

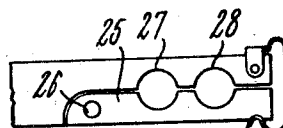
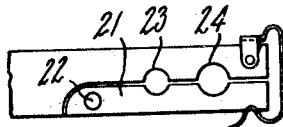
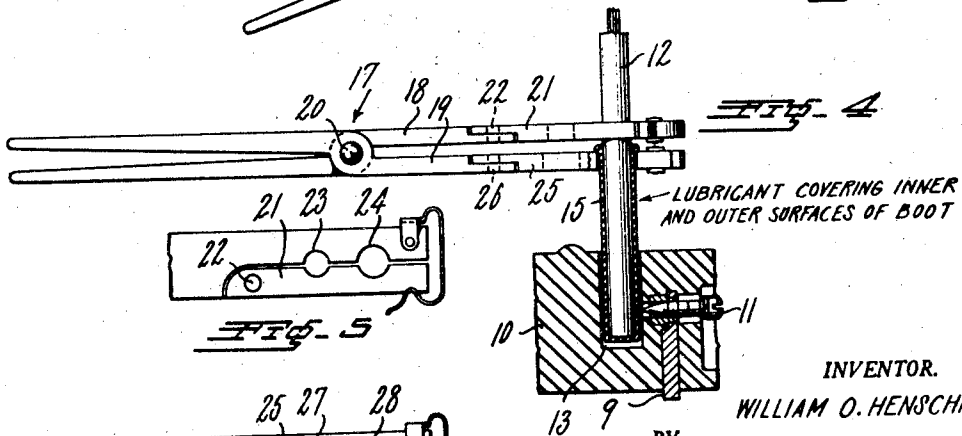
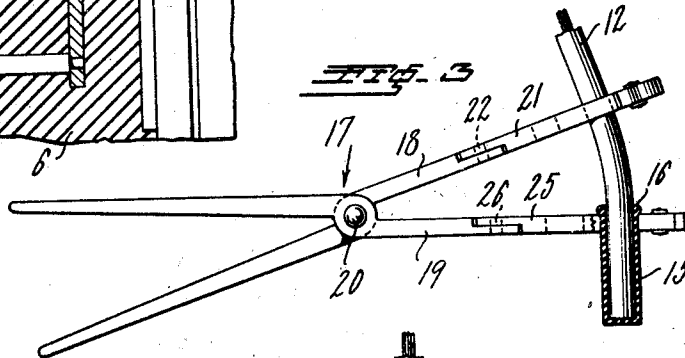
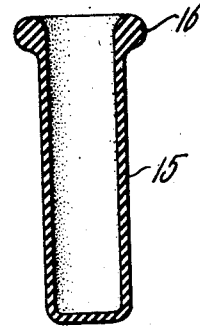
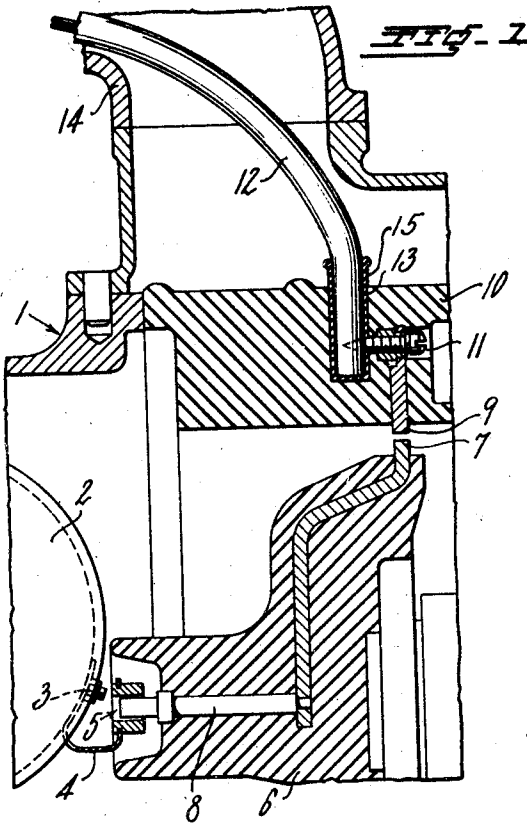
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SEALING HIGH TENSION IN SOCKETS

