Feb. 21, 1956 R. TEXTROM ET AL 2,735,932

ANTENNA FOR COMPACT RADIO EQUIPMENT

Filed Nov. 7, 1952 3 Sheets-Sheet 1

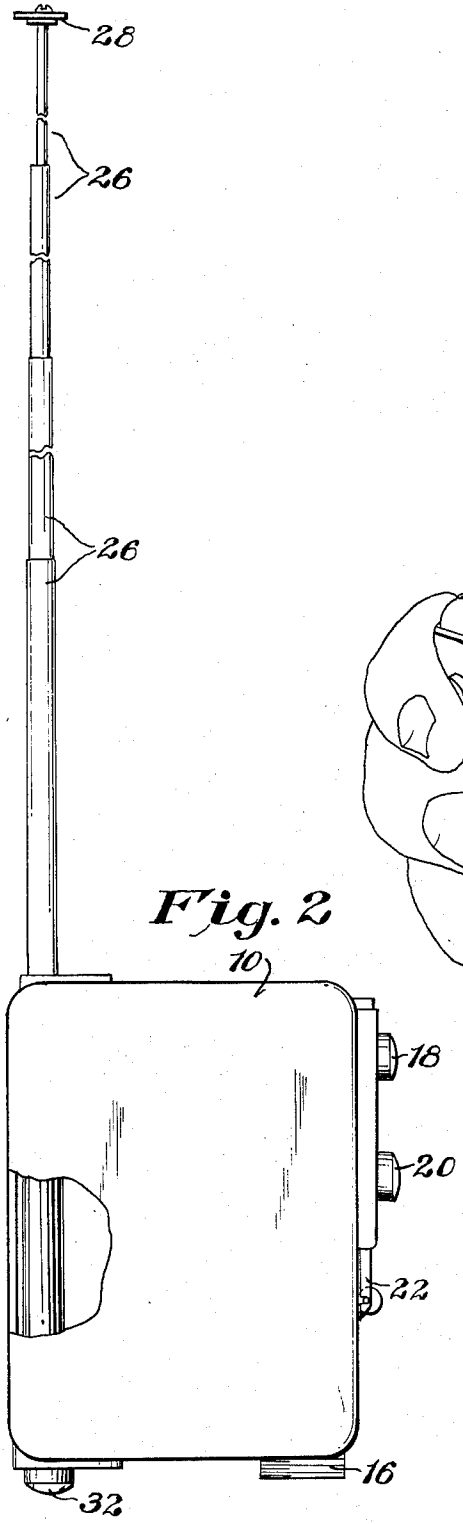


