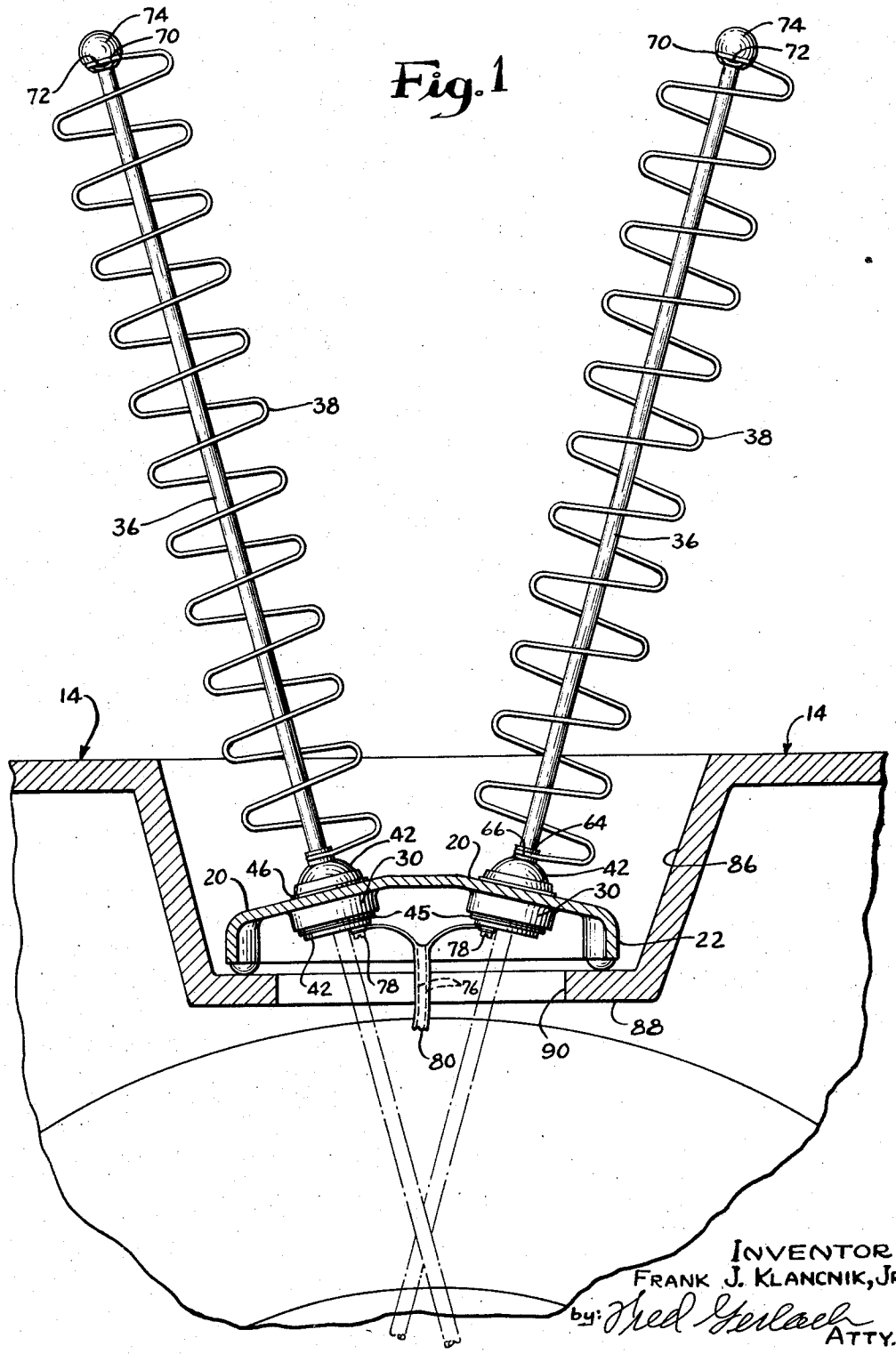
July 14, 1959 F. J. KLANCNIK, JR 2,895,130

