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APPROACH ALARM SYSTEM WITH UNWANTED SIGNAL ELIMINATION

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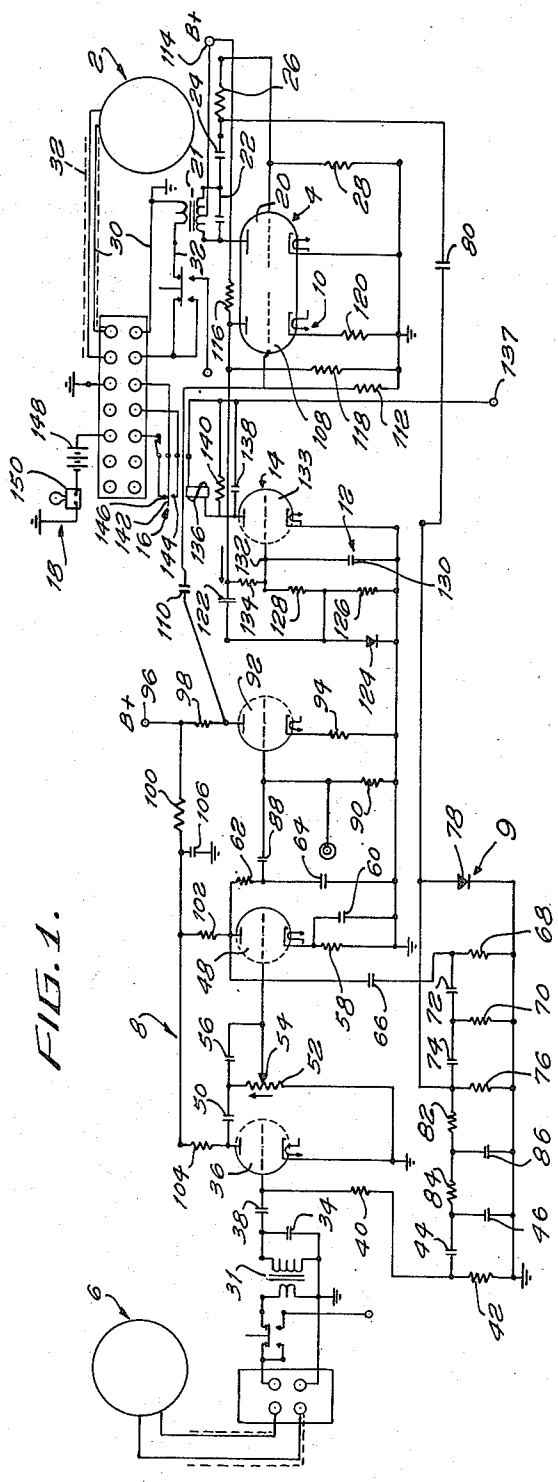

FIG. 1.

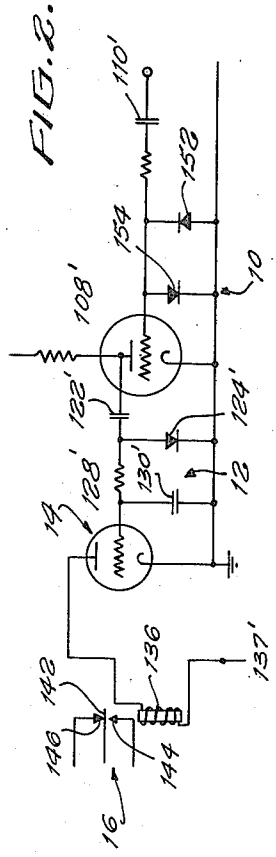

FIG. 2.

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APPROACH ALARM SYSTEM WITH UNWANTED SIGNAL ELIMINATION

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8 Claims. (Cl. 340—258)

The present invention relates to an alarm system adapted to detect certain occurrences and so designed as to prevent other occurrences, which might give to spurious signals, from causing the alarm to be actuated. It is here specifically disclosed as embodied in a motion detecting system operating on the Doppler principle, of the type described and claimed in my application Ser. No. 776,368, filed September 26, 1947, and entitled "Method and Apparatus for Detecting Motion in a Confined Space," now Patent No. 2,655,645. It will be understood, however, that the subject matter of this application may be used in systems other than those disclosed in the aforementioned application.

