Nov. 6, 1923. 1,473,107

M. M. KOHN

RESISTOR

Filed Feb. 3, 1921

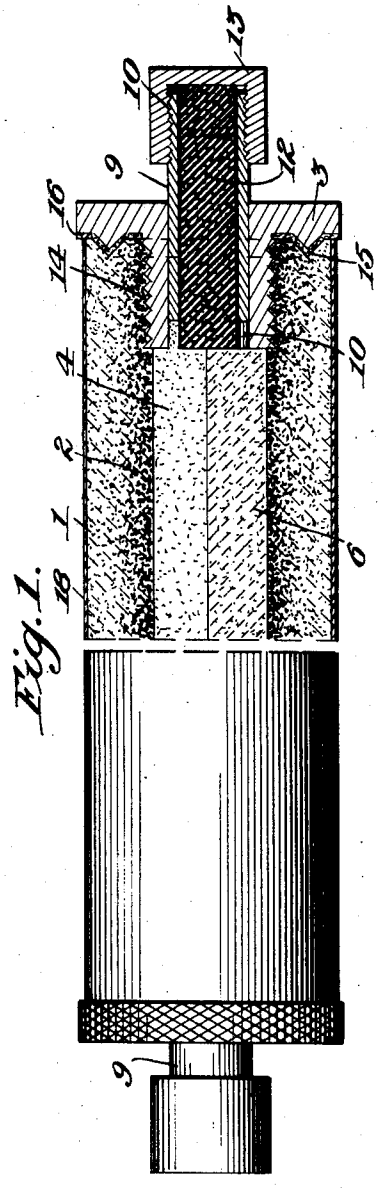


Fig. 1.



Fig. 3.

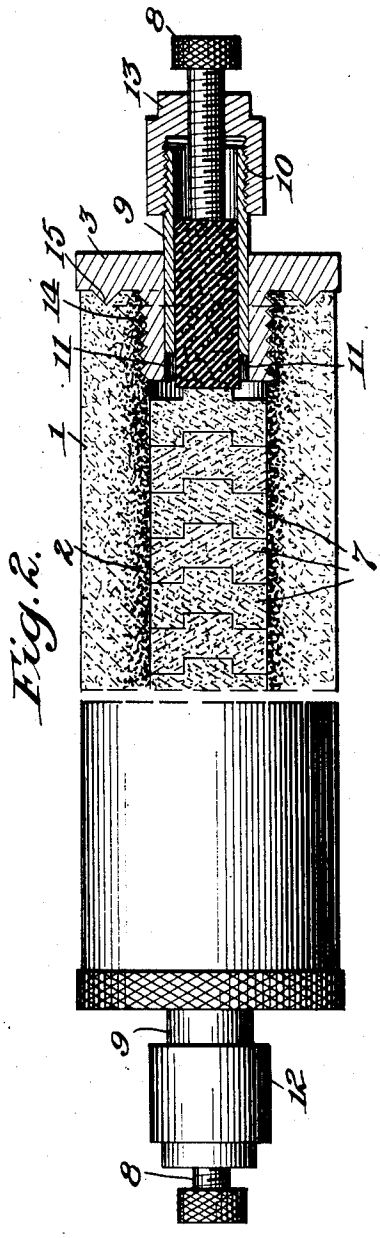


Fig. 2.

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UNITED STATES PATENT OFFICE.

MILTON M. KOHN, OF NEW YORK, N. Y.

RESISTOR.

Application filed February 3, 1921. Serial No. 442,047.

To all whom it may concern:

Be it known that I, MILTON M. KOHN, a citizen of the United States, residing at New York, in the county of New York and State of New York, have invented certain new and useful Improvements in Resistors, of which the following is a specification.

The use of graphite material and compounds as electrical resistors has been attempted many times, but up to the present, with very slight success. This is due to the rapid oxidation of the graphitic material or compounds when the temperature exceeds the ignition point. Up to the present, there have been but three means of overcoming this inherent difficulty or tendency. The first is the use of a vacuum or void; the second, the operating of the graphitic material in a neutral atmosphere, such as that produced by nitrogen, argon, etc., and the third, operating the compounds in a deoxidizing or reducing atmosphere, such as that produced by hydrogen, carbon monoxide and similar gases. The first method has been used in a small way and is fairly satisfactory for small furnaces, but owing to the complicated mechanism and apparatus required, together with the water cooling of the contacts, it is too expensive and bulky for work on a large scale. The second method, that of operating in an inert atmosphere, requires that said gases be continually replenished, this also being complicated and expensive, and particularly with large furnaces where, either a number of resistors would be used or one resistor of large cross section. The third method, namely, the use of the deoxidizing or reducing atmosphere, offers the most feasible and practical method, but even this has not been commercially practical hitherto, with the means available.