HELICAL ANTENNA COMPONENT AND ADJUSTABLE MOUNTING MEANS THEREFOR

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Fig. 1



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Fig. 2

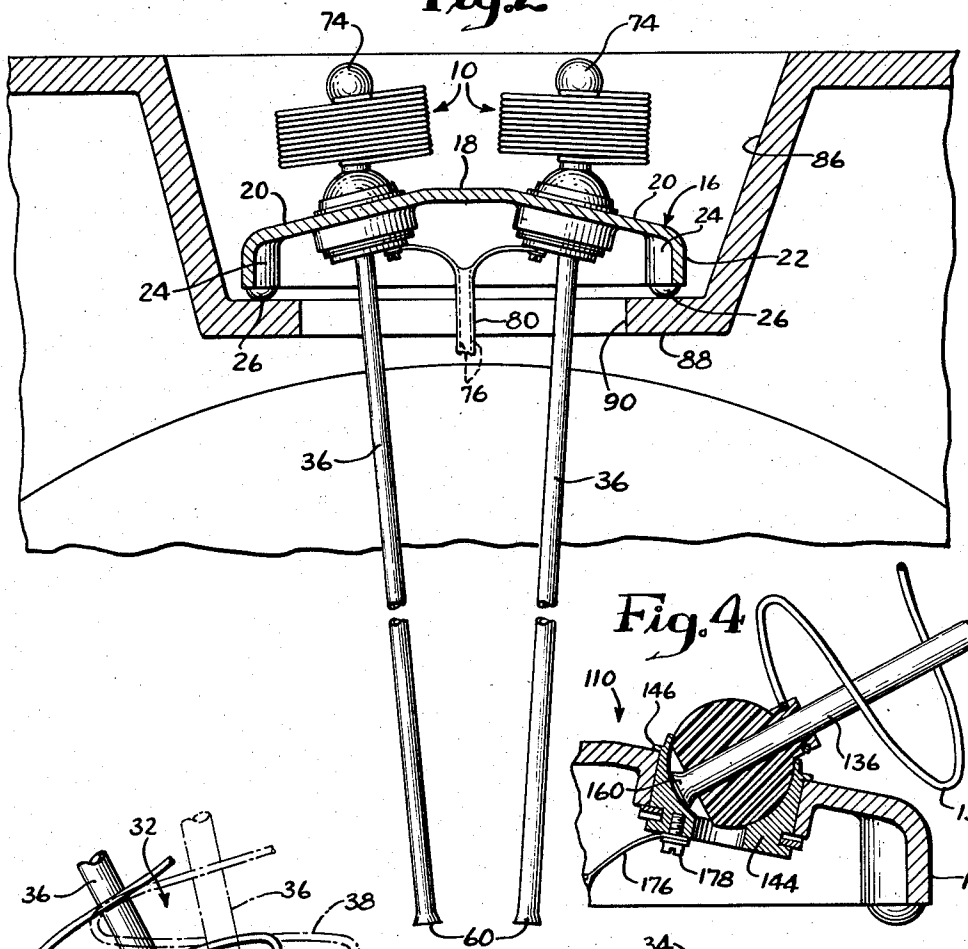
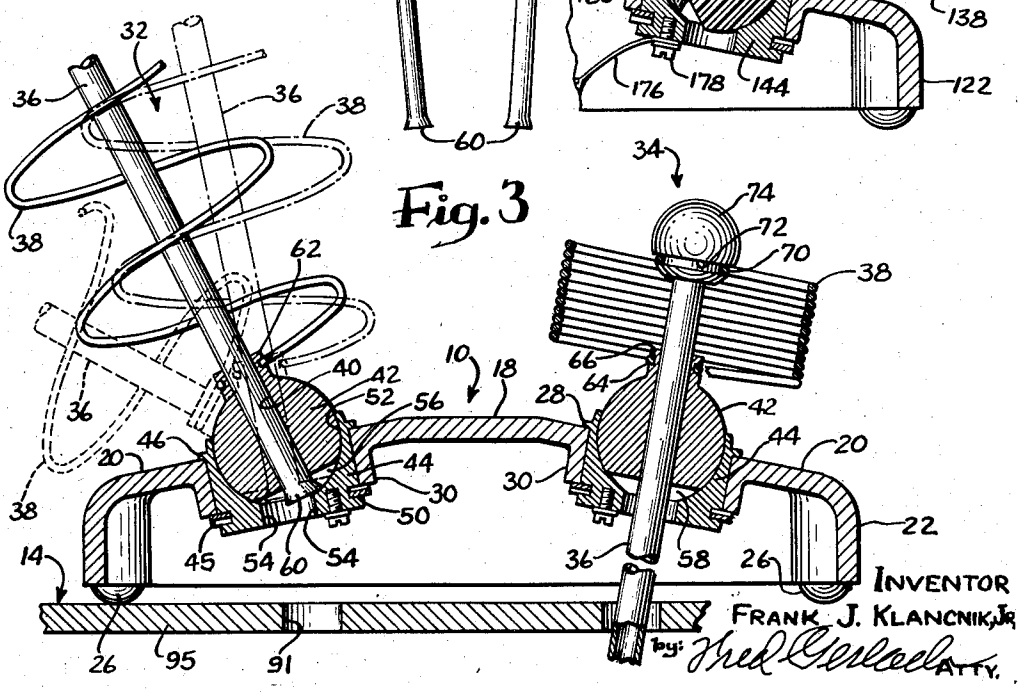


