PATENT SPECIFICATION

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COMPLETE SPECIFICATION.

Improvements in and relating to the Selective Transmission of Sound Waves to Microphones.

We, BRITISH ACOUSTIC FILMS LIMITED, a Corporation organised under the Laws of Great Britain, and OTTO KURT KOLB, Dr. Phil., a German citizen, both of "Film House", Wardour Street, London, W.1, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

In recording sounds, for instance on gramophone plates or films, or in radio-telephonic transmission of sound, it is frequently of essential importance to be able to catch sound at a fairly great distance from the sound-producer, for instance when it is desired to transmit or record a lecture of a speaker who cannot be approached closely, for instance because he is surrounded by a crowd of people, or for other reasons, or when it is desired to transmit or record the sounds produced by animals or the like.

In such cases it is useless to employ a highly sensitive microphone, because such a microphone will catch not only the sounds to be transmitted or recorded, but also all other sounds that are produced in the vicinity of the microphone and which, therefore, have a relatively great effect on the microphone. It is thus commonly known that in sound-film reproductions of actual occurrences in open air the sounds produced in close vicinity to the recorder microphone and having no connection at all with the picture recorded are relatively very prominent in the reproduction, and will, therefore, manifest themselves in a disturbing manner. To this must be added the further circumstance that in the case of very faint sound-impressions the so-called "microphone noise" will make itself felt very distinctly in the reproduction, and this microphone noise sets, in fact, a limit for the distance at which it is possible to catch the sound for recording or transmission, in such a manner that the reproduction will be intelligible. Attempts have been made to overcome these difficulties, for instance by fitting the microphone with a funnel, at the bottom of which the microphone diaphragm is disposed, the funnel itself being directed towards the source of sound. Such a funnel to some extent assists in amplifying the sound but at the same time generally produces a distortion of frequency, and further serves only to a very small extent to exclude sounds other than those to be recorded. The orientation effect of a funnel is, in fact, not very pronounced, unless very large funnels of inconveniently large dimensions are used.

In connection with telephone transmitters or receivers suggestions have been made to provide a concave sound reflecting surface which is of semi-circular, elliptical, parabolic or other suitable form in cross section, the concave surface being formed with a straight generating line, whilst a microphone turned towards the reflector is located on the focal line of the latter. It has also been suggested to provide telephone transmitters with a mouthpiece or horn which is of parabolic section and provided at its apex and focus with a microphone turned towards the incoming sound.

Suggestions have also been made in connection with apparatus for concentrating and focussing sound waves, to provide a substantially cup-shaped reflector formed by two curved surfaces intersecting to form a cuspoid, the apex of the cuspoid lying along the axis of a diaphragm which faces the reflector and receives sound waves which have been reflected one or more times by the reflector. The present invention differs from such an arrangement in that the reflector is formed as a portion of a surface of revolution generated by rotation of a conic section about its axis by which the sound waves are only reflected once upon a microphone facing the reflector and situated at the focus of the latter.

According to the present invention a sound receiving device consists of a sound reflector, formed as a portion of a surface of revolution generated by rotation of a conic section about its axis, and a microphone situated at the focus of the reflector, the microphone facing the reflector so that no direct sound waves reach the microphone, but only sound waves which

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have only been reflected once by the reflector, whereby a selective concentration of sound waves on the microphone is effected.

Further details of the invention will appear from the following description of the constructions of the invention shown in the accompanying drawings, wherein:—

Figures 1 to 3 show diagrammatic longitudinal sections of three different constructions of a sound-receiving arrangement.

Figure 4 shows a cross-section of a fourth form of construction with a reflector adapted to be rotated about a vertical and horizontal axis.

Figure 5 shows the same construction as Figure 4 in front elevation, and

Figure 6 shows a cross-section of a construction in which the reflector is composed of several parts.

Figure 1 shows a reflector *a* shaped as a paraboloid of revolution with its focus at *b*. *c* is a microphone, the diaphragm *d* of which is disposed in such a manner that the focus of the reflector is located at the centre of the diaphragm. Sound waves arriving from a source of sound at a considerable distance from the reflector *a*, and for instance in the direction of the lines *e*, are concentrated at the focal point *b*, i.e. at the centre of the diaphragm *d*, at which point the diaphragm is generally most sensitive. Sound waves arriving in other directions, for instance along the dot-and-dashed lines *f* are concentrated on the diaphragm at points situated nearer to the edge of the diaphragm than the point *b*, or possibly entirely beyond the edge of the diaphragm, so that they do not actuate the diaphragm or, at any rate, only actuate it to a smaller extent than the sound waves arriving in the direction along the lines *e*.

