

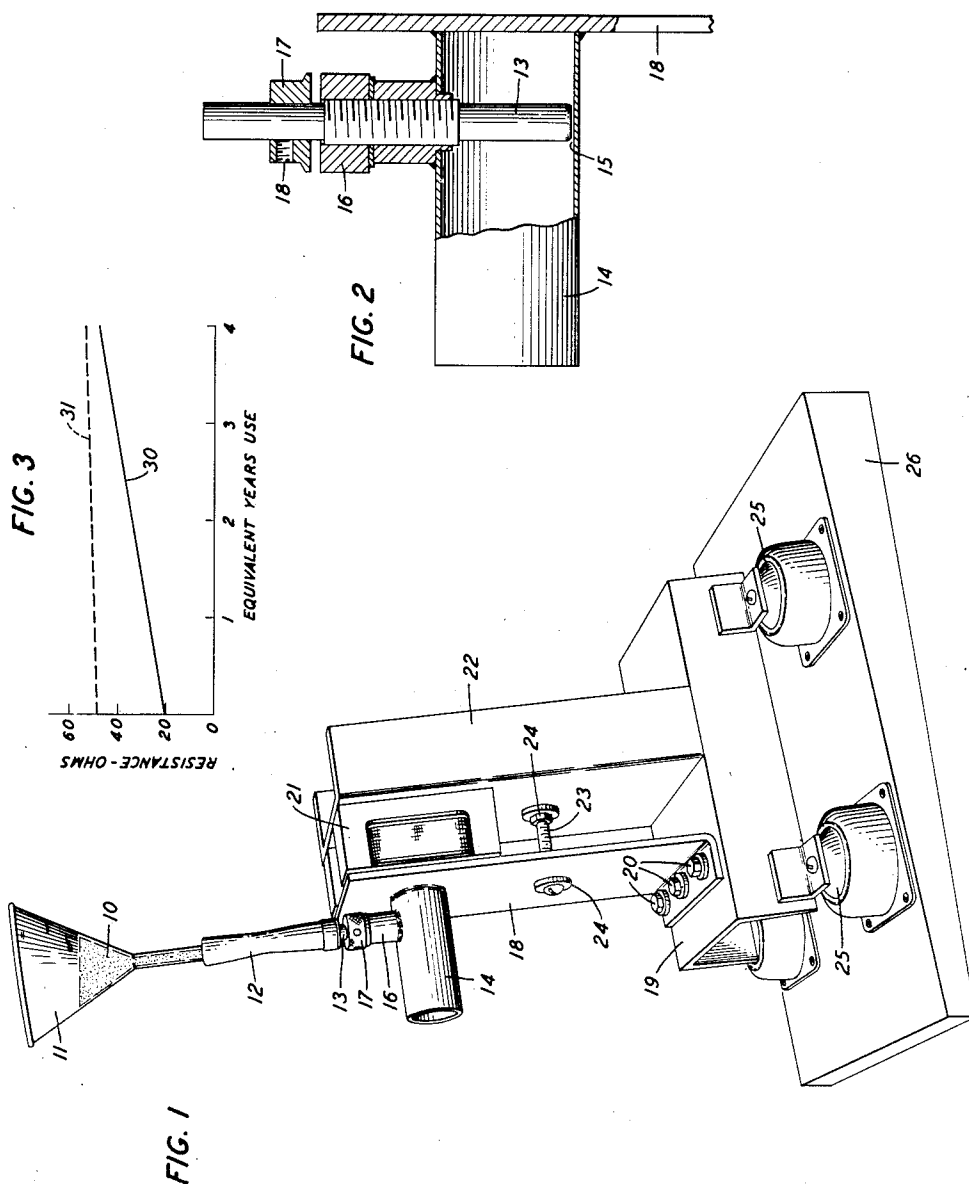
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PREPARATION OF MICROPHONIC CARBON

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PREPARATION OF MICROPHONIC CARBON

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This invention relates to the preparation of microphonic carbon and more particularly to a method for stabilizing the electrical characteristics of the carbon during its preparation for use in telephone transmitters, so that the resistance of the carbon will be substantially unaffected by the mechanical aging due to use.

