

Dec. 6, 1949

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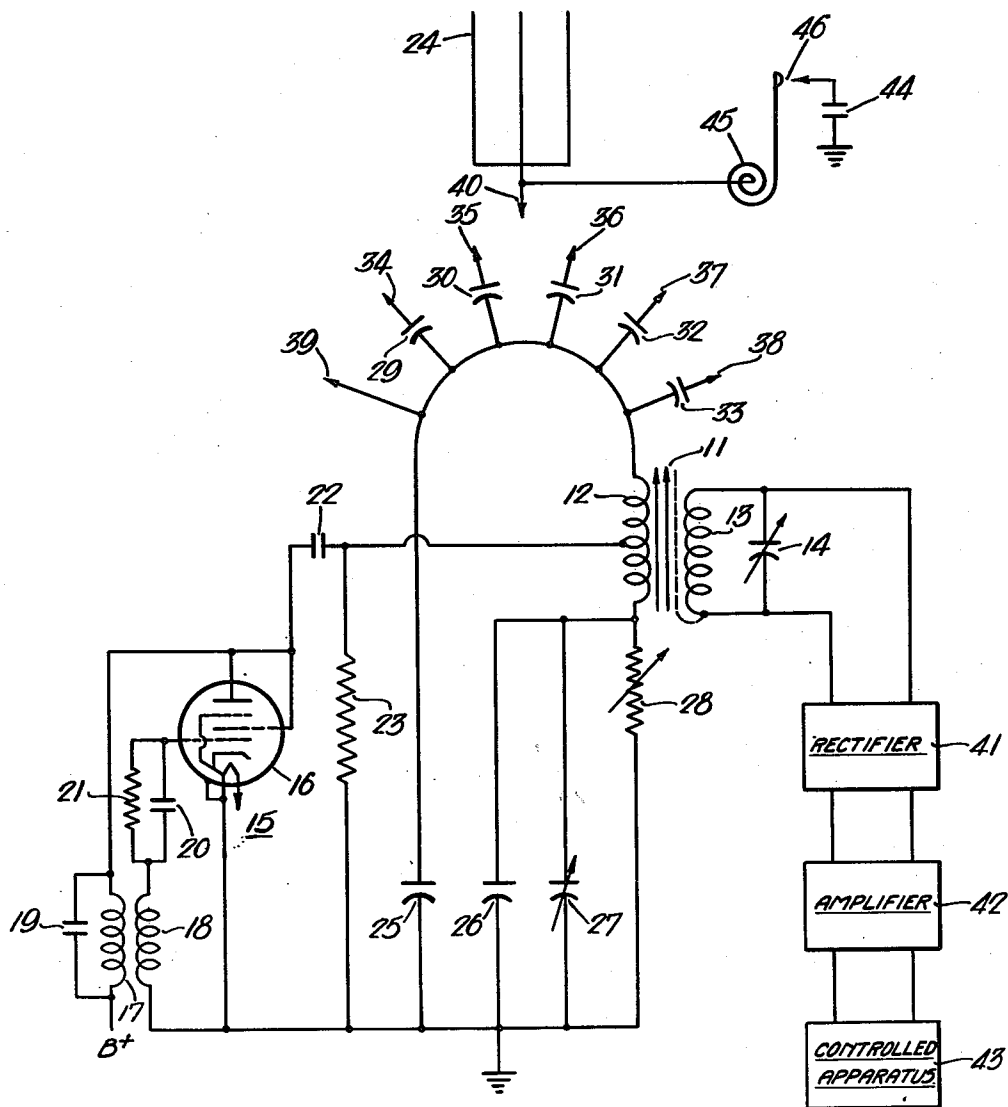
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CAPACITY RESPONSIVE SYSTEM

Filed Jan. 4, 1946

6 Sheets-Sheet 1

FIG. 1.