As shown by Figure 1 the diaphragm *d* has its face turned towards the reflector, whereby the sound-waves are prevented from impinging directly upon the diaphragm, which would be the case if the diaphragm were disposed in the opposite direction. If the latter were the case, the entire device would only have a small power of orientation or directional efficiency, that is to say would only be exposed to sound waves arriving within a comparatively small area in a definite direction, unless the opening of the reflector were very large relatively to the dimensions of the diaphragm, and a very large proportion of the incoming sound waves impinged upon the diaphragm after reflection from the reflector. It will, therefore, be preferable to dispose the microphone and the diaphragm *d* in the manner illustrated by Figure 1. The rear side of the microphone is suitably, but not necessarily, coated with some sound-absorbing substance, whilst the part of the reflecting surface of the reflector that is situated directly opposite the diaphragm, viz. the part thereof upon which the sound waves arriving parallel to the axis *g* of the reflector do not impinge, is also preferably coated with a sound absorbing substance *h*. In this manner there is obtained the advantage that the power of orientation of the entire device is increased, as sound waves which are not parallel to the axis *g* are weakened. Another advantage obtained is the avoidance of stationary waves in the axial space between the diaphragm *d* and the part of the reflector formed by the sound-absorbing material *h*. The same advantage may be obtained by omitting entirely the otherwise coated part *h* of the reflector surface opposite the diaphragm, so that an opening is provided in the reflector instead of the said covered part.

In the construction shown in Figure 1 only a portion of the reflecting surface is utilised, viz. the portion thereof which is situated inside the plane *i*, which is perpendicular to the axis *g* and indicated by a dotted line. This limited utilisation of the reflector is a drawback, because just the sound waves striking the diaphragm under the most favourable angle in incidence are lost for the selective effect. This drawback may be removed by disposing the microphone in the manner shown in Figure 2, in which case the axis *g* of the reflector is situated in the plane of the diaphragm *d*. When this is the case, practically one half of the reflecting surface of the reflector is utilised, under favourable angles of incidence for the sound waves reflected, without the incoming sound waves impinging directly upon the microphone.

If it is desired to utilise the entire reflecting surface of the reflector formed as a paraboloidal segment, a microphone with two diaphragms *d* and d^1 may be used as shown in Figure 3, the said two diaphragms being actuated in the same phase, and being disposed each in a similar manner to the diaphragm in Figure 2, i.e. in such a manner that their planes are parallel to the axis *g* of the reflector, and are situated close to the focus of the reflector.

The double microphone may be a condenser microphone or a carbon-grain microphone with two chambers, or any other suitable type.

It will be seen directly that the reflector *a* also assists in protecting the microphone against sounds arriving from the side towards which the back of the reflector is pointing. The action of the reflector in this respect is improved, when the rear side thereof is coated with a sound-absorbing material, and when the extent of the reflector in an axial direction is increased. The reflecting side of the reflector is preferably made of metal, the surface of which is so smooth that the absorption of sound will be insignificant.

The selectivity of the device will increase, when the focal length of the reflector is decreased, but for a reflector of given length the diameter and thus the sensitiveness of the device will at the same time be decreased. In practice it is, therefore, necessary to select the focal length of the reflector with due regard to the selectivity as well as to the sensitiveness. In practice the selectivity can easily be regulated by moving the microphone more or less towards or away from the focal point.

Figure 4 shows a construction in which the microphone *e* is adapted to slide along two rods *k*, in such a manner that it can be adjusted axially relatively to the reflector *a* and thus be fixed with the diaphragm exactly at the focus of the reflector. The reflector is adapted to be swung about a vertical as well as about a horizontal axis, in such a manner that the axis of the reflector can be adjusted accurately in the direction of the incoming sound. For this purpose the reflector, Figure 5, is pivoted in a fork *l* journalled on a post *m*. By means of lock nuts *n* the reflector can be fixed in any desired position.

The adjustment of the reflector relatively to sound producer so as to obtain the best possible effect may as a rule be done by listening, but under particularly difficult conditions, for instance when the source of sound is remote, the reflector may be suitably fitted with optical means for assisting the adjustment, for instance a telescope, the axis of which is parallel to the axis of the reflector or—in the case of recording at night—with a projector or search-light, the axis of which is similarly parallel to the axis of the reflector, and which is directed towards the source of sound. Both of these means may, if desired, be disposed on the same reflector.

In the above described constructions the reflector forms one integral unit. This, however, is not a necessary condition. On the contrary it may be suitable, under certain circumstances, to divide the reflector into several reflecting bodies or surfaces, for instance as shown by Figure 6, where the reflector is composed of three smaller reflectors a^1, a^2 and a^3 with a common focus *b* situated at the centre of the diaphragm *d*. The three reflector parts a^1, a^2, a^3 are supported in a suitable arbitrary known manner, so that each reflector part may be swung separately, about an axis passing through the focus *b*, independently of the other parts. This construction of the reflector offers the advantage that it is possible simultaneously to concentrate, on to the microphone diaphragm, sounds arriving from more than one source. In this manner there is obtained the advantage that it becomes practicable to mix at once on the diaphragm the sounds to be reproduced simultaneously, while heretofore the only way out has been the far more complicated procedure of mixing the sounds after the same were converted into microphone currents in separate microphones.

