[Second Edition.]

PATENT SPECIFICATION

Application Date: Aug. 30, 1927. No. 22,762 / 27. **301,441**

Complete Left: March 14, 1928.

Complete Accepted: Nov. 30, 1928.

PROVISIONAL SPECIFICATION.

Improvements in or relating to Microphones.

I, LESLIE HAROLD PADDLE, of 502, Chiswick High Road, Chiswick, in the County of London, England, a British subject, do hereby declare the nature of this invention to be as follows:—

This invention has reference to telephone transmitters of the microphone type and to that kind wherein sound waves or other vibrations are caused to vary the intensity of a steady current flowing through granular conducting material disposed between fixed electrodes in such manner that the sound waves or other vibrations impinge on a skin or diaphragm, associated with the granular conducting material, in a direction substantially perpendicular to the direction of current flow through the said granules whereby a variation of resistance in the current path is caused which is dependent on the frequency and amplitude of the influencing vibrations.

The invention has for its object to effect improvements in microphones whereby fidelity of reproduction of audio frequencies may be obtained.

It is well known to those versed in the art that the frequency response characteristic of a microphone depends to some extent on the size of the carbon granules employed. Thus, for example, the natural period of vibration of a given quantity of granules of large mass would be low relative to the natural period of a similar quantity of granules of small mass.

It will therefore be appreciated that a microphone employing a mass of granules of substantially one size will suffer the defect of resonating and giving undue prominence to a band of frequencies corresponding to the natural period and harmonics thereof of the mass of granules used.

In order to overcome this disadvantage it has been proposed to use granules of various sizes mixed together. To some extent the trouble has been avoided but it will be followed, on consideration, that avoidance of the disadvantage cannot wholly, by this means, be secured since the granules of largest mass will tend to gravitate to the lowest position whilst the granules of lesser mass will find their level according to size. For example, in a transmitter employing five different grades of granules there will be substantially five layers merging one into the other, the order of the layers being dependent on the plane or angle in which the transmitter is held. Let us consider that, due to the manner of suspension of the microphone, the granules of largest mass are near the surface, that is, in juxtaposition to the sound reception surface of the transmitter, whilst the granules of small mass are remote therefrom. Under these circumstances the energy in the high frequency component of a given audio frequency band would be, to a great extent, damped out due to high frequency vibrations having less power of penetration than have the lower frequencies. Thus a true reproduction of the influencing sound would not be secured.

In order to obviate this disadvantage, according to the present invention, a transmitter is so constructed that granules of one grade of size suitable for reproduction of a particular band of frequencies are located and confined in one particular zone whilst groups of granules of other sizes suitable for reproduction of other frequency bands are similarly confined to separate zones, each zone being in electrical circuit with another or other zones and each group of granules being so disposed that its surface can readily be influenced directly by sound waves or other vibrations.

According to one example two rectangular electrodes of carbon are mounted in spaced parallel relationship and disposed diametrically opposite each other in a rectangular recess formed in a block of insulating material such as ebonite or other suitable material in such manner that current flows from one electrode to the other through granular conducting material which covers the exposed surfaces of the electrodes, and which is situated between the electrodes. The influencing vibrations are incident on the surface of the granular material in a direction substantially at right angles to

[*Price* 1/-]

the direction of current flow. Disposed in the region between the electrodes are spaced barriers or walls or non-oxidisable conducting material, which are carried by the block or bed of insulating material. Each barrier lies parallel to its neighbours and either at right angles to the direction of current flow (in which case each said barrier would be substantially parallel with the electrodes), or coincident therewith. In the series of troughs formed between the barriers or in some cases between an electrode and a barrier is situated the granular conducting material. One trough, formed between the side wall of one electrode and the side wall of an adjacent barrier, contains granules of a very fine character, say for example, such that would just pass a sieve of 500 meshes per square inch, the next trough or receptacle containing granules of a larger size and so on in progression, the last trough formed between a side of the other electrode and a barrier containing the largest granules. Adapted to extend over and touch each of the barriers, which may be of greater height from the insulating bed or block than are the electrodes, is a skin or diaphragm of thin rubber or oiled silk, mica or the like, which serves to retain the groups of granules in their respective chambers or troughs and forms the sound or other vibration receptive surface.