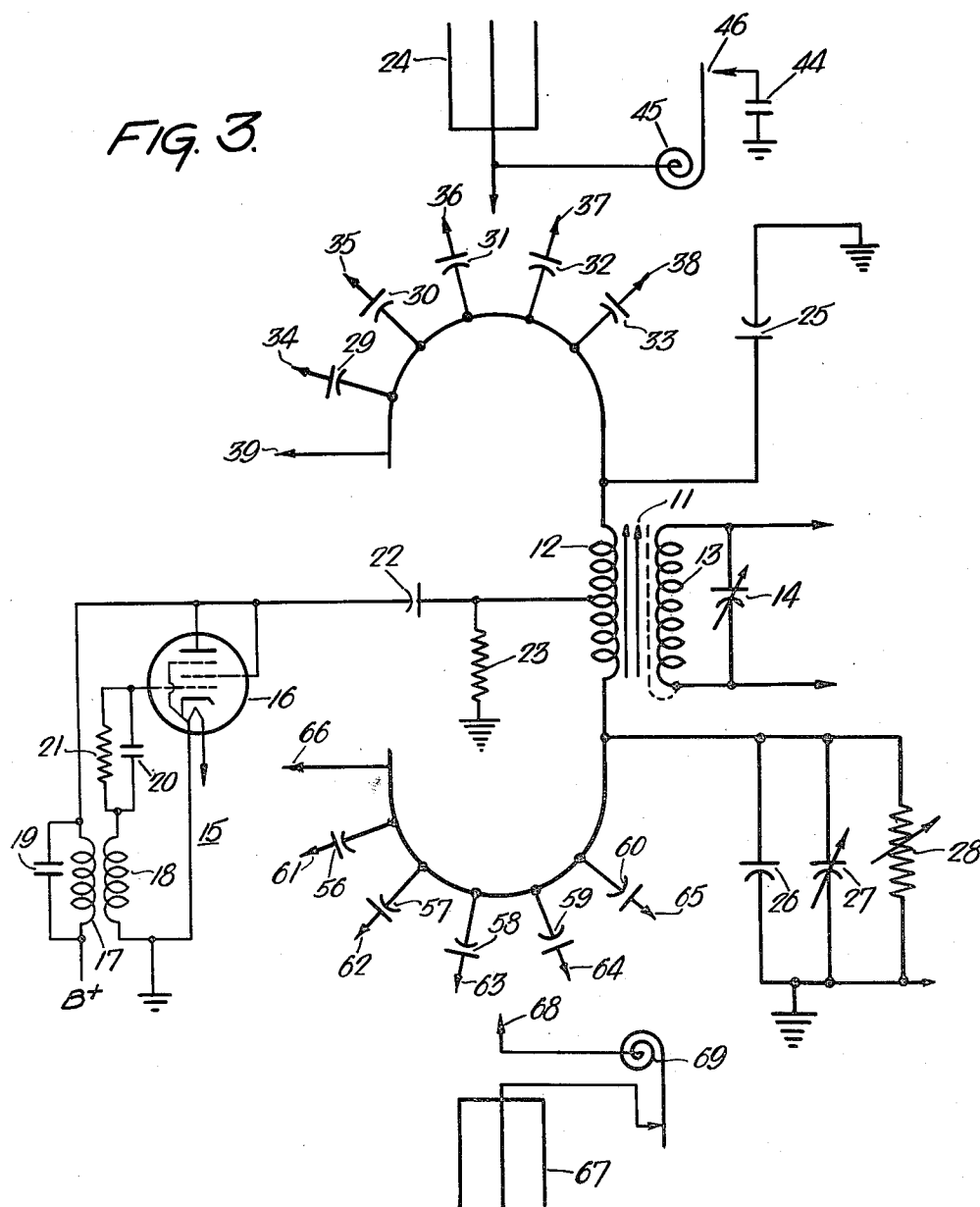
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## CAPACITY RESPONSIVE SYSTEM

