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SOUND TRANSLATION

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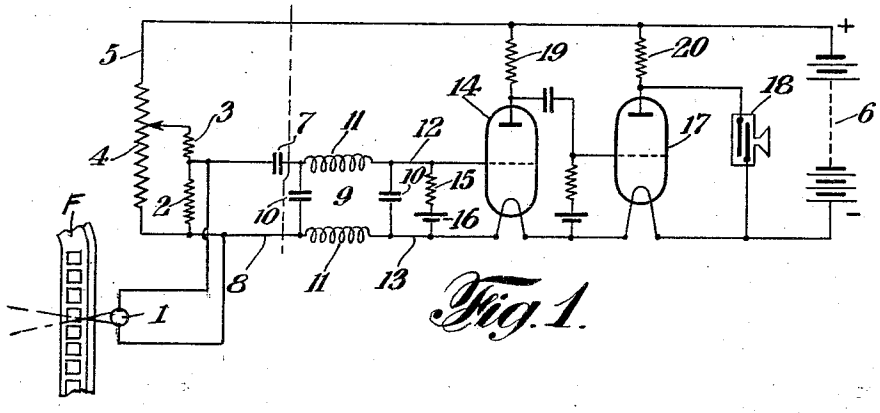

Fig. 1.

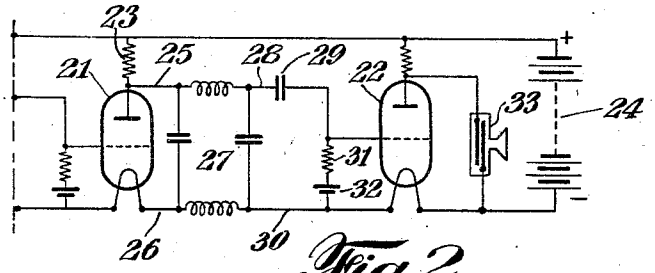

Fig. 2.

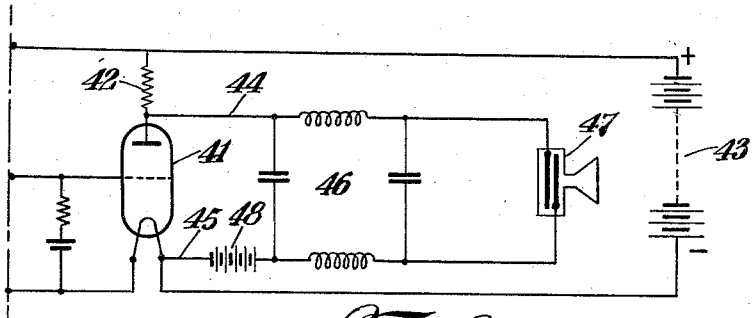

Fig. 3.

INVENTOR
Josef Engl
BY
Wood, Crosby & Neal
ATTORNEYS

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UNITED STATES PATENT OFFICE

JOSEF ENGL, OF BERLIN-GRUNEWALD, GERMANY, ASSIGNOR TO ENGL PRODUCTS CORPORATION, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK

SOUND TRANSLATION

Application filed October 2, 1929, Serial No. 396,882, and in Germany October 2, 1928.

This invention relates to sound reproduction and amplification of sound from sound carriers, such for example as light films having a sound track thereon.

The object of this invention is to prevent or reduce disturbing phenomena which occur in the reproduction of sound records and particularly talking films which manifest themselves in such sound reproduction in the loud speaker or other sound amplifier connected thereto, by continuous hissing and buzzing noises which are caused partly by small scratching on the flim strip and partly by fluctuating electrostatic influences which are produced by the record film, which is an insulator, in moving past the photo-electric cell or other parts of the electrical circuits. Also, the disturbing noises may be caused by the small current fluctuations which are always present in electrical amplifiers and other devices which are supplied from an outside source of current.

The object of this invention is to prevent such disturbing noises from becoming perceptible in the loud speaker or other sound reproducer, by means of the insertion of a "low-pass" electric filter circuit between the photo-electric cell and the loud speaker. The filter circuit is so dimensioned that the alternating currents of a frequency above a definite amount, which give rise to disturbing noises, are not allowed to pass as far as the loud speaker. It has proven to be the case that a frequency in the neighborhood of 8,000 to 10,000 per second is generally advantageous as such frequency limit.

Another object of the invention is to adapt an amplifying system more particularly to uses with the electrostatic type of loud speaker which is under certain circumstances quite susceptible to current fluctuations of this character.

Various further specific objects, features and advantages will more clearly appear from the detailed description given below taken in connection with the accompanying drawings which form a part of this specification.

The invention consists in such novel features, arrangements and combinations of parts as may be illustrated and described in connection with the apparatus herein disclosed by way of example only and as illustrative of certain preferred embodiments.

In the drawings, Fig. 1 shows diagrammatically as one example, an arrangement of the filter system between the photo-electric cell and the loud speaker;

Fig. 2 illustrates how a filter system may be arranged between two successive stages of a multi-stage amplifier; and

Fig. 3 shows an example of the filter system inserted between the last amplifier tube of a multi-stage amplifier and the loud speaker.

In Fig. 1, 1 represents the photo-electric cell in which there is produced, by means of illumination which varies in conformity with the blackenings on the film F, a variable electric current whose intensity corresponds to the degree of blackening upon the film strip at any particular instant. In parallel with the cell 1 there is a resistance 2 and in series therewith a resistance 3. The operating potential for the photo-electric cell may be adjusted by the shifting of a contact on the potentiometer 4 to the most favorable value. The upper end of the potentiometer is connected by a lead wire 5 to the positive pole of a battery 6. The negative pole of this battery is shown as connected with the lower end of the potentiometer. A coupling capacity 7 together with a lead wire 8 connect the cell circuit with a filter circuit 9. This filter circuit may consist of several parallel capacities 10, 10, and self-inductances 11, 11.