Fig. 2

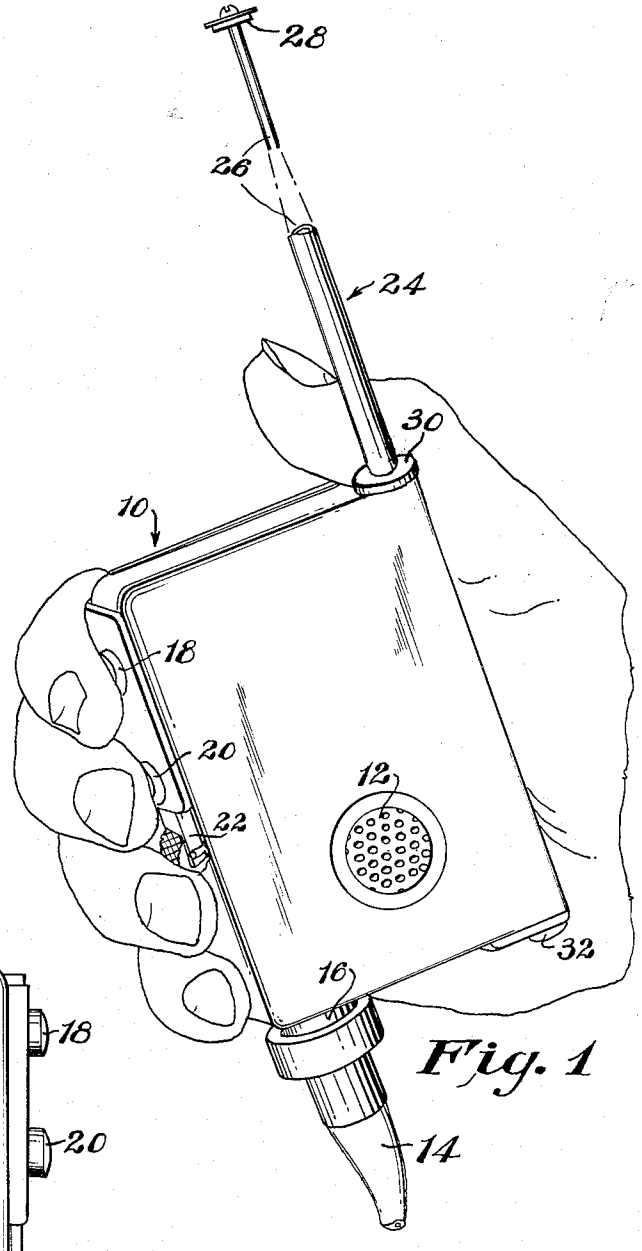


Fig. 1

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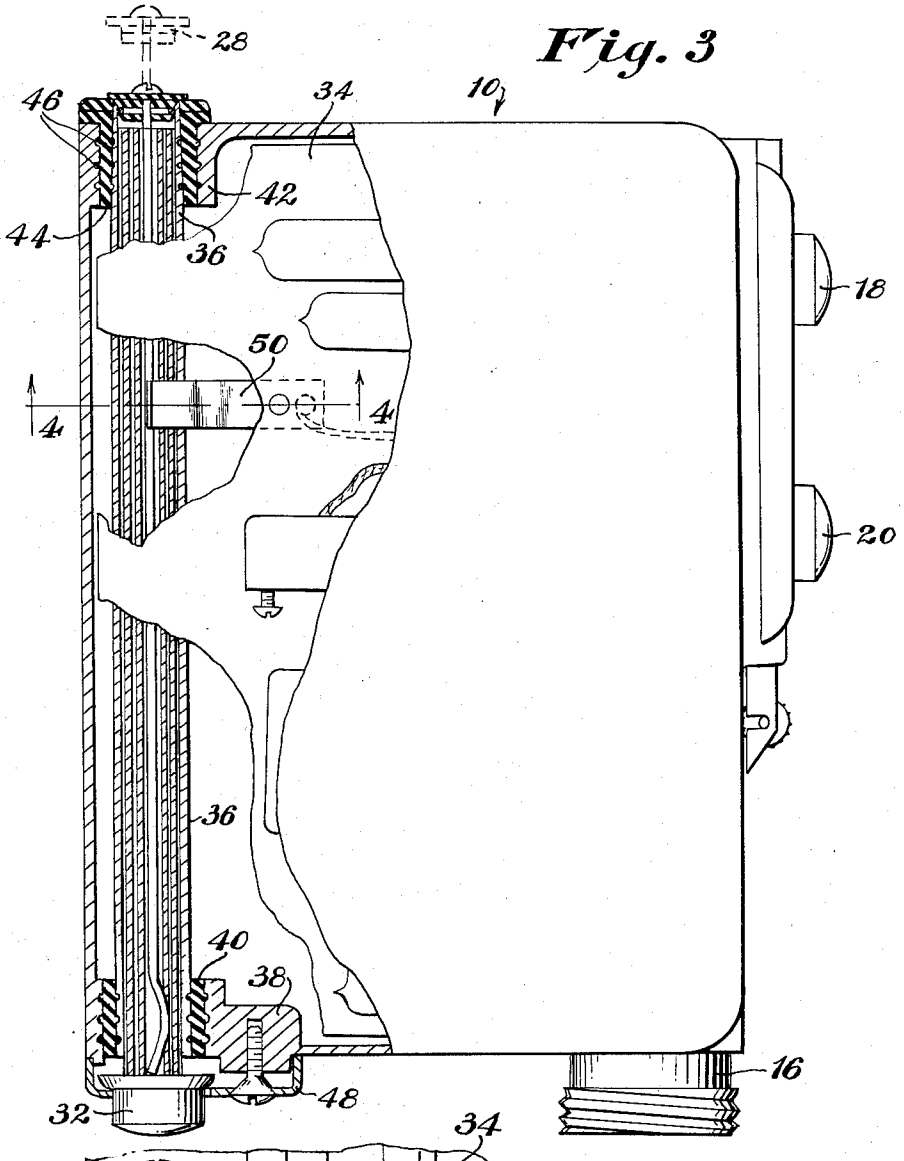