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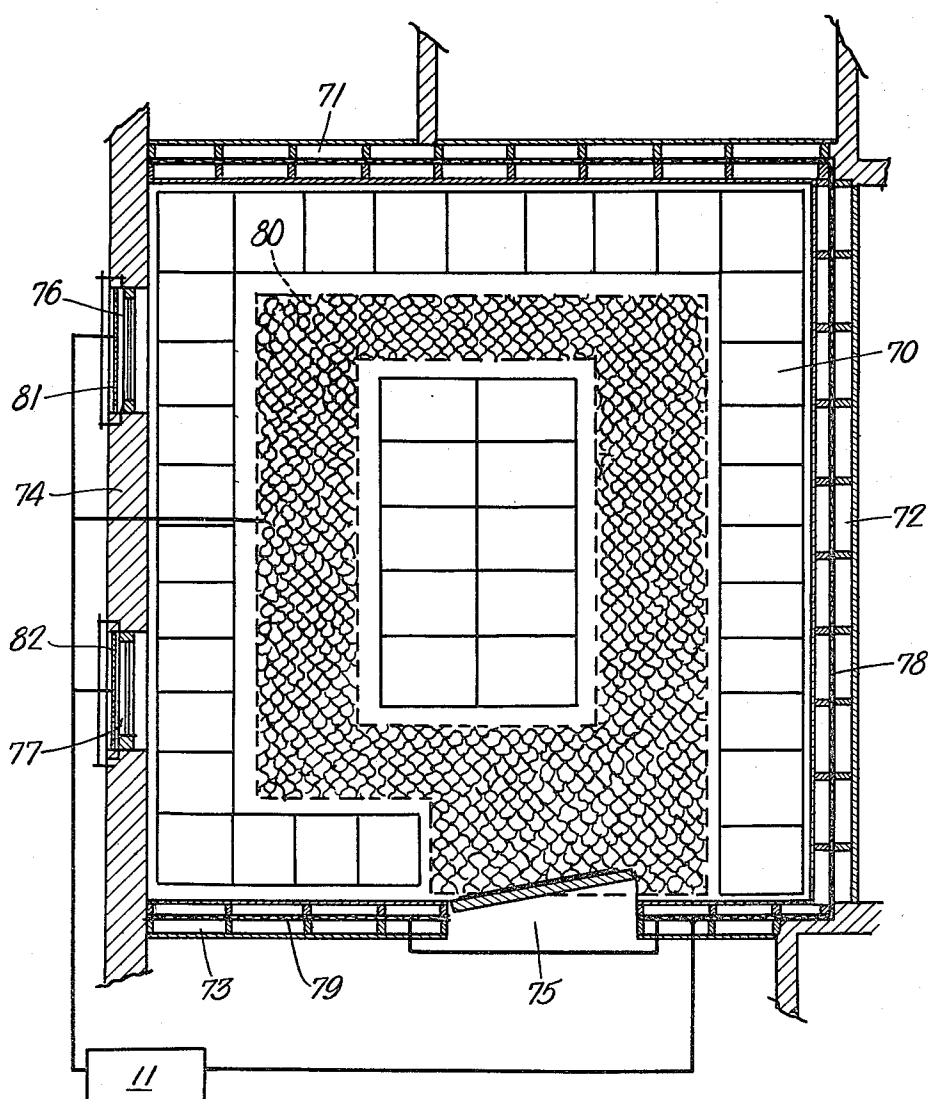
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CAPACITY RESPONSIVE SYSTEM

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FIG. 4.



