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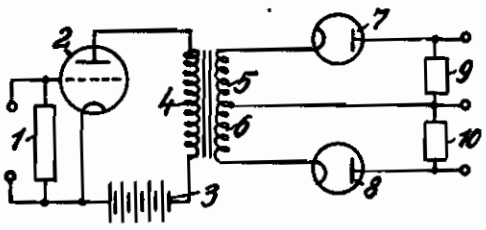

Fig. 1

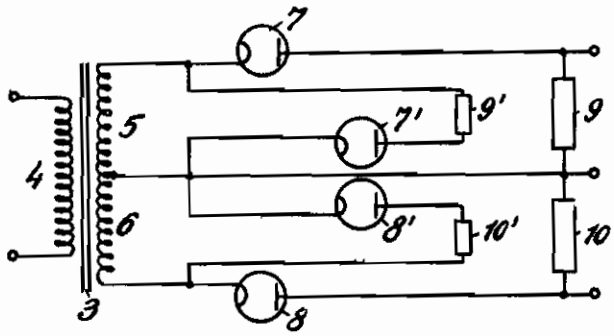

Fig. 2

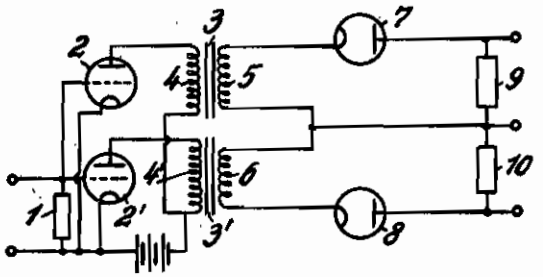

Fig. 3

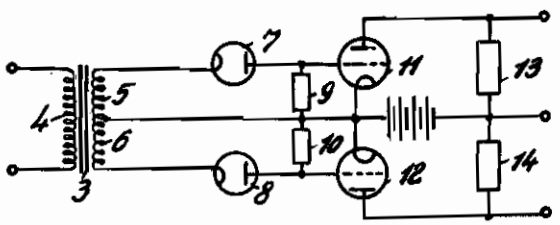

Fig. 4

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Fig. 5

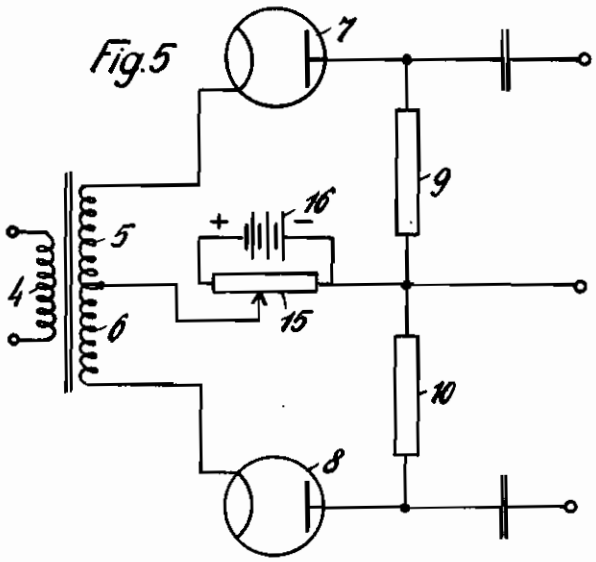
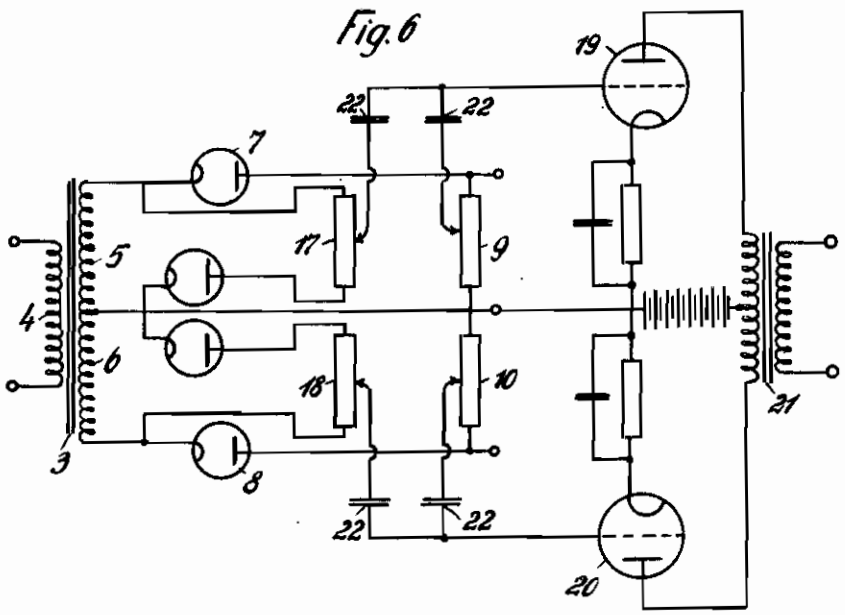