The sizes of the capacities and self-inductances of the filter are chosen in such a way that, starting from the desired predetermined frequency limit, the filter has a very high impedance and accordingly becomes practically non-conducting for all higher frequencies.

The output terminals 12 and 13 of the filter lead to the cathode and grid of the first amplifier tube 14. Between the cathode and grid of this tube there are connected, the resistance 15 and the grid bias battery 16. To the first amplifier tube there is connected in well known manner a second stage of amplification with a tube 17 to which a loud speaker

18 is connected. The tubes 14 and 17 may be suitably energied by "A" batteries, not shown, and by the battery 6 through reactances 19 and 20, respectively.

In Fig. 2 the filter system is connected between two successive stages of a multi-stage amplifier which may be connected to a photo-electric cell as shown in Fig. 1. It will be understood that the connections shown in Fig. 2 may be substituted for those shown to the right of the dot and dash line of Fig. 1. Also the connections shown in Fig. 3 hereinafter described may similarly be substituted in Fig. 1. As shown, the filter circuit is located between the second from the last tube 21 and the last tube 22. To the amplifier tube 21 there is connected across a resistance 23, the positive pole of a battery 24, whose negative pole is connected with the cathode of the tube 21. The lead wires 25 and 26 conduct the output potential of the tube 21 to the filter circuit 27, which is constructed in a manner similar to the filter in Fig. 1. The lead wire 28 is connected to the coupling capacity 29 and the lead wire 30 is connected to the tube 22 for the purpose of influencing the grid potential thereof. Between the cathode and the grid there is connected a resistance 31 and the grid bias battery 32. The loud speaker 33 is connected to the output connections of tube 22 in any well known manner.

This hook-up has various advantages in comparison with that of Fig. 1. In the first place not only the frequencies coming from the photo-electric cell above the predetermined frequency limit are filtered out, but also all those which originate from the succeeding stages of application with the exception of the last are eliminated. Furthermore the impedance of the filter at a frequency above the predetermined frequency limit is considerably greater than that of the parallel resistance 31. This resistance being adapted to the impedance of the tube 22 is appreciably smaller than the parallel resistance 15 of the first tube 14 in Fig. 1. On this account it is advantageous to connect the grid circuit of the final tube 22 with the filter circuit, since the latter is less sensitive than the grid circuit of the first tube illustrated in Fig. 1 and fluctuations therein produce less total effect.

A third example of the invention is illustrated in Fig. 3. In this case 41 is the last tube of a multi-stage amplifier which is connected through a resistance 42, with a positive pole of a battery 43, the negative pole of which is connected to the cathode of the tube 41. The output of a photo-electric cell as shown in Fig. 1 may be connected to the input connections of tube 41. The fluctuations of potential of audio-frequency which have been amplified by the preceding tubes are conducted to the grid of this tube. The lead wires 44 and 45 conduct the fluctuations of potential produced in the tube 41 to a filter circuit 46. In the lead wire 45 there is inserted a polarization battery 48 which supplies the polarization potential for a loud speaker 47, which is preferably of the electrostatic type.

It is thus apparent that there are many advantages resulting from this arrangement, particularly in connection with the use of electrostatic telephones and loud speakers, since electrostatic loud speakers are more intensely influenced by high frequencies than electromagnetic or other types of loud speakers. Also the amplifiers are rendered more stable and quiet in operation.

It is further apparent that an efficient arrangement is provided for eliminating electrostatic disturbance arising from frictional forces applied to the insulating rapidly moving film in passing through the reproducing apparatus. The low-pass filter arrangements above described are particularly adaptable for eliminating these disturbances, since the larger part thereof are of high frequencies.

In my copending application Ser. No. 404,496, filed November 2, 1929, covering divisional subject matter, certain electrical connections for a photoelectric cell in sound reproduction apparatus are claimed and disclosed in detail.

While the invention has been described in detail with respect to certain particular preferred examples which give satisfactory results, it will be understood by those skilled in the art that various changes and modifications may be made without departing from the spirit and scope of the invention, and it is intended therefore, to cover all such changes and modifications in the appended claims.

What I desire to claim is:

1. In a system for reproducing sound from light-sound records utilizing a moving insulating strip, a loud speaker, amplifiers, and a light responsive cell, means for energizing said cell including a common high potential source of power, and a filter arranged to pass currents having frequencies in the neighborhood of from 8,000 to 10,000 per second and below, consisting of series inductances and parallel capacities, said loud speaker being of the electrostatic type and connected to the filter in such a way as to be energized by said high potential source through said inductances.

2. In a system for reproducing sound from light sound records, a light responsive cell arranged to be affected by a sound record on a film, a plurality of resistance successively coupled amplifiers for amplifying the effects of the current variations in said light cell, a resistance connected across the input of each amplifier, the resistance of the last being less than that of the first, a loud speaker connected to receive the amplified

currents, and a low-pass filter arranged between two of said amplifiers.

3. In a system for reproducing sound from light sound records, a light responsive cell arranged to be affected by a sound record on a film, a plurality of resistance successively coupled amplifiers for amplifying the effects of the current variations in said light cell, a resistance connected across the input of each amplifier, the resistance of the last being less than that of the first, a loud speaker connected to receive the amplified currents, and a low-pass filter arranged between the last two amplifiers, the reactance of the filter being greater with respect to the resistance of the last amplifier than with respect to the resistance of the first or subsequent amplifiers.

In testimony whereof I have signed my name to this specification.

JOSEF ENGL.