Fig. 4

Fig. 3



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2,895,130

HELICAL ANTENNA COMPONENT AND ADJUSTABLE MOUNTING MEANS THEREFOR

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Application December 26, 1956, Serial No. 630,636

7 Claims. (Cl. 343—747)

The improved antenna structure comprising the present invention has been designed for use primarily in connection with the reception of short wave electrical radiation of unlike frequency in the broad high frequency radiation area of television reception. The invention is, however, capable of other uses and the present antenna structure may, if desired, with or without suitable modification, be utilized for the reception of electrical radiation in other bands. Irrespective, however, of the particular use to which the invention may be put, the essential features thereof are at all times preserved.

Specifically, the invention relates to antenna structures of the general type set forth in United States patent to Klancnik et al. No. 2,495,579, dated January 24, 1950, for "Antenna," and over which structure the present antenna structure is an improvement. The antenna shown and described in the above mentioned patent is of the dipole variety and the principle of its operation is predicated upon the use of a principal component having a resonant frequency responsive to radio waves of a selected frequency, and an auxiliary component having a resonant frequency responsive to radio waves of a lower frequency, the two components being inductively coupled but electrically isolated from each other in such a manner that a highly effective impedance match with the apparatus to which the antenna structure is connected is attained. The principal antenna component is electrically connected directly to the input of the television or other receiver with which the antenna structure is associated for transmission thereto of signals of relatively high frequency and the signals of lower frequency to which the principal component ordinarily is not responsive are induced in the principal component by the auxiliary component so that they too may be transmitted to the receiver. This principle of operation has come to be known as the "Hi-Lo" operating principle and, in the present antenna structure, it has, with modification, been preserved.

Accordingly, it is an object of the present invention to provide an antenna structure which operates upon the basic principle briefly outlined above and having associated therewith adjusting means whereby the average impedance at the take-off terminals of the structure may be varied over a considerable range. In carrying out this object, the invention contemplates the construction of the principal antenna component in the form of a split dipole element of rod-like design each section or leg of which has individually associated therewith an inductively coupled coil element, the two coil elements, in combination, constituting the secondary or auxiliary antenna component. The auxiliary component may be electrically disassociated from the principal component but it is within the scope of the present invention to maintain electrical connection between the two components, providing such connection exists at the split dipole section terminals where a region of high current but practically negligible voltage exists. According to the present invention, means are provided for individually varying the angle of acceptance of either or both composite dipole sections, with each section being capable of universal pivotal or swinging movement throughout a wide solid angle to produce an infinite number of tuning or impedance matching effects.

In addition to the above outlined electrical features of the present antenna structure, the same involves certain novel mechanical features, principal among which is the utilization of a novel and effective means for establishing an electrical connection between the low voltage ends of the two dipole sections of the principal antenna component and the current take-off terminals of the structure, the connection remaining effective in any of the adjusted positions of the sections.

The invention is particularly well suited as a so-called indoor antenna structure of the type which when operatively associated with a television receiver is maintained in proximity to the receiver as, for example, being supported on the top or table portion of the receiver. Toward this end, the invention is illustrated herein in one environment thereof as being positioned directly on the receiver and as constituting a component part of the same. In another environment of the invention, the antenna structure is shown as being associated with a base member which may be positioned either on the receiver or on a supporting surface in the immediate vicinity of the receiver. In either instance, where the antenna is supported on the receiver, means are provided whereby the antenna structure may be collapsed so that it will occupy but little space with portions of the structure actually extending into the television receiver cabinet and from which cabinet these portions may be extended when the structure is set up for reception purposes.