Fig. 6



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ALIEN PROPERTY CUSTODIAN

PRODUCING SOUND RECORDS IN HALF-WAVE RECORDS

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Application filed August 27, 1940

The present invention relates to connections for the production of half-waves derived from the currents of sound frequency microphones such as are required for making sound records in half-wave records (so-called push-pull class B records). By these connections the disturbances and distortions are to be prevented or removed which occur with the known connections when an alternating current and an alternating voltage respectively is divided into two half-wave trains.

Fig. 1 shows the known connection for producing half-waves. Applied to the resistance 1, arranged between the grid and the cathode of an amplifier tube 2, are the eventually previously amplified microphone currents and voltages respectively. In the anode circuit of the tube 2 the primary winding 4 of the push-pull transformer 3 is arranged. Symmetrically connected in series with the secondary windings 5 and 6 is a diode 7 and 8 respectively and a resistance 9 and 10 respectively. As the diodes allow current to pass in one direction only, current may flow in each of the circuits 5, 7, 9 and 6, 8, 10 respectively in one direction only due to the diodes 7 and 8 being connected in opposite sense. Therefore, voltage drops in the one direction only occur at the resistance 9 and in the other direction at the resistance 10. The half-wave voltages tapped at 9 and 10 may then be supplied to the record member.

Now, it has been found that this connection does not allow the production of sound records in half-wave records free of objections for the following reasons: At each reversal of the current flow in the transformer 3 the diodes 7 and 8 effect a connection in such a manner that always one of the push-pull circuits is cut in and the other cut out. As substantial powers are required for the operation of the recording members considerable current intensities must be switched. The windings 5 and 6 are alternately short-circuited and opened by way of a relatively small resistance. The same conditions then occur as with the opening and closing of a circuit in which a self-induction is arranged. The voltages occurring by these connections in the self-induction cause disturbances in the corresponding push-pull circuit itself as well as in the other push-pull circuit due to reactive effects by way of the transformer 3. These disturbances particularly also those due to the reactive effect mentioned above cause such strong distortions in the sound record as to render same useless.

Now, according to the invention connections are described which prevent the above mentioned disturbances and allow a production of half-waves free of objections.

In the accompanying drawings some electrical connections according to the invention are diagrammatically shown by way of example in Figures 2 to 6 inclusive.

The arrangement shown in Fig. 2, illustrating electric balancing, starts from the principle of preventing the opening and closing of the windings 5 and 6 of the transformer 3 by which the disturbances are caused. This is obtained in an exact manner by the fact, that a second circuit, consisting of the diode 7' (and 8' respectively) and the resistance 9' (and 10' respectively), is connected in parallel to each of the two push-pull windings besides the circuit, consisting of the diode 7 (and 8 respectively) and the resistance 9 (and 10 respectively). As far as the electric dates are concerned, the resistances and diodes of the two circuits connected in parallel exactly correspond to each other and the two diodes 7 and 7' (or 8 and 8' respectively) are so connected as to allow current to pass in opposite directions. This connection ensures that an opening and closing of the circuits imposed upon the windings 5 and 8 does no longer occur and the transformer acts in the same manner as an ordinary push-pull transformer. The two half-wave voltages are tapped at the resistances 9 and 10. Of course, the half-wave voltages produced at the resistance 9 and 10 also may be supplied to the recording members.

Another arrangement for producing half-waves free of objections in accordance with the invention is shown in Fig. 3. As empiracally the largest proportion of the distortions is effected by the opening- and closing voltage of one push-pull winding acting upon the other push-pull winding by way of the transformer 3, two single-cadence transformers 3 and 3', supplied by two tubes 2 and 2' connected in parallel at the input side, are used according to the invention instead of the push-pull transformer. Between the grid and the cathode of the tubes 2 and 2' the eventually previously amplified microphone voltages are applied. Connected to the anode circuits of the tubes are the primary windings 4 and 4' of the transformers 3 and 3' respectively. In the manner shown in the drawing the secondary windings 5 and 6 are connected to the circuits consisting of the rectifier and resistance. The circuits connected to the windings 5 and 6 can no longer mutually influence, but at the best react upon the anode circuit of the corresponding

tube 2 and 2' respectively. Such a reaction, however, is intercepted by the anode circuit and practically remains of no importance.

