PUBLISHED
JUNE 8, 1943.
BY A. P. C.

R. J. JASSE
ELECTRIC COMPENSATOR FOR PLANTS
FOR LOCATING SOUNDS
Filed July 1, 1942

Serial No.
449,539
4 Sheets-Sheet 1

Fig.2

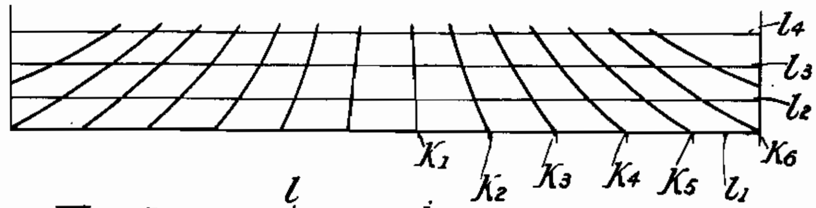
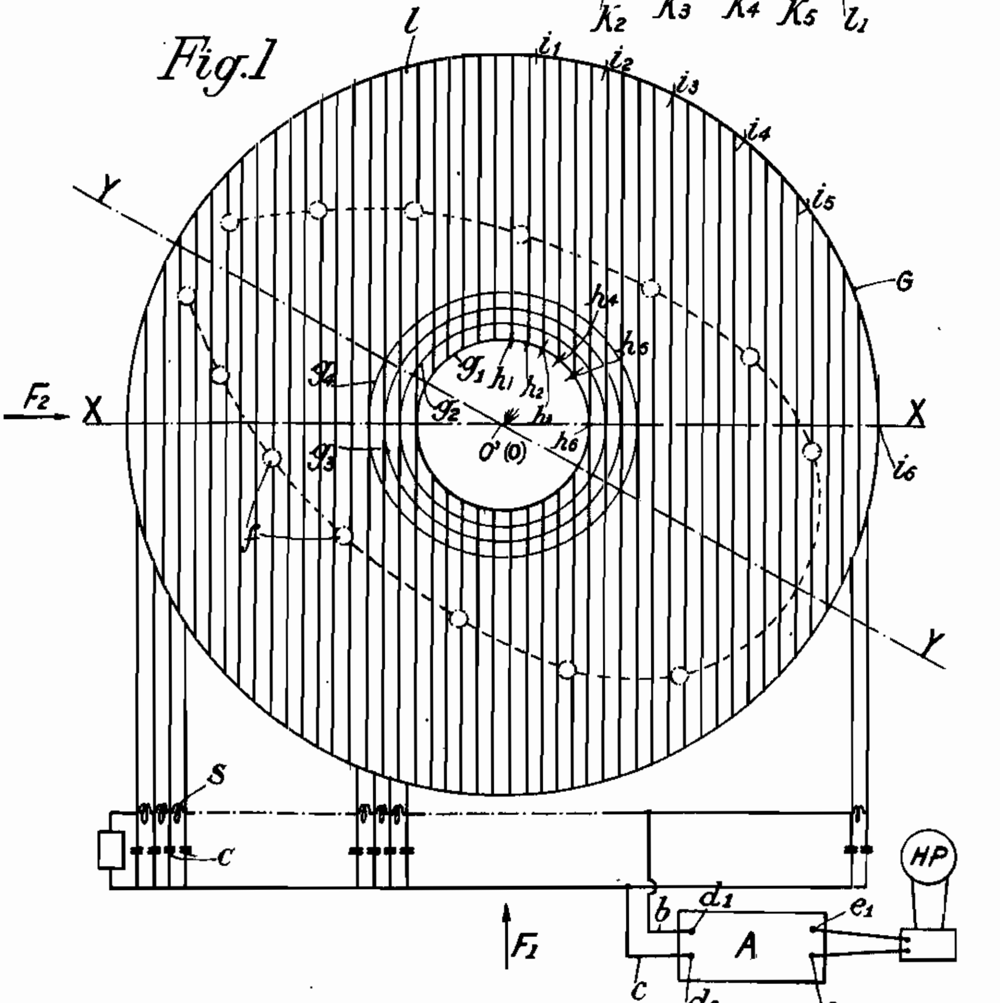


Fig.1



Inventor:
Raymond Joseph Jasse
By: Haseltine, Lake & Co.
Attorneys

PUBLISHED

JUNE 8, 1943.

