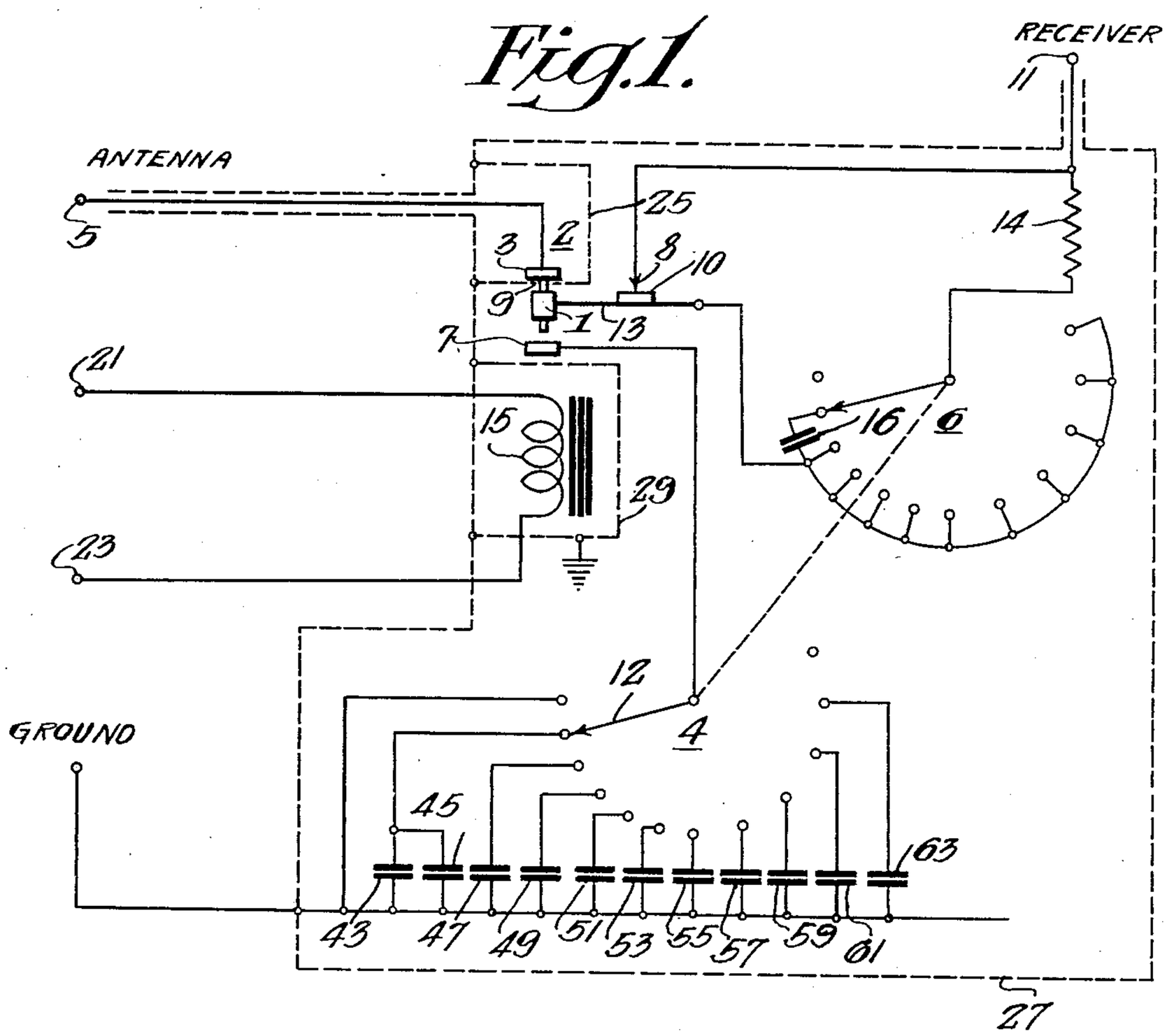
Dec. 19, 1939. S. GUBIN 2,183,612

SHIELDED RELAY ATTENUATOR

Filed Oct. 22, 1938 2 Sheets-Sheet 1

Fig. 1.