The method and apparatus of the aforementioned application constitutes a burglar and fire alarm which is actuated by reason of the fact that motion of an intruder in a given space or the existence in such a space of a thermal disturbance, be it fire, an overheated radiator, or the like, when such a space is filled with vibrations of a predetermined frequency or frequencies, preferably of supersonic value, will give rise to the existence, in such a space, of effective frequencies of vibration differing from the predetermined frequencies and normally differing from said predetermined frequencies by an amount of a different order of magnitude from said predetermined frequencies.

When those sound vibrations of different frequencies are converted into electrical vibrations of corresponding frequencies, and when those electrical vibrations are passed through a detecting apparatus capable of distinguishing between the frequencies and of actuating some control mechanism, such as a switch which controls an alarm, on the basis of the presence or absence of such differing frequencies, an operable alarm system is produced.

The utility of an alarm system is determined not only by its reliability in indicating each time that a certain event takes place, but also by its freedom from false alarms. The system disclosed in the aforementioned application, while it has functioned entirely satisfactorily from a commercial point of view and while it has met with a very favorable response, has nevertheless been subject to false alarms occurring with a frequency which was undesirable although far from prohibitive. These false alarms arose from a variety of transient phenomena which are usually unrelated to the security of the premises being protected. A radical change in the line voltage fed to the apparatus, momentary interruptions in such line voltage, shock sounds such as those due to "water hammer" in radiator pipes, or sparking of electrical contacts have all tended to cause false alarms from time to time. It is to eliminate the effect of these and similar factors without detracting from the inherent sensitivity and reliability of operation of the basic system that the present invention is primarily directed.

Percussive shock sounds, such as "water hammer" or the like, hammer blows outside the protected premises the sound of which is transmitted to the protected premises by various structural elements, and the sounds produced by structural elements as they contract or expand in accordance with changes in temperature, ultimately result in vibrations having frequencies comparable to those produced by an actual intruder. These sounds, when detected, and if of sufficient magnitude, will therefore tend to actuate the system of the aforementioned application to set off the alarm. One disclosed modification of that system was capable of eliminating the effect of shock sounds, but with an insufficient degree of reliability.

Another problem arose from the fact that, unless elaborate ann expensive precautions were taken, the contacts of the relay which control the alarm would tend to spark when the relay opened. These sparks would generate radiations which would, through electromagnetic interaction, be reproduced in the detecting circuit and give rise to a signal of sufficient amplitude and proper frequency to cause the alarm to go off. Thus, after the alarm had been once actuated and then deactuated, the system would sometimes become inoperative—the spark accompanying the initial normal de-actuation would cause an unwanted actuation, this would be followed by a de-actuation, another unwanted actuation would result, and so on. The relay would continuously recycle and render the system useless until steps were taken to eliminate the effect. If the only time that the alarm were set off were to correspond to the actual detection of an intruder, this might not be too undesirable, since the supervisory personnel, when they came to the protected premises to investigate the alarm, could terminate this malfunctioning. However, systems of the type under discussion are often connected to a central station which periodically tests the security of the apparatus by subjecting it to a simulated intruder. An apparatus which would continuously recycle, and thus be useless, after each such test would not long be tolerated. Moreover, it is usually the case that a plurality of these systems are all connected to the same central station and sparking of the relay contacts of one system is often transmitted to the systems in other locations by the telephone lines linking the protected premises, so that the actuation of one alarm sometimes has the effect of setting off alarms in other locations and making it difficult for the central station to determine the location of the actual intruder.

"Static" of other sorts also can be carried to a given unit by the telephone lines so as to cause the alarm of that unit to be actuated at an improper time.