BY A. P. C.

R. J. JASSE

ELECTRIC COMPENSATOR FOR PLANTS FOR LOCATING SOUNDS

Filed July 1, 1942

Serial No. 449,539

4 Sheets-Sheet 2

Fig. 5

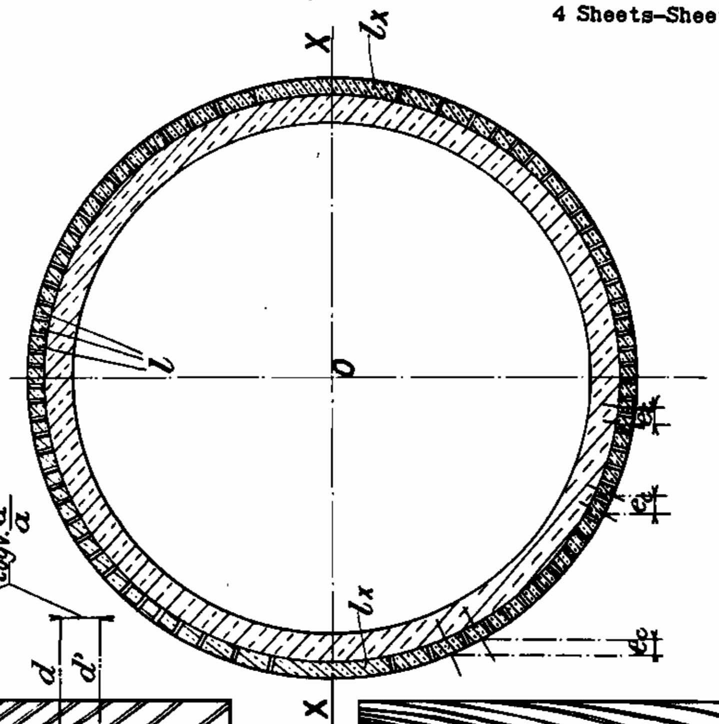


Fig. 3

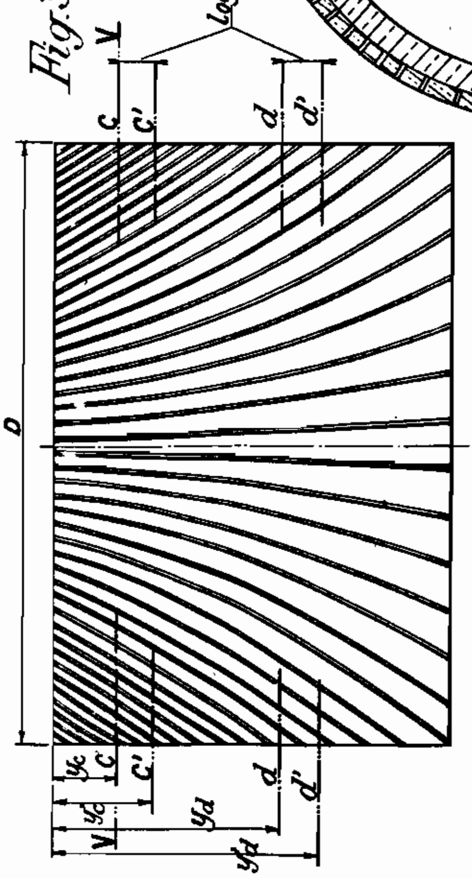
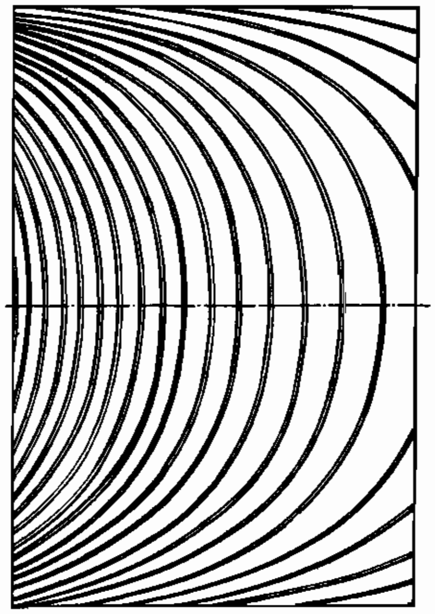


