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METHOD OF MAKING IGNITION APPARATUS

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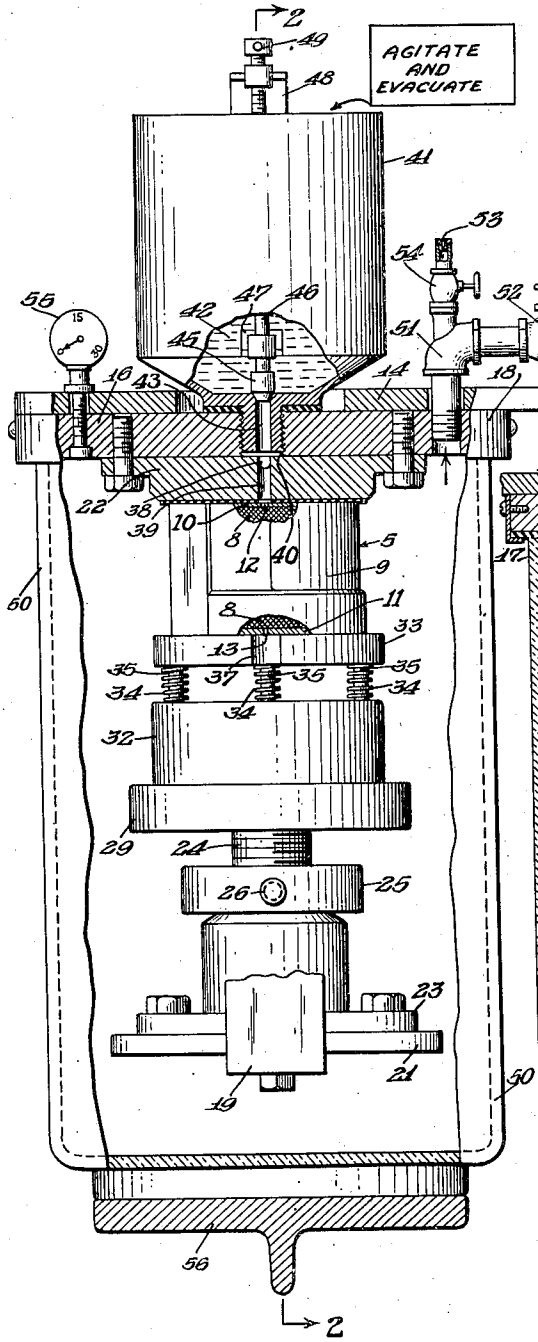


FIG. 1.