Fig. 3

Fig. 4

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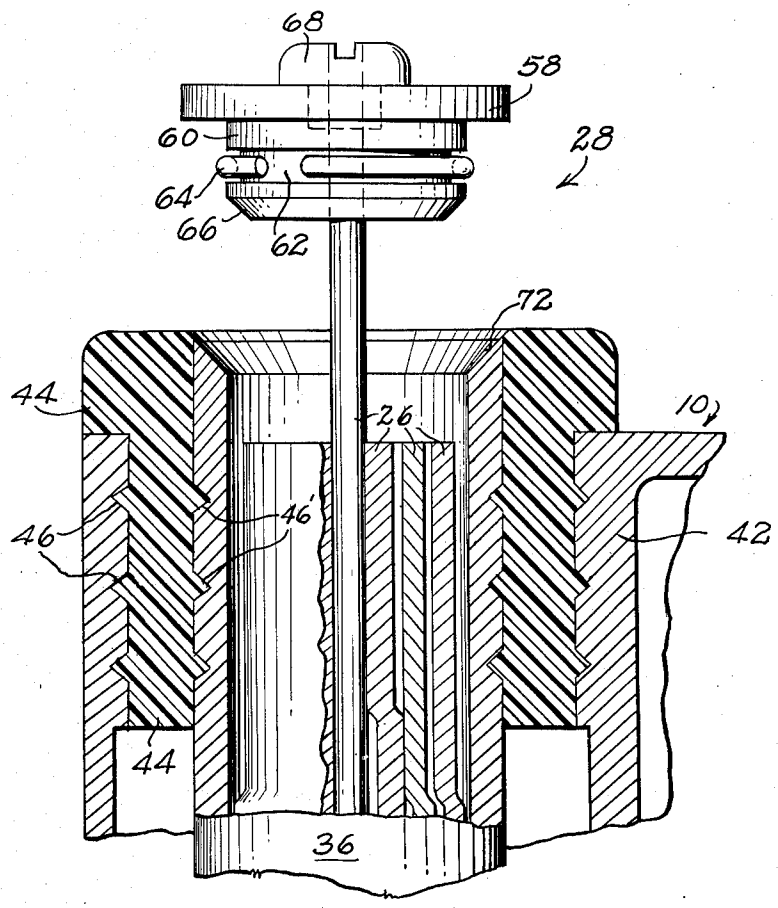


Fig. 5

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ANTENNA FOR COMPACT RADIO EQUIPMENT

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6 Claims. (Cl. 250—14)

This invention pertains to radio equipment, and particularly to improvements in a highly compact and portable combination radio transmitter and receiver.

More particularly, the invention deals with an improved antenna arrangement whose special features provide increased transmitting and receiving efficiency, and important operational advantages as compared with the antennas of prior equipments of this general nature.

The design of extremely compact radio apparatus involves many problems, among which are the necessity of utilizing a minimum of space for each component, and the difficulty of providing rugged elements of small size which must be capable of practical operation by the user under all conditions. Thus, and particularly where operation under field conditions and adverse weather is contemplated, it is necessary that the controls be capable of ready operation even though the user may be encumbered with heavy gloves and the like. Such conditions also require that the equipment be resistant to hard usage and accidental shocks and the like.

These requirements are difficult enough in the case of equipments of moderate size, and their difficulty increases as the sizes of the component parts are reduced to achieve more and more compact apparatus.

The present invention deals with a solution of that portion of the general problem which concerns the antenna system to be used in miniature radio equipments, and has for its principal object the provision of a collapsible antenna which can be housed in a completely protected position in the casing of the apparatus when it is not in use, but can be extended therefrom rapidly and conveniently even under conditions which require the operator to be gloved.