Fig. 4



Inventor:-
Raymond Joseph Jasse

By: Haseltine, Lake & Co.
Attorneys

PUBLISHED

JUNE 8, 1943.

BY A. P. C.

R. J. JASSE
ELECTRIC COMPENSATOR FOR PLANTS
FOR LOCATING SOUNDS
Filed July 1, 1942

Serial No.
449,539

4 Sheets-Sheet 3

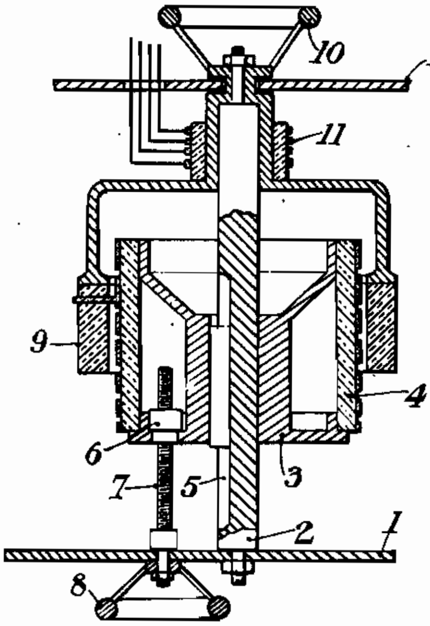


Fig.6

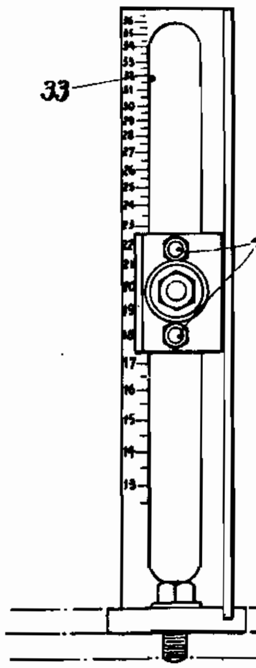


Fig.7

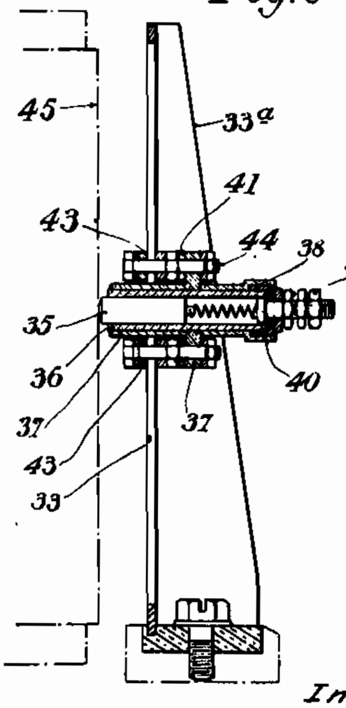


Fig.8

Inventor:
Raymond Joseph Jasse

By: Haseltine, Lake & Co.
Attorneys

PUBLISHED

JUNE 8, 1943.

BY A. P. C.