The cubic capacity may be made different for each granule chamber so that when each respectively is filled with its allotted granules it will normally be of equal resistance to any of the others.

In a modified arrangement each barrier is perforated with holes of such size that the bigger granules are not permitted to pass through but which will admit of the smaller associated granules entering the holes and contacting with the larger granules which effectually preclude the smaller ones from percolating through and mixing with the larger ones.

According to a modification each barrier surface adapted to contact with granules is corrugated or serrated in order to present a large surface area.

A further modification provides, in the insulation bed, grooves adapted to accommodate and form a seating for the barriers.

These grooves may be of greater width than the thickness of a barrier thereby forming channels on either side of the base of a barrier which will accommodate granules.

Dated the 30th day of August, 1927.

L. H. PADDLE.

COMPLETE SPECIFICATION.

Improvements in or relating to Microphones.

I, LESLIE HAROLD PADDLE, of 502, Chiswick High Road, Chiswick, in the County of London, W. 4, a British subject, 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:—

This invention has reference to telephone transmitters of the microphone type and to that kind wherein sound waves or other vibrations are caused to vary the intensity of a steady current flowing through granular conducting material disposed between fixed electrodes in such manner that the sound waves or other vibrations impinge on a skin or diaphragm, associated with the granular conducting material, in a direction substantially perpendicular to the direction of current flow through the said granules whereby a variation of resistance in the current path is caused which is dependent on the frequency and amplitude of the influencing vibrations.

The invention has for its object to effect improvements in microphones whereby fidelity of reproduction of audio frequencies may be obtained.

It is well known to those versed in the art that the frequency response characteristic of a microphone depends to some extent on the size of the carbon granules employed. Thus, for example, the natural period of vibration of a given quantity of granules of large mass would be low relative to the natural period of a similar quantity of granules of small mass.

It will therefore be appreciated that a microphone employing a mass of granules of substantially one size will suffer the defect of resonating and giving undue prominence to a band of frequencies corresponding to the natural period and harmonics thereof of the mass of granules used.

In order to overcome this disadvantage it has been proposed to use granules of various sizes mixed together. To some extent the trouble has been avoided but it will be followed, on consideration, that

avoidance of the disadvantage cannot wholly, by this means, be secured since the granules of largest mass will tend to gravitate to the lowest position whilst the granules of lesser mass will find their level according to size. For example, in a transmitter employing five different grades of granules there will be substantially five layers merging one into the other, the order of the layers being dependent on the plane or angle in which the transmitter is held. Let us consider that, due to the manner of suspension of the microphone the granules of largest mass are near the surface, that is, in juxtaposition to the sound reception surface of the transmitter, whilst the granules of small mass are remote therefrom. Under these circumstances the energy in the high frequency component of a given audio frequency band would be, to a great extent, damped out due to high frequency vibrations having less power of penetration than have the lower frequencies. Thus a true reproduction of the influencing sound would not be secured.

In order to obviate this disadvantage, according to the present invention, a transmitter is so constructed that granules of one grade of size suitable for reproduction of a particular band of frequencies are located and confined in one particular zone whilst groups of granules of other sizes suitable for reproduction of other frequency bands are similarly confined to separate zones, each zone being in electrical circuit with another or other zones and each group of granules being so disposed that its surface can readily be influenced directly by sound waves or other vibrations.

The invention consists broadly therefore of a microphone or telephone transmitter of the type wherein the direction of current flow between the electrodes is substantially perpendicular to the incident sound waves, comprising a plurality of electrodes in electrical connection with each other and with a plurality of separate groups of conducting granules differently graded as to size, each group of granules being separated from adjacent groups.

A further feature of the invention is the provision of a microphone of the type described having its granules arranged in groups separated by partitions of conducting non-resonant material.

The invention is illustrated in the accompanying drawings in which Fig. 1 is a sectional perspective view showing one form of construction whilst Figs. 2 and 3 are sectional views showing modifications. Fig. 4 is a view to an enlarged scale showing in perspective two details of modifications.

Fig. 5 is a perspective view of another modified detail whilst

Fig. 6 shows diagrammatically in plan a further modification.