A further object of the invention is to provide an antenna of the above type whose collapsible sections are housed or stored within a sleeve fixed within the casing, with which sleeve the antenna sections are in electrical contact. This permits the connections from the radio components within the casing to the antenna to be relatively fixed, in the sense that it is a connection which is not moved, flexed or otherwise altered during extension of the antenna.

An additional object of the invention is to provide a connection between the antenna and the radio components which is readily separable when it is necessary to remove the radio components, or their carrying plate, from the casing for servicing or for other reasons.

An ancillary object of the invention is to provide a construction having the above features and which is readily adapted to modern mass production methods requiring a minimum of special assembly work.

A further object of the invention is to provide cooperating means between one of the extendable antenna sections and the housing sleeve which serves both to retain the antenna sections in their collapsed and protected position, and operates initially to eject a substantial portion of the antenna for ready manual extension to its full length when required.

Still another object of the invention is to provide an antenna assembly in combination with an apparatus case, and such that the complete unit will be air and watertight insofar as concerns the opening through which the antenna extends, and the opening required for the operating button for extending the antenna.

The above and other objects of the invention will best be understood by referring to the following detailed specification of a preferred embodiment thereof, reference being made to the accompanying drawings, in which:

Fig. 1 is a perspective view of a radio equipment embodying the invention, illustrating its major parts in the condition of use;

Fig. 2 is a side elevational view of the equipment, with the antenna sections fully extended and partly broken away;

Fig. 3 is an enlarged view in side elevation, with parts broken away and parts in section;

Fig. 4 is a fragmentary sectional view taken on line 4—4 of Fig. 3; and

Fig. 5 is a greatly enlarged fragmentary sectional view of the upper end of the antenna button and housing sleeve of the invention.

Referring now to Figs. 1 and 2 of the drawings, the radio equipment of the invention is shown as comprising a main casing **10** of relatively flat, rectangular proportions, having on one major face a grill or the like **12** behind which is disposed a combination speaker and microphone. Power for energizing the radio components contained in casing **10** may be derived from external batteries (not shown) connected to a cable **14** leading to a socket **16** on the casing **10**. Operating push-buttons **18** and **20** are provided on one minor face of the casing **10** to permit the apparatus to be conditioned for transmitting and receiving respectively, and a locking arrangement **22** for said push-buttons is provided to enable them to be held in desired positions.

The antenna, which functions during both transmission and reception, is generally indicated by numeral **24**, and comprises a plurality of telescopically related sections **26**. The innermost of these sections, which may be a solid conductor, is terminated in a button **28** which, when the antenna sections are collapsed into the casing **10**, cooperates with a fitting **30** to retain the sections in that condition. In view of the small size of the equipment, and the desirability of having no substantial projections from its outer surface when not in use, it would be quite difficult to extend the antenna by lifting on button **28**, or by any other obvious technique. Therefore, the present invention provides at the lower end of casing **10**, a manually operable button **32** so arranged that manual depression thereof will cause one or more of the collapsed antenna sections to be ejected from the casing, so that they may be grasped and pulled into their positions of use in a simple manner.

Referring now to Figs. 3 and 4 of the drawings, in which the parts already described have the same reference numerals as above, it will be seen that the major electronic components of the radio equipment in casing **10** are carried by a chassis plate **34**, portions of which overlie a metallic sleeve **36** fixed in the casing **10**. To this end, the lower side of the casing may have an enlarged portion or boss **38**, suitably bored to receive an insulating bushing **40** which in turn receives one end of the sleeve **36**. At the upper side of casing **10**, there is a similar enlargement or boss **42** receiving an insulating bushing **44** which has an enlarged head portion which seats against the casing wall.