R. J. JASSE

ELECTRIC COMPENSATOR FOR PLANTS FOR LOCATING SOUNDS

Filed July 1, 1942

Serial No. 449,539

4 Sheets-Sheet 4

Fig. 9

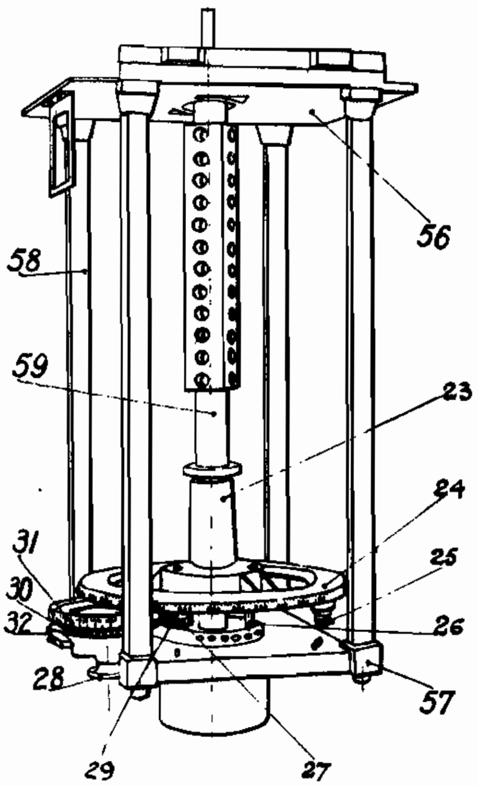
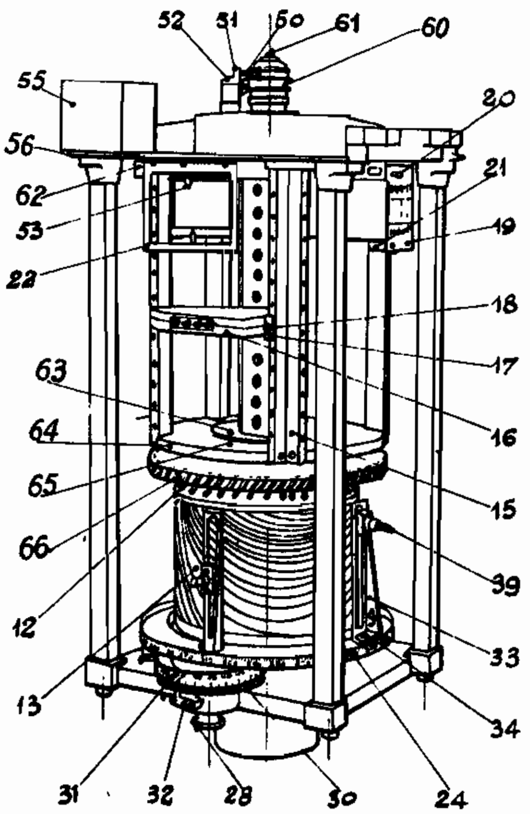


Fig. 10



Inventor:
Raymond Joseph Jasse

By: Haseltine, Lake & Co.
Attorneys

Published June 8, 1943

Serial No. 449,539

ALIEN PROPERTY CUSTODIAN

ELECTRIC COMPENSATOR FOR PLANTS FOR LOCATING SOUNDS

Raymond Joseph Jasse, Vichy, France; vested in the Alien Property Custodian

Application filed July 1, 1942

The present invention has for object an electric compensator for plants for locating sounds in space by means of a set of receivers or microphones distributed all round the compensator and in the circuits of which are inserted electric elements or cells of variable retardation, composed of a self shunted by a capacity, said elements being so chosen that to any direction of sound can correspond a combination of said elements intended to ensure the placing in phase of all the electric currents issuing from the receivers. The compensator is actuated in order to obtain a maximum amplitude of the sound corresponding to the placing in phase of the microphone currents and the combination of retarding elements thus obtained then gives the indication of the direction of the sound.

Apparatus of this type are known in which the compensator comprises a collector formed by a flat plate capable of rotating about a central spindle at right angles to its plane—which is at the same time the central point of compensation for all the receivers—and on one face of which are secured rectilinear electric contact blades, of the same width, parallel to each other, contiguous, but electrically insulated from each other.