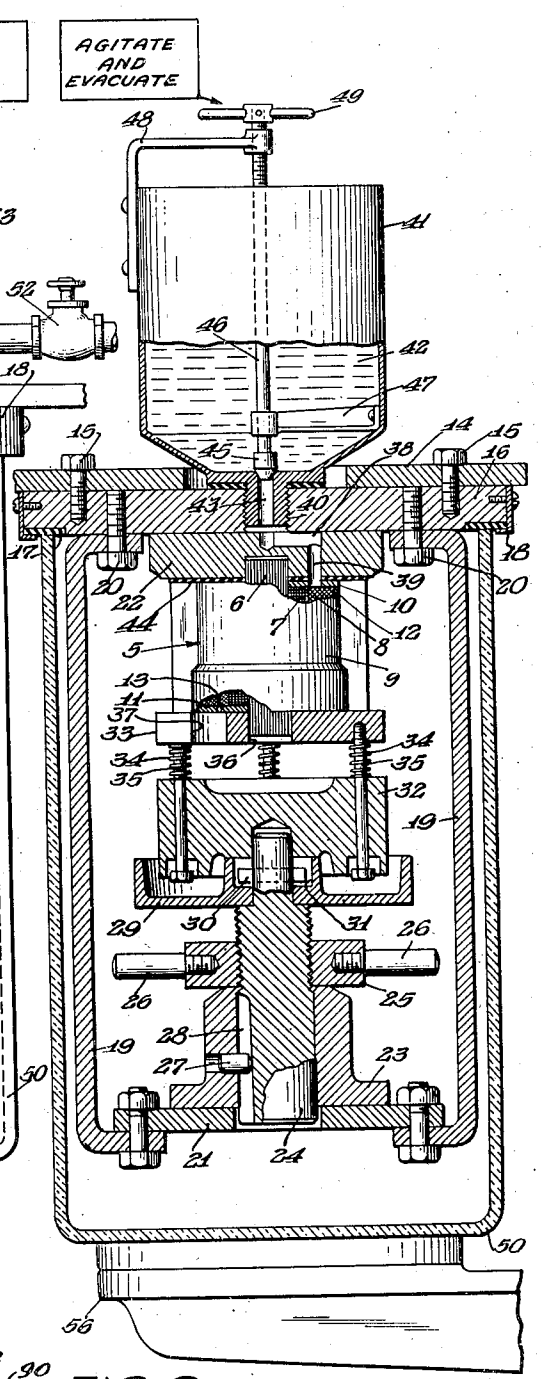


FIG. 2.

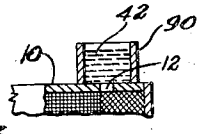


FIG. 3.

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METHOD OF MAKING IGNITION APPARATUS

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This invention relates to methods for making electrical structures impregnated with insulating material.

The desirability of filling the casings of ignition coils and the like with suitable insulating materials and at the same time thoroughly impregnating the contents of the casing with said materials has long been recognized but no satisfactory method of accomplishing the filling in a satisfactory manner with a satisfactory material has heretofore been found. With processes and materials heretofore practiced and used it has not been possible to completely fill the device with a suitable dry substance which has the necessary electrical, heat resisting and moisture repellant qualities.

It is accordingly one of the objects of the present invention to provide a novel method for making ignition apparatus, such as ignition coils and shielding harnesses, wherein the wires for carrying electrical current are encased and embedded in an insulating material.

Another object of the invention is to provide a novel method for filling and impregnating ignition equipment with an insulating material consisting chiefly of processed oil obtained from the shells of cashew nuts or substances having similar properties when suitably processed.

A further object is to provide a novel method of making filled or impregnated ignition apparatus wherein the filling or impregnating material consists of a liquid adapted to dry through chemical reaction with or without the application of heat.

The above and further objects and novel features of the invention will more fully appear from the following detailed description when the same is read in connection with the accompanying drawings. It is to be expressly understood, however, that the drawings are for the purpose of illustration only and are not intended to define the limits of the invention, reference for this latter purpose being had primarily to the appended claims.

In the drawings, wherein like reference characters refer to like parts throughout the several views,

Fig. 1 is a side elevation, partly in section and with parts broken away, of one type of apparatus which may be employed in carrying out the process of the invention;

Fig. 2 is a sectional view of said apparatus taken substantially on line 2—2 of Fig. 1; and

Figure 3 is a detail section showing the shrinkage reservoir in place and full.

The novel process comprehended by the invention is described below, by way of example, in its application to the impregnation of ignition coils and the simultaneous filling of the casings therefor with insulating material. One material

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which has been found to be particularly suitable for filling coils and radio-shielding harnesses consists of a product resulting from the processing of the cashew nut shell oil in accordance with U. S. patents issued to The Harvel Corporation, such as Harvey Patents Nos. 1,725,797, 1,838,077 and 2,128,247. A filling material thus constituted is stable and durable and has excellent heat resisting and insulating properties, as well as being yieldable and hence not subject to cracking under vibration or shock.

One suitable apparatus adapted for use in carrying out the method of the invention and particularly adapted for filling and impregnating an ignition coil 5 is shown in the drawings, by way of example. The coil may be of any suitable design, the one shown comprising a laminated metallic core 6 on which primary and secondary windings 7 and 8 are wound. The windings and the central portion of core 6 are enclosed in a casing which, as illustrated, comprises a shell 9 of molded insulating material and end walls or plates 10 and 11 of similar material surrounding the projecting ends of core 6. The coil casing is preferably rendered substantially air-tight by use of lacquer, wax, or other suitable substances at the inner and outer peripheries of end plates 10 and 11 if these are not integral with shell 9. The walls 10 and 11 are provided with small openings 12 and 13, respectively, the former serving as an inlet for the filling compound and the latter as a bleed hole for air and the filling compound. These openings 12 and 13 are preferably located as far away from one another as is practically possible in order to insure a thorough impregnation of the coil windings as the filling compound finds its way from the inlet 12 to the bleed hole 13.