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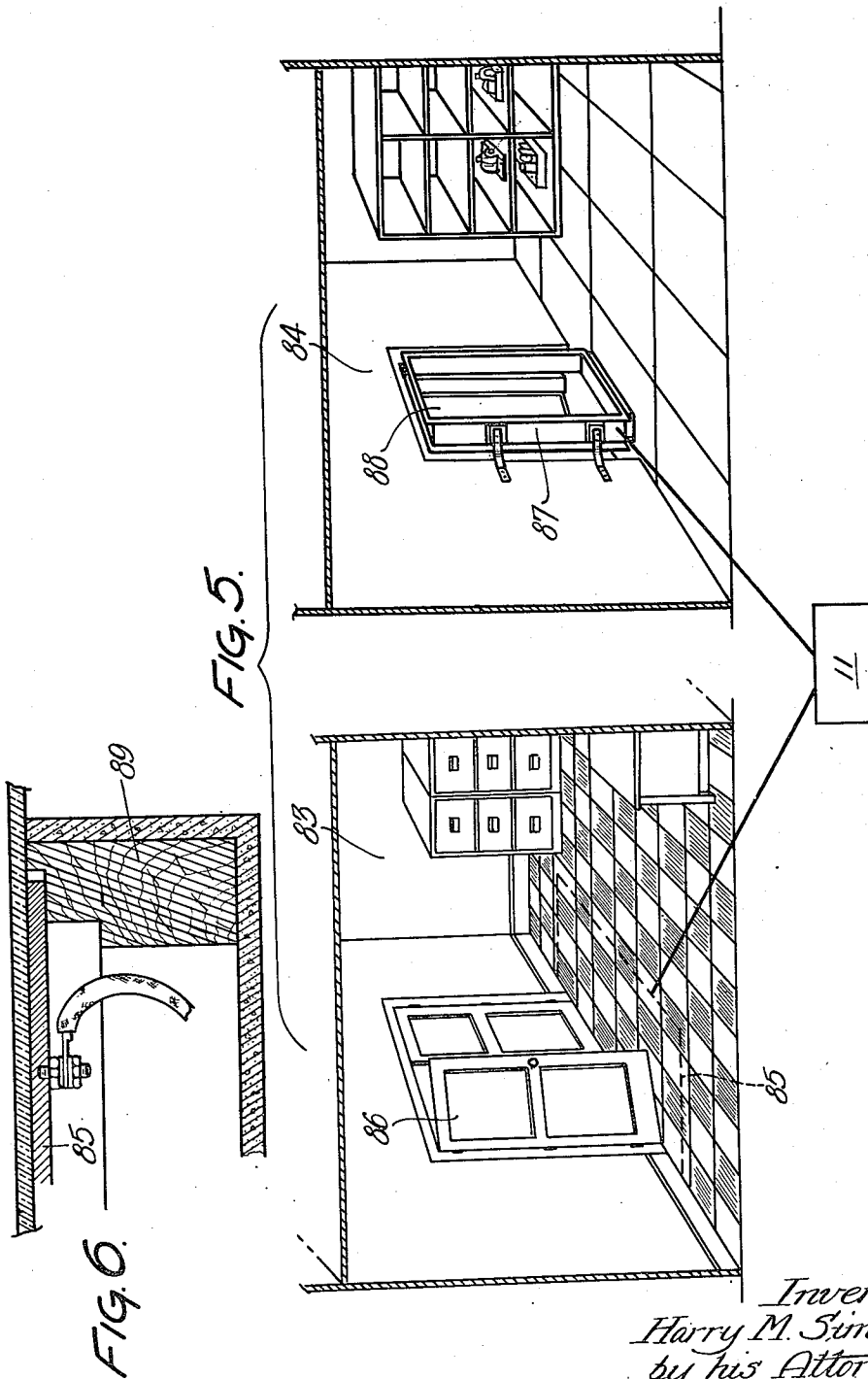
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CAPACITY RESPONSIVE SYSTEM