Each of the contact blades of the collector is connected to one of the retarding cells mounted in parallel between two wires to form together an artificial line of uniform retardation, the two wires of which are connected to the input of an amplifier, at the output of which is connected the listening-in apparatus, for instance a loudspeaker.

The wiper brushes are distributed on the flat surface of the collector so as to form a geometrical figure which must be a true reduction of the real geometrical figure formed in plan, by the receivers distributed all round the compensator.

It is known that in this arrangement, the set of receivers is compensated when the axis of symmetry of the collector,—which is at right angles to the direction of the blades—forms with the axis of the geometrical figure formed by the brushes, an angle equal to that made by the direction in which the sound is propagated with the axis of the geometrical figure formed by the set of receivers.

Compensators having a flat collector have the serious inconvenience that it is mechanically very difficult to simultaneously or separately displace the wiper brushes to adapt the compensator to the variations of the speed of the sound according to the medium of its propagation, on the one hand, and to the shape of the geometrical figure formed by the receivers, on the other hand.

As regards this latter point, it is known that, for instance on a ship, the installation of the microphones can be but rarely rigorously in conformity with a pre-established plan; for obtaining perfect similitude between the geometrical figure formed by the receivers and that formed by the wiper brushes of the compensator, one is therefore led to fix the position of said brushes according to the assemblage of the receivers. Moreover, a compensator already in service can only be replaced by another compensator at the expense of costly and laborious transformations.

In order to adapt the compensator to the different speeds of sound, the geometrical figure formed by the wiper brushes must be homothetically enlarged or reduced relatively to the plan of the geometrical figure formed by all the receivers, and this can only be done by radially displacing the brushes relatively to the centre of rotation of the collector which is at the same time the centre of compensation for all the receivers. Now, for effecting the rapid adaptation of the compensator to the medium of the propagation of the sound, it is necessary that the radial displacement of all the brushes should take place simultaneously by means of a single operating knob, which leads to an extremely complicated, costly and very delicate mechanical device.

The object of the present invention is to remedy this inconvenience; the problem consists in distributing the blades of the collector on the periphery of a cylinder in such a manner that the adaptation of the compensator to the medium of propagation of the sound can be obtained by a simultaneous axial displacement of the brushes, and said axial displacement can be obtained by means of an extremely simple and cheap mechanical device; the measurement of the azimuth of the sound is then effected by a circular movement of the brushes in a plane at right angles to the axis of the cylinder.

Starting from a flat collector having rectilinear contact blades of the same width, parallel to each other, contiguous, but electrically insulated from each other, the cylindrical collector according to the invention can be obtained by dividing the flat collector into a certain number of annular elements by equidistant circles concentric with the centre of rotation of said flat collector and by enlarging said annular elements with the fractions of blades they carry, proportionally up to the diameter of the outer circle, or by reducing said annular elements and their fractions of blades down to the diameter of the inner circle, the cylindrical shape of the collector then resulting from an equidistant superposition of the enlarged or reduced elementary circles.

The accompanying drawing shows a form of construction of a collector according to the invention.

Fig. 1 illustrates a flat collector divided into elementary circles.

Fig. 2 illustrates the origin of a cylindrical collector according to the invention by the superposition of enlarged or reduced annular elements.

Fig. 3 is a side elevation of a collector constructed according to the data of the invention.

Fig. 4 is a view similar to that of Fig. 3, but offset to the extent of 90° relatively to the latter.

Fig. 5 is a cross section made according to line V—V of Fig. 3.

Fig. 6 shows in vertical section a diagrammatic view of a unit constituted by a compensator provided with the new collector.

Figs. 7 and 8 show in front view and side view a modification of the support for the brushes.

Figs. 9 and 10 show a preferred embodiment of the object of the invention.