The provision of an antenna structure of the character briefly outlined above being among the principal objects of the invention, it is a further object thereof to provide a collapsible antenna structure wherein the auxiliary antenna component, as outlined above, is in the form of a pair of helical coil springs each associated with one of the primary dipole components and the force of which spring is utilized firstly to establish intimate electrical contact between the dipole section and the supporting structure in which it is mounted, secondly, to afford good frictional engagement between the dipole section and its supporting section for maintaining the composite dipole section including the primary and auxiliary components thereof in any desired physical position of adjustment, and thirdly, to maintain the structure collapsed when it is in its inoperative position.

It is another object of the invention to provide an antenna structure of the character briefly outlined above which is capable of being manufactured as a built-in component of an original television receiver to the extent that when it is in its inoperative or collapsed condition, it assumes a position wholly within the confines of the receiver cabinet yet which when in its extended operative position has its principal and auxiliary antenna components disposed wholly outside the confines of the cabinet so that it is not subject to those reception limitations which are invariably attendant upon antenna structures which are completely housed within the receiver cabinet, as, for example, capacitance, inductance, or other shielding effects derived from its close proximity to other elements of the receiver.

A further object of the invention is to provide an antenna structure of this sort which may be readily applied to existing television receivers without requiring extensive modification of the receiver cabinet or of the instrumentalities which it houses.

The provision of an antenna structure which is extremely simple in its construction and which, therefore, may be manufactured at a low cost; one which is rugged and durable and which, therefore, will withstand rough usage; one which although it is capable of physical adjustment is comprised of a minimum number of relatively moving parts and which, therefore, is unlikely to get out of order; one which requires no oiling or lubrication for its maintenance yet which if lubricated will not be impaired insofar as electrical contact between its frictional engaging parts is concerned; one which is attractive in its appearance and pleasing in its design; and one which otherwise is well adapted to perform the services required of it, are further desiderata which have been borne in mind in the production and development of the present invention.

In the accompanying two sheets of drawings forming a part of this specification, two embodiments of the invention have been shown.

In these drawings:

Fig. 1 is a fragmentary sectional view taken substantially centrally and vertically through a television receiver cabinet specially constructed to accommodate the antenna structure of the present invention and showing such structure operatively applied thereto and in its extended position of use;

Fig. 2 is a sectional view similar to Fig. 1 showing the antenna structure in its collapsed condition;

Fig. 3 is an enlarged fragmentary sectional view taken substantially longitudinally and centrally through the antenna structure of the present invention showing the same operatively associated with a supporting surface or shelf which may constitute a portion of the top wall of an existing television receiver cabinet; and

Fig. 4 is a fragmentary sectional view taken substantially centrally through an alternative form of ball and socket joint capable of use in connection with the antenna structure of Figs. 1 and 3, inclusive.

Referring now to the drawings in detail, the preferred form of the present antenna structure has been designated in its entirety at **10**, the structure being shown in Figs. 1 and 2 as being operatively mounted on a television receiver cabinet **12** and as constituting a built-in component of the receiver as manufactured. In Fig. 3, the antenna structure **10** is shown as being applied to an existing television receiver cabinet **14**, the latter being slightly modified to accommodate the antenna structure as will be described subsequently.

The antenna structure **10** involves in its general organization a platform or base **16** of inverted cup-shaped configuration and which may, if desired, be formed of a suitable plastic material. The base **16** is generally of rectangular configuration in horizontal cross section and is formed with an upper dome-like portion having a narrow flat apex portion **18** from which there slopes downwardly and outwardly a pair of flat inclined portions **20**. A depending apron **22** extends around the base structure and constitutes the side walls thereof. At the four corners of the base structure there are provided internal ribs **24** which may be drilled to accommodate reception therein of the shank portion of conventional anti-friction foot members **26**.

Each of the flat portions **20** of the base structure **16** is provided with a medially disposed opening **28** therethrough, the openings being defined by relatively short depending cylindrical bosses **30**. Supported on the base member **16** and within the respective openings **28** and bosses **30** associated therewith are a pair of composite antenna assemblies, the two assemblies being identical in their construction but being for facility of description designated separately in their entirety at **32** and **34**, respectively. Since the two assemblies **32** and **34** are identical, it is thought that a description of the assembly **32** will suffice for the assembly **34**.