While it would be possible to thread the insulating bushings **40** and **44** into threaded holes in the bosses **38** and **42**, assembly would be difficult and the parts relatively expensive to make. Therefore, a different ar-

rangement is preferred. The bore through each boss 38 and 42 is provided with a number of annular grooves 46, and each end of the sleeve 36, where it will pass through the corresponding insulating bushings, is also provided with a series of such grooves 46'. The bushings 40 and 44 are made of a plastic insulating material which shrinks slightly when cooled; a material such as "Teflon" is suitable for this purpose. The bores in the bushings are sized so that they fit tightly upon the respective ends of the antenna sleeve 36, and they are seated in place on said sleeve prior to its assembly in the case. The unit including tube 36 and the insulating bushings is then cooled, for example in Dry Ice, and while cold it is pressed into the bosses in the case 10. The bore in boss 42, for example, may be of such size that the lower bushing 40 can pass therethrough during this operation, but the bores in both bosses are sized so that, when the bushings are cold, light pressure is required to seat the bushings in the corresponding bores.

Since the parts were pre-cooled to a temperature lower than the lowest specified for operation of the equipment, and since the plastic bushings increase in size as they warm up, the bushings will remain tightly seated during all conditions encountered by the equipment. Also, as the bushings expand when the unit is warmed up to room temperature, the plastic material will be extruded into the grooves 46 and 46' in the respective bosses and on the ends of the antenna sleeve 36. This extrusion locks the bushings permanently in place, provides a water and presure tight assembly, and eliminates any possibility of the antenna sleeve being pulled out of the case even under low-temperature operating conditions.

The telescopic antenna includes a plurality of sections, whose number is immaterial to the present invention and is governed by the operating frequency of the equipment and hence by the desired length of the extended antenna.

The center one of these sections may be a solid rod, but in any event, to ensure good contact between the sections themselves and between the outermost section and sleeve 36, the telescopic parts are preferably provided with out-struck portions or other distortions which will provide such contact without impeding the desired telescopic action. Designs of this type are well-known to the prior art. In the embodiment shown, the innermost or solid rod section of the antenna carries the retaining bottom 28 at its upper end as shown in dotted lines in Fig. 3. When the antenna is completely collapsed with button 28 engaged within the upper end of sleeve 36, erection of the antenna would be quite difficult. To facilitate such erection, the manually operable button 32 is disposed beneath the lower ends of the telescoped antenna sections where they project below the bottom of sleeve 36, so that this operating button 32 may be used to apply endward pressure to all or part of the telescoped sections. Button 32 is retained somewhat loosely in position by a housing 48 fastened to casing 10 below boss 38 as by a screw or the like.

When it is desired to extend the antenna, the user has merely to press upon button 32, and this not only elevates one or more of the antenna sections slightly, but, by means to be described below, actually forcibly ejects one or more antenna sections a substantial distance beyond the casing 10, so that it or they may be grasped by the user and pulled to extended position.

Figs. 3 and 4 also illustrate the manner of electrical connection to the antenna sections. Inasmuch as the chassis plate 34 must be removed from the casing for occasional service operations, it is desirable to have this antenna connection one which freely disconnects upon removal of plate 34. It is also desirable that the connection be a fixed one when the apparatus is in assembled condition, in the sense that it should not require any flexible lead whose position would alter the electrical characteristics of the antenna or other parts, and which would be subject to wearing. It is also desirable to avoid a sliding contact for connection to the extendable antenna, because such contacts invariably become erratic or "noisy" after prolonged use.

The above problems are solved, in accordance with the present invention, by the use of fixed housing sleeve 36 in electrical contact with the antenna sections, in combination with a fixed spring contact 50 carried on one side of the chassis plate 34. Where necessary, and as best shown in Fig. 4, this spring contact 50 may be carried on plate 34 by an insulating spacer 52, and it preferably is provided with a reversely curved portion 54 to provide independent spring action. The free end of contact 50, designated by numeral 56, is positioned to engage firmly against the surface of sleeve 36 whenever the chassis plate 34 is secured in position within casing 10.

It will be seen from the above description that the contact between elements 50 and 36, via portions 54 and 56, is fixed in position when the device is assembled, so that dependable contact is assured for the life of the equipment and regardless of minor variations in the positioning of the plate 34 within the casing. Also, the contact is automatically made and broken as plate 34 is installed in or removed from the apparatus. Access to the casing for servicing and other purposes may be provided by a removable cover plate, which may constitute one of the major walls of the casing.