The sensitivity of the system of the aforementioned application to radical changes in the voltage of the operating current or to momentary interruptions of that current arose from the fact that, in accordance with the normal requirements, the system had to "fail safe," that is to say, had to give an alarm if power failure occurred. It fulfilled this requirement exceedingly well, so well indeed that it would give an alarm for transient conditions as well as for steady state conditions. Alarm-actuating situations comparable to those produced by momentary interruption of the power supply have also been traced to intermittent electrical components in the circuit.

One characteristic of all of these causes of trouble is that they generally do not last very long. However, their intensity ordinarily is so great as to compensate and thus produce in the detecting circuit an ultimate signal of sufficient strength to cause the alarm to go off. It has been found that all of these problems can be virtually eliminated without any appreciable sacrifice in the essential reliability and sensitivity of the system by providing means in the system for distinguishing between highly transitory phenomena and phenomena of longer duration

which arise from movement of an intruder. I have discovered that this can be done in a surprisingly simple manner. The signal which sets off the alarm is composed of a series of electrical pulses, either uni-directional or alternating. The prior system was capable of distinguishing between pulses the frequency of which came within a certain range and pulses having other frequencies, but the transient phenomena under discussion gave rise to signals of the proper frequency. If to frequency discrimination is added numerical pulse determination—counting the actual number of individual pulses which occur in a predetermined period of time independently of their amplitude, the problem is solved. By so controlling the actuation of the alarm that it is set off only if at least a predetermined number of pulses are received and detected within a predetermined period of time, all of the above disadvantages may be minimized or entirely avoided.

It must be borne in mind that more is here involved than merely integrating the signal pulses. Integration is partly a function of the number of pulses received within a predetermined period of time, but it is also a function of the magnitude of those pulses. Hence if a certain number of pulses of normal magnitude within a given period of time will cause the alarm to go off, a smaller number of pulses of greater magnitude within the same period of time would have the same effect insofar as integration is concerned. Since shock sounds and signals due to sparking are often quite extreme in magnitude, integration does not reliably eliminate them as adverse factors. It may be noted in this regard that the system of the aforementioned application included integration, but that these troubles were none the less present to a degree.

In order to eliminate the effect of the magnitude of the pulses in the system here disclosed, the integrating circuit is preceded by a circuit having an amplitude-limiting feature. Such a circuit has the characteristic that so long as its input signals have a predetermined minimum amplitude its output signals will have substantially the same magnitude, no matter how high above the minimum the input signals may go. Circuits having this characteristic have long been known and may take a number of forms, and I here make no claim to the specific type of any such circuit. However, by utilizing such an amplitude-limiting circuit in conjunction with an integrating circuit, the alarm system becomes substantially independent of transient effects. Shock sounds will not set off the alarm unless they occur with great frequency and with practically no interval therebetween. Sparking, unless long continued and substantially continuous, will not set it off. Even momentary interruptions in the circuit or in the power supply will not set it off. The use of the limiter circuit also renders the system much more insensitive to variations in line voltage than has heretofore been the case.

Of course, the use of the limiter-integrator circuit combination is not the only way in which the number of pulses received within a given period of time can be determined independently of their magnitude, or at least independently of any excess of their magnitude above a predetermined normal value. For example, a time-sensitive electronic counter of any conventional type could be employed to count the number of pulses continuously received and to permit the alarm to be actuated only after a predetermined number of pulses had been counted, provision being made to start counting all over again after passage of a predetermined time or after detection of a discontinuity in a series of pulses.

To the accomplishment of the above, and to such other objects as may hereinafter appear, the present invention relates to an alarm system in which means are provided for distinguishing between real and spurious signals and controlling the alarm correspondingly, as defined in the following claims and as described in this specification, taken together with the accompanying drawings in which:

Fig. 1 is a circuit diagram of one embodiment of the present invention; and

Fig. 2 is a simplified fragmentary circuit diagram of another embodiment thereof.