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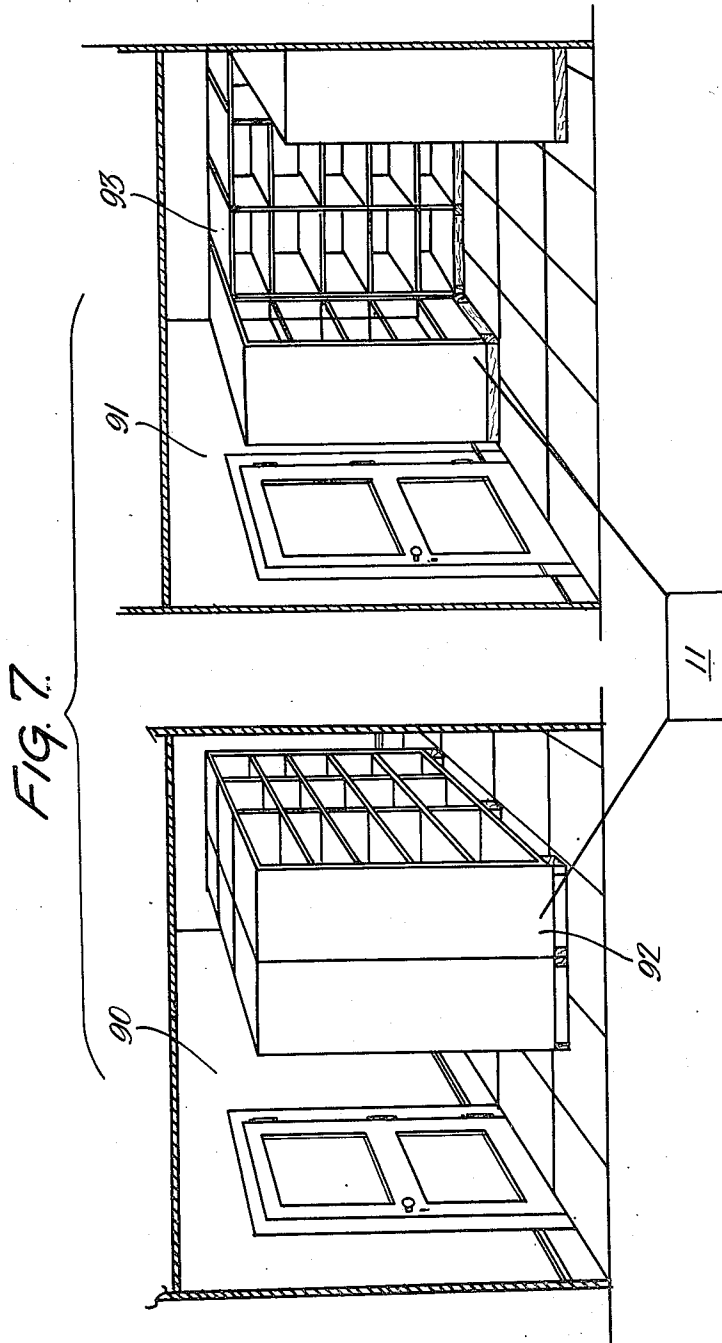
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CAPACITY RESPONSIVE SYSTEM

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6 Sheets-Sheet 6



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## UNITED STATES PATENT OFFICE

2,490,238

## CAPACITY RESPONSIVE SYSTEM

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Application January 4, 1946, Serial No. 639,123

2 Claims. (Cl. 177—352)

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This invention relates to capacity-responsive electrical systems, and more particularly to systems which operate in response to capacity changes of an antenna produced by some condition, such as the presence of a person or object in the vicinity of the antenna. The invention relates more especially to a novel balance-type antenna system which is adapted to respond to capacity changes or variations that disturb the normal condition of balance or predetermined unbalance.

In a capacity-responsive system, it is desirable to provide for different sensitivities according to the different specific uses to which the system may be applied. In some instances, as where the system is used for burglar protection and the antenna is in the form of a window screen, low sensitivity is desirable to prevent undesired operation in response to opening and closing of the window. In other instances, as where the system is used to indicate or record the number of persons who view an advertising display, high sensitivity may be desired in order that the system will operate in response to the presence of a person in the general vicinity of the display. In still other instances, intermediate degrees of sensitivity may be desired.

It is also desirable that such a system be adaptable for operation either in response to a capacity increase or a capacity decrease, depending upon the specific manner in which the system is to be used in a given instance.

In the case of a balance-type system, it is further desirable that the system shall be capable of being readily adjustable to different conditions. In some instances, it may be desired to provide a condition of exact balance, while in others it may be desired to provide a condition of predetermined unbalance. But since the antenna may take various forms and sizes depending on the particular installation, the desired easy and accurate adjustability has heretofore been impossible of achievement.