The manner in which the snap action referred to above is obtained upon ejection of the antenna by operation of button 32, will now be described. Referring to the enlarged fragmentary showing in Fig. 5, the parts already described bear the same reference numerals. The button 28 is shown as comprising an upper disc-like portion 58 and a reduced circular portion 60 extended therebelow, which has an annular groove 62 loosely receiving a springy snap ring 64. The under edge of portion 60 is chamfered as at 66 to facilitate seating in the upper end of sleeve 36 when the antenna is collapsed. The button 28 is fastened to the center rod antenna section 26 as by a slotted-head lock screw 68. The entire upper end of rod 26 may be threaded, a portion of the threads engaging in a threaded portion of button 28, and the remainder engaging similar threads in a bore in screw 68, so that these parts are functionally integral after assembly.

It will be noted that the free diameter of the snap ring 64 is somewhat greater than the internal diameter of the upper end of the sleeve 36, so that when the antenna is collapsed and button 28 seated within the sleeve 36, the snap ring 64 is compressed. The chamfered upper edge 72 of sleeve 36 facilitates forcing the snap ring into position in the mouth of the sleeve, and when so seated, the friction between the snap ring and sleeve 36 retains the antenna sections securely in collapsed condition.

When the operating button 32 on the bottom of the casing is pressed, lengthwise pressure is set up in one or more of the antenna sections 26, and this pressure is sufficiently great to force button 28 upwardly to a point at which the compressive force on snap ring 64 is suddenly released. When this happens, button 28 is forcibly popped out of the sleeve 36, and one or several of the telescopic antenna sections are drawn along with it, so that they or button 28 may readily be grasped for final complete extension of the antenna.

It will be seen from the above description and drawings that the objects of the invention have been accomplished in a novel and efficient manner. However, the details of the construction may be varied to suit individual cases, and it is intended not to limit the invention to the details shown except as may be required by the scope of the appended claims.

What is claimed is:

1. An extendable antenna for compact radio equipment of the cased type, comprising a sleeve mounted in the casing and having its ends secured in opposite walls there-

of, telescopically related antenna sections disposed in said sleeve and extendable therefrom for use, a button carried by one of said sections and arranged to be received resiliently within one end of said sleeve to retain said sections in collapsed condition therein, said end of the sleeve being internally chamfered to guide said button into received position and a manually operable ejecting element mounted adjacent the opposite end of said sleeve to contact said sections and operable to overcome the retaining force of said button, whereby upon operation of said ejecting element said sections are forcibly projected from said sleeve with a snap action.

2. The invention in accordance with claim 1, in which said button comprises a snap ring loosely encircling a portion thereof and having a relaxed diameter slightly greater than the inside diameter of the cooperating end of said sleeve.

3. In a compact portable radio equipment, a casing containing a collapsible antenna normally housed entirely within said casing and having telescopically related portions arranged to be extended in length to project beyond said casing, an annular element secured in one wall of said casing and through which the sections of the antenna pass in moving to extended position, a button element on one section of said antenna, said element being dimensioned to be received within said annular member to retain the antenna sections in collapsed condition, and a snap ring loosely carried by said button element and having a free diameter slightly greater than the internal diameter of said ring member.

4. The invention in accordance with claim 3, and means

for forcing said button element out of said ring member to eject said antenna sections with a snap action.

5. The invention in accordance with claim 3, in which the terminal inside edge of said ring member is chamfered to facilitate fitting said button therein.

6. In a compact, portable radio equipment, a casing, an assemblage of connected radio circuit components, a common supporting panel carrying said components and removable from said casing as a unit, an antenna mounted in said casing and arranged to have its major portion selectively extended from said casing for use, a conductive sleeve mounted in said casing adapted to receive and house the extendable portions of said antenna and in continuous electrical connection with said portions, a spring contact element carried by said panel and adapted to engage said sleeve when said panel is mounted in said casing, and conductive means connecting said spring contact element with said assemblage of circuit components, whereby said antenna is automatically connected with said circuit components whenever said panel is disposed in its operative position within said casing.

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