In general the system in connection with which the instant invention is specifically illustrated comprises a transmitter generally designated **2** adapted to be energized by an oscillator **4** so as to transmit vibrations of a predetermined frequency of, for example 19 kilocycles per second, into a confined space. These radiations are reflected from walls and objects in the room and eventually impinge upon a receiver **6** which transforms the received radiations into an electrical signal fluctuating at a corresponding frequency. These signals are amplified in an amplifier section **8** and are then caused to beat with the original transmitted frequency in a detecting circuit portion **9** so that, if the received radiations differ in frequency from the transmitted radiations, as will be the case if there is movement within the confined space, a signal is produced having a frequency equal to the difference between the received and transmitted frequencies. The frequency of this signal is fairly low, the system usually being designed to detect such frequencies within the range of approximately 3 and 180 cycles per second. These frequencies will hereinafter be referred to as "low" frequencies, the transmitted and received frequencies being referred to as "high" frequencies. These terms are relative, and it will be appreciated that their actual magnitudes may be widely varied. For example, the high frequency could be in the radio frequency spectrum, and the low frequency would have a much higher range than that specified.

The low frequency signal is amplified, in the embodiment here specifically disclosed passing through the same amplifier section **8**, and is then fed to an amplitude-limiting circuit generally designated **10**, the output of which will have substantially the same frequency as the input but the amplitude of the output of which will not substantially exceed a given value no matter how much the amplitude of the low frequency pulses fed thereinto may exceed a normal predetermined value. Of course, weak input signals may produce correspondingly weak output signals. The important point is that there is an upper limit on the amplitude of the output signals.

The output from the amplitude-limiting circuit **10** is fed to an integrator circuit generally designated **12**, where it is integrated with respect to time. The output of the integrating circuit **12** is connected to a control circuit generally designated **14** which as here disclosed is bias-sensitive and which is biased by the integrating circuit **12**. The control circuit **14** is operatively connected to a relay generally designated **16** which controls the operation of an alarm of any desired type, generally designated **18**.

The nature of the control circuit **14** is such that it will cause the relay **16** to close and actuate the alarm **18** only when a bias of predetermined amount is applied thereto. The integrating circuit **12** and limiter circuit **10** are so designed that such a bias will be produced only when a predetermined number of impulses are received from the low frequency signal within a given period of time, and when those impulses have a predetermined minimal magnitude. The amplitude-limiting circuit **10** serves to ensure that any excess in magnitude of the impulses in the low frequency signal over and above this normal minimal magnitude will have no effect on the control circuit **14**.

Having reference now specifically to the circuit of Fig. 1, the basic transmitted frequency of approximately 19 kilocycles per second is generated by the oscillator circuit **4**, defined by the triode **20** (half of a 6NS7 tube) the frequency of output of which is determined by the center tapped primary of transformer **21** across which the .0015 mfd. condenser **22** is connected, the output of the tube

20 being fed back to the grid thereof by means of .001 mfd. condenser 24 and 22,000 ohm resistor 26. A grid bias resistor 28 of 47,000 ohms is connected between the grid and the cathode. The transformer 21 steps down the output of the oscillator to approximately 6 volts, that output being fed to transmitter 2 by means of shielded leads 30 and 32.

The receiving transducer 6 picks up radiations impinging thereon and converts them into corresponding electrical fluctuations which are fed to the primary of transformer 31 which functions as a step-up transformer and the secondary of which is tuned by means of the 200 mmfd. condenser 34. The output of this tuned circuit is coupled to the grid of tube 36 (one half of a 6SL7 tube) by means of 200 mmfd. condenser 38, a 220,000 ohm grid resistor 40 leading to ground via 10 megohm bias resistor 42, the latter being bypassed for high frequencies by .01 mfd. condenser 44 and .05 mfd. condenser 46. The output of tube 36 is coupled to the grid of tube 48 (the other half of the 6SL7 tube) by means of .01 mfd. condenser 50 and grid bias potentiometer 52, the latter having a resistance of 1 megohm and having a movable tap 54 bypassed by 500 mmfd. condenser 56. Because of the low impedance of the condenser 56 to the high frequency signal, the position of the tap 54 along the potentiometer 52 will have little effect on the magnitude of that signal, except when the tap 54 is very close to the low end of the potentiometer 52, at which time the impedance from the tap 54 to ground approaches the impedance of condenser 56, thus causing the high frequency signal to be attenuated. The primary function of the tap 54, as will become apparent later in the explanation, is to control the amplitude of the detected low frequency signal and thus to control the sensitivity of the unit to the amplitude of detected Doppler frequency effects.

