Dec. 18, 1934. F. GAHN 1,984,925

RESISTOR

Filed Jan. 16, 1933

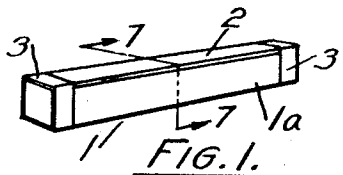



FIG. 1.

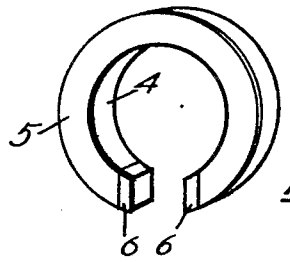



FIG. 2.

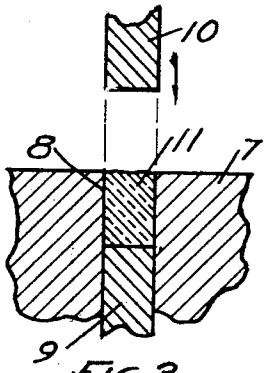



FIG. 3.

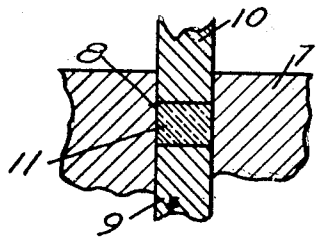



FIG. 4.

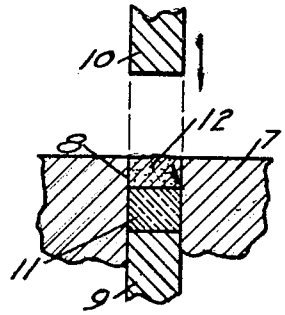



FIG. 5.

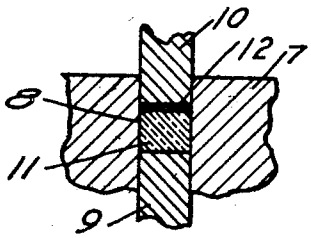



FIG. 6.

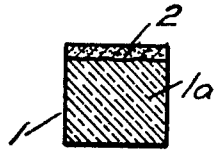



FIG. 7.

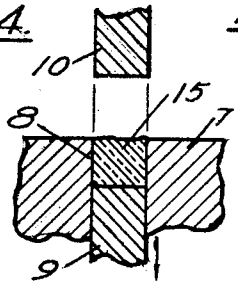



FIG. 8

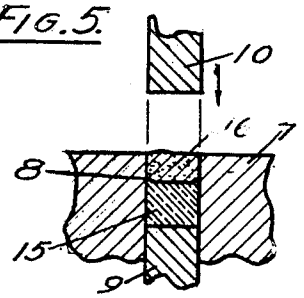



FIG. 9.

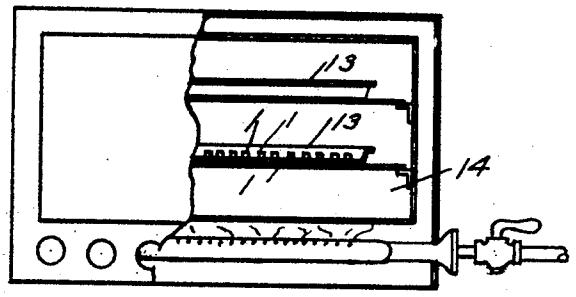



FIG. 11.

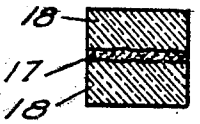



FIG. 10

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Patented Dec. 18, 1934

1,984,925

# UNITED STATES PATENT OFFICE

1,984,925

## RESISTOR

Frank Gahn, Erie, Pa., assignor to Erie Resistor Corporation, Erie, Pa., a corporation of Pennsylvania

Application January 16, 1933, Serial No. 651,968

1 Claim. (Cl. 201—76)

The present invention is designed to improve resistors both as to the method of making such resistors and the finished article. It is common practice to form resistors from molded material, as for example, a material containing carbon as the conductor, a filler, such as sand, and a binder such as bakelite or shellac. In order to give the resistor element sufficient body to maintain itself under ordinary conditions of use it is often necessary in order to give a sufficient cross sectional dimension to give it sufficient strength to decrease the carbon content and this results in considerable lack of uniformity. Further with such a reduction in carbon the ratio resistance to radio frequency current and D. C. current differs greatly and it is desirable to maintain the values of the resistors for either service. Reducing the cross sectional dimension so as to give the desirable density of carbon also involves a reduction in its heat exchange capacity by reason of its reduced radiating surface. With the present invention I provide a backing for the resistor element of non-conductive material. This gives the added strength so that the cross dimension of the element may be made as small as desirable and the backing being united integrally with the element itself affords a heat exchange and dissipation of the heat of the resistor element so as to give it a desired capacity.