As shown in Fig. 1, the flat collector which serves as base for the construction of the cylindrical collector according to the invention, comprises a certain number of rectilinear contact blades l, of the same width, parallel to each other, contiguous, but insulated from each other. Each of the blades is electrically connected to a retarding cell, composed of a self S and of a capacity C and all the cells are inserted in parallel in an artificial line of uniform retardation, constituted by two wires b and c respectively connected to the input terminals d_1, d_2 of an amplifier A, the output terminals e_1 and e_2 of which are connected to the terminals of a loud-speaker HP.

On the contact blades l rub a number of contact brushes f diagrammatically illustrated in the figure. The arrangement of all the brushes forms a geometrical figure indicated in dotted lines and which must be the true reduction of the plan of the geometrical figure formed by all the microphone receivers not shown. Each receiver is connected by a conducting wire to one of said contact brushes f.

The plate carrying the contact blades l is rotatively mounted about a centre O' which must exactly coincide with the centre O of the compensation for all the microphone receivers. X—X designates the axis of symmetry of the collector, at right angles to the direction of the contact blades l. Y—Y is the axis of the figure formed by all the wiper brushes f and which must be set exactly as the axis of the plan of the figure formed by all the microphone receivers. It will be seen that the set of receivers will be compensated when the angle formed by X—X and Y—Y is equal to the angle formed by X—X with the axis of the figure formed by all the receivers.

For converting the flat collector according to Fig. 1, on which the wiper brushes f must be radially displaced to adapt the compensator to the speed of propagation of the sound, into a cylindrical collector on which the same adaptation is effected by an axial displacement of the wiper brushes, said flat collector is divided into annular zones by equidistant circles g_1, g_2, g_3, g_4 . . . etc. up to the circle of maximum compensation G. Each of the circles g_1, g_2, g_3, g_4 . . . etc. is then enlarged up to the diameter of the circle G, that is to say that the points of intersection of said circles with the edges of the contact blades l are radially transferred on to the circle G, which is assumed to correspond to the diameter of the cylindrical collector it is desired to obtain (Fig. 2).

Taking for instance the inner circle g_1, the points of intersection h_1, h_2, h_3, h_4, h_5 and h_6 are radially transferred on to the circle G, on which are then obtained the points i_1, i_2, i_3, i_4, i_5 and i_6, the enlarged distribution of which is exactly the same.

The same method of procedure is adopted for all the circles g_2, g_3, g_4, up to the circle of maximum compensation G, and the points thus found on the circle G for each of the circles g_2, g_3, g_4 are respectively projected on equidistant superposed planes l_1, l_2, l_3, l_4, parallel to the axis of symmetry X—X of the flat collector.

The lateral elevation of the cylindrical collector shown in Fig. 2 results therefrom, whereas the points found on the circle of maximum compensation G correspond to the exact position of each of said points on the periphery of the cylindrical collector.

Fig. 3 shows in side elevation the unit constituted by a cylindrical collector thus obtained, seen in the direction of the arrow F_1 of Fig. 1, whereas Fig. 4 is a similar elevation, but seen in the direction of the arrow F_2 of Fig. 1.

Fig. 5 shows in cross section the setting of the axis of symmetry X—X of the collector.

The mathematical translation of the two conditions to be satisfied by the collector according to the invention:

Measurement of the azimuth of the sound by a circular movement of the wiper brushes in a plane at right angles to the axis of the cylindrical collector,

Modification by axial displacement, of the ratio of similitude between the figure formed in plan by all the microphone receivers and that of the wiper brushes in view of adapting the compensator to a variation of the speed of the sound,

will also be advantageously effected by taking as a basis the consideration that the cylindrical collector according to the invention is obtained by a particular transformation of a flat collector having rectilinear and parallel blades.

In this case, a basis can be taken on the fact that, for satisfying the first condition, it is necessary that, in a plane at right angles to the axis of the cylindrical collector, the distribution of the contact blades should be such that the interval e_0 between the axes of two adjacent blades projected on the axis X—X is constant (Fig. 5).