An arrangement shown in Fig. 7 illustrates one embodiment of the invention wherein four separate microphone units, each adapted to respond to a separate frequency band, are connected together and are adapted collectively to form one complete microphone. Fig. 8 is a view similarge to Fig. 7 showing a modified arrangement.

Referring to Fig. 1, two rectangular electrodes 1 of carbon are mounted in spaced parallel relationship and disposed diametrically opposite each other in rectangular recesses formed in a massive block of insulating material 2 such as ebonite or other suitable material in such manner that current flows from one electrode to the other through granular conducting material 3 which covers the exposed surfaces of the electrodes, and which is situated between the electrodes. The influencing vibrations are incident on the surface of the granular material in a direction substantially at right angles to the direction of current flow. Disposed in the region between the electrodes are spaced barriers or walls 4 of non-oxidisable conducting material, which are carried by the block or bed 2 of insulating material and which are disposed parallel to each other. In the series of compartments formed between the barriers or in some cases between an electrode and a barrier is situated the granular conducting material 3. One compartment 5 formed partly between the side wall of one electrode and partly between the solid block 2 and the side wall of an adjacent barrier 4, contains granules of a very fine character, say for example, such that would just pass a sieve of 500 meshes per square inch, the next receptacle 6 containing granules of a larger size, and so on in progression, the last compartment 8 formed partly between a side of the other electrode and partly between the solid block 2 and a barrier containing the largest granules. Adapted to extend over and touch each of the carriers 4, which may be of greater height from the insulating bed or block than are the electrodes, is a skin or diaphragm 9 of thin rubber or oiled silk, mica or the like, which serves to retain the groups of granules in their respective chambers or troughs and forms the sound or other vibration receptive surface.

The cubic capacity of each granule chamber may be made different so that when each respectively is filled with its allotted granules it will normally be of equal resistance to any of the others.

According to modifications illustrated in Fig. 4 each barrier is perforated with holes 10 of such size that the granules of two groups are permitted to mix to some extent with each other. The holes may be of such size, however, that the bigger granules are not permitted to pass through but which will admit of the smaller associated granules entering the holes and contacting with the larger granules which effectually preclude the smaller granules from percolating through and mixing with the larger ones.

From Fig. 5 it will be seen that each barrier surface adapted to contact with granules may be corrugated or serrated as at 11 in order to present a large surface area.

A further modification illustrated in Fig. 3 provides in the insulation bed, grooves 12 adapted to accommodate and form a seating for the barriers 4.

These grooves 12, as can be seen from Fig. 2, may be of greater width than the thickness of a barrier thereby forming channels 13 on either side of the base of a barrier which will accommodate granules.

In Fig. 6 there is shown an arrangement wherein the barriers 4, which in this instance may be formed of non-conducting material, are arranged parallel to one another although at right angles to the electrodes 1, whereby each group of granules of one grade of size extends directly from one electrode to the other.

Fig. 7 illustrates an arrangement according to the invention wherein four separate units *a*, *b*, *c* and *d*, each respectively adapted to contain a group of granules of a size different from any other group, each of which latter respectively are disposed between stationary electrodes 1, as shown, or with the interposition of barriers such as hereinbefore described, are electrically connected together in series as indicated by the dotted lines and are mounted in one frame or holder 14 which may be a solid massive substantially vibrationless body or any other suitable means.

An arrangement similar to Fig. 7 is shown in Fig. 8 but wherein the separate units *a*, *b*, *c* and *d*, are electrically connected together in parallel. In this example to ensure that each unit is of similar normal resistance and takes a similar amount of current under non-working conditions the cubic capacity of the chambers formed between the electrodes 1 are made different for each unit, in such manner that a chamber of large cubic capacity would accommodate a group of granules which would have a resistance substantially equal to a lesser volume of another type of granule situated in another chamber of smaller cubic capacity.

It should be noted that I am aware that in a different type of transmitter where different sized granules were employed, it was suggested to separate the different sizes into groups by partitions of non-conducting fibrous material and I make no claim to any such device.

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

1. A microphone or telephone transmitter of the type wherein the direction of current flow between the electrodes is substantially perpendicular to the incident sound waves, comprising a plurality of electrodes in electrical connection with each other and with a plurality of separate groups of conducting granules differently graded as to size, each group of granules being separated from adjacent groups.