Inventor
Samuel Gubin

By

Attorney

Dec. 19, 1939. S. GUBIN 2,183,612

SHIELDED RELAY ATTENUATOR

Filed Oct. 22, 1938 2 Sheets-Sheet 2

Fig. 2.

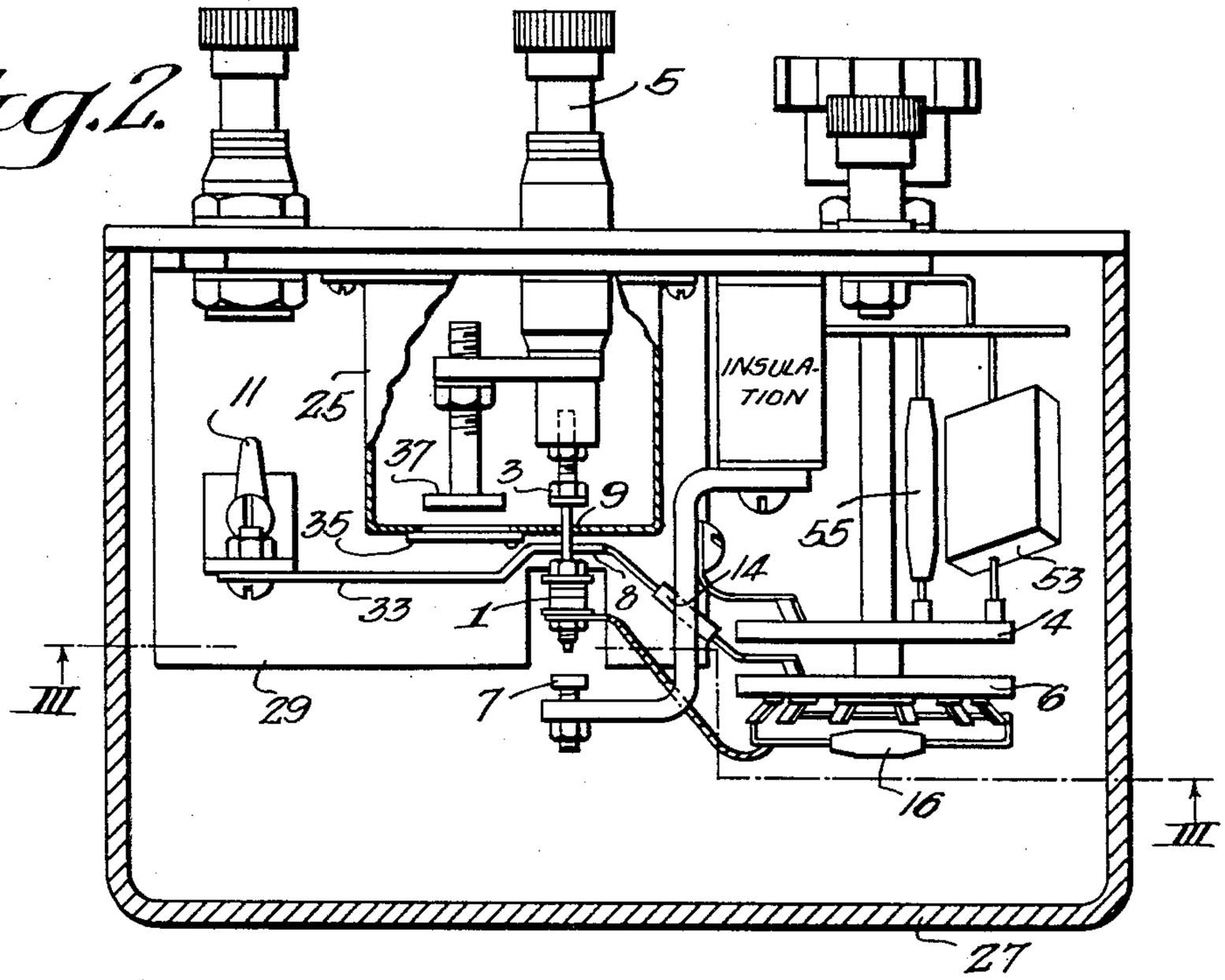
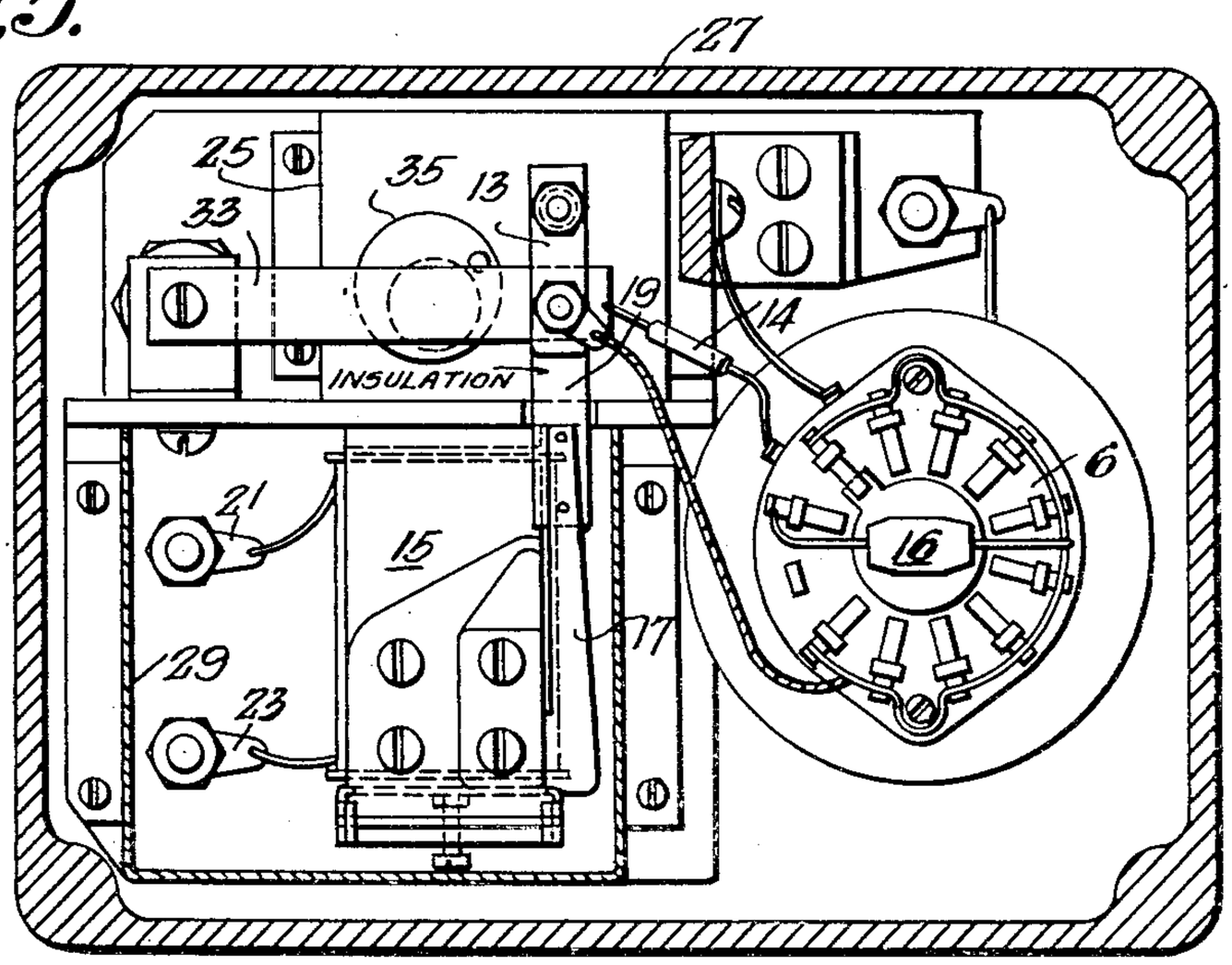


Fig. 3.