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SEALING HIGH-TENSION WIRES IN
SOCKETS

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3 Claims. (Cl. 173—340)

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This invention relates to methods of and means for sealing and resealing insulated high tension wires in insulator sockets of electrical devices, for example the sockets of distributor blocks of insulating material for high tension ignition generators as magnetos or timer distributors, and particularly for the sealing and resealing thereof to fill the space between the wire and socket to thereby prevent at high altitudes of operation electrical discharges or flashovers from the electrical connector in the socket for the wire to metal parts outside the socket, owing to the reduced dielectric strength of the rarified atmosphere to which the electrical connector is exposed, said method and means permitting the removal at will of the seal and wire from the socket.

Heretofore where high tension wires extended into sockets, appreciable space existed between the outer surface of the insulation of the wire and the interior of the socket, or at least in portions of such space, due to looseness of the wire in the socket or to depressions, projections or other irregularities on the surface of the wire or the socket. It happened therefore that when such space was subjected to rarified atmosphere as at high altitudes, electrical discharges sometimes passed from any uninsulated high tension part in the socket as the piercing screw or other electrical connector for the wire to any metal part near the socket as the radio shield. In the case of an ignition generator the distributor block of insulating material containing the sockets for the high tension wires leading to the spark plugs of the associated internal combustion engine, were often subjected to such electrical discharges no matter how much spacing distance as a practical matter existed between the connector and the metal part if the altitudes of operation exceeded about 35,000 feet as is sometimes reached by combat airplanes. Thus the block became carbonized or cracked or in other ways had its insulating property reduced or destroyed. This then resulted in the electrical breakdown of the block and the entire ignition system and thereby resulted in danger to the airplane. Furthermore, the loss of energy from the ignition generator through dissipation due to this cause, even before the destruction of the insulating property of the block, interfered with the ignition at the sparkplugs and thereby resulted in reduction in power output of the engine or in stopping it. In some cases the ignition generator was redesigned to meet this situation, as by a construction arranged to maintain compressed

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or supercharging air or an inert gas of sufficient pressure or density around the exterior of the distributor plate where the sparkplug wires were connected. Such redesign was costly and often resulted in increased size and weight of the generator and sometimes in the failure thereof upon excessive leakage of the supercharging air or of the inert gas. In other cases the exposed sockets were filled with insulated compound to fill the spaces around the wire, but then the wires were not readily removable and replaceable, and also the operation cannot be performed so readily in the field to overcome flashover troubles occurring in magnetos installed on airplanes.

In accordance with this invention, I provide a sack-shaped member or boot of elastic insulating material, as rubber and more preferably synthetic rubber capable of resisting oil and gasoline and retaining permanently its elasticity at the extreme temperatures likely to be attained in service. This boot when collapsed has an inner diameter at most substantially equal to the outer diameter of the wire over its insulation, and an outer diameter at least substantially equal to the inner diameter of the socket, but preferably an inner diameter less than that and an outer diameter more than that so that when assembled as noted hereinafter the boot more snugly fits the wire and socket and into the irregularities of the surfaces thereof to thereby fill solidly the space between the wire and socket and to exclude the free passage of air therebetween. This boot is placed over the end of the wire to be inserted in the socket, and before insertion therein is stretched in an appropriate manner and to an appropriate extent. In this step of stretching, the inner surface of the boot creeps along the outer surface of the wire and the outer diameter of the boot is decreased as a result of the reduced thickness of its wall. The wire with the stretched boot around its end is then inserted in the socket and when down therein, the boot is released to assume its collapsed condition, whereupon it fills the space between the wire and the socket as aforesaid. The piercing screw or other electrical connector for the wire may be made either while the boot is stretched or is collapsed, but preferably the latter since the electrical connection is thereby facilitated and the space in the socket around the connector is filled in either case. In order that the boot in being stretched and in collapsing will slide along the wire and the socket more readily and will not stick to either at any place and thereby prevent the uniform stretching and collapsing of the boot, pref-

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erably a suitable lubricant is spread over the inside and outside surfaces of the boot. Preferably also, a bead is formed at or near the open end of the boot so as to prevent the stretching tool, when used, from slipping off the end of the boot in stretching the same, and also to strengthen the open end of the boot.

