

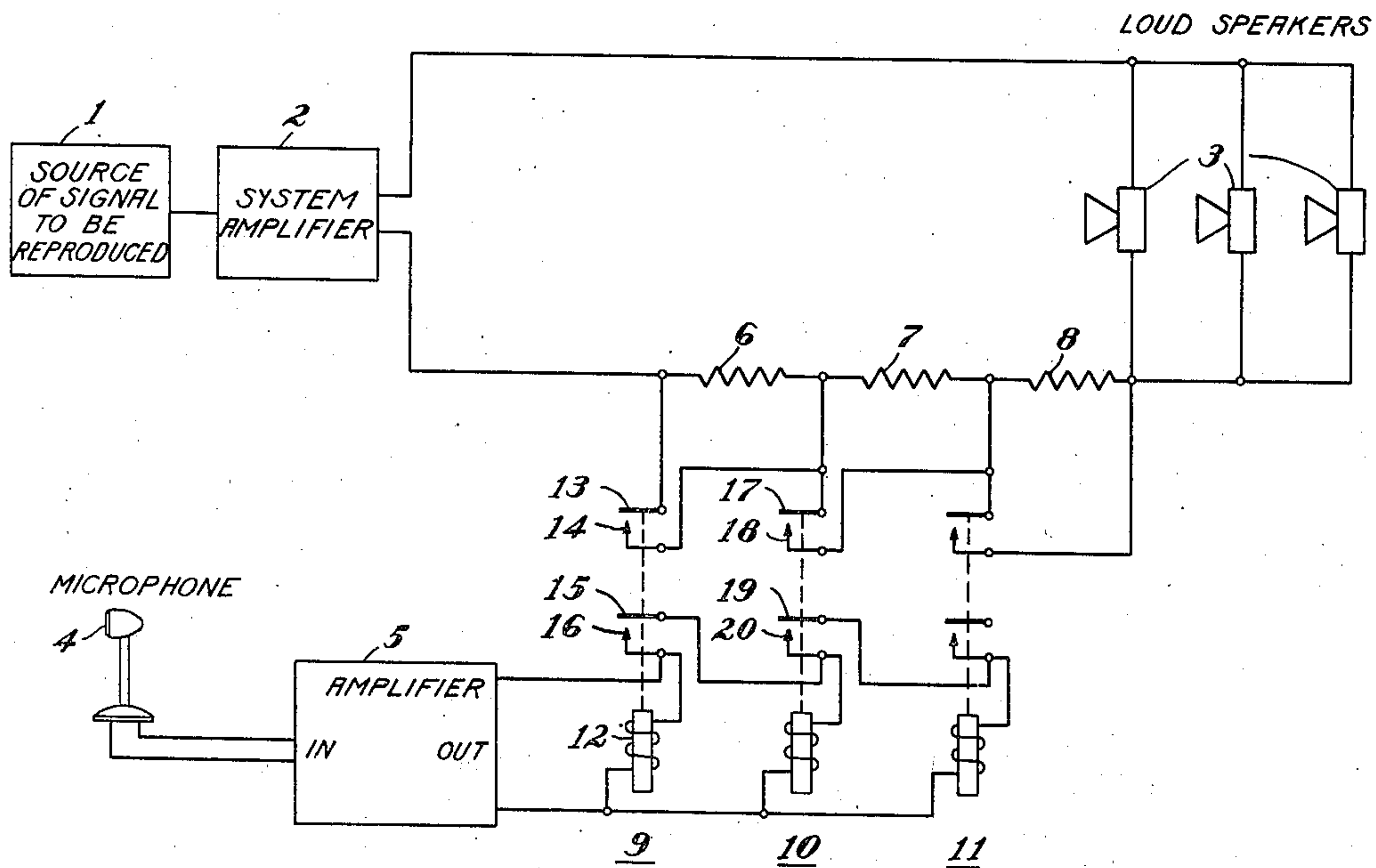
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A. E. EKSTRAND

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SOUND CONTROL SYSTEM

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INVENTOR.
ALFRED E. EKSTRAND
BY *J. L. Bowes*
ATTORNEY

UNITED STATES PATENT OFFICE

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SOUND CONTROL SYSTEM

Alfred E. Ekstrand, Rochester, N. Y., assignor to
Stromberg-Carlson Company, a corporation of
New York

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This invention relates to sound reproducing systems and more particularly to sound systems, such as public address or paging systems, for example, adapted for use in areas having variable noise levels as in factories, dining rooms, theaters, schools, and the like.

Sound reproducing systems of the type indicated above may be provided with volume control means. Manual controls have been used to enable an operator to adjust the output level to take account of changes in the noise level which may take place because of variations in the size of an audience in a theater or the number of persons using a dining room or restaurant, for example. However, it is disadvantageous to require the services of an operator merely for the control of the volume of sound reproduction. Moreover, where the sound reproducing devices, such as loud-speakers, are located in different remote positions, such as in various parts of a factory, a single manual control is not adequate.