The mechanism shown for filling coil 5 comprises a stationary support or member 14 mounted on a table or bench in any suitable manner (not shown). Attached to the bottom face of member 14 by bolts 15 is a plate 16 which has a gasket 17 of rubber or other suitable material countersunk in the periphery thereof and held in place by a bracket 18. Suspended from plate 16 is a rigid supporting cradle consisting of two straps 19, which are secured to the plate by bolts 20, and a cross-piece 21 secured to the lower ends of straps 19.

Cradle 19, 21 serves as a mounting for suitable supporting apparatus for coil 5 whereby the latter may be raised and lowered into and out of contact with an adapter plate 22 to be hereinafter described. Said supporting apparatus, in the form shown, consists of a block 23 having a bore for slidably receiving a spindle 24. The upper portion of the latter is threaded and has a nut 25 threaded thereon which rests upon the upper surface of block 23 and may be turned in oppo-

site directions by means of suitable handles 26 to effect a raising and lowering of spindle 24. The latter is prevented from turning by a pin 27, which is mounted in block 23 and extends into a longitudinal slot 28 in spindle 24. On the upper end of said spindle there is preferably mounted a tray 29 for catching any filling material that flows out of coil casing 9 through bleed hole 13, said tray being held against rotary movement, if desired, by a pin and slot connection 30, 31 with spindle 24.

Loosely mounted on tray 29 is an adapter assembly which may be varied to suit the particular type of coil or other unit being filled. In the form shown, said assembly comprises a member 32 which is centered by the reduced upper portion of spindle 24 and rests upon the central portion of tray 29. A plate 33, which engages the lower face or end of coil 5, is resiliently supported on member 32 by a plurality of springs 34, of which there are preferably four, that surround guide pins 35 which are attached to plate 33 and slidably extend through passages in member 32.

The specific structure of plate 33 will depend upon the particular coil or other unit for which it is adapted. As shown, adapter plate 33 is provided with a passage 36 for receiving the lower end of coil core 6. It is also provided with a groove 37 at the periphery of plate 33 (Fig. 1) for the purpose of clearing bleed opening 13 to permit air and filling compound to flow out through the latter.

Mounted on the lower face of plate 16 directly above coil 5 is the upper adapter plate 22, the construction of which also depends upon the contour of the device being filled with insulating compound. As shown, plate 22 is countersunk for receiving the end of core 6 and is provided with a slot 38 in the upper surface thereof for directing the filling compound. Slot 38 is connected at one end with a passage 39 leading to inlet opening 12 and at its other end to a central threaded opening 40 in plate 16. A supply container 41 for filling compound 42 is provided at its lower end with a threaded extension or nipple threaded into opening 40. The compound will thus flow through outlet 43 in the bottom of the container, through slot 38 and passage 39 into the coil casing through opening 12. If desired, a gasket 44 of cork or other suitable material may be interposed between the upper face of coil 5 and adapter plate 22 to render the contact between coil 5 and plate 22 substantially air and liquid tight.

Container 41 is fitted with a valve 45 for opening and closing outlet 43. Valve stem 46 is guided at its lower end by a bracket 47 and has external threads at the upper end thereof which cooperate with internal threads on a bracket 48. Handles 49 may be fixed to the upper end of stem 46 for the purpose of turning it to thereby move valve 45 to closed or open position.

Coil 5 and its supporting structure may be enclosed by a removable jar 50 which is preferably made of glass. The upper edge of jar 50 fits against gasket 17 (Fig. 2). The air may be exhausted from said jar and, hence, from the interior of coil 5 by means of a conduit 51 which is fixed in an opening in plate 16 and connected through a valve 52 with a suitable source of vacuum, such as a suction pump (not shown). The interior of jar 50 may also be connected with atmosphere through a small bleed hole 53 in the end of a pipe through which flow is controlled by a valve 54.

A suitable pressure gauge 55 may be provided for indicating the pressure within jar 50 and a support or pad 56 may be suitably hinged or otherwise suitably supported so that it may be swung beneath jar 50 to obviate dropping and breaking of the latter if the vacuum within the jar should fail. The detailed operation of the above-described apparatus will appear from the following description of the novel process comprehended by the invention.