2. A microphone or telephone transmitter according to Claim 1 comprising two spaced electrodes and a number of separate electrically connected groups of granular conducting material disposed between and in electrical connection with said electrodes for the purpose specified.

3. A microphone or telephone transmitter according to Claim 1 wherein the separate groups of conducting granules are separated one from the other by partitioning of conducting material.

4. A microphone or telephone transmitter according to any of the preceding claims wherein the groups of granules are arranged electrically in series between the electrodes.

5. A microphone or telephone transmitter according to Claims 1, 2 and 3 wherein the groups of granules are arranged electrically in parallel between the electrodes.

6. A microphone or telephone transmitter comprising in combination a plurality of separate electrically connected microphone units each comprising spaced electrodes with granular conducting material therebetween and each adapted to be more responsive to one band of frequencies than are any of the other units by making the granules in each unit of a different size from any others substantially as described.

7. A microphone or telephone transmitter of the type defined wherein the conducting granules are arranged in groups separated one from the other by partitions of conducting non-resonant material.

8. A microphone or telephone transmitter substantially as described with reference to the accompanying drawings.

Dated the 14th day of March, 1928.

A. A. THORNTON,
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7, Essex Street, Strand, W.C. 2,
For the Applicant.

Abingdon: Printed for His Majesty's Stationery Office, by Burgess & Son.
[Wt. 123A.—50/8/1931.]

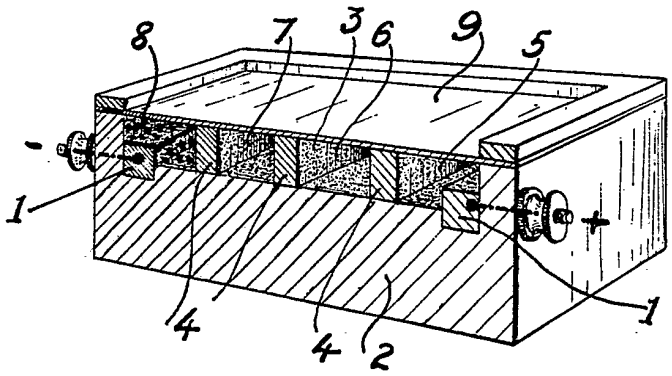

FIG. 1.

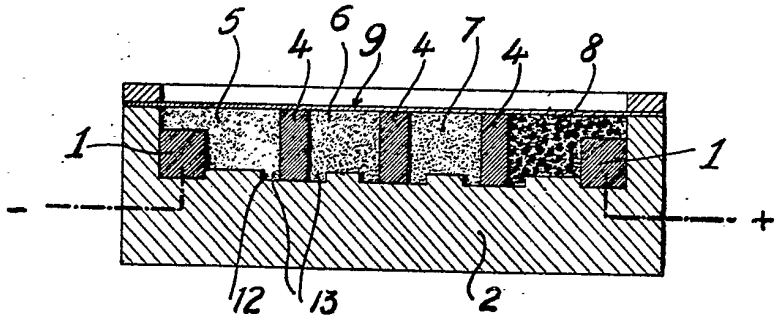

FIG. 2.

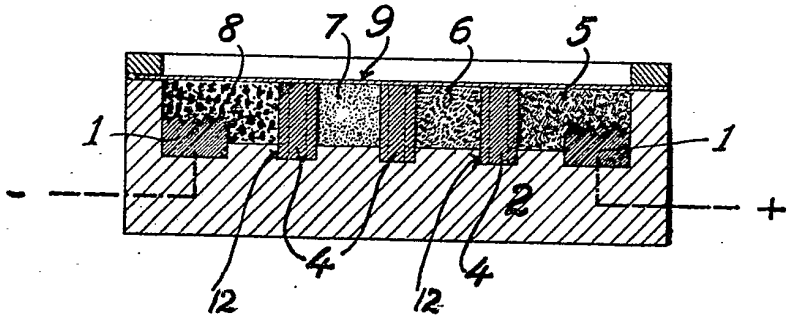

FIG. 3.