The high frequency signal will be amplified by tube 48, whose bias is derived from the cathode biasing resistor 58 of 4,700 ohms, high frequency bypassed by .1 mfd. condenser 60. The 510,000 ohm resistor 62 and the .01 mfd. condenser 64 constitute a low pass filter which will not permit high frequency components to pass. The high frequency signal is coupled by 500 mmfd. condenser 66 to a high pass filter defined by 510,000 ohm resistors 68 and 70 and 500 mmfd. condensers 72 and 74, together with 470,000 ohm resistor 76. A selenium rectifier 78 is connected across resistor 76 and, by shunt rectification, detects the high frequency signal amplified by tube 48 and passed by the high pass filter. At the same time, a portion of high frequency output from the oscillator 4 is coupled thereto by means of 10 mmfd. condenser 80, thus causing the received high frequency signal to beat against the signal transmitted by the speaker unit, and if it received a signal at a frequency different from the transmitted signal, to produce a low frequency signal having a frequency equal to the beat or difference between the received and transmitted frequencies.

The frequency of such variations in the received signal caused by an intruder or by fire may range from between 3 and 180 cycles per second in a normal burglar alarm installation. In order to prevent spurious alarms, such as might be caused by convection from normally operating radiators, it is preferred to cause the system to be actuated only when frequencies in a range between about 15 and 100 cycles per second are detected. The low pass filter consisting of 220,000 ohm resistors 82 and 84, together with .01 mfd. condenser 86 and .05 mfd. condenser 46, permits the low frequency signal to pass therethrough, that signal being coupled to the grid of tube 36 by condenser 44 through resistor 40. The low frequency signal is then amplified by the same tube 36 which had previously amplified the high frequency signal. This simultaneous amplifying of low and high frequencies by the same tube is known as "reflexing" and it will be seen that both tubes 36 and 48 therefore operate as a two-stage reflex amplifier. The low frequency, when it reaches the potentiometer 52, is not bypassed by the condenser 56 and hence the setting of the tap 54 along the potentiometer 52 will control the amplitude of the low frequency signal applied to the grid of the amplifier tube 48. Because the cathode bypass condenser 60 for the tube 48 has a value of .1 mfd., this stage of amplification is degenerative at the low frequencies only. The amplified low frequency signal is taken off the plate of the tube 48 by means of the low pass filter defined by the resistor 62 and condenser 64. The low frequency signal is blocked from passing through the condenser 66 because of the high pass characteristics of the filter 68—76. The low frequency signal is coupled by .01 mfd. condenser 88 and 1.2 megohm resistor 90 to the grid of amplifying tube 92 (one half of a second 6SL7 tube), that tube degeneratively cathode biased by 4700 ohm resistor 94.

Plate potential is applied to the tubes 36, 48 and 92 from B+ terminal 96 via 270,000 ohm resistor 98, 120,000 ohm resistor 100, 180,000 ohm resistor 102 and 270,000 ohm resistor 104, the plate voltage being bypassed to ground by 10 mfd. condenser 106.