The principal object of the present invention is to provide a capacity-responsive system which possesses all of the aforementioned desirable characteristics as well as others hereinafter mentioned.

Another object of the invention is to provide a system which is insensitive to voltage variations.

Still another object of the invention is to provide a system which will respond to excessive temperature as well as to the presence of a person or object.

A further object of the invention is to provide

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a system which enables the capacities of two antennas to be balanced against one another, thereby enabling the same system to be used with the two antennas either of which will detect the presence of a person or object.

Other objects and features of the invention will be apparent from the following detailed description.

In the accompanying drawings

Fig. 1 is a schematic illustration of a system embodying the present invention;

Fig. 2 is a schematic illustration showing a preferred form of the rectifying arrangement employed;

Fig. 3 is a schematic illustration of another embodiment wherein the capacities of two antennas are balanced against one another; and

Figs. 4 to 7 show different examples of installations wherein the system of Fig. 3 may be employed.

Referring first to Fig. 1 of the drawings, there is provided a high frequency transformer 11 having a center-tapped primary winding 12, and a tuned secondary winding 13. If desired, the transformer may be of the adjustable core type, as indicated, to facilitate tuning thereof to a particular frequency. An adjustable tuning condenser 14 may be connected across the secondary winding to tune the same to the desired frequency.

A source of high frequency oscillations is connected between the center tap of the primary winding and ground. In the specific illustration, the said source is shown as comprising an oscillator 15 of the tuned plate type. Such oscillator comprises a vacuum tube 16 whose plate is connected to a coil 17 which is inductively coupled to a grid coil 18 to provide the necessary feedback action. The plate coil 17 and the associated condenser 19 constitute the tank circuit which determines the frequency of oscillation. The condenser 20 and the resistor 21 are the usual grid condenser and grid leak, respectively. The oscillator is connected between the center tap of winding 12 and ground by means of the coupling condenser 22 and resistor 23. Preferably the oscillator is designed to operate at a frequency of about 150 kc.

The system or network illustrated in Fig. 1 serves to counter-balance the capacity of some antenna, represented at 24, so as to produce a desired normal condition. Such condition may be one of balance, so that normally there is no voltage produced across the secondary winding 13 of transformer 11, or it may be one of prede-

terminated unbalance so that there is normally a voltage across the secondary winding. A fixed capacitor 25 is connected between the upper end of the primary winding 12 and ground. A similar capacitor 26 of substantially equal value is connected between the lower end of winding 12 and ground. An adjustable balancing capacitor 27 is connected in shunt relation with capacitor 26 and an adjustable resistor 28 is also connected in shunt relation with capacitor 26. A plurality of capacitors, numbered 29 to 33, having different capacitance values, each has one of its plates connected to the upper end of the primary winding 12. Terminals 34 to 38 are connected to the other plates of these capacitors. A terminal 39 is connected directly to the upper end of the primary winding 12. This arrangement enables the antenna 24 to be connected to any one of the various terminals so that the antenna may be connected to any one of the capacitors 29 to 33, or it may be connected directly to the upper end of winding 12 by means of the terminal 39. To this end, a terminal 40 may be connected to the antenna for connection to any one of the above mentioned terminals. Alternatively, a selector switch may be provided, in which case the terminals 34 to 39 may take the form of stationary switch contacts, and the terminal 40 may take the form of a movable switch contact adapted to engage any one of the stationary contacts. Obviously, the provision of a selector switch will facilitate connection of the antenna to any one of the capacitors 29 to 33, or to the upper end of winding 12 directly.

It will be noted that when the antenna is connected, there are two parallel capacitive paths between the upper end of winding 12 and ground, one path including the capacitance of capacitor 25 and the other including the capacity of the antenna. There are also two parallel capacitive paths between the lower end of winding 12 and ground, including capacitors 26 and 27, respectively. Since the capacitors 25 and 26 are substantially equal, the adjustable capacitor 27 serves to balance the capacity in shunt with the capacitor 25, or to provide a desired degree of unbalance. The purpose of the adjustable resistor 28 is to balance the antenna resistance where necessary.