Sound reproducing systems have been proposed, wherein the noise level in the speaker area automatically controls the volume of reproduced sound in response to changes in the ambient noise level to provide a signal which is loud enough to be heard, but not objectionably loud when the noise level is low. Heretofore, such proposals have been expensive and in many cases, increases in reproduced sound serve to energize the noise pickup means so that the increase in volume of sound reproduced changes at a greater rate than desired.

It is an object of my invention to provide a new and improved system for accurately controlling the volume of reproduced sound in accordance with the noise level within the listening area.

In carrying out the objects of my invention, there is provided volume control means in association with the output of the sound system. A plurality of relays is arranged in such a manner that the relays are operated in succession at predetermined noise levels to vary the adjustment of the volume control means.

The details of my invention and refinements, thereof, as well as further objects and advantages will be apparent from a reading of the following specifications and claims in connection with the accompanying drawing which illustrates one embodiment of the principles of my invention.

Referring to the drawing, there is indicated a source of signal to be reproduced, represented by the numeral 1. This source may be a microphone including a suitable speech amplifier, if

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necessary, a record player or magnetic sound reproducer, the audio system of a radio receiver, a wired sound service, or other suitable source. A suitable amplifier 2 is employed to amplify the output of the source 1.

The output of amplifier 2 is suitably connected to at least one sound reproducing device or loud-speaker 3. The number and disposition of speakers depends upon known factors such as the size of the listening area, the noise level to be expected, etc. The listening area may comprise a single room or space or a plurality of spaces or rooms which may be adjacent or remote from each other in the same building or in separate buildings.

In each area in which it is desired to maintain a predetermined sound level above ambient noise, there is located noise responsive means such as an analyzing microphone or noise pickup means 4, the placement of which is not critical. The output of microphone 4 may be suitably amplified as by means of amplifier 5.

In series with the loud-speakers 3 and amplifier 2, there is provided adjustable volume control means which in the illustrated form of my invention comprises a plurality of resistances 6, 7 and 8. There may be three separate resistances as shown, or a single tapped resistor of suitable resistance may be used.

In order to control the volume of sound emitted from the loud-speakers, means is provided for varying the amount of resistance associated with the sound reproducing devices or loud-speakers 3 in accordance with the combined noise level in the listening area or areas. In the preferred form of our invention, the control means comprises means for developing a control quantity, the value of which is proportional to the ambient noise level including sound pick-up or microphone 4 and sound transmission means such as an amplifier 5 and means utilizing the control quantity, such as a plurality of relays 9, 10 and 11. Each relay has a pair of contacts connected to short circuit the associated resistance when the associated relay is energized and to permit the associated resistance to be inserted in the circuit when the associated relay is deenergized. Thus, the output of amplifier 5 is connected directly across the coil 12 of relay 9. The relay 9 is adjusted so that it will operate only upon a predetermined increase in the ambient noise level within the listening area. When relay 9 operates armature 13 engages contact 14 to short circuit resistance 6. Hence, only resistances 7 and 8 are left in the circuit and the volume of repro-

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duced sound is increased proportionately to the decrease in resistance.

Energization of relay 9 prepares a circuit for the energization of relay 10 through armature 15 and contact 16 of relay 9.

If the volume of noise in the listening area increases beyond a second predetermined level, as determined by the construction or adjustment of relay 10, relay 10 becomes energized to short circuit resistor 7 through armature 17 and contact 18 and prepare a circuit for relay 11 over armature 19 and contact 20. Relay 11 is constructed and arranged to be energized upon a third increase in volume of predetermined amount. Thus, the volume of desired sound is adjusted a predetermined amount whenever the ambient noise level exceeds a predetermined amount.

While there have been illustrated three relays and associated resistances, any necessary number of relays and resistances may be employed.

From the foregoing it is seen that as the ambient noise level in the listening area increases, more signal is picked up by the microphone or noise pickup device 4. By connecting a plurality of relays in parallel circuit arrangement, each relay requiring greater current to cause its operation, any desired number of volume steps may be obtained and the volume of reproduced sound is regulated in proper proportion to the ambient noise levels.

In order to prevent increases only in the volume of reproduced sound from furnishing excitation to energize the next control relay, the relays are so adjusted that the increase in volume of reproduced sound resulting from the operation of any one relay is insufficient alone to cause operation of the next relay. Therefore, additional resistance is not cut out of the circuit unless the combined desired and undesired noise levels increase beyond predetermined amounts.