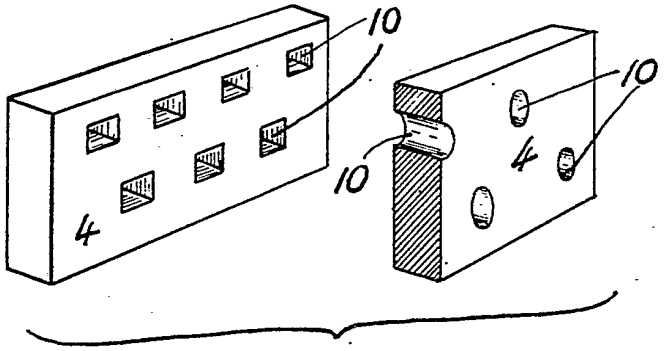

FIG. 4.

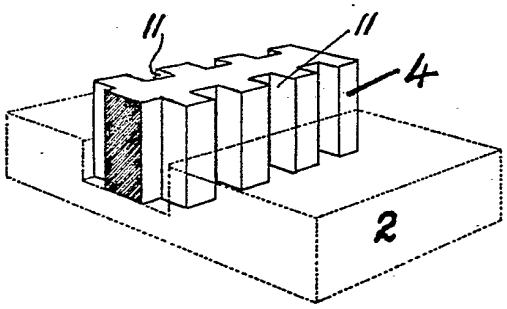

FIG. 5.

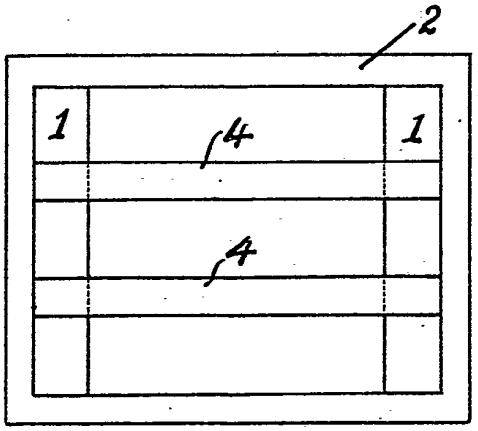

FIG. 6.

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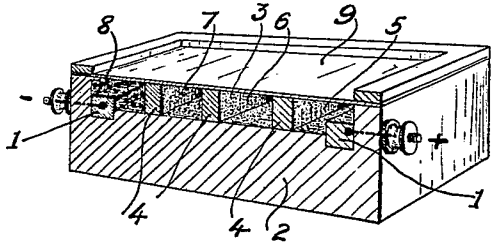

FIG. 1.

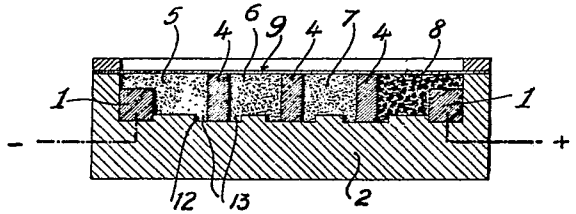

FIG. 2.

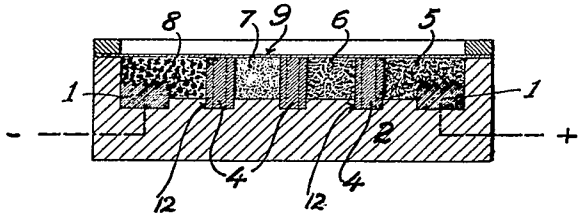

FIG. 3.

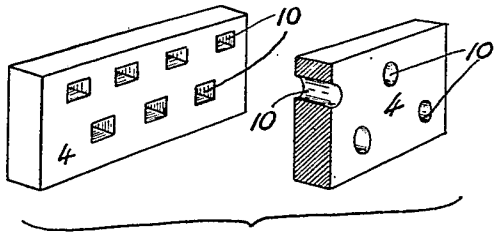

FIG. 4.

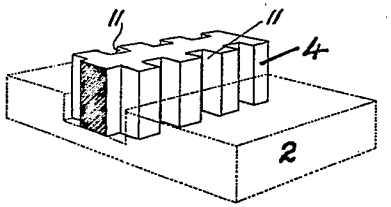

FIG. 5.

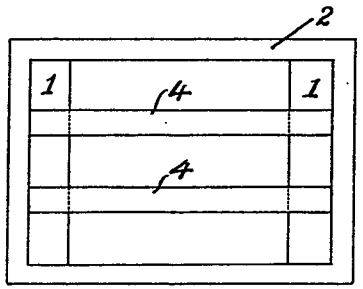

FIG. 6.