The antenna structure per se of the present invention comprises a principal two-part dipole component consisting of two hollow rod-like tubular elements **36**, one of which is associated with each of the two assemblies **32** and **34**, an auxiliary component consisting of two helical spring wire coils **38**, one of which is associated with each of the assemblies, together with novel means for mounting and supporting the principal and auxiliary components of each assembly in their operative physical and electrical relationship with respect to each other. Each section **36** of the principal antenna structure comprises a straight tubular rod of electrical conducting material, the rod being slidably disposed within a radially extending bore **40** provided in a frusto spherical ball member **42** carried in a socket member **44** fixedly supported within the opening **28** and its surrounding boss **30**. The socket member **44** is in the form of a cup-shaped casing having a cylindrical outer wall which fits snugly within the opening **28** and having an annular flange **46** formed thereon adjacent the upper rim thereof. Adjacent the lower end of the socket member **44**, a split wave spring washer **45** is seated within an annular groove **50** and serves to retain the socket member in the openings **28**. The socket member **44** is formed with a hollow spherical socket **52** in which the retaining ball **42** is snugly disposed for limited universal turning movement therein. The socket **52** encompasses a major portion of the ball **42** so that the ball is permanently retained within the socket against dislodgement. The socket **52** communicates with a hole **54** which is provided at the bottom of the socket member **44** and the function of which hole will become clear presently. In the form of the invention illustrated in Figs. 1 to 3, inclusive, the supporting member **44** is formed of a suitable conductive metal and the ball **42** which is partially encompassed by the socket member **44** is likewise formed of a conductive metal. The retaining ball **42** in which the rod **36** is slidable 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 **52**. The extreme lower end of the tubular rod **36** is formed with an enlargement **60** thereon which may be formed by a flaring operation which is performed on the metal of the rod at this region. The overall diameter of the enlargement **60** is slightly less than the overall diameter of the hole **54** and is greater than the overall diameter of the bore **40**. Thus the rod **36** may not be pulled outwardly from the bore **40** in the ball **42** inasmuch as the lower rim of the bore **40** will serve as a limit stop for the rod but the rod may be pushed downwardly so that it enters and passes through the hole **54** when the rod assumes a position of substantial alignment with the axis of the hole **54**. By such an arrangement, the rod **36** may be moved from the elevated position in which it is shown in Fig. 1 and at the left hand side of Fig. 3 to the lowered position in which it is shown in Fig. 2 and at the right hand side of Fig. 3. When the rod is in its elevated position, the enlargement or flared end **60** thereof is contained wholly within the pocket **58** provided for it by the truncated portion **52** of the spherical ball **42** so that the lower flared end of the rod will clear the rim of the hole **54** and thus permit the ball **42** to be universally turned within the socket **52**.

The auxiliary component of the antenna structure which comprises the two helical coils **38** has each section or coil thereof insulated from but inductively coupled to its respective primary component section or tubular rod **36**. Each helical wire coil **38** consists of a few coil turns of the wire material, eleven such turns being disclosed herein purely for illustrative purposes. It will be understood, of course, that a greater or lesser number of such turns may be employed if desired. The outer region of the supporting ball **42** is formed with a short cylindrical neck portion **62** having an annular groove **64** formed therein and the lower or inner end of the helically wound coil is looped as at **66** around the neck portion **62** within

the groove 64 with a tight frictional fit, thus anchoring the lower end of the helical coil element 38 to the supporting ball 42. The outer end of the helical coil 38 is similarly looped as at 70 within an annular groove 72 provided in a cap member 74 of insulating material telescopically received over the outer end of the rod 36. From the above description it will be seen that the helically wound coil 38 is substantially equal in overall length when the rod 36 is in an extended position to the overall length of the metal rod itself.

The helically wound coils 38 which, in combination, comprise the auxiliary antenna component are manufactured so that in their free state the coils are collapsed with the adjacent convolutions thereof in contiguity as shown in Fig. 2 and at the right hand side of Fig. 3.

When the rods 36 are moved to their extended position, therefore, the helices are under tension and the rods are thus normally biased downwardly toward the base 16. Thus, when the rod 36 is so extended and the ball support 42 in which the rod is slidable is moved to an angular position with respect to the longitudinal axis of the hole 54 provided in the socket member 44 as indicated by either of the dotted line positions shown at the left hand side of Fig. 3, the flared lower end of the rod 36 is forced into firm frictional contact with the metal wall of the spherical socket 52 through a sharp circular line of contact thus affording positive electrical engagement between the rod 36 and the socket member 44. The socket members 44 may thus be directly connected to the input of a television receiver or other receiving apparatus by means of electrical conductors 76, the ends of which are anchored to screw terminals 78 provided on the underneath surface of the socket members 44 and which conductors may be embedded in the usual flat lead-in type of conductor cable 80.

