July 11, 1939. E. BRANDT 2,165,781

LOUDSPEAKER SYSTEM

Filed June 16, 1936

*Fig. 1*

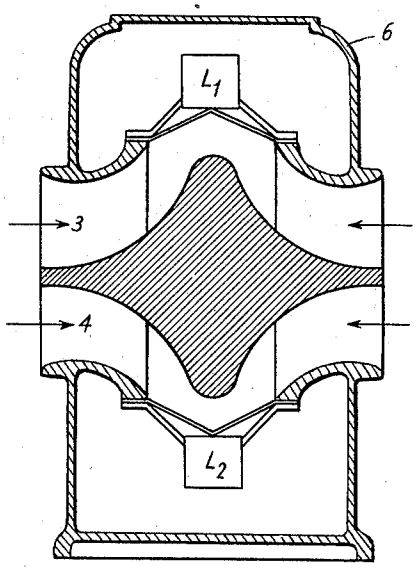



*Fig. 2*

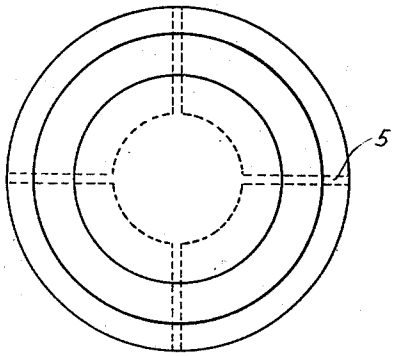
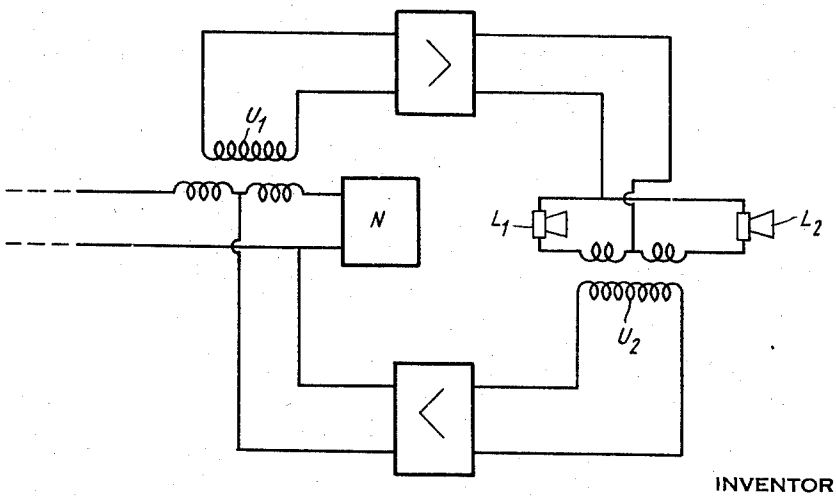



*Fig. 3*




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## LOUDSPEAKER SYSTEM

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3 Claims. (Cl. 179—81)

This invention is concerned with loudspeaker arrangements for subscribers' stations free from feedbacks, in which the transmitter and receiver are inter-connected by a split or forked connection and consist of two structures, say, loudspeakers. In order to preclude feedbacks liable to arise as a result of unequal radiation resistances of the loudspeaker, recourse is had to "mushroom" type loudspeakers.

In all instances where subscribers' stations are equipped with loudspeakers care must be taken so that between loudspeaker and microphone, or between transmitter and receiver, there will arise no feedbacks either acoustic or electric in nature. For this reason it has been suggested to interpose between the sending branch and the receiving branch stopper means of the kind of feedback stoppers known from four-wire operation and which serve the purpose always to block one branch so that any tendency to reaction between the two branches will be killed. Circuit organizations of this kind involve the drawback that they may occasionally be operated inadvertently and that mutual locking of both branches may be occasioned with the result that satisfactory communication will be entirely precluded.

For this reason it has been suggested to provide, in lieu of such mechanical stopper arrangements, a scheme in which acoustic feedback is avoided by that transmitter and receiver consist of two exactly equal systems or structures, say, two loudspeakers. The basic idea of this scheme is that by the use of two exactly alike systems there is a guarantee for the two halves of the electrical "shunt" being of like impedance so that, at any rate, the electrical part of the coupling will not cause any difficulties at all. However, in experiments made with arrangements of this kind it has been discovered that instances will arise again and again where whistling in the amplifiers is produced in a scheme of the said sort. Further observations have shown that conditions of this nature are caused by certain local circumstances, say, owing to the fact that persons who happen to be inside the room where such a subscriber's station with loudspeaker is provided are at different proximity to the various loudspeakers.