Inventor

Samuel Gubin

By

Attorney

Patented Dec. 19, 1939

2,183,612

UNITED STATES PATENT OFFICE

2,183,612

SHIELDED RELAY ATTENUATOR

Samuel Gubin, Erlton, N. J., assignor to Radio Corporation of America, a corporation of Delaware

Application October 22, 1938, Serial No. 236,436

8 Claims. (Cl. 178—44)

My invention relates to automatic relay devices, and more particularly to a shielded relay which may be used in conjunction with an attenuator circuit to give a high degree of attenuation at radio frequencies, and which makes possible the selection of any desired degree of attenuation.

This application is a continuation in part of my application entitled "Shielded relay attenuator", Serial No. 192,710, filed February 26, 1938.

In a radio station which is used for two-way communication with other stations, operation is greatly facilitated if "break-in" is possible. By "break-in" is meant the ability of a receiving operator to interrupt the transmission of the sending operator in case interference interrupts his reception, or for any other reason. To permit this, it is evident that the receivers of both operators must be receptive to signals from the other station whenever the local transmitter is not actually in use. The receivers should operate between letters or words in code transmission, or in the pauses in speech transmission. It is not a satisfactory solution of this problem for each operator merely to leave his receiver turned on and connected to the antenna at all times, because the large voltages picked up from the local transmitter might damage the receiver. At least the excessive signal strength would force the operator to remove his headphones. This would make "break-in" impracticable. It is also highly desirable to be able to utilize the regular receiver to monitor the local transmission.

Various devices have been tried to make satisfactory "break-in" operation possible, without complicated apparatus. Manual operation of switches is too tedious and slow, and often does not sufficiently reduce the sensitivity of the receiver to prevent "blocking". Automatic volume control systems may limit the audio output, but cannot prevent damage to the input circuit. Automatic relays which short-circuit the receiver input terminals may protect the receiver from damage, but cannot provide an adjustable attenuation of the local signal in case the receiver is to be used simultaneously to monitor the local transmission.

Furthermore, shorting relays often do not sufficiently reduce the receiver input to prevent blocking of the receiver. The equivalent generator impedance of a receiving antenna is roughly of the order of 300 ohms. An attenuation of the order of a million is necessary to satisfactorily reduce the signal strength of a powerful local transmitter. To accomplish this degree of attenuation by means of a shunt across the antenna and ground terminals of the receiver, it would be necessary for the shunt to have an impedance equal to one-millionth of 300, or .0003 ohm. Such a value of impedance could certainly not be obtained with an ordinary relay, even at low radio frequencies.

In many communication systems several stations operate on the same frequency. In such case it is a decided convenience if the protecting device can also be arranged to reduce the local signal to a value approximately equal to that of the distant station. The operator may then listen to his own transmission at a normal reception level without having to readjust his receiver.

It has also been suggested that a relay be used to disconnect the antenna, or that a variable attenuator be placed in the antenna lead to the receiver which could be shorted out by the action of a relay operated by the sending key, or controlled by voice signals. However, it has been found that all available types of relays have such inherently high capacity between contacts that a sufficient attenuation cannot be attained by these methods, particularly at high frequencies.

It is, therefore, an object of this invention to provide a relay which has an extremely small capacity between the open contacts; another object is to provide a shielded relay; a further object is to provide a relay which in conjunction with a circuit operates as a voltage attenuator and is adjustable over a wide range; a still further object is to provide a shielded relay and circuit suitable for attenuating high frequency radio frequency signals.

The invention will be better understood from the following description when considered in connection with the accompanying drawings. Its scope is indicated in the appended claims.

Referring to the drawings:

Figure 1 is a circuit diagram of my invention;

Figure 2 is a plan view, partly in section, of one embodiment of my invention; and

Figure 3 is an elevation taken on line III—III of Fig. 2. It is partly in section.

Similar reference numerals refer to similar parts throughout the several drawings.