From the above description it will be seen that the primary dipole component rod sections 36 may be fashioned during manufacture thereof so that they will resonate in response to radio waves of a predetermined frequency such as exist in the high frequency television band. The auxiliary component comprising the helically wound coils 38 may also be fashioned for response to radio waves of a frequency different from that to which the primary component is responsive, as, for example, radio waves in the low frequency television band. High frequency waves received by the primary component are transferred to the input of the television apparatus through the conductor 76 directly. Radio waves received by the auxiliary component are transferred by induction to the primary component and from thence they are transmitted through the conductors 76 to the input of the television receiver.

The ball and socket mounting for the composite primary and secondary component sections of the antenna structure make possible limited tuning facilities whereby the overall response of the antenna structure may be varied, thus varying the angle of acceptance of either or both composite sections between horizontal and vertical positions of the sections so that more accurate impedance matching in either the high frequency or low frequency range may be attained. Where the antenna structure is installed so that the base 16 is fixedly oriented and cannot be turned about a vertical axis, directional coincidence of the antenna components may be attained by imparting clockwise or counterclockwise components of horizontal swinging movement to the antenna sections 32 and 34.

As to the mechanical aspects of the present invention, when it is contemplated that the antenna structure shall be incorporated as an integral composite part of a television receiver as manufactured and designed for sale with the receiver, the structure 10 may be loosely supported with a shallow well or the like such as has been shown in Figs. 1 and 2 and designated at 86, the well having a bottom wall 88 provided with a circular opening 90 therein through which the rods 36 may be projected when the antenna structure is in its collapsed condition as illustrated in Fig. 2. The base or platform 16 is adapted to span the distance of the circular opening 90 with the feet 26 resting loosely on the bottom wall 88. The entire antenna structure may thus be bodily turned within the well 86 so as to bring the antenna structure into directional coincidence with a particular broadcasting station. By such an arrangement, the antenna structure when in its collapsed condition is contained wholly within the confines of the receiver. The structure is thus in an out-of-the-way position where it presents no obstruction during transportation of the receiver or moving thereof. Additionally, such a construction makes it possible to lift the antenna assembly out of the well 86 for purposes of on-the-spot inspection when necessary. Where the antenna structure is employed in connection with existing television receivers, the same may be mounted on the receiver cabinet by any suitable means (not shown) in such a manner that the rods 36, when in their lowered positions, will clear the edge of the cabinet and project downwardly behind the same. Alternatively, if desired, holes such as have been shown at 91 in Fig. 3 may be drilled in the top wall 95 of the cabinet 14 to accommodate reception of the lowered rods. It will be understood, of course, that such holes will be employed only when a convenient clearance space for the rods may be found within the interior of the cabinet. Despite the fact that the supporting ball 42 is formed of conductive metal so that an electrical connection between the socket member 44 and rod 36 is established through the ball 42, this path for the flow of current is not relied upon solely for transmission purposes inasmuch as there is a more positive path for the flow of current directly from the inner end of the rod 36 which is forced into frictional and electrical engagement with the bottom wall of the socket 52. It is contemplated that it will be the practice of users of the antenna structure to introduce oil into the space existing between the ball and its confining socket for lubrication purposes. Should this expedient be resorted to, any insulating film of oil or other foreign matter which may accumulate within the socket, it will not destroy the efficiency of the apparatus inasmuch as the frictional contact between the flared end of the rod 36 and socket wall under the influence of the spring action afforded by the helically coiled secondary antenna component 38 will supply the necessary electrical contact, as well as the necessary responses to gravitational forces acting on the composite antenna sections or assemblies 32 and 34.

In the form of the invention shown in Fig. 4, the antenna structure remains substantially the same as that shown in Figs. 1 to 3, inclusive, with the exception that in this instance the ball portion of the ball and socket connection which exists between the lower end of the dipole rod and the base member 10 is formed of a suitable insulating material such as Bakelite or other plastic material. To avoid needless repetition of description, similar reference numerals of a higher order have been applied to the corresponding parts in Figs. 3 and 4. It will be seen, therefore, that since the ball 142 is formed of an insulating material, there will be no flow of current from the inner end of the rod 136 to the socket member 144 and from thence to the transmission terminals 176. The only path of the flow of current from the rod to its respective terminal will be through the region of frictional contact between the flared end 160 of the rod and the opposed wall of the socket 152.