The end blades l_x of the cross section c—c (Fig. 3) define on the artificial line of retardation two positions separated by a number of cells SC equal to

$$\frac{D}{e_0}$$

and consequently to a retardation

$$\frac{D}{e_0}\cdot r$$

r designating the retardation per cell. The cross section c—c (Fig. 3) is therefore suitable for the brush of a microphone located at R_c from the centre of compensation, if:

$$\frac{2R_c}{a}=\frac{D}{e_c}\cdot r$$

in other words, if

$$e_c=\frac{aDr}{2R_c}$$

Likewise, the cross section d—d is suitable for the brush of a microphone located at a distance R_d from the centre, if

$$e_d=\frac{aDr}{2R_d}$$

and as a, D and r are constants, it will be seen that, generally speaking, R is reversely proportional to e.

If now the speed of the sound varies and becomes equal to a', the brushes must be moved according ti a generatrix of the collector to bring them on new cross sections c'—c' and d'—d' in which the intervals

$$e'_c=\frac{a'Dr}{2R_c}=e_c\cdot\frac{a'}{a}$$

and

$$e'_d=\frac{a'Dr}{2R_d}=e_d\cdot\frac{a'}{a}$$

Now, the law which determines the value of the interval e on a cross section in function of its distance y from the apex of the collector is exponential, that is to say that:

$$E=kv^y$$

k and v being constants.

It results therefrom that if the intervals e are considered on the four cross sections c—c, d—d, c'—c', d'—d', the following equations are obtained:

(1) $e_c=kv^{y}c$

(2) $e_d=kv^{y}d$

(3) $e'_c=kv^{y'}c$

(4) $e'_d=kv^{y'}d$

By dividing side for side the equation (3) by the equation (1), and equation (4) by equation (2), one obtains:

$$\frac{e'_c}{e_c}=v(y'_c-y_c)$$

and

$$\frac{e'_d}{e_d}=v(y'_d-y_d)$$

Now, it is necessary that

$$\frac{e'_c}{e_c}=\frac{a'}{a}=\frac{e'_d}{e_d}$$

therefore that

$$v^{(y'c-yc)}=v^{(y'd-yd)}=\frac{a'}{a}$$

consequently:

$$y'c-yc=y'd-yd=\log_v\frac{a'}{a}$$

This proves that it suffices to move all the brushes along their generatrix to the same extent

$$\log_v\frac{a'}{a}$$

This operation is very easy to effect mechanically, it suffices that all the brushes should be mounted on a common support which can slide along the axis of the collector.

This arrangement has been obtained in the embodiment of the compensator according to the invention diagrammatically illustrated in Fig. 6.

However, in this arrangement, the block of wiper brushes 9 receives the setting movement as a bearing whereas the collector 4 receives the longitudinal movement of translation allowing to adapt it to the speed of sound. Between two plates 1 is mounted a shaft 2 which is fixed and on which is mounted by means of the bracing 3 the collector 4 according to the invention. The block 3 can slide along the shaft 2 in the guide 5, owing to the nut 6 and the screw 7 controlled by a fly-wheel 8. The brushes are mounted, for instance in the manner described, on the block 9 the rotation of which is controlled by the operating fly-wheel 10. A ring collector 11 allows of supplying current to the brushes.

Without departing from the principle of the invention, devices might also be imagined in which the block of brushes or the collector receives the two movements of translation and of setting, the other member being then completely stationary.

Figs. 7 and 8 show a particular assemblage of the wiper brushes. Said brushes 35 of square cross section, are made of carbon of high copper content. They slide in a tubular metallic guide 36 covered with an insulating tube 37 and closed at one end by a beaded cover 38.

The brush 35 is connected by a flexible wire to a terminal 38 and it is pressed against the surface of the collector 45 by a coil spring 40. The guiding tube 36 and its insulating sheath 37 are clamped in a slotted metallic block 41.

