

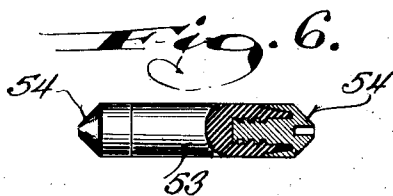
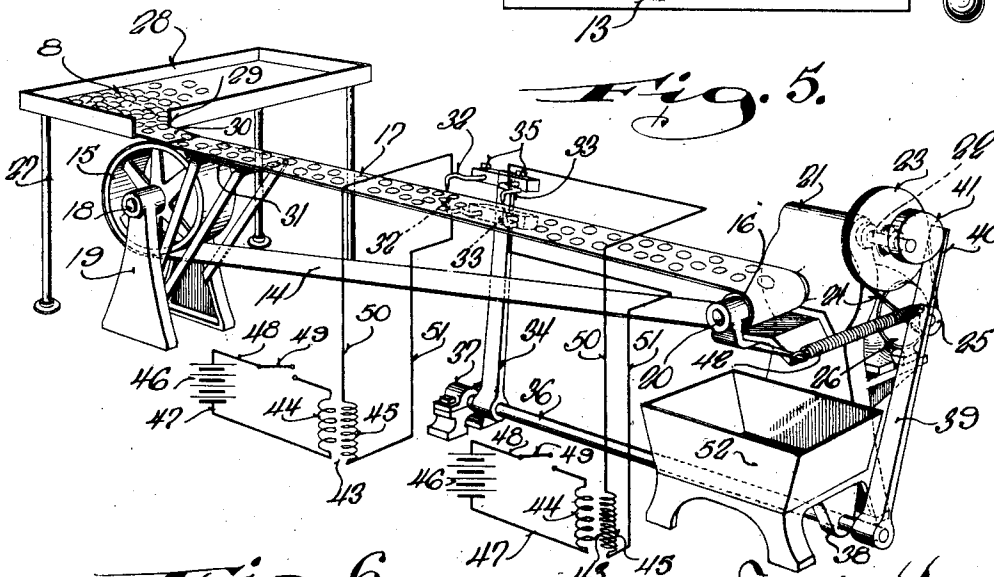
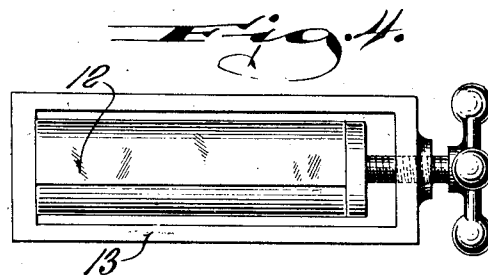
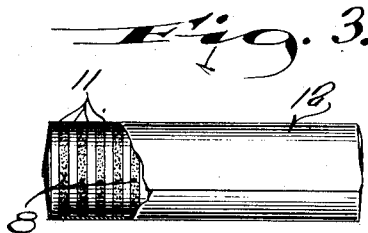
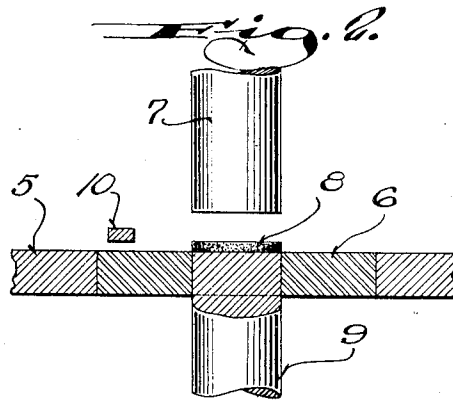
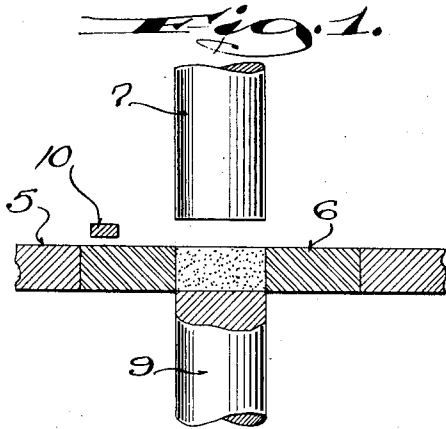
Feb. 16, 1932.