The invention is not to be limited to the exact arrangement of parts shown in the accompanying drawings or described in this specification as various changes in details of construction may be resorted to without departing from the spirit of the invention. For example, while the ball and socket assemblies 42, 44 are shown herein as being operatively mounted on a base

member 16, it is contemplated that in certain installations wherein the antenna structure is operatively associated with a television receiver as a built-in component thereof, the base structure 16 may be omitted and these two assemblies may be mounted in side-by-side relationship in respective openings formed directly in the top wall of the receiver cabinet. Irrespective, however, of the particular mounting for the dual composite antenna components, the essential features of the invention are at all times preserved.

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 formed of electrically insulating material, a pair of rods forming a principal dipole antenna component, a ball and socket connection between the inner end of each rod and the base whereby the rods may be individually swung through respective solid angles between positions of wide divergence and positions of parallelism, said connection comprising a metal socket member fixedly secured to the base and having a socket formed therein, a ball loosely mounted for universal turning movement in said socket, said ball being formed with a radial bore extending completely therethrough and opening into the socket, the inner end of said rod projecting completely through the bore and being slidable therein, a normally collapsed helical wire coil encompassing each rod axially and coextensively and through which the rod extends centrally, means for securing the outer end of said coil to the outer end of said rod while maintaining the same electrically insulated from the rod, means for securing the inner end of the coil to said ball whereby the coil is constrained to follow the swinging movements of the rod, said coils being inductively coupled to their respective rods and constituting an auxiliary antenna component, each coil by its attachment to the outer end of its respective rod and ball associated therewith existing under tension whereby said rod is urged inwardly of the socket and its end is forced into sliding frictional and electrical contact with the confining wall of the socket, and means for electrically connecting each socket member to one terminal of a transmission line.

2. In an antenna structure, in combination, a base formed of electrically insulating material, a pair of rods forming a principal dipole antenna component, a ball and socket connection between the inner end of each rod and the base whereby the rods may be individually swung through respective solid angles between positions of wide divergence and positions of parallelism, said connection comprising a metal socket member fixedly secured to the base and having a socket formed therein, said socket member being provided with an opening therethrough communicating with the bottom of said socket, a ball loosely mounted for universal turning movement in said socket, said ball being formed with a radial bore extending completely therethrough and opening into the socket, the inner end of said rod projecting completely through the bore and being slidable therein, a normally collapsed helical wire coil encompassing each rod axially and coextensively and through which the rod extends centrally, means for securing the outer end of said coil to the outer end of said rod while maintaining the same electrically insulated from the rod, means for securing the inner end of the coil to said ball whereby the coil is constrained to follow the swinging movements of the rod, said coils being inductively coupled to their respective rods and constituting an auxiliary antenna component, each coil by its attachment to the outer end of its respective rod and ball associated therewith existing under tension whereby said rod is urged inwardly of the socket and its end is adapted to be forced into sliding frictional and electrical contact with the confining wall of the socket, the diameter of said opening in the socket member being greater than the diameter of said rod whereby when the latter is moved into axial alignment with said opening, said rod will be projected through said opening and downwardly through the base to a position wherein said coil is collapsed, and means for electrically connecting each socket member to one terminal of a transmission line.

3. In an antenna structure, the combination set forth in claim 2 wherein said ball is formed of insulating material whereby the contact between the inner end of said rod and the confining wall of the socket is the sole means for establishing electrical contact between said rod and socket member.

4. Antenna structure comprising in combination a base formed of electrically insulating material, a pair of rods forming a principal dipole antenna component, a ball and socket connection between the inner end of each rod and the base whereby the rods may be individually swung through respective solid angles between positions of wide divergence and positions of parallelism, said connection comprising a flared enlargement on the inner end of said rod, a metal socket member fixedly secured to the base and having a socket formed therein, a ball loosely mounted for universal turning movement in said socket, said ball being formed with a radial bore extending completely therethrough and opening into the socket, the inner end of said rod projecting completely through the bore and being slidable therein, the diameter of such enlargement being greater than the diameter of said bore whereby the rim of said bore constitutes a limit stop to prevent outward pulling of the rod from its telescopic relation with the ball, a normally collapsed helical wire coil encompassing each rod axially and coextensively and through which the rod extends centrally, means for securing the outer end of said coil to the outer end of said rod while maintaining the same electrically insulated from the rod, means for securing the inner end of the coil to said ball whereby the coil is constrained to follow the swinging movements of the rod, said coils being inductively coupled to their respective rods and constituting an auxiliary antenna component, each coil by its attachment to the outer end of its respective rod and ball associated therewith existing under tension whereby said rod is urged inwardly of the socket and its end is forced into sliding frictional and electrical contact with the confining wall of the socket, and means for electrically connecting each socket member to one terminal of a transmission line.