Referring to Fig. 1, the invention is seen to consist of a relay 2, a double section selector switch 4 and 6, and a number of capacitors 43, 45, 47, . . . 63. The relay 2 is essentially a modified single pole double throw switch consisting of two movable contacts 1 and 10 and three fixed contact points 3, 7 and 8. Contact 3 is located within a shielded compartment 25, facing a small

aperture 9 in the shield. Movable contact 1 is designed to have an extension on one end which will pass through the aperture 9 and engage contact 3 when the relay is in its normal position. At the same time, the other movable contact 10 engages the third fixed contact 8. Movable contacts 1 and 10 are mounted on and connected to an armature 13. The fixed contact 8 is connected to a terminal 11, to which may be connected the shielded antenna lead from a receiver, which is not shown. An antenna, which is not shown, may be connected to terminal 5 which terminates in contact 3. A direct connection is thus provided by contacts 3—1 and 10—8 from the antenna to the receiver when the relay is in its normal or "receive" position.

An electromagnet 15 is provided which will actuate the relay when a suitable potential is applied across terminals 21 and 23. For example, this voltage may be supplied by a battery through a contact on the sending keying of the transmitter. When the sending key is pressed, contacts 1 and 10 move away from contacts 3 and 8, respectively, and contact 1 engages contact 7. The relay is preferably adjusted so that contact 1 is completely withdrawn from aperture 6 when the electromagnet is energized. Consequently, the capacity between contacts 1 and 3 is extremely small due to the effect of the shield 25. The antenna is thus very effectively removed from the receiver. If the receiver is to be used as a monitor for the local transmitter, it is desirable not to completely attenuate the signal. A signal sufficient to provide monitoring should reach the receiver.

An adjustment to provide for a satisfactory signal strength is desirable, to take care of changes in receiver sensitivity. For best results, the signal strength should be adjustable over the entire range of amplitude covered by the signals received from all the stations with which communication is to be held.

This has been accomplished by the switches 4 and 6 and the associated capacitors. When the relay is energized, the armature moves to the "transmit" position and contact 1 engages contact 7 which is connected to the selector arm 12 of switch 4. The various contact points of switch 4 are respectively grounded by a plurality of attenuating capacitors 43, 45, 47 . . . 63. All but the first and second contact points of the other switch 6 are connected together and to the armature 13. The first contact point of switch 6 is left open, and the second contact point is coupled to the armature 13 by a small capacitor 16. The movable arm of the switch 6 is connected to the receiver terminal 11 through a resistor 14.

The purpose of resistor 14 is to increase the effective receiver input impedance. At high frequencies the shunt impedance of the receiver input may become quite low. Since the receiver is connected across one of the attenuating capacitors it is necessary to keep the receiver impedance high with respect to the impedance of the capacitors. If this is not done, the selector switch 4 will be ineffective in changing the signal attenuation. When the relay is in the "receive" position, this resistor is short circuited by contacts 8—10, and the antenna is connected directly to the receiver.

At very high frequencies complete attenuation cannot be obtained by the usual arrangement of grounding the receiver input. Inherently there is a considerable length of conductor between the armature and ground, and the inductance of this conductor cannot be neglected. A closed inductive circuit is established which picks up a large signal voltage. With the switch 4 in the maximum attenuation position and the armature 13 grounded, it was found that by disconnecting the receiver antenna from the armature complete attenuation could be attained. To accomplish this, the first contact of switch 6 was left open. In the second position of the attenuator it was found best to insert a small capacitor 16 in series with the receiver input. This is also accomplished by the switch 6. By means of this switch, therefore, the receiver input terminal 11 may be opened or connected to ground through any one of the several capacitors 43 and 45, 47, 49 . . . 63. In the minimum attenuation position of the switch the receiver input is connected to the armature, but the armature is not grounded. The stray coupling to the armature provides a maximum amount of signal when the armature is not by-passed to ground. Intermediate steps are provided by selecting the capacitor which provides the desired attenuation. The attenuating capacitors may be selected to have successively decreasing impedance. For example, each capacitor may have one-half the capacity of the one following it.

It is evident that the voltage reaching the receiver from the antenna, when the relay is energized, is equal to the voltage on the antenna multiplied by the impedance of the capacitor selected by switch 4, divided by the sum of the impedance between contacts 3 and 1 and the impedance of the capacitor selected, assuming the shunt receiver input impedance to be large. Since the impedance between contacts 3 and 1 can be made extremely large in the shielded relay of my invention, a very great attenuation can be realized.