Now, the present invention is predicated upon the proper appreciation of this fact that the reasons underlying the coming out of step of such an arrangement may be sought in that the impedance of the two loudspeakers is not an exactly defined magnitude, but that it is also and at the same time partly dependent upon the prevailing radiation resistance. Hence, as soon as the radiation resistance of the two loudspeakers, either when mounting or operating them, becomes unequal, balance or adaptation in the fork adjacent the apparatus is disturbed with the result the feedback currents are set up, which, as soon as the amplification has reached a certain limit or is exceeded, are liable to lead to whistling or squealing of the equipment. Hence, for this reason difficulties will always arise whenever, as a result of special circumstances, also the line-end simulation assumes unfavorable values.

Now, according to the present invention the said difficulties are obviated by that loudspeakers are employed in which, by means of certain construction features, conditions are made so that the radiation thereof is made practically independent of changes inside the room and that the radiation resistance is thus made always the same in both of the two loudspeakers used. This end may be attained by that the active surface through which the sound waves enter into the loudspeaker, are formed annular. In this case any alteration of the radiation resistance in one direction, inside the room, means practically no change in the total radiation resistance, inasmuch as the radiation resistance of the loudspeakers is not directive so that a variation in one sense would mean only a slight percentage value in the aggregate radiation resistance. For the identical reason, also the radiation resistance for the two loudspeakers that are used are practically equal inside the room seeing that the entire space is governing for both. To be sure, it is necessary in this connection that the two loudspeakers should be disposed co-axially and that their position in the room should be practically alike.

In the attached drawing is shown an exemplified arrangement which is intended to explain the invention in detail. Fig. 1 is a sectional view of the arrangement, Fig. 2 is a top view, and Fig. 3 is a circuit diagram illustrating the arrangement. The loudspeaker systems $L_1$ and $L_2$ are co-axially disposed inside a joint casing 6. The supply of the sound-waves is through the ducts 3 and 4 which have annular inlet surfaces. It is merely broken at points 4 by partitions 5. The construction of the loudspeaker systems as well as of the casing, as to the rest, may be chosen at will to conform to rules and conventions prevalent in the building of loudspeakers. What is only essential in connection with the invention is the disposition of the system in space and the

formation of the active surface for the entrance of the sound-waves.

Fig. 3 is a circuit diagram showing the connection of the two loudspeakers $L_1$ and $L_2$. $U_1$ and $U_2$ are the two forked repeaters. An amplifier is provided for each direction of operation or conversation. N is the simulation or network provided at the first fork. By means of this network the first fork $U_1$ is perfectly balanced. Now, inasmuch as evidently also the second fork $U_2$ must be balanced if self-excitation of the system is to be precluded, it is necessary that the two loudspeakers $L_1$ and $L_2$ should be exactly alike. This condition presupposes that also their impedance should be identical in size, and this is attainable in practice only with a geometric or physical arrangement as shown in the sketch and as described in the specification.

A loudspeaker arrangement of this kind, as a matter of fact, evidences a practically constant radiation resistance, for the acoustic waves, if the loudspeakers act as microphones, are able to bring action upon both loudspeakers from all sides in a uniform and simultaneous way. Moreover, their radiation resistance will not be appreciably interfered with or affected by persons who are present in the room seeing that they occupy only a very small fraction of the room or space served or covered by the loudspeakers. In other words, the constancy or stability of the radiation resistance is governed by the construction of the two loudspeakers according to this invention. Moreover, a change in the radiation conditions would affect both loudspeakers in a similar way seeing that the circular inlet and outlet openings of the two loudspeakers are directly superposed, with the result that it is normally not even feasible to vary the radiation resistance of one of the loudspeakers without simultaneously and incidently affecting that of the other to the same degree.

What I claim is:

1. Loudspeaker arrangement for subscribers' stations free from feedbacks, in which transmitter and receiver are disposed in a common enclosure and are electrically inter-connected by means of a fork or split connection, and consist of two substantially similar loudspeakers which are mounted axially, with the characteristic features that the loudspeakers are so designed and disposed that their radiation resistance inside a given room will be practically alike, and that the active surface for the entrance of sound waves is made annular.

2. In combination, a pair of loudspeakers disposed within a common enclosure, said speakers being coaxially mounted and facing one another as regard to the direction of the emitted sound, said enclosure having sound ports, one on either side of the speaker axis, and means within the enclosure for deflecting the sound radiation from each speaker through both of said sound ports.

3. The invention according to claim 2 wherein one of the loudspeakers is employed as a sound transmitter and the other as a sound receiver, and both are substantially similar electrically whereby their radiation resistances are substantially the same.

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