5. In an antenna structure, in combination, a base formed of electrically insulating material, a pair of rods forming a principal dipole antenna component, a ball and socket connection between the inner end of each rod and the base whereby the rods may be individually swung through respective solid angles between positions of wide divergence and positions of parallelism, said connection comprising a flared enlargement on the inner end of said rod, a metal socket member fixedly secured to the base and having a socket formed therein, said socket member being provided with an opening therethrough communicating with the bottom of said socket, a flared enlargement on the inner end of said rod, a ball loosely mounted for universal turning movement in said socket, said ball being formed with a radial bore extending completely therethrough and opening into the socket, the inner end of said rod projecting completely through the bore and being slidable therein, the diameter of such enlargement being greater than the diameter of said bore whereby the rim of said bore constitutes a limit stop to prevent outward pulling of the rod from its telescopic relation with the ball, a normally collapsed helical wire coil encompassing each rod axially and coextensively and through which the rod extends centrally, means for securing the outer end of said coil to the outer end of said rod while maintaining the same electrically insulated from the rod, means for securing the inner end of the coil to said ball whereby the coil is constrained to follow the swinging movements of the

rod, said coils being inductively coupled to their respective rods and constituting an auxiliary antenna component, each coil by its attachment to the outer end of its respective rod and ball associated therewith existing under tension whereby said rod is urged inwardly of the socket and its end is adapted to be forced into sliding frictional and electrical contact with the confining wall of the socket, the diameter of said opening in the socket member being greater than the diameter of said rod whereby when the latter is moved into axial alignment with said opening, said rod will be projected through said opening and downwardly through the base to a position wherein said coil is collapsed, and means for electrically connecting each socket member to one terminal of a transmission line.

6. Antenna structure comprising in combination a base formed of electrically insulating material, a pair of rods forming a principal dipole antenna component, a ball and socket connection between the inner end of each rod and the base whereby the rods may be individually swung through respective solid angles between positions of wide divergence and positions of parallelism, said connection comprising a metal socket member fixedly secured to the base and having a socket formed therein, a ball loosely mounted for universal turning movement in said socket, said ball being formed with a radial bore extending completely therethrough and opening into the socket, the inner end of said rod projecting completely through the bore and being slidable therein, a normally collapsed helical wire coil encompassing each rod axially and coextensively and through which the rod extends centrally, a cap member of insulating material telescopically received on the free end of said rod there being an annular groove formed in said cap member, the outer end of said coil being looped around the the bottom of said groove so as to fixedly secure said end to the cap member, said ball being formed with a protruding neck portion through which said radial bore extends, there being an annular groove formed in said neck portion, the lower end of said coil being looped around the bottom of said groove and thus fixedly secured to the ball, said coils being inductively coupled to their respective rods and constituting an auxiliary antenna component, each coil by its attachment to the outer end of its respective rod and ball associated therewith existing under tension whereby said rod is urged inwardly of the socket and its end is forced into sliding frictional and electrical contact with the confining wall of the socket member, and means for electrically connecting each socket to one terminal of a transmission line.

7. Antenna structure comprising in combination a base formed of electrically insulating material, a pair of rods forming a principal dipole component, a ball and socket connection between the inner end of each rod and the base whereby the rods may be individually swung through respective solid angles between positions of wide divergence and positions of parallelism, said connection comprising a metal socket member fixedly secured to the base and having a spherical socket formed therein, said socket member being provided with an opening therethrough communicating with the bottom of the socket, a metal ball disposed within said socket in frictional engagement with the wall of said socket and capable of universal turning movement in the socket, said ball being provided with a radial bore extending completely therethrough, the inner end of said rod projecting completely through the bore and being slidable therein, a helical wire coil formed of spring wire stock encompassing each rod axially and coextensively and through which the rod extends axially, means for securing the outer end of said coil to the outer end of said rod while maintaining the same electrically insulated from the rod, means for securing the inner end of the coil to said ball whereby the coil is constrained to follow the swinging movements of the rod, said coils being inductively coupled to their respective rods and constituting an auxiliary antenna component, the diameter of said opening in said socket member being greater than the diameter of said rod whereby said rod may be projected through the opening downwardly through the base to a position wherein the coil is collapsed, and means for electrically connecting each socket member to one terminal of a transmission line.

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