In carrying out the process of the invention as applied to coil 5, the primary and secondary windings 7, 8 of the coil are wound on core 6 and then thoroughly dried in a vacuum oven. The winding and core assembly is then placed in casing 9, 10 and cover 11 is put in place. The other end 10 of the casing may be integral with shell 9 or, if it is not, it may be installed in the same manner as cover 11. The outer rim of cover 11 is coated, before it is inserted in shell 9, with a sealing substance, such as tacky "Bakelite" varnish or lacquer to hold the same in place and render the joint substantially air-tight. In addition, varnish or some other sealing substance may be placed on the joint after the cover is in place. Any spaces between core 6 and the peripheries of the openings in the ends 10, 11 of the coil casing and any openings for electrical leads or the like may be sealed with valspar putty or a similar sealing substance. The encased coil is then dried again in a vacuum oven, after which it is ready for filling with the insulating compound 42.

One compound which has been successfully used in carrying out the process comprises a mixture of processed cashew nut shell oil and paraformaldehyde, formaldehyde, or a similar reaction agent. In preparing this compound or mixture, three parts by weight of powdered paraformaldehyde are slowly added to and simultaneously thoroughly mixed with 100 parts by weight of processed cashew nut shell oil, such as that known commercially as Harvel No. 621 made by Irvington Varnish and Insulator Company, Irvington, New Jersey, said processed oil having a viscosity, at 75° to 80° F., of about that of heavy liquid lubricating oil. After these ingredients have been thoroughly mixed in an open top container, the latter with the mixture therein is placed under a high vacuum in a bell jar or the like and the mixture is stirred vigorously for several minutes. After stopping the mixer or agitator, the filling mixture is submitted to atmospheric pressure again. This vigorous mixing or stirring under vacuum should be repeated one or more times for the purpose of removing substantially all air and gases from the mixture.

When substantially all of the gases have been removed from the mixture in the above manner, it is placed in container 41 while valve 45 is in closed position. With the coil held firmly between adapter plates 22 and 33 in the manner shown in the drawings and after a high vacuum (preferably 28 to 30 inches) has been established in jar 50 by opening valve 52, the valve 45 is moved to open position by turning stem 46 with handle 49. The compound 42 is then forced from the container by atmospheric pressure into the evacuated coil casing through inlet opening 12 and fills all of the voids therein, some finally reaching and flowing out through bleed port 13.

After a small amount of the filling compound 42 has come out through bleed port 13 and such flow is smooth and continuous, thereby indicating that the coil casing is completely filled and the coil windings are impregnated with the compound,

the vacuum valve 52 is closed and atmospheric valve 54 is opened to permit the entrance of air through opening 53. The latter is preferably very small so that the change from full vacuum to atmospheric pressure within jar 50 takes place slowly. Success has been had by employing an atmospheric bleed port 53 of such size that it requires from about thirty seconds to a minute for the complete pressure change. The pressure change should be sufficiently slow to prevent any backing up of the liquid filling compound in the coil casing due to the pressure at bleed port 13. After atmospheric pressure has been restored in jar 50, as indicated by gauge 55, the jar is removed and adapter plate 33 is lowered away from coil 5 by turning nut 25 while the coil is manually held by the operator against adapter plate 22. The coil should be drawn away from the latter plate at the same time that valve 45 is moved toward closed position. The valve is constructed in such a manner as to serve during the closing movement thereof as a plunger for forcing filling compound 42 toward the coil and out through hole 13, thereby preventing any of the compound from being pulled out of the coil casing through opening 12 due to its viscosity and preventing the entrance of any air through hole 13.

Immediately after removal of the coil in this manner, a cover, such as adhesive tape, is placed over opening 13 and a small hollow cylinder 90 of any suitable material, which serves as a reservoir, is placed on end on the end 10 of the casing around opening 12 and filled with some of the filling compound 42. If there have been any bubbles in the filling material within the casing, this additional compound will be drawn into the coil casing when the bubbles contract after removal of the coil from the vacuum chamber or when any settling of the compound occurs for any other reason.

The filled coil is then preferably placed in an oven and baked for the purpose of speeding up the chemical setting of the liquid compound 42. Suitable baking for a coil of the type illustrated in the drawings may require approximately 15 hours at 120° F. and then 4 hours at 200° F. The times and temperatures may differ for different size and types of filled units. In the filling of radio-shielding harnesses and other devices which differ considerably in shape from coil 5, it is necessary to employ apparatus which differs considerably in design from the apparatus illustrated but the fundamental method employed is the same.