The output of the amplifier tube 92, which consists exclusively of the low frequency if detected, is coupled to the grid of amplitude limiter tube 108 (the other half of the 6NS7 tube) by means of .01 mfd. condenser 110 and 2.2 megohm resistor 112. The plate of the tube 108 is connected to the B+ terminal 114 via 1.2 megohm resistor 116, and is also connected to ground via 160,000 ohm resistor 118. The resistors 116 and 118 define a voltage divider by means of which the plate of the tube 108 is operated at a voltage considerably lower than the voltage at the B+ terminal 114. For example, if the voltage at 114 is approximately 280 volts, the voltage at which the plate of tube 108 is operated will be approximately 25 volts. The A. C. output voltage from the tube 108 is limited by the 25-volt plate voltage and cannot exceed it no matter how large the input. The limiter is stabilized by the degenerative action of 3300 ohm cathode biased resistor 120. Hence, except for very small signals, the amplitude of the output of the limiter circuit 10 is substantially constant and independent of the amplitude of the low frequency signal applied to the grid of tube 108.

The low frequency output from the limiter circuit 10 is coupled by .1 mfd. condenser 122 to selenium rectifier 124 and a 1.2 megohm resistor 126 connected in parallel. The rectifier 124 acts as a shunt rectifier across resistor 126. During the positive half of the cycle, while the rectifier is conducting, it shuts out the input signal. During the negative half of the cycle, the rectifier is nonconducting and the voltage across it becomes equal to the input. As a result, there is an average negative voltage across the rectifier which shows up as a series of D. C. negative peaks. Therefore low frequency signal caused by the motion of an intruder or by fire is converted by rectifier 124 into a series of negative pulses, one pulse for each cycle of the low frequency signal. These negative pulses are fed to an integrating circuit consisting of 1.2 megohm resistor 128 and .5 mfd. condenser 130, the junction point 132 therebetween being connected to the grid of tube 133 (the other half of the second mentioned 6SL7 tube), which forms a part of the control circuit 14. Since the resistor 128 limits the charging current, the .5 mfd. condenser 130 must integrate the charge it receives from the rectifier 124 over several cycles before it becomes sufficiently negative to operate the control circuit.

The average plate voltage of the limiter tube 108, filtered by 10 megohm resistor 134 and capacitor 130, is applied to the selenium rectifier 124 through resistor 128. When there is no low frequency signal, there is no negative voltage developed by rectifier 124 and the positive threshold voltage is applied to the grid of the relay tube 14 through the resistor 134 from the plate of the limiter tube 108. Low frequency signals reaching rectifier 124 via limiter tube 108 and condenser 122 will be rectified

and integrated by the resistor 128-condenser 130 combination until they are large enough to overcome the positive threshold bias on the grid of tube 14. Thus minor signals caused by small amounts of air turbulence or circuit noise will not affect the plate circuit of the relay tube 14. Only if the magnitude of the low frequency signal is great enough will any negative grid control take place. Then rectification will tend to build up a negative charge on the upper end of condenser 130 and thus bias the grid of tube 14 negatively so as to decrease its plate current.

The charge on condenser 130 will tend to leak off via resistors 126 and 128, the rate of leakage being determined by the magnitude of these latter components. The integrating circuit will therefore have a characteristic and predetermined time-charge characteristic. If an insufficient number of cycles of low frequency signal are rectified by rectifier 124 within a given period of time, the charge on condenser 130 will not be built up sufficiently to overcome the positive bias normally applied thereto and bring it to a sufficiently negative point. It is only when a predetermined number of such cycles of low frequency signal are rectified that the positive bias on the grid of tube 14 will be overcome and the grid made sufficiently negative to operate the relay, and, it will be noted, because of the interposition of the limiter circuit 10 ahead of the integrator circuit 12, the latter will not be affected by variations in the amplitude of the low frequency signal above a certain predetermined normal value.

The alarm relay coil 136 is connected in the plate circuit of tube 14, plate voltage being supplied from B+ terminal 137. Shunted across coil 136 are 10 mfd. condenser 138 and 15,000 ohm resistor 140 in parallel, the former acting as a filter condenser to prevent chatter, and the latter acting as a protective resistor to prevent condenser 138 from being subjected to overvoltage should the relay coil 136 be opened or the relay removed.