Microphonic carbon is distinguished from other types of carbon by certain general characteristics. Specifically, to be considered microphonic, the carbon must have a modulating efficiency sufficiently high for the transmission of electrical signals, as occurs in the normal operation of microphones and transmitters in which such carbon is incorporated. This requires in turn that the carbon have good elasticity properties. Additionally, the microphonic carbon has a hard outer surface, though the entire carbon granule need not be as hard as its surface. Also, the resistance of the carbon must be such that it is usable in the transmission of electrical signals. Carbon of this type is generally specifically prepared in one of several ways for employment in microphone or telephone transmitters. One such exemplary process is described further below together with one specific illustrative embodiment of this invention.

The resistance and pressure characteristics of the carbon granule body in a telephone transmitter by which it functions in transforming the air pressure waves of the human voice into electrical pulses which may be transmitted by wire, as well as other operational characteristics of the carbon, are a function of the nature of the surface of the granules and of the amount and kind of gas adhering to this surface. This surface, however, is subject to undergo a transformation during use of a transducer such as a telephone transmitter.

Specifically, the resistance of the carbon granules is known to increase with both time and use. However, in order to design transducers that most efficiently can employ the carbon during their entire life span, it is advantageous to provide carbon granules of stable resistance. Further, it is advantageous to provide a method of stabilizing their resistance such that the carbon is always of approximately the same resistance during its useful life.

It has therefore been proposed to initially abrade the surface of the carbon, as carbon not initially abraded becomes so in service and consequently in time develops a higher contact resistance. The production of an initial abraded surface thus produces a stabilizing effect in that it reduces the mechanical aging of the carbon in

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service and therefore reduces the undesirable variations in its electrical characteristics, both the increase in resistance and the decrease in modulation and efficiency. This stabilization effects substantially the mechanical aging of the carbon, which is its change in resistance due to use.

The exact physical changes that take place during the use of the carbon and which are generally referred to as aging are not entirely known. One theory is the "gas absorption" theory which emphasizes the changes in the gas content of the surface. A second theory emphasizes instead the presence of sub-microscopic spheroids of hydrocarbon on the surface which are not reduced fully even at the elevated temperature of the final roasting process and which are crushed down during the aging, causing the hydrocarbon, which acts more as an insulator, to spread over the surface and thereby increase the resistance. Other theories propound the concept of the breaking off of a sub-microscopic piece of carbon from the surface and general combinations of these various effects mentioned. The present invention though is not dependent on the validity of any one of these theories and in describing this method it is to be understood that the use of the words "aging" and "abrade," when referring to the carbon surface, is not to be interpreted in terms of any of these theories but in terms of the disclosure and the known beneficial results therefrom.

Priorly, it has been proposed to roughen the surface of the carbon granules by various methods such as dipping in acid baths or by baking or roasting the carbon whereby the hydrogen content of the carbon is controlled. It was thought that the double roasting process, whereby the carbon is pre-roasted to a high temperature and then subjected to a final roasting, would sufficiently stabilize the carbon. However, while increasing the temperature of the roasting process does in fact inhibit aging in the carbon, it also greatly lowers its modulation characteristic, so that there is an optimum high temperature above which it is undesirable to go. Therefore, roasting or baking alone appears to be insufficient to prevent aging of the carbon in service.

An object of this invention is to stabilize the electrical characteristics of microphonic carbon.

A further object of this invention is to stabilize the microphonic carbon by a method which does not require considerable equipment and is not time-consuming.

These and other objects are accomplished in

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accordance with this invention by vibrating the carbon granules in an enclosed space while carefully controlling the rate of flow of the carbon into the space and the intensity of the vibration.

In accordance with one feature of this invention, carbon is stabilized by vibrating the carbon granules in an enclosed space.

In accordance with another feature of this invention, the rate of flow of the carbon through this space and the intensity of vibration of the carbon are closely controlled.

In accordance with still another feature of this invention, carbon granules are stabilized by rapid vibration in an enclosed space in a gaseous atmosphere.

In accordance with another feature of this invention, the stabilization is accomplished with a minimum detrimental effect on the modulation characteristic of the carbon.

In one illustrative apparatus which may be employed with this method, carbon is fed through a small tube into a larger cylinder, the end of the tube projecting into the cylinder and being adjacent the opposite internal side thereof. The cylinder is attached to a vibratory armature adjacent an electro-magnet. The rate of flow of the carbon can be controlled by regulating the space between the end of the small tube and the opposite inner wall of the cylinder while the intensity of the vibration is controlled by regulating the voltage applied to the windings of the electro-magnet.