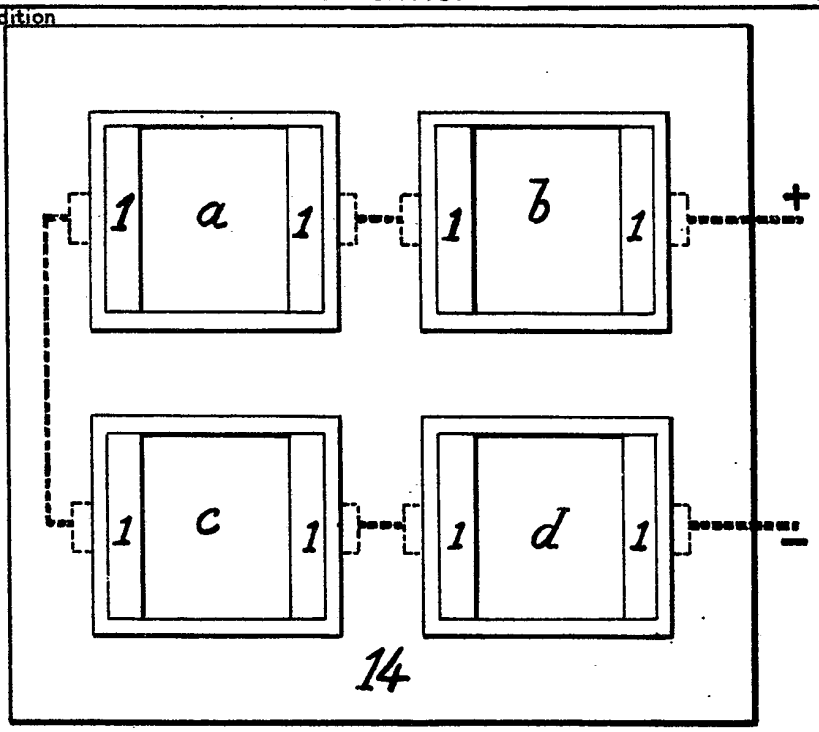

FIG. 7.

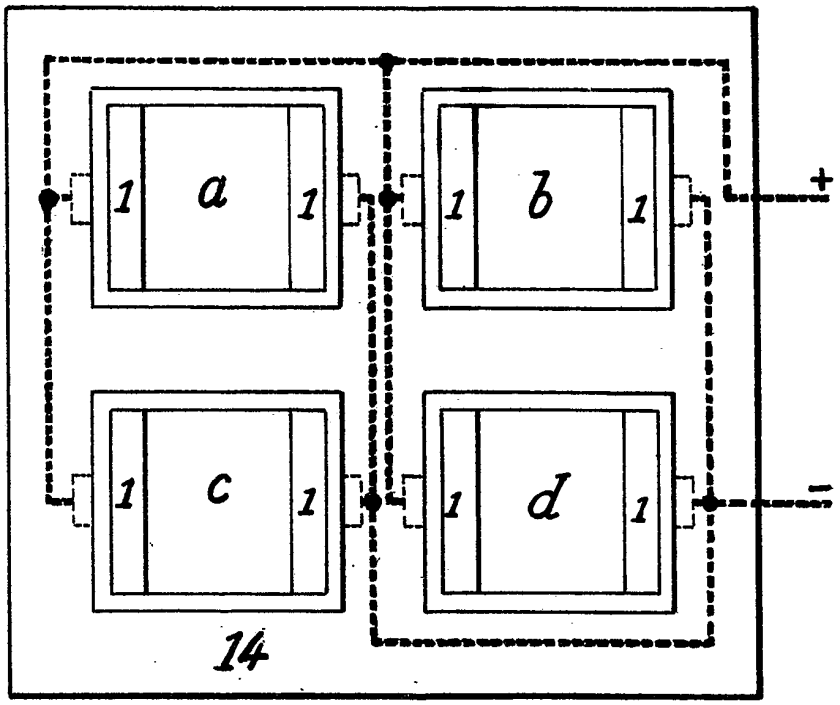

FIG. 8.

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