My invention has for its object the production and operation of oxidizable compounds usually, but not necessarily, of a graphitic nature, as resistors in a deoxidizing or reducing atmosphere, the essential points of the invention being, first, the resistor element itself, which will be described hereinafter, and the use thereof within a body of material which is impermeable, at least substantially so, to the passage of the gases either from the interior outwardly or from the exterior inwardly. It will, of course, be understood that the invention consists of two elements, but combined to produce a complete unitary result. The resistor proper is composed of a mixture preferably of graphite and silicon carbide, better known as carborundum. The proportions thereof can be varied to a wide degree, ranging approximately from about 2½% to 95% graphite, the percentage depending on the ohmic resistance desired.

Referring to the drawings, Fig. 1 is a view, partially in section and partially in elevation, of my resistor, showing two modifications; Fig. 2 is a similar view of another modification; and Fig. 3 is a sectional view through a disc used in the modification illustrated in Fig. 2.

The protecting casing can be of any desired size and shape and is composed of carborundum mixed with a very small percentage of graphite, for example one or two per cent, both substances being in a rather fine state of subdivision, and a relatively small proportion of a binding compound, such as glucose, dextrine, tar compounds, or any other suitable binding substance which is preferably of a carbonaceous nature. This composition is very thoroughly admixed and then molded into the desired shapes either by pressure and suitable molds, etc., or it can be poured into molds and allowed to set and harden. After it has been air dried and hardened it is slowly heated in a suitable kiln or sagger to an extremely high temperature, namely, about 3000 to 3300° F. The purpose of this intense heating is to compact and make the structure an extremely dense one. A structure produced in this manner has a high heat conductivity, is almost neutral as regards temperature strains and is substantially impermeable to gases at very high temperatures. In connection therewith it is to be noted that substantial thickness of the wall is of importance; a thin wall, of whatever density, would permit of the passing or mixing of the gases at the extremely high temperatures which are intended with respect to the manufacture and use of these impermeable tubes or casings. I prefer to make the inner lining of the same of fairly large grains, for example, about equal to a number 8 or 10 grain, as indicated at 2 on the drawing. The object thereof is to provide for retain-

ing pockets on the interior of the casing, so that the gases given off will be retained within said pockets, the object of which will appear hereinafter. The operation of this resistor in practice is as follows.

When the resistor is placed within the casing 1 and sealed at the ends, as by caps 3, the same is practically hermetically enclosed therein, it being, of course, understood that the resistor and the casing are dry, or at least contain no free moisture.

When current is supplied to the resistor and the temperature thereof reaches the ignition point there is a slight preliminary oxidation of the graphite, a slight volume of carbon monoxide being given off. This CO gas is extremely heavy as compared with other gases and, also having very slight diffusive quality, does not tend to penetrate the tube, and the pockets formed by the large grains above mentioned act as retaining means to hold this gas within the casing and in close proximity to the resistor proper. It will be well understood by those skilled in the art that graphitic compounds or any other carbonaceous material cannot oxidize in a CO atmosphere and, due to this and the additional fact that the CO is practically hermetically sealed within the tube and in contact with the resistor, the graphite can be used for very long periods of time without perceptible deterioration.

The resistor proper can be made and used in a number of forms, one of which may be granular, as indicated by 4 on the drawing, a solid as indicated at 6, or molded interlocking discs 7, each of which is best adapted for some specific use, and I do not limit myself to any particular forms. The resistance of the resistor proper can be somewhat varied through the pressure applied by the screws 8 at each end of the complete unit. An object of the interlocking discs is to provide for various resistances, as the discs can have approximately one ohm resistance each, one half ohm, or any other desired resistance according to the use desired. The resistance of the whole can be varied by varying the resistance of the discs and the number of discs.

The terminals or contacts for this type of resistor are of very great importance, as the difficulty hitherto experienced in making contacts between metals and graphitic materials, either molded or in granular form, have been almost insurmountable, and in almost every case have been water-cooled to reduce the danger of melting them. This is due to the contact resistance, that is to say, the resistance at the point of contact beween the resistor proper and the material which conducts the current from the resistor to the outside or exposed terminal. I overcome this difficulty in my construction by terminating the resistor at a relatively slight distance from the end of the casing. Through the end of the casing, which can have a separate cap if desired, as shown on the drawing, I insert an ordinary iron or steel tube 9, preferably threaded, as at 10. This tube is set in the casing and cemented in position sometimes by the same compound as the casing itself or threaded into it. The inner end of this metallic tube does not come in contact with the resistor itself, but is preferably terminated a short distance from the end thereof, leaving a space 11, electrical contact being made by filling the said metallic tube with commercial graphite either in the form of grains, molded stick or a plastic mass, which is then allowed to harden within the tube. The outer end of the threaded tube is closed by means of an ordinary pipe cap 13, to which are attached the terminal screws for connecting the line wires (not shown).