L. BRADLEY

1,845,828

RESISTOR UNIT AND METHOD OF FORMING SAME

Filed Aug. 19, 1925



Lynde Bradley
Inventor
By *Ina Milton Jones*
Attorney

UNITED STATES PATENT OFFICE

LYNDE BRADLEY, OF MILWAUKEE, WISCONSIN, ASSIGNOR, BY MESNE ASSIGNMENTS, TO ALLEN-BRADLEY COMPANY, OF MILWAUKEE, WISCONSIN, A CORPORATION OF WISCONSIN

RESISTOR UNIT AND METHOD OF FORMING SAME

Application filed August 19, 1925. Serial No. 51,273.

This invention has as one of its objects the provision of an improved resistor unit which is especially adapted for use in radio receiving and broadcasting apparatus, or which
5 may be employed in any other situation where a resistor unit is desirable.

Another object of this invention resides in the provision of a compressible resistor unit having a low internal resistance and a
10 high contact or microphonic resistance, so that a column of units will have a comparatively low resistance under maximum pressure in comparison to their resistance under minimum or no pressure, thus giving a great-
15 range of variation of resistance under varying pressures.

A further object of this invention resides in the provision of an improved apparatus for forming resistor units in accordance with
20 this invention in an economical and practical manner.

With the above and other objects in view which will appear as the description proceeds, my invention resides in the novel method, construction, combination and arrangement of parts substantially as hereinafter described and more particularly defined by the
25 appended claims, it being understood that such changes in the precise embodiment of the hereindisclosed invention may be made as come within the scope of the claim.

In the accompanying drawings, I have illustrated several complete examples of the physical embodiment of my invention constructed according to the best modes I have
35 so far devised for the practical application of the principles thereof, and in which:

Figure 1 is a fragmentary view, partly in section and partly in elevation, of a diagrammatic illustration of a press for forming disc-shaped resistor units;

Figure 2 is a view similar to Figure 1 illustrating the completion and ejection of the disc unit;

Figure 3 is a side view of a stack of disc-shaped resistor units wrapped prior to receiving treatment in the presence of heat, part of the wrapping being broken away;

Figure 4 is a side view of a clamp or compression member which may be applied to the

wrapped stacks of disc-shaped resistor units to maintain the same under pressure during the heat treatment;

Figure 5 is a perspective view of an apparatus employed to subject the units to the
55 influence of an electric current having the power or capacity to reduce the specific or internal resistance of the units, a diagrammatic view of one wiring circuit being shown, and
60

Figure 6 is a view, partly in elevation and partly in section of a modified form of resistor unit.

The resistor unit illustrated in Figures 1 to 5, inclusive, is especially adapted to be arranged in stacks or piles to form the resistor
65 element of a compressible resistor, whereas the unit illustrated in Figure 6 is designed for use as a fixed resistor.

In a disc unit it is desirable that its specific
70 or internal value be relatively low and its microphonic or contact resistance be relatively high so that the resistance offered by a column of the discs, when under pressure, is relatively low. A column of discs having
75 these characteristics will give a greater spread or range from minimum to maximum as the method of treating or "shooting" the discs, hereinafter described, eliminates the resistance that heretofore could not be
80 squeezed out. In the unit illustrated in Figure 6, it is also desirable that its internal resistance be fixed or unchangeable under normal conditions, and it is also of the utmost
85 importance that its resistance be capable of calibration. The method of calibrating the resistance is closely allied to the method of shooting the discs and is described in detail in my copending application, Serial No. 53,570, filed Aug. 31, 1925.
90