There is thus provided a novel method for making ignition devices, such as coils, radio-shielding harnesses, etc., which are filled after complete assembly with insulating material which may be injected into the same in liquid form and which sets without appreciable shrinkage to a dry, yieldable solid that is not affected by high temperatures or moisture and has good insulating properties. The invention also comprehends a novel method for filling such devices whereby the outer surface of the device is not contaminated in any way with the filling material.

Although the method of this invention has been described in its application to the filling of encased ignition coils, it is to be expressly understood that the invention is not limited thereto. It will also be understood that the process of the invention may be carried out with apparatus other than the specific apparatus illustrated in the drawings. Other variations which will now be apparent to those skilled in the art may also be made in the specific details of the method and

apparatus described without departing from the spirit and scope of the invention. For a definition of the limits of the invention, reference is had primarily to the appended claims.

What is claimed is:

1. The method of vacuum filling and impregnating an ignition device of the type having a substantially fluid-tight casing except for one or more filling holes and one or more bleed holes adjacent the opposite ends thereof, which method consists in placing said casing in a chamber with the interior of the casing in communication with the chamber through a bleed hole, evacuating said chamber and casing, subjecting a liquid filling compound to a stirring action under vacuum to remove substantially all free gases therefrom, employing the vacuum in said chamber to inject said gas-free compound through a filling hole into said casing until said compound flows from said bleed hole, slowly admitting air to the chamber to gradually reestablish atmospheric pressure therein, and subjecting the filled casing to heat to accelerate the setting of said compound.

2. The method of filling and impregnating ignition apparatus with an insulating compound, said apparatus being of the type having a casing which is substantially fluid-tight except for filling and outlet openings therein, said filling and outlet openings being remotely spaced from each other, which includes the steps of placing said casing in a chamber with the interior of the casing in communication with said chamber through said outlet opening, evacuating said chamber and casing, subjecting a liquid filling compound to stirring action under vacuum to remove substantially all free gases therefrom, injecting said compound into said casing through said filling opening until the casing is filled, and slowly admitting air to said chamber for gradually reestablishing atmospheric pressure therein.

3. The method of insulating ignition apparatus and the like with a liquid compound, said apparatus being of the type having a casing which is substantially fluid-tight except for filling and outlet openings therein, said filling and outlet openings being remotely spaced from each other, which consists in placing said casing in a chamber with the interior of the casing in communication with said chamber through said outlet opening, evacuating said chamber and casing, subjecting a quantity of processed cashew-nut-shell oil to a stirring action while slowly adding thereto a powdered drying agent, such as paraformaldehyde, subjecting the resulting mixture to a stirring action in an evacuated space, injecting said compound into said casing through said filling opening until the casing is filled, and slowly admitting air to said chamber for gradually reestablishing atmospheric pressure therein.

4. The method of insulating ignition apparatus of the type having a casing which encloses electrical conductors, which includes the steps of evacuating the interior of said casing, subjecting a liquid insulating compound to a stirring action under vacuum for removing substantially all free gases therefrom, injecting said compound into the interior of said evacuated casing to completely fill the latter and heating the casing to solidify the compound.

5. The method of insulating ignition apparatus of the type having a casing for enclosing electrical conducting means, which consists in subjecting a flowable insulating substance to a stirring action under vacuum for removing substan-

tially all free gases therefrom, evacuating said casing through an opening in one side thereof, and injecting said substance into said casing through an opening in the other side thereof until said casing is filled with said substance.

6. In the method of insulating ignition apparatus of the type comprising a casing, the steps of subjecting a liquid filling compound to stirring action under vacuum to remove substantially all the free gases therefrom, placing said casing in a closed chamber and evacuating said chamber and casing, injecting said compound into said casing through an opening in the wall thereof, and slowly subjecting the casing to atmospheric pressure.

7. In the method of insulating ignition apparatus of the type having a casing, the steps of removing free gases from a liquid substance having a relatively high viscosity, evacuating said casing, injecting said liquid into said evacuated casing through an opening in the wall of the latter, and slowly subjecting the casing to atmospheric pressure.