As above stated, the life of the graphitic compound in my structure is comparatively a long one, but when it becomes necessary to replace or replenish the resistor a very simple operation is sufficient, this consisting of unscrewing or removing one of the threaded cap ends 3 and removing the exhausted material, and substituting a fresh charge. By this construction I provide a practical method of producing extremely high temperatures, heating structures by the use of graphitic material, and devices of any desired size and shape at low initial cost and low maintenance charges.

The caps 3 are suitably attached to the casing 1, the preferred method being by means of the screw threaded connection 14. An annular V-shaped shoulder 15 on the cap 3 may project into the end of the casing and a plastic packing 16 may, if desired, be interposed between the resistor casing and the end cap covers to insure additional impermeability.

The casing 1, if desired may be coated with any composition which will increase its impermeability, and such coating is preferably applied to the exterior of the casing, and may consist, for example, of a paint or paste of zirconium silicate, which may be burned on, as at 18 on the drawing.

I claim:

1. A resistor comprising a mechanically and chemically protective casing and resistor material within said casing, said casing being made of granular material.

2. A resistor comprising a mechanically and chemically protective casing and resistor material within said casing, said casing being made of granular material, the granules at the inner side being coarse and the granules at the outer side being fine whereby substantially impermeable gas pockets are formed.

3. A resistor comprising a mechanically

and chemically protective casing and resistor material within said casing, said casing being made of granular material, and an impermeable coating on the outer side of said casing.

4. A resistor comprising a mechanically and chemically protective casing and resistor material within said casing, said casing being made of granular material, the granules at the inner side being coarse and the granules at the outer side being fine, whereby substantially impermeable gas pockets are formed, and an impermeable coating on the outer side of said casing.

5. A resistor comprising a mechanically and chemically protective casing and resistor material within said casing, said casing being made of granular material, and a coating of zirconium silicate on the outer side of said casing.

6. A resistor comprising a mechanically and chemically protective casing and resistor material within said casing, said casing being made of granular material, the granules at the inner side being coarse and the granules at the outer side being fine, whereby substantially impermeable gas pockets are formed, and a coating of zirconium silicate on the outer side of said casing.

7. A resistor comprising a mechanically and chemically protective casing made of granular material, resistor material within said casing and electric terminals attached to the casing and contacting with the resistor material.

8. A resistor comprising a mechanically and chemically protective casing made of granular material, and resistor material comprising oxidizable material within said casing.

9. A resistor comprising a protective casing and resistor material comprising graphitic oxidizable material within said casing.

10. A resistor comprising a protective, non-oxidizable, high temperature resisting casing and resistor material comprising graphitic oxidizable material within said casing.

11. A resistor comprising a mechanically and chemically protective casing made of granular material and resistor material comprising oxidizable material within said casing, said casing being substantially impermeable.

12. A resistor comprising a protective casing and resistor material comprising graphitic oxidizable material within said casing, said casing being substantially impermeable.

13. A resistor comprising a protective casing and resistor material comprising oxidizable material within said casing, said casing being substantially impermeable and having pockets interiorly thereof to retain non-oxidizing products of combustion.

14. A resistor comprising a protective casing and resistor material comprising graphitic oxidizable material within said casing, said casing being substantially impermeable and having pockets interiorly thereof to retain non-oxidizing products of combustion.

15. A resistor comprising a protective casing, resistor material within said casing, caps at the ends of said casing, tubes closed at the outer end projecting through said caps, conducting material within said tubes, said conducting material being in electrical contact with said resistor material.

16. A resistor comprising a protective casing, resistor material within said casing, caps at the ends of said casing, tubes closed at the outer end projecting through said caps, the inner ends of the tubes being spaced from the main body of the resistor material, conducting material within said tubes, said conducting material being in electrical contact with said resistance material.

17. A protective casing for a resistor element comprising a casing having coarse grains at the inner surface thereof.

18. A protective casing for a resistor element comprising a casing having coarse grains at the inner surface thereof and fine grains at the outer surface thereof.

19. A resistor comprising a protective casing comprising graphite and carborundum and a resistor element within said casing comprising graphite and carborundum.

20. An electrical resistor for high temperatures, consisting of a graphitic and silicon carbide compound in varying proportions, a substantially impermeable refractory casing or covering therefor, means for sealing the ends and providing electrical terminals therefor, means for increasing the degree of impermeability by adding a coating of burned zirconium silicate thereon, and the retention of reducing or deoxidizing gases in close contact with the resistor material within said casing.

In testimony whereof I affix my signature.

MILTON M. KOHN.