The circuit arrangement enables accurate balancing of the capacities connected to the opposite ends of the primary winding 12, and it also enables the attainment of different degrees of sensitivity. The capacitors 29 to 33 provide a range of selectable supplementary capacitances which serve to vary the resultant capacity in shunt with capacitor 25. By varying the capacity in series with antenna 24, the resultant capacity in shunt with capacitor 25 may be varied in relation to that of capacitor 25. The smaller the series capacity, the smaller will be the resultant capacity in relation to that of capacitor 25 and the lower will be the sensitivity of the system. As the series capacity is increased, the resultant capacity is increased and the sensitivity is increased.

In any instance, the antenna to be employed may be connected to different ones of the terminals 34 to 39 and the adjustable elements 27 and 28 may be varied to obtain the desired sensitivity and the desired condition of balance or predetermined unbalance. With the circuit properly adjusted, any capacity variation which disturbs the normal condition will produce a voltage or change in voltage across the secondary

winding 13. The resultant voltage may be rectified, amplified, and supplied to an indicator or alarm apparatus, such as that shown in copending application, Serial No. 639,121, filed January 4, 1946, now Patent No. 2,479,274, issued August 16, 1949. Since the present invention is not concerned with the subsequent portion of the system, the elements thereof are merely represented in block form at 41, 42 and 43.

The system shown in Fig. 1 can be adjusted so that there is normally no voltage across the secondary winding 13, and any capacity change which disturbs this condition will produce a voltage across said winding. The system may also be adjusted so that there is normally a small voltage across the secondary winding, and some capacity changes will produce an increase of said voltage while other capacity changes will produce a decrease of said voltage. Both a voltage increase and a voltage decrease may be caused to operate the apparatus being controlled. It should be borne in mind that the antenna 24 may be of such character that its capacity decreases in response to some action, as for example the opening of a vault door.

It will be noted that any change in the operating voltages applied to the oscillator 15 will not produce a voltage across the secondary winding 13, since the opposed voltages across the two halves of the primary winding 12 will vary by the same amount.

The system may be made to serve for the detection of excessive temperature changes, such as those due to a fire, by providing a capacitor 44 and a normally open switch 46 forming part of a thermal responsive device 45. Actuation of device 45 will cause connection of capacitor 44, which will disturb the normal condition.

The values of the various elements may be chosen according to the expected range of antenna capacities which may be encountered in the particular use to which the system is to be applied.

Fig. 2 shows the preferred form of rectifying means which has been employed in a system embodying the present invention. As illustrated, the rectifying means may comprise a diode 47 and load resistors 48, 49 and 50 having associated by-pass condensers 51 and 52. The voltage across resistor 50 may be applied to an amplifying tube 53 by means of a coupling condenser 54 and resistor 55. The rectifying system is described more fully in copending application, Serial No. 639,122, filed January 4, 1946, now Patent No. 2,481,954, issued September 13, 1949. As there pointed out, the system is somewhat unusual but it has been found from actual usage to be highly desirable.

In Fig. 3 there is shown another embodiment of the invention which enables the balancing of the capacities of two antennas employed with the same system. The elements corresponding to those of Fig. 1 are designated by the same reference characters and require no further description. In addition to such elements, a plurality of capacitors, numbered 56 to 60, having different capacitance values, each has one of its plates connected to the lower end of the primary winding 12. Terminals 61 to 65 are connected to the other plates of these capacitors, and an additional terminal 66 is connected directly to the lower end of winding 12. A second antenna 67 may be connected to any one of these terminals, by means of a connecting terminal 68. In this instance also, a selector switch may be employed,

as previously described. The system may be adjusted by connecting the antennas 24 and 67 to different ones of their associated terminals, and by varying the adjustable elements 27 and 28.

In the system of Fig. 3, the arrangement may be such that the system responds to increase in the capacity of antenna 24 or to increase in the capacity of antenna 67. The system may be slightly unbalanced, so that an increase in the capacity of antenna 24 will cause an increase in the voltage across the secondary winding 13, while an increase in the capacity of antenna 67 will cause a decrease in said voltage. Such voltage changes may not only serve to indicate disturbance of the normal condition but may also indicate from which side the disturbance originated.