Finally a further modification allowing suppression of the disturbances caused by the effect of the connection of the diodes is shown in Fig. 4. As the degree of reaction of the two diode circuits of Fig. 1 upon each other depends on the intensity of the currents flowing in the circuits, the tendency prevails to maintain these currents as small as possible. However, as a considerable power is required for controlling the recording members connected to the resistances 9 and 10, these currents cannot be chosen as large as desired. Now, in accordance with the present invention very high ohmic values are chosen for the resistances 9 and 10 so that a disintegration into half-waves of the eventually previously amplified microphone currents applied to the primary winding of the push-pull transformer 3 (Fig. 4) practically remains without effect and no substantial currents flow through the windings 5 and 6. Due to the high values of the resistances 9 and 10 the half-wave voltages occurring at these resistances, are not adapted for controlling the recording members but are used to control the power amplifying tubes 11 and 12. The voltages occurring at the anode resistances 13 and 14 are then supplied to the recording members.

As the characteristics of the diodes do not pass through the zero point, but have a starting characteristic extending into the negative voltage field, no half-wave record but a push-pull class A or class AB record) is obtained with the described connections operating at small amplitudes.

This defect of the connections above described is avoided according to the present invention by inserting in each of the diode circuits an adjustable negative counter voltage which is chosen so large that the effective operating characteristic of the diode passes through the zero point.

Fig. 5 shows such a connection. Applied to the primary winding 4 of the push-pull transformer 3 are the speech currents to be recorded. symmetrically connected in series with the push-pull windings 5 and 6 is a diode 7 and 8 respectively and a resistance 9 and 10 respectively. As the diodes allow current to pass in one direction only, current may flow in the circuits 5, 7, 9 and 6, 8, 10 respectively in one direction only due to the diodes 7 and 8 being connected in opposite sense. Therefore, at the resistance 9 voltage drops only occur in the one direction. The half-wave voltages tapped at the resistances 8 and 10 are then supplied to the recording members.

As a matter of fact the diodes, however, do not allow current to pass in one direction only, but small amplitudes are also allowed to pass in the opposite direction. For the purpose of avoiding this undesired effect a variable counter voltage is applied between the connecting point of the resistances 9 and 10 and the common point of the push-pull windings 5 and 6. Preferably the common point of the push-pull windings 5 and 6 is arranged at the wiper of the potentiometer 15 to the ends of which the voltage source 16 is applied as indicated in the drawing. The potentiometer 15 then is so adjusted that the effective operating characteristic of the diodes 7 and 8 passes through the zero point. Hereby the diodes really allow current to pass in one direction only.

In making records it is absolutely necessary either to permanently or temporarily supervise the half-wave voltages serving to control the recording members. This is effected by composing the two half-waves to a complete curve again and eventually supplying same by way of an amplifier, to a control member, for instance a Braun tube, a loudspeaker etc. This composition may be effected in a particularly simple manner by employing for making records the above described connections in which two circuits are applied in parallel to each of the push-pull windings of the transformer serving to produce the half-waves and in which the rectifiers in these circuits allow current to pass in opposite directions.

This connection shall now be explained by way of Fig. 6. Applied to the primary winding 4 of the push-pull transformer 3 are the speech currents. In the manner described already two circuits are applied to each of the push-pull windings 5 and 6. The recording members are supplied with the half-waves occurring either at the resistances 9 and 10 or at the resistances 17 and 18. Now, for a listening control, portions of the half-wave voltages occurring at the resistances 9 and 10 are supplied to the amplifier tubes 19 and 20 respectively arranged in push-pull fashion. Now, in composing the amplified half-waves in the push-pull transformer 21 the above mentioned disturbances would occur. However, as half-wave voltages occur at the resistances 17 and 18 respectively which are displaced in time and direction about 180° from the half-wave voltages occurring at the resistances 9 and 10 respectively, the half-wave voltages applied to the grids of the tubes 19 and 20 may be completed to a total wave in a simple manner by the fact that by way of a condenser 22 a partial voltage in a corresponding magnitude is tapped at the resistances 17 and 18 respectively also and is added to the voltage tapped at 9 and 10 respectively. Complete curves, therefore, are applied to the grids of the tubes 19 and 20, which operate in the same manner as an ordinary push-pull class A stage so that switching impulses no longer occur in the transformer. To avoid phase defects attention is to be directed to the fact that the four coupling condensers 22 which also may be omitted correspond to each other as the resistances 9, 10, 17 and 18 had to be balanced exactly to each other for the production of the half-waves. The voltage occurring at the secondary winding of the transformer 21 is supplied to the control member.

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