While I have illustrated and described a preferred embodiment of the principles of my invention, other embodiments and modifications may be made by those skilled in the art. For example, frequency weighting or compensation networks may be utilized, and any desired number of adjustment steps may be provided. My system is not limited to use in one area, but one control system is preferably associated with each distinct listening area. Further, means may be provided for setting the relative levels of reproduced sound and noise. I, therefore, intend to cover all such modifications and embodiments as may fall within the spirit and scope of my invention in the appended claims.

What I claim as new and desire to secure by United States Letters Patent is:

1. In a sound system having a source of sound to be reproduced and at least one sound reproducing device, resistance means connected in circuit with said sound reproducing device for controlling the volume of reproduced sound, and means responsive to the ambient noise level in the listening area adjacent said device for varying the amount of resistance connected in circuit with said device in accordance with said levels, said last mentioned means comprising only sound pick-up means, sound transmission means and one or more relays connected to be energized by said sound transmission means.

2. In a sound system including a source of voltage representing a signal to be reproduced and at least one sound reproducing device, the combination therewith of resistance in series with

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said source and said device, means for developing a control quantity the value of which is proportional to the ambient noise level, and means consisting only of one or more relays utilizing said control quantity for varying the amount of resistance a predetermined amount whenever variation of the ambient noise level exceeds a predetermined amount, whereby substantially constant volume of reproduced sound relative to the ambient noise level is obtained.

3. In a sound system including a source of voltage representing a signal to be reproduced and at least one sound reproducing device, means for varying the voltage applied to said device, a plurality of ambient level responsive devices, each of said devices being constructed and adjusted to operate at a different noise level, and means utilizing only said devices for rendering effective said voltage varying means for effecting the adjustment of the volume of reproduced sound in accordance with predetermined changes of ambient noise level.

4. In a sound system, a source of voltage representing a signal to be reproduced, at least one sound reproducing means, means for adjusting the volume of reproduced sound, means for developing a control quantity the value of which is proportional to the ambient noise level, a plurality of relays, each of said relays being constructed and adjusted to operate at a different noise level, circuit means including only said relays for connecting said relays to said control quantity developing means in a predetermined sequence and means utilizing the operation of each of said relays for sequentially effecting adjustment of said volume control means.

5. In a sound system, a source of voltage representing a signal to be reproduced, at least one sound reproducing means, means for adjusting the volume of reproduced sound, means for developing a control quantity the value of which is proportional to the ambient noise level, a plurality of relays, each of said relays being constructed and adjusted to operate at a different noise level, circuit means including only said relays for normally connecting one relay to said source of control quantity, and means responsive to the operation of said one relay for adjusting the volume of reproduced sound and for also connecting another relay to said source of control quantity.

6. In a sound reproducing system having a source of voltage representing sound to be reproduced and at least one sound reproducing device, resistance connected in series with said device, a plurality of relays, each of said relays having a pair of normally open circuit-closing contacts, said contacts of each relay being connected to short-circuit different portions of said resistance, means for producing a control quantity the value of which is dependent upon the ambient noise level of the listening area in the vicinity of said device, means for impressing said quantity on the winding of one relay whereby said one relay operates to short-circuit a portion of said resistance whenever said quantity exceeds a predetermined value, said one relay having a second pair of normally open circuit-closing contacts in series with the winding of a second relay for connecting said second relay winding to said control quantity upon operation of said one relay, said second relay being constructed and arranged to operate on another predetermined value of said quantity substantially higher than said first value for short-circuiting a second portion of said resist-

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ance for again increasing the volume of sound reproduced by said device.

7. In a sound reproducing system having a source of voltage representing sound to be reproduced and at least one sound reproducing device, resistance connected in series with said device, a plurality of relays, each of said relays having a pair of normally open circuit-closing contacts, said contacts of each relay being connected to short-circuit different portions of said resistance, means for producing a control quantity the value of which is dependent upon the ambient noise level of the listening area in the vicinity of said device, means for impressing said quantity on the winding of one relay whereby said one relay operates to short-circuit a portion of said resistance whenever said quantity exceeds a predetermined value, said one relay having a second pair of normally open circuit-closing contacts in series with the winding of a second relay for connecting said second relay winding to said control quantity upon operation of said one relay, said second relay being constructed and arranged to operate

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on another predetermined value of said quantity substantially higher than said first value for short circuiting a second portion of said resistance for again increasing the volume of sound reproduced by said device, said relays being so arranged that the increase in volume of reproduced sound only caused by operation of one relay is insufficient to cause operation of another relay unless the undesired noise level also increases beyond a predetermined amount.

ALFRED E. EKSTRAND.

REFERENCES CITED

15 The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,338,551	Stanko	Jan. 4, 1944
2,382,848	Baumgartner	Aug. 14, 1945
2,392,218	Anderson	Jan. 1, 1946
2,420,933	Crawford	May 20, 1947