If desired, the system may be made to respond to excessive temperature variations, such as would be caused by a fire, by providing the previously mentioned elements 44 to 46 in conjunction with antenna 24, and by providing a temperature responsive switch device 69 in conjunction with the second antenna 67. It will be obvious that operation of either of the thermal responsive switches will cause response of the system.

The adaptability of the system in Fig. 3 to various installations is illustrated in Figs. 4 to 7. Fig. 4 is a schematic sectional plan view of a room or other enclosure having built-in antenna members. The illustration shows the floor 70 and the four walls 71 to 74. The wall 73 has a door opening 75, while wall 74 has windows 76 and 77. One of the antennas employed in the system of Fig. 3 comprises interconnected screen or like elements 78 and 79 built into the walls 71 to 73. The other antenna comprises a screen or like element 80 built into the floor, and window screens 81 and 82. The transformer 11 to which the antennas are connected is represented in block form. Of course, in any instance the antenna elements should be suitably insulated from ground.

Fig. 5 illustrates the application of the two-antenna system to two different rooms represented at 83 and 84. One antenna comprises a plate or screen shown in dotted outline at 85 built into or beneath the floor of room 83 in the vicinity of the doors 86. The other antenna comprises a metal door structure 87 within the door opening 88 in room 84. The antenna plate 85 may be insulated from ground, as shown in Fig. 6, by means of insulating support members such as shown at 89.

Fig. 7 illustrates a similar application of the system to two rooms or enclosures shown at 90 and 91. One of the antennas comprises metal shelving 92 in room 90, while the other antenna comprises metal shelving 93 in room 91.

Thus it will be seen that the two-antenna system of Fig. 3 has wide application and makes it possible to utilize a single system for the protection of a plurality of areas.

From the foregoing description, it will be apparent that the system or network provided by the invention is readily adaptable to various uses and conditions, and has various desirable features. As previously stated, the values of the elements may be selected according to the expected range of antenna capacities. By way of example and with reference to Fig. 1, the antenna might comprise one or more window screens and might have a capacity within a range

of 50 to 300 micro-microfarads, in which case the values of the principal elements may be as follows:

- 25—1000 micro-microfarads
- 26—950 micro-microfarads
- 27—730 micro-microfarads
- 28—1 megohm
- 29—750 micro-microfarads
- 30—500 micro-microfarads
- 31—250 micro-microfarads
- 32—100 micro-microfarads
- 33—50 micro-microfarads

While the invention has been described with reference to certain embodiments and arrangements, it will be understood that the illustrations and description are only for the purpose of disclosure and are not intended to limit the invention.

I claim:

1. In a capacity-responsive electrical system, a transformer having a center-tapped primary winding, a source of high frequency oscillations connected between the center tap of said winding and ground, a plurality of capacitors having different capacitance values connected to one end of said winding, means for connecting a first antenna to any one of said capacitors, a plurality of capacitors having different capacitance values connected to the other end of said winding, and means for connecting a second antenna to any one of said last-mentioned capacitors.

2. In a capacity-responsive electrical system, a transformer having a center-tapped primary winding, a source of high frequency oscillations connected between the center tap of said winding and ground, a fixed capacitor connected between one end of said winding and ground, an adjustable capacitor in shunt with said fixed capacitor, a plurality of capacitors having different capacitance values each having one of its plates connected to the said end of said winding, terminals connected to the other plates of said last-mentioned capacitors, a terminal connected directly to the said end of said winding, whereby an antenna may be connected to any one of said terminals, a fixed capacitor connected between the other end of said winding and ground, a plurality of capacitors having different capacitance values each having one of its plates connected to said other end of said winding, terminals connected to the other plates of said last-mentioned capacitors, and a terminal connected directly to said other end of said winding, whereby a second antenna may be connected to any one of the latter terminals.

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