In carrying out my invention I preferably provide a plastic material for the resistor having low conductivity and a material for the backing preferably having the same kind of material except for that part of the material, as carbon, giving to it its current-carrying capacity. In this manner the completed unit may be formed in substantially the same molding operation and the treatment for setting the material, ordinarily a heating process, may be identical and an economical production can be attained for the material so formed. Features and details of the invention will appear from the specification and claim.

A preferred embodiment of the invention is illustrated in the accompanying drawing as follows:—

Fig. 1 shows a perspective view of an improved resistor in the form of a straight bar.

Fig. 2 a similar resistor of ring form.

Fig. 3 a mold filled with material for forming the backing.

Fig. 4 a material for the backing shaped by compression.

Fig. 5 an added layer of resistance material added to the mold.

Fig. 6 a pressure molding action uniting the layers and compacting the material.

Fig. 7 a section on the line 7—7 in Fig. 2 with the unit removed from the mold and in its united form.

Fig. 8 shows the mold loaded with the backing material.

Fig. 9 the mold supplied with a layer of material for the resistance element before compression.

Fig. 10 a modified form of resistor.

Fig. 11 a chamber for heat-treating the molded units.

In the resistor shown in Fig. 1, 1 marks the resistor unit, 1*a* the backing for the resistor unit, 2 the resistor element formed integrally with the backing 1*a*, and 3 the conductor ends, such as sprayed copper for facilitating the electric connection to the resistor unit.

In the ring form of Fig. 2, 4 marks the backing, 5 the resistor element forming a layer on the backing and 6 the ends.

The mold has the mold plate 7, the mold cavity 8, the stripping bar 9 and the pressure plunger 10.

As shown in Fig. 3, the stripper bar is in its lower position, the mold cavity filled with material 11 suitable for the backing.

In Fig. 4 the plunger 10 has been forced downwardly compressing the material for the backing and giving it a shape of a uniform layer.

In Fig. 5 the plunger 10 has been lifted, the cavity filled with material 12, the compound for the constituent for giving the proper resistance.

In Fig. 6 the plunger has been forced downwardly compressing both the resistor element and the backing. As the plunger is returned the stripper plate 9 is raised, thus expelling the united unit. The layers then have the form shown in Fig. 7. After the units are thus formed they may be placed in pans 13 and subjected to a heat process, as in the oven chamber 14.

A preferred composition for the element comprises carbon giving the desired conductivity, a filler, such as silicate, thus making the conductivity dependent practically entirely on the carbon so that it may be very definitely controlled and a binder of some material, preferably a phenolic condensation such as "Bakelite". The backing preferably has the same material with the absence of carbon. With this material after it is pressed into form it is heated above the ordinary heating temperature for "Bakelite," a desirable temperature being about 500° Fahrenheit and over a period of a few minutes. This completely sets the "Bakelite" both in the backing and in the resistor element.

Afterwards the ends are treated with a metal spray to facilitate electrical connection of the resistor in a circuit.

With the article so formed a greater proportion of carbon may be used in the element and consequently greater uniformity may be achieved both in the production and as to capacity, or value for different kinds of current. At the same time, the backing which is united with the element in an integral structure strengthens the unit as a whole so that it may be readily handled and installed and stand the shocks of service and this may be accomplished even where the cross section of the resistor element is very small. Further the backing being integrally united with the resistor element there is a ready dissipation of heat from the entire surface of the unit and this gives to the resistor a greater capacity.

In Figs. 8 and 9 the backing material 15 is first filled to its desired depth, the stripper 9 is dropped down to provide for a measured space for the resistor element and then the resistor element material 16 filled into the mold, as shown in Fig. 9, and the plunger 10 depressed, thus compressing both the backing layer 15 and the resistor layer 16 in one operation.

In Fig. 10 the resistor unit is formed with a central resistor element 17 and this has a backing 18 at each side. To form this structure it is only necessary to fill in the mold, above the resistor element and compress the backing over the resistor element as well as below it. This again gives greater strength and greater capacity for heat diffusion, or radiation.

While the binder of phenolic condensation such as "Bakelite" operates well, shellac may be also used, and as this may be set with the same temperature as "Bakelite" the resistor element may be formed with either "Bakelite" or shellac as the binder and the backing may be formed with either "Bakelite" or shellac as the binder. Preferably the element and the backing should be made of materials yielding to the same sort of molding formation and to the same setting treatment. Preferably the binder of both the element and the backing will be made of the same material.

What I claim as new is:—

A resistor having a layer of material of low electric conductivity for a resistor element and a backing for the element of insulating material, both of said materials comprising a binder, the binder of one of said materials being a phenolic condensation and the binder of the other of said materials being shellac.

FRANK GAHN.