A complete understanding of the method contemplated by this invention and the operation thereof and an appreciation of various desirable features thereof may be gained by consideration of the following detailed description and the accompanying drawings in which:

Fig. 1 is a perspective view of one illustrative device that may be employed in practicing the method of this invention;

Fig. 2 is an enlarged view partly in section of the cylinder and inserted tube of the device of Fig. 1; and

Fig. 3 is a graph showing the relative changes in resistance of carbon prepared by prior methods and carbon stabilized in accordance with this invention.

Referring to Fig. 1 of the drawing, a suitable device for vibrating the carbon granules in an enclosed space is shown. This device, which is illustrative of those that may be employed, comprises a receptacle for the carbon granules 10, here illustrated as a funnel 11, from which the granules flow through a length of flexible tubing 12 into a short rigid tube 13 which forms part of the vibrating mechanism. The container 11 is shielded from vibration by the flexible tubing 12. The short tube 13 extends into a larger tube 14 and discharges the carbon granules 10 into it through a controlled vent 15, best seen in Fig. 2, formed by an opening between the open end of the tube 13 and the lower inside wall of the tube 14. Both tube 13 and tube 14 may advantageously be of stainless steel or other similar material. The smaller tube 13 is held in position in a threaded tubular member 16 which is attached, as by soldering, to the tube 13. The vent 15 is controlled by raising or lowering the tube 13 to vary the distance between it and the inside wall of tube 14, a nut 17 and lock screw 18 being provided to prevent variation in the vent 15 during operation.

The vibrating tube 13 and the attached exit tube 14 are held in position by a single canti-

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lever support 18 which forms a 90 degree angle with a base member 19 to which it is attached as by screws 20. The vibratory mechanism is maintained in continuous vibration by the electromagnetic driver, as an electromagnet 21 which is actuated by an alternating current of controlled frequency and intensity. The electromagnetic driver 21 is supported from a support member 22 which is attached to the base member 19. Accurate spacing of the air gap between the electromagnetic driver 21 and the armature 18 is determined by a screw 23 and appropriate nuts and washers 24 between the armature 18 and the support member 22.

The base member 19 is mounted by spring supports 25 on a tilted base 26, whereby the exit tube 14 is tilted downward sufficiently to permit the carbon to flow out into receiving hoppers or through resistance measuring cells into hoppers. The angle of tilt may advantageously be of between 5 and 10 degrees.

The carbon stabilization in this device takes place in the vibrating tube 13 and in the vent 15 through which the carbon granules 10 enter the discharge or exit tube 14. The degree of stabilization is controlled by the intensity of vibration of this device and the rate of flow of the carbon granules. The intensity of vibration is controlled by adjusting the input voltage to the electromagnetic driver 21 and by controlling the air gap between the driver 21 and the vibrating armature 18. The rate of flow of the carbon is controlled by adjustment of the vent opening 15.

With one particular device employing a 110-volt, 60 cycle source with voltage control and with a vent opening 15 formed by backing the smaller tube 13 away from the exit tube 14 one-quarter of a turn, in its support which has 32 threads per inch, the resistance of the carbon, vibrated in air, was found to vary with voltage applied to the electromagnetic driver 21 according to the following table:

Driving Voltage	Percent Increase in Resistance
30	20
40	30
50	42
60	60
70	90
80	115
90	160
100	210
110	260

Further in one stabilization process employed to provide carbon granules for use in telephone handsets the initial resistance of the unstabilized carbon is 22 ohms; the voltage is then chosen to provide a final stabilized resistance of 43 ± 3 ohms, or an increase of substantially 100 per cent. The amount of stabilization desired, however, is dependent on the instrument with which the carbon is to be used, as both the instrument and the carbon resistance are designed together to achieve the greatest efficiency over the life of the instrument. By this method the desired degree of stabilization may be obtained by regulating the vent and voltage settings.

It is to be noted that the percentage change in resistance through the use of this method is also dependent on the atmosphere in which the stabilization takes place. The contact resistance, which with the specific resistance of the carbon makes up the actual resistance, is in part dependent on the adsorbed or surface gas. Thus

certain high quality hard anthracite transmitter carbons which are inherently hard to stabilize in air can be stabilized to the desired resistance in a gaseous atmosphere, as of nitrogen or hydrogen.