The tube 14 to the grid of which a positive bias is normally applied, therefore normally passes current. The relay coil 136 is normally energized, and the relay armature 142 is normally engaged with blind fixed contact 144. The fixed contact 146, with which the armature 142 makes contact when the relay coil 136 is de-energized, is connected to battery 148 and then to ground via an alarm instrumentality 18 which may take any desired form and which is here specifically disclosed as a bell 150. It will therefore be appreciated that so long as the tube 14 passes a sufficient amount of current the circuit through the alarm instrumentality 18 will be open, but whenever the relay coil 136 is insufficiently energized, as will be the case when a sufficiently negative bias is applied to the grid of the tube 133 by the integrating circuit 12, the armature 142 will engage the fixed contact 146 (as shown in Fig. 1), the circuit through the instrumentality 18 will be closed, and the alarm will be set off.

By choice of values of circuit components, any desired operating conditions can be achieved. With the circuit components here specifically disclosed, it has been found that approximately 5 pulses per second of normal magnitude received by the integrator circuit 12 will cause the alarm to go off, but any fewer number of pulses per second will not cause the alarm to go off. From a practical point of view, this means that one shock sound per second will not set off the alarm but that one shock sound every tenth second will set it off. Shock sounds of the latter frequency are so rare that they warrant investigation, and consequently this is not deemed to be a drawback. This particular adjustment means that movement of an intruder of approximately 3½ inches in a second will still cause the alarm to go off, and this limitation is entirely practical.

The amplitude limiting circuit 10 in the system of Fig. 1 operates on the principle of reduction of the voltage applied to the plate of the limiter tube 108. Fig. 2 illustrates an alternative arrangement in which the voltage to the grid of limiter tube 108′ is rendered substantially insensitive to variations in magnitude of the low frequency signal above a predetermined normal value by connecting a pair of selenium rectifiers 152, 154 in parallel across the grid circuit and active in opposite directions. The characteristics of such a network are such that the amplitude of the voltage output varies with the amplitude of the voltage input only over the lowest values of voltage input amplitude, after which the voltage output amplitude will be substantially constant no matter how high the voltage input amplitude may go. This is to be considered merely exemplary of numerous amplitude-limiting arrangements which might be used.

By the same token, certain specific integrating circuits are disclosed, and many other types of such circuits are known and may be used.

It will be appreciated that when, in the specification and claims, signals or variations in voltage or current are referred to in terms of pulses, that term is broad enough to include pulses of widely varying wave shapes and also pulses which alternate in direction, as in the case of alternating current.

By the arrangement above described the system has been rendered substantially insensitive to variations in line voltage and has been enabled to differentiate between transient conditions and continuing conditions, the term "transient" being employed in the sense that the number of signal pulses produced in a given period of time is below that number required to set off the alarm. The effectiveness of the instant invention can be evaluated not only from the fact that shock sounds, sparking and static no longer produce false alarms, but also from the fact that the plug connecting the unit to its source of power may be pulled out and pushed back into the socket quickly a number of times without causing the alarm to go off, whereas if the plug is held out of the socket for an appreciable period of time the alarm will go off.

While but two embodiments of the invention have been here specifically disclosed, it will be apparent that many variations may be made therein without departing from the spirit of the following claims.

I claim:

1. In a motion detecting system comprising means for transmitting radiations of a given frequency into a space to be protected, means for receiving said radiations after they have traversed said space, and means for detecting variations in the frequency of said received radiations when compared with said transmitted radiations and indicating the presence or absence of motion in said space in accordance with the presence or absence of said detected variations; the improvement which comprises said indicating means being actuated in accordance with the presence or absence of a predetermined degree of electrical bias applied thereto, said detecting means comprising means for transforming said detected frequency variations, if present, into a series of pulses, means operatively connecting said pulses to an amplitude limiting circuit the output of which is substantially uniform in amplitude independently of variations in the amplitude of its input above a normal value and operatively connected to receive said pulses, and an integrating circuit, the output of said limiting circuit being electrically connected to said indicating means via said integrating circuit to bias said indicating means, whereby the attainment of the predetermined degree of electrical bias sufficient to cause said detecting means to indicate the presence of motion within said space is determined by the number of pulses reaching said integrating circuit within a predetermined period of time and substantially independent of possible excess in amplitude of said pulses.