Referring now more particularly to the accompanying drawings in which like numerals designate like parts throughout the several views, the numeral 5 designates the bed plate of a forming machine having a
95 female die 6 mounted therein and cooperating with a male die or compression plunger 7 which is movable therein to compress materials, to be later described, and form the unit 8, which is removed from the die by an
100

ejector 9. Suitable mechanism, not shown, is connected with the plunger and ejector to register the upper end of the ejector with the bottom of the die opening and move the compression plunger thereinto, the ejector being moved upwardly through the die upon retraction of the plunger to eject the unit 8 formed by the compressing of the substance, to be later described, forming the unit into disc shape, the unit being removed from between the compression plunger and ejector by an automatic finger member 10.

The resistance unit, while illustrated in Figures 1 to 5, inclusive, as of disc shape, may be formed as illustrated in Figure 6, or in my co-pending application filed therewith, or in any desired shape. The units are preferably formed from an organic substance having a conductor mixed therein and the following ingredients and proportions have been found by experience to produce a highly efficient unit:

Formula for high resistance unit:

Graphite #1 AF	3%	545	grams
Asbestos powder #1250	10%	4	pounds
Phenolic condensation product #60	87%	34	pounds, 13 ozs.

Formula for low resistance unit:

Graphite #1 AF	10%	1816	grams
Asbestos powder #1250	10%	4	pounds
Phenolic condensation product #60	80%	32	pounds

The above formulas may, of course, be changed to suit various conditions, but have been found to be very practical and efficient and the general process of manufacturing is briefly as follows:

First:—Mixing dry graphite and powdered asbestos with the dry, powdered phenolic condensation product.

Second:—Wetting the mixture thoroughly with denatured alcohol to dissolve the phenolic condensation product.

Third:—Grinding the wet mixture to make a thoroughly homogeneous mixture, also to form the mass into long, thin strings so it may be dried much more readily.

Fourth:—Removing the alcohol by heat and vacuum.

Fifth:—Pulverizing and sifting the dried product.

Sixth:—Dry-mixing the powder to make it absolutely uniform.

Seventh:—Blending mixtures containing different percentages of graphite in order to obtain mixtures which will give required resistances when molded into units.

The discs 8 resulting from the compression of the composition previously described are arranged in stacks of alternate resistor discs and separators 11, preferably of carbon, and wrapped with a suitable covering 12 such as heavy paper or the like. The stack of discs is then heat treated, being placed in an oven maintained at 400 degrees Fahrenheit for a period of two hours and then allowed to cool. If desired the stack may be secured in

a clamping mechanism 13 to maintain the same under pressure during the heat treatment.

Upon removal from the heating oven the units are complete and may be used in a resistor column, but their specific or internal resistance is high, and for better results and increased spread or variation of contact resistance through variations of pressure, it is necessary that their internal resistance be materially lowered. Tests have proven that resistor units subjected to the method hereinafter described have their internal or specific resistance materially lowered.

The unit 8 is, therefore, subjected to the influence of an electrical current having the power or capacity to change the characteristics thereof to the extent of reducing its specific or internal resistance and at the same time maintaining its high contact or microphonic resistance. It has been found that a current that oscillates and is of high potential, or high frequency has the power to so change the characteristics of a resistor unit to obtain the desired results, although it is to be understood that any current having the capacity or power to produce the desired results may be employed, and in Figure 5 I have illustrated one embodiment of a machine for subjecting resistor units to the influence of such a current.

An endless belt 14 is preferably trained about a relatively large idle pulley 15 and a relatively small drive pulley 16, the upper or top-most portions of which are substantially horizontally aligned to maintain the upper stretch 17 of the belt on a horizontal plane. The idle pulley 15 is mounted on a shaft 18 supported in standards or mountings 19 and the drive pulley 16 is fixed on a drive shaft 20 connected with a gear reduction unit 21. The drive shaft 22 of the unit 21 has a pulley 23 mounted thereon which is driven by a belt 24, trained about it and the drive pulley 25 of a motor 26. The relative sizes of the pulleys 23 and 25, and the pulleys 15 and 16 and the gear reduction 21 cause the belt 14 to advance at a relatively slow speed.