The above-described device is only exemplary of those that may be employed to provide the stabilization of carbon granules in accordance with this invention. Other methods of vibrating the carbon granules that could be employed are causing the granules to reciprocate in an enclosed space, as by being bounced up and down by tilted paddles, or by causing the granules to progress upward along a vibrating tube. Still other vibration methods will be apparent to those skilled in the art.

Carbon employed in this method is first prepared in any manner known to those skilled in the art. This may include taking the carbon from carefully selected and tested anthracite coal, crushed, ground, screened to the proper size, washed and dried, and then pre-roasted in a hydrogen atmosphere, finally roasted also in a hydrogen atmosphere and then spread out in the air for a time prior to the stabilization process. It is then introduced to a stabilization device, such as described above, wherein it is stabilized, the surface undergoing transformation through the contact of the granules with each other and with the surfaces in the enclosed space. Upon removal from the stabilizing device it passes through a resistance gauge which checks that its resistance has been increased to the desired value, after which the carbon is ready for installation in telephones or other transducers as are known in the art. Carbon thus stabilized has been found to have no decrease in the modulation characteristic and in certain cases an increase.

Fig. 3 shows the comparative changes in resistance due to the mechanical aging of continued use over an equivalent four-year period, as determined by laboratory tests checked against actual field performances. As is readily seen the unstabilized carbon, which follows the line 30, suffers an approximately 150 per cent increase in use whereas the stabilized carbon, which is shown by the line 31, increases less than 10 per cent. The carbon employed in these tests was pre-roasted at 1000° C. and finally roasted at 1175° C. The stabilizing took place in the device illustrated in Fig. 1 in a nitrogen atmosphere.

It is to be understood that the above-described arrangements are illustrative of the principles of the invention. Numerous other arrangements may be devised by those skilled in the art without departing from the spirit and scope of the invention.

What is claimed is:

1. The method of producing microphonic carbon granules whose electrical resistance is substantially stable with respect to mechanical aging which comprises feeding microphonic carbon granules into an enclosed space, vibrating said carbon rapidly in that space with such intensity that the microphonic carbon substantially immediately attains a high stabilized value of resistance, and allowing said carbon to exit from that space.

2. In the processing of microphonic carbon granules, the method of stabilizing the resistance of the microphonic granules with respect to mechanical aging which comprises continuously feeding said carbon granules into an enclosed space, controlling the rate of feed of said granules in said space, causing said carbon granules

to vibrate rapidly in said space with substantial violence, and allowing said carbon granules to exit from said space when the rapid vibration has produced stabilized carbon granules of at least appropriately twice their initial resistance.

3. In the processing of microphonic carbon granules, the method of stabilizing the electrical resistance of said microphonic carbon granules which comprises causing the granules continuously to be brought rapidly into contact with each other and with adjacent surfaces with such intensity that the microphonic carbon substantially immediately attains a high stabilized value of resistance.

4. The method of stabilizing the electrical resistance of microphonic carbon granules with respect to mechanical aging in use which comprises continually feeding the microphonic carbon granules into a container, causing said carbon granules continuously to be brought rapidly into contact with each other and with the surfaces within said container with substantial violence so that the microphonic carbon substantially immediately attains a high stabilized value of resistance, and allowing said carbon to exit from said container when said carbon electrical resistance has been increased to at least approximately 40 ohms.

5. In the processing of microphonic carbon granules, the method of stabilizing the electrical characteristics of microphonic carbon granules which comprises causing microphonic carbon granules of an initial resistance of approximately 20 ohms to be brought rapidly into contact with each other and with adjacent surfaces with such intensity that said microphonic carbon granules substantially immediately attain a stabilized value of resistance at least greater than approximately 40 ohms.

6. The method of producing microphonic carbon granules whose electrical resistance is substantially stable with respect to mechanical aging in use which comprises feeding the microphonic carbon granules into an enclosed space, vibrating said carbon granules in a gaseous atmosphere in said space with such intensity that said microphonic carbon granules substantially immediately attain a high stabilized value of resistance, and allowing said carbon granules to exit from said space.

7. The method of producing microphonic carbon granules of stable electrical characteristics in accordance with claim 6 wherein said atmosphere is of hydrogen.

8. The method of producing microphonic carbon granules of stable electrical characteristics in accordance with claim 6 wherein said atmosphere is of nitrogen.

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