2. In the motion detecting system of claim 1, means constantly biasing said indicating means in a sense opposite to the bias developed by said integrating circuit,

the bias produced by said integrating circuit therefore having to overcome said bias before said detecting means can be biased to indicate the presence of motion.

3. The motion detecting system of claim 1, in which the pulse output of said detecting means is alternating in character and in which said integrating circuit comprises a rectifying means in parallel with a condenser, a point of junction between said rectifying means and said condenser being connected to said indicating means to bias the latter.

4. In an alarm system or the like, an alarm, control means operatively connected to said alarm and sensitive to the presence or absence of a predetermined degree of electrical bias applied thereto, means including a receiver for detecting the occurrence of a given event and translating said detection into an output defined by an alternating series of electrical pulses, a limiting circuit, the output of which is substantially uniform in amplitude independently of variations in the amplitude in its input above a normal value, the output of said detecting means being electrically connected to and defining the input to said limiting circuit, and an integrating circuit electrically connected to the output of said limiting circuit and comprising a rectifying means in parallel with a condenser, a point of junction between said rectifying means and said condenser being electrically connected to said alarm control means to bias said control means to an alarm-actuating condition, whereby the attainment of the predetermined degree of the electrical bias sufficient to cause said control means to actuate said alarm is determined by a minimum number of pulses of the output of said receiver which reach said integrating circuit within a given period of time and is substantially independent of possible excess in amplitude of said pulses.

5. In a motion detecting system comprising means for transmitting radiations of a given frequency into a space to be protected, means for receiving said radiations after they have traversed said space, and means for detecting variations in the frequency of said received radiations when compared with said transmitted radiations and indicating the presence or absence of motion in said space in accordance with the presence or absence of said detected variations; the improvement which comprises said detecting means comprising means for translating said variations into a series of electrical pulses, a limiting circuit, the output of which is substantially uniform in amplitude independently of variations in the amplitude in its input above a normal value, said pulses being fed to and defining the input to said limiting circuit, and an integrating circuit, the output of said limiting circuit being electrically connected to said indicating means via said integrating circuit, said indicating means being so constructed and arranged as to indicate the presence of motion within said space in accordance with the reception by said integrating circuit of a predetermined number of pulses within a given period of time, said indicating means therefore being actuated substantially independently of possible excess in amplitude of said pulses.

6. In the system of claim 5, means constantly biasing said indicating means away from motion-indicating condition, the output from said integrating circuit acting in opposition thereto and having to overcome said constant bias before said indicating means will indicate the presence of motion.

7. In a motion detecting system comprising means for transmitting radiations of a given frequency into a space to be protected, means for receiving said radiations after they have traversed said space, and means for detecting variations in the frequency of said received radiations when compared with said transmitted radiations and indicating the presence or absence of motion in said space in accordance with the presence or absence of said detected variations; the improvement which comprises said detecting means comprising means constructed and arranged for counting the number of pulses of said variations, if present, which are detected within a given period of time substantially without regard to excess of the amplitude of said pulses above a normal value, said counting means being operatively connected to said detecting means and actuating the latter only when a predetermined number of pulses are counted within a given period of time, said counting means comprising an amplitude limiting circuit to which the detected variations are fed, the amplitude of the output of said limiting circuit being substantially independent of variations in the amplitude of its input above a normal value, and wherein an integrating circuit is connected in series with said limiting circuit, said indicating means including a bias-sensitive instrumentality operatively connected to the output of said integrating circuit and biased thereby.

8. In the motion detecting system of claim 7, means to apply a constant bias to said instrumentality in a sense opposite to the bias developed by said integrating circuit.

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