The end of the belt trained about the pulley 15 is the receiving end and mounted thereover on a suitable support 27 is a tray 28 having a discharge opening 29 from which extends a guide 30. The guide lies close to the upper stretch of the belt and the units 8 are moved thereover from the tray onto the pulley 14 by an operator, a belt support 31 being mounted under the guide 30, as illustrated.

As the upper stretch of the belt moves from the pulley 15 to the pulley 16, the units thereon are subjected to the influence of a current having the power or capacity to reduce the internal resistance of the unit. This is accomplished in the present embodiment by means of pairs of contact members 32 and 33 forming spark gaps through which the upper stretch of the belt and the units 8 thereon

pass as the current jumps from one contact to the other of each pair.

The contacts of each pair are supported from an oscillating lever 34, the upper-most contact being preferably adjustable by a screw or other means 35 to regulate the length of the spark gap. The lever 34 is supported from a shaft 36 journaled at one end in a bearing 37 and at its other end in a bearing 38, an actuating lever 39 having one end fixed to the shaft and its other end 40 held in engagement with a rotating eccentric 41 fixed on the shaft 22, by a spring 42. The shaft 22 being constantly rotated as the belt is advanced, rapidly oscillates the lever 34 to move the contacts across substantially the entire width of the belt to insure the passing of the units through the path of the current flowing across the spark gaps. But one pair of contacts may be used, but the provision of more than one insures each unit coming within the influence of the current flowing across the contacts.

The circuit illustrated in connection with the present embodiment of my invention consists of a spark coil 43 which may be of conventional construction having a primary coil 44 and a secondary coil 45, the primary coil being connected with a source of energy 46 by conductors 47 and 48, a controlling switch 49 located within one of the conductors to permit the disruption of the circuit. One end of the secondary coil is connected with the upper contact of one pair by a conductor 50 and the other end thereof is connected with the lower contact of the pair by a conductor 51. A single coil or circuit may be employed if desired for both pairs of contacts, although a separate circuit for each contact is illustrated.

After the units have been subjected to the influence of the current flowing across the spark gap and consequently through the units, they are discharged automatically from the belt at its discharge end into a container 52. The finished units may, after being treated as above described have their scorched or punctured surfaces burnished or smoothed to restore them to their original microphonic condition before being incorporated in a compressible resistor or any other type of device with which the same is adapted to be used. The restoring of the original microphonic condition of the discs can be accomplished by any ordinary smoothing or polishing device, but in practice it has been found satisfactory to merely tumble the discs in a revolving drum.

In Figure 6 another type of resistor unit is illustrated, which is more particularly described and claimed in my application filed herewith and which is especially designed for use as a fixed resistance unit in contradistinction to the use of the type of unit hereinabove described. This unit consists of

a body 53 formed of the ingredients above described and molded under pressure with end caps or contact members 54 which facilitate their connection in an electric circuit. The resistance of the unit illustrated in Figure 6 is reduced by subjecting the same to the influence of a current having the power or capacity to so change the unit characteristics.

As above described, the subjecting of a unit of the character described to the influence of a current of the desired characteristics so acts on the unit as to reduce its resistance and permits the calibration of the resistance to approximately any predetermined value, which it holds against change. The method and apparatus for calibrating the resistance of the unit at approximately any desired predetermined degree is better described and illustrated in my co-pending application above referred to.

From the foregoing description taken in connection with the accompanying drawings, it will be readily apparent to those skilled in the art to which an invention of this character appertains that I provide a very novel and improved resistor unit and method of and apparatus for forming same whereby the unit is very efficient and reliable and can be very efficiently produced.

I claim:

The method of forming a resistor unit, which consists in molding the same from a mixture of 86 parts phenolic condensation product, 10 parts asbestos and 4 parts graphite and in heat treating the unit.

In testimony whereof I affix my signature.

LYNDE BRADLEY.