It will be recognized that a completely shielded receiver is necessary to insure that the attenuator will function properly. Direct pick-up in the receiver itself cannot be eliminated by the attenuator.

Referring to Figs. 2 and 3, constructional details of a preferred embodiment of my invention have been shown. Since the parts are numbered as in Fig. 1, no detailed description need be given. Two features should be noted, however, which are clearly shown in these figures.

First, an adjustment has been provided whereby the capacity between the antenna terminal and the receiver terminal may be increased in case the local transmitter signal is not strong enough to give satisfactory monitoring with minimum attenuation. An adjustable plate 37 is connected to terminal 3 within shield 25 facing an opening in the shield having substantially the same diameter as the plate. On the other side of shield 25 and directly opposite the opening a rigid strip 33 is provided, which is connected to the antenna lead 11, and which also is utilized to mount the third fixed contact point 8. An adjustable shutter 35 is fastened to shield 25. This shutter may be rotated to any position to provide any required amount of coupling between the antenna and the receiver input.

Second, to prevent pick-up to the receiver the electromagnet 15 has been placed in a shielded compartment 29. The movable contact 1 is preferably operated by means of an insulated strip 19 connected to the relay armature 17. The entire unit is preferably mounted in an outer shield box 27.

I claim as my invention:

1. An attenuator including in combination a pair of fixed contacts and a movable contact, a shielding compartment, said shield enclosing the first of said fixed contacts, means for bringing said movable contact either into direct electrical engagement with said first fixed contact within said compartment or into direct electrical engagement with the other fixed contact, a selector switch having a movable arm for engaging one of a plurality of contact points, said arm being connected to said last named contact, a plurality of capacitors respectively connected between said contact points and ground, an input terminal connected to said first contact within said shield, and an output terminal connected to said movable contact.

2. A device of the character described in claim 1 in which the means for bringing said movable contact either into direct electrical engagement with said first fixed contact within said compartment or into direct electrical engagement with the other fixed contact, includes an electromagnet.

3. An attenuator including in combination a first and second fixed contact and a movable contact, a shielding compartment enclosing said first fixed contact, said compartment having an aperture, an electromagnet for bringing said movable contact either into direct electrical engagement, through said aperture, with said first contact or into direct electrical engagement with said second contact, a selector switch having a movable arm connected to said second fixed contact, a plurality of contact points for engagement with said movable arm, a plurality of capacitors connected between respective contact points and ground, an input terminal connected to said first fixed contact, and an output terminal connected to said movable contact, whereby in one position of the movable contact said input terminal is electrically connected to said output lead, and in the other position of said movable contact the capacity between said input terminal and said movable contact is negligible by reason of the intervention of said shielding compartment, and said movable contact connects said output lead to ground through said selector switch and one of said capacitors.

4. A device of the character of claim 3 which is further characterized by the inclusion of an adjustable capacitor between said first contact and said movable contact.

5. An attenuator including in combination a first and second fixed contact and a movable contact, means for bringing said movable contact either into direct electrical engagement with said first contact or into direct electrical engagement with said second contact, a selector switch having a movable arm connected to said second fixed contact, a plurality of contact points for engagement with said movable arm, a plurality of capacitors connected between respective contact points and ground, an input terminal connected to said first fixed contact, and an output terminal connected to said movable contact, whereby in one position of the movable contact said input terminal is electrically connected to said output terminal, and in the other position of said movable contact the capacity between said input terminal and said movable contact is small, and said movable contact connects said output terminal to ground through said selector switch and one of said capacitors.

6. In a device of the character described in claim 3, means for connecting an impedance between said output terminal and said movable contact, when said movable contact is in engagement with said second fixed contact.

7. In a device of the character described in claim 3, means for connecting an impedance between said output terminal and said movable contact when said movable contact is in engagement with said second fixed contact, and means for short circuiting said impedance when said movable contact is in engagement with said first fixed contact.

8. In a device of the character described in claim 3, a second selector switch for connecting an impedance between said movable contact and said output terminal, and means for short circuiting said impedance when said movable contact is in engagement with said first fixed contact.

SAMUEL GUBIN.