Said block is slidable in a groove 33 formed in a supporting upright 33a and in which it can be secured in a given position by a foundation plate 43 and two screws 44. The sliding movement of block 41 causes the brush 35 to slide axially on the collector 33a. Its position in the groove 33 depends on the horizontal distance between the corresponding microphone receiver and the centre of compensation O of all the receivers. The runner indicating the position is formed by the upper edge of the block 41. The graduation carried by the supporting upright 33a indicates the distance.

Figs. 9 and 10 show a preferred embodiment of the compensator forming the subject-matter of the invention.

Two rectangular plates 56 and 57 (see Fig. 9) braced by four columns 58 form a rigid cage in the form of a parallelepipedon.

Between the plates 56 and 57 freely rotates a central shaft 59 which carries all the rotating members of the compensator. The shaft rests on an abutment, not shown, located in the recess of the lower plate 57.

On shaft 59 are mounted, starting from the top, the following members (see Fig. 10) which rotate therewith:

(a) The output line collector having three rings 60 which is keyed on the shaft and held in position by the screw 61.

(b) A circular plate 62 secured on the square shoulder of the shaft.

(c) A cylindrical sleeve 63 keyed on the shaft and which supports the following members:

1°—A circular plate 64 similar to plate 62 and secured by the screws 65.

2°—A toothed ring 66. Said ring serves for driving the shaft and also as a support for the relay terminals 12 between the blades of the collector and the artificial line.

3°—A compensating collector 13 which is keyed on the sleeve 63 and held in position by a ring screw threaded at the lower part.

The two circular plates 62 and 64 are braced by four right-angle members 15. It is between these two plates that the boxes 16 are mounted containing the elements of the artificial line. Fig. 10 clearly shows the securing of said boxes on the right-angle members 15 by means of yokes 17 and screws 18, the boxes carry a stud which engages in the holes provided for that purpose on the square part of the shaft. The boxes are distributed in four piles.

Each box is constituted by two symmetrical half-boxes assembled by three screws. The four terminals are grouped on a small plate fitted between the two half-boxes.

On the upper circular plate 62 is secured a cylindrical compass-card 19 in four equal sectors centered by a tongue engaging in a groove of the plate and secured by screws 26. The sectors are connected together at their lower part by small screwed reinforcing plates 21.

The compass-card carries two graduations: one, continuous, from 0 to 360°, and the other in two parts from 0 to 180° in reverse direction.

The bearing of the receivers is read on one or the other of said graduations opposite the pointers of the frame 22 screwed on the upper plate 56 of the cage.

From the rings of the output line collector 60 lead flexible wires which pass through the plate 56 in grooves formed in the shaft.

The members connected to the hull are:

The brush-carrying sleeve 23 and its accessories (see Figs. 9 and 10). The sleeve 23 is centered on the shaft 59; it supports a graduated circular ring 24 having a groove, and held on the arms of the sleeve by the screws 25. The fixed setting of the sleeve relatively to the cage is ensured by the finger 26 rigid with the lower plate 57. The rectilinear sliding movement of the sleeve is obtained by the screw having square threads 27 driven by the grooved plate 28 and the train of pinions 29 and 30.

The pinion 29 carries a graduated drum 31 which allows of locating the vertical position of the ring 24 which is read opposite the index 32 rigid with the lower plate 57. The graduation is expressed in speed of sound.

The ring 24 is concentric with the compensating collector, it carries grooved uprights 33 which are secured by their base by means of screws 34.

A line engraved on the base allows of locating the position of the upright along the graduation in degrees of the ring 24. Finally, the section of the passage-way of the screw 34 allows of locking the upright at any angle.

The angle of lead of an upright is moreover equal to the angle formed by the corresponding radius of the microphone (that is to say the line which joins the projected centre of the diaphragm of said microphone, and the centre of compensation 0 of the group) with the front-rear axis of the structure; said angle is counted from the front and in the usual direction of the bearings.

RAYMOND JOSEPH JASSE.