8. In the method of insulating ignition apparatus of the type having a casing, the steps of removing free gases from a liquid substance having a relatively high viscosity, injecting said liquid into said evacuated casing through an opening in the wall of the latter, gradually reestablishing atmospheric pressure in said casing, and thereafter placing a reservoir of said substance in communication with said filling opening while the liquid substance settles and sets in said casing.

9. In the method of insulating ignition apparatus of the type having a casing, the steps of stirring a quantity of polymerized cashew-nut-shell oil while slowly adding thereto a drying agent, such as paraformaldehyde, removing substantially all free gases from said mixture, injecting said gas-free mixture into the evacuated casing for filling the voids in the latter, and slowly subjecting the casing to atmospheric pressure.

10. A method for insulating an ignition device of the type having conductors mounted within a substantially air-tight casing having a filling aperture in one end and a bleed hole in the opposite end thereof, which consists in positioning the casing within a removable container, evacuating the container and casing, introducing through the inlet opening of the casing a liquid insulator from which free gases have been removed, slowly subjecting the casing to atmospheric pressure and baking the casing to accelerate the setting of the liquid insulator.

11. A method for insulating an ignition device of the type having electrical conductors enclosed in a substantially air-tight casing provided with an inlet opening in one end and a bleed opening in the other end, which consists in simultaneously agitating and subjecting a liquid insulator to a vacuum to remove free gases therefrom, introducing the gas-free insulator through the inlet opening by vacuum effective at the outlet opening, slowly subjecting the casing to atmospheric pressure, and heating the casing to accelerate the solidification of the liquid insulator.

12. The method of filling and impregnating ignition apparatus with an insulating compound, said apparatus being of the type having a casing which is substantially fluid tight except for filling and outlet openings therein, said filling and outlet openings being remotely spaced from each other, which includes the steps of placing said casing in a chamber with the interior of the casing in communication with said chamber through said outlet opening, injecting a liquid filling compound from which substantially all free gases have been removed into said casing through said filling opening until the casing is filled, and slowly admitting air to said chamber for gradually reestablishing atmospheric pressure therein.

13. The method of insulating ignition apparatus and the like with a liquid compound, said apparatus being of the type having a casing which is substantially fluid tight except for filling and outlet openings therein, said filling and outlet openings being remotely spaced from each other, which comprises the steps of placing said casing in a chamber with the interior of the casing in communication with said chamber through said outlet opening, evacuating said chamber and casing, injecting a liquid compound into said casing through said filling opening until the casing is filled, said compound comprising a mixture of processed cashew-nut-shell oil and a powdered drying agent, such as paraformaldehyde, from which substantially all free gases have been removed, and slowly admitting air to said chamber for gradually reestablishing atmospheric pressure therein after said casing is filled.

14. The method of setting an encased magneto coil in a resilient solid that comprises stirring cashew nut shell oil under vacuum whereby to remove therefrom entrapped gases, evacuating the encased magneto coil and impregnating it with a composition comprising the degassed oil and formaldehyde under conditions that tend to maintain the vacuum and exclude gases, setting the oil about the coil by heat, and supplying additional oil to compensate for volume change during setting.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
483,397	Smith	Sept. 27, 1892
518,946	Forbes	May 1, 1894
627,398	Dolley et al.	June 30, 1899
691,675	Thomson	Jan. 21, 1902
917,018	Dempster	Apr. 6, 1909
1,037,824	Fasting	Sept. 3, 1912
1,242,673	Schroeder	Oct. 9, 1917
1,270,969	Parker	July 2, 1918
1,754,003	Johnson et al.	Apr. 8, 1930
1,838,077	Harvey	Dec. 22, 1931
2,047,260	Franklin	July 14, 1936
2,047,273	Kopinski	July 14, 1936
2,091,234	Branson	Aug. 24, 1937
2,136,423	Fields et al.	Nov. 15, 1938
2,142,270	Henst	Jan. 3, 1939
2,166,205	Anderson et al.	July 18, 1939
2,183,763	Brown	Dec. 19, 1939
2,300,910	Camilli	Nov. 3, 1942

FOREIGN PATENTS

Number	Country	Date
389,236	Great Britain	Mar. 16, 1933
410,807	Great Britain	May 22, 1934