By suitably dimensioning the superficial area of the individual reflectors the advantage is attained that each reflector delivers approximately the same sound energy to the microphone diaphragm.

The reflector parts a^1, a^2, a^3 may be mounted on a common frame adapted to be swung about a vertical as well as about a horizontal axis.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. A sound receiving device consisting of a sound reflector, formed as a portion of a surface of revolution generated by rotation of a conic section about its axis, and a microphone situated at the focus of the reflector, the microphone facing the reflector so that no direct sound waves reach the microphone, but only sound waves which have only been reflected once by the reflector, whereby a selective concentration of sound waves on the microphone is effected.

2. A sound receiving device according to claim 1, characterised in that the microphone is adjustably mounted at or near the focus of the reflecting surface.

3. A sound receiving device according to claim 1, characterised in that the axis of the microphone passes through the focus of the reflector, and is perpendicular to the axis of the reflector.

4. A sound receiving device according to claim 3, characterised in that the microphone is a double microphone with two sound sensitive members, both of which face the reflecting surface of the reflector.

5. A sound receiving device according to claim 1, characterised in that the rear side of the reflector is coated with a sound absorbing material.

6. A sound receiving device according to claim 1, characterised in that the microphone is adjustably secured to the

reflector which is pivoted about a vertical as well as about a horizontal axis.

7. A sound receiving device according to claim 1, characterised in that the microphone is adjustable in a direction parallel to the axis of the reflector.

8. A sound receiving device according to claim 1, characterised by the provision of optical means mounted on the reflector and adapted to facilitate the adjustment of the axis of the reflector in the direction of the sound producer.

9. A sound receiving device according to claim 1, characterised in that the reflector consists of two or more separate reflecting members, all of which concentrate sound waves on to the sound sensitive member or members of the microphone, and are adjustable independently of one another, so that the axes of the various reflecting members may be directed towards different sound producers.

10. Sound receiving devices constructed, arranged and adapted for use as a whole substantially as described in connection with the accompanying drawings.

Dated the 16th day of January, 1931.

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Fig. 1.

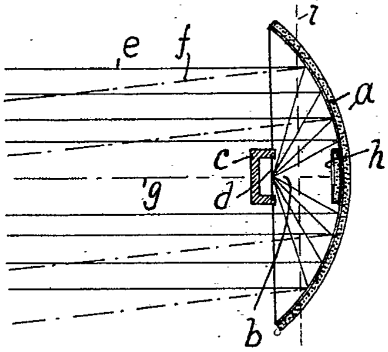

Fig. 2.

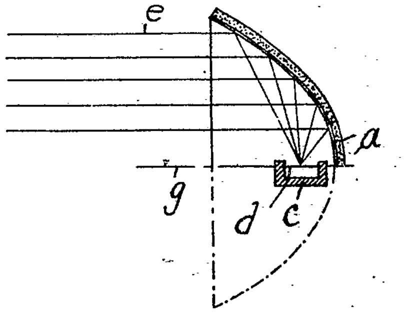

Fig. 3.

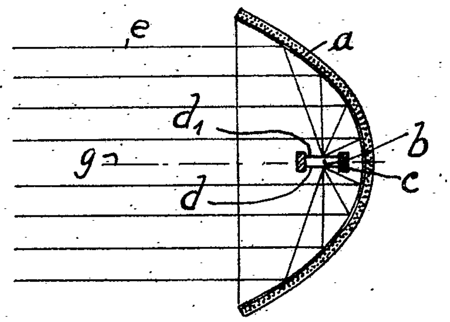

Fig. 5

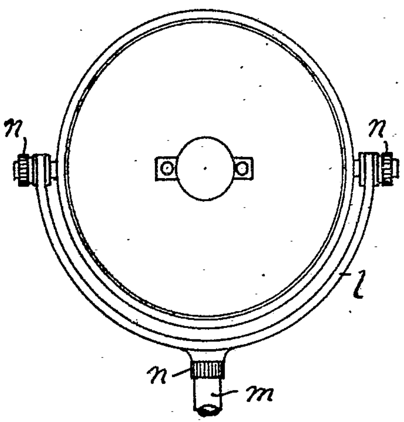

Fig. 6.

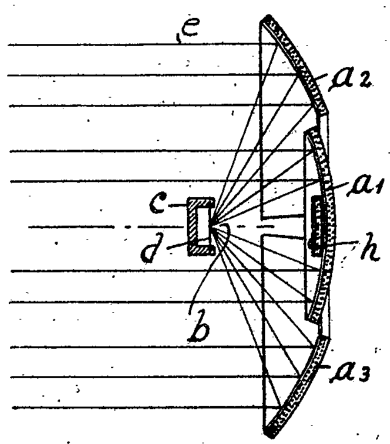

Fig. 4.