This invention not only includes the method of inserting the boot-enclosed end of the insulated wire in the insulator socket and electrically connecting the wire therein, but it also includes the structure resulting from that method of sealing the wire in the socket. The accompanying drawings illustrate the preferred embodiments thereof in application, as an example, to a distributor block of a multicylinder high tension magneto.

Fig. 1 shows in vertical section, partly in elevation, a portion of a magneto having in the outer surface of its distributor block sockets for the insertion of insulated wires leading to the spark-plugs of the cylinders of an associated internal combustion engine; Fig. 2 shows in central longitudinal section, on an enlarged scale, an insulating boot of synthetic rubber, in collapsed condition, intended for insertion in a socket of Fig. 1; Fig. 3 shows in plan view, partly broken away, a plier type of tool for stretching the boot on the end of the wire preliminarily to its insertion in the socket, the boot being shown in collapsed condition before the stretching operation; Fig. 4 shows the elastic boot in stretched condition on the end of the wire in the process of being inserted in the socket; Fig. 5 shows in side elevation one jaw of the tool for use with two different diameters of insulated wires; and Fig. 6 shows in side elevation the other jaw of the tool for use with one outer diameter of boot.

Referring to Fig. 1, the internally supercharged magneto 1 has any suitable form of magnetic stator and rotor structures (not shown) for generating ignition impulses in a high tension ignition coil 2 at the high tension terminal 3 thereof. This terminal is electrically connected by the conductor 4 to a gap connector 5 arranged on the axis of rotation of the distributor rotor 6 of insulating material having a distributor electrode 7 which is electrically connected to the gap connector by the conductor 8 and which is sequentially cooperative in the well known way with the circularly arranged stationary electrodes as 9 of the distributor block 10 of insulating material. This electrode 9 is provided with a piercing screw 11 for electrically connecting the electrode to the insulated wire 12 which, as hereinafter described, is arranged in the socket 13 of the distributor block and which together with the wires from other similar sockets, leads into and through the grounded ignition manifold 14 to the sparkplugs in the engine cylinders in the well known way.

The cable boot 15, when collapsed, is of a length greater than the depth of the socket, as shown in Fig. 1, and is made of synthetic rubber of so-called elastic grade, which is unaffected by suitable oil or other lubricant, as hereinafter noted, at the extreme temperatures likely to be attained in service, and also is substantially unaffected by any corona effects occurring at high altitudes, that is such as is permanently elastic throughout its operating life in the service for which it is intended. Also, when collapsed, this boot has an outer diameter at least substantially equal to the diameter of the socket 13 in which it is to be inserted, and preferably has an outer

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diameter slightly greater than the diameter of the socket so that when collapsed it more completely fills all the depressions, projections and other irregularities in the surface of the socket. Furthermore, when collapsed, the boot has an inner diameter at most substantially equal to the outer diameter of the insulated wire 12, and preferably an inner diameter slightly less than the diameter of the wire so as to snugly fit around the wire and fill all the depressions, projections and other irregularities of the insulation thereof. The boot 15 has a bead 16 arranged around its open end so that, as hereinafter described, the tool for stretching the boot will be less apt to slip off the outer end of the boot in stretching the same and also so as to strengthen the open rim of the boot. As an example of the dimensions of the preferred form of boot for a 7 mm. insulated wire having a diameter of 0.270 in. to 0.290 in., for which the socket has a diameter of 0.295 in. to 0.300 in., the boot when collapsed has an inner diameter of 0.270 in. to 0.275 in. and an outer diameter of 0.315 in. to 0.320 in. In order to use in the same socket a 5 in. insulated wire having a diameter of 0.200 in. to 0.208 in., the boot has an inner diameter of 0.200 in. to 0.205 in. and the same outer diameter as noted above.

The tool preferably used in inserting the boot-enclosed wire in the socket 13, according to the method hereinafter described, is in the form of pliers 17 having two arms 18 and 19 pivoted at 20. The arm 18 has a spring-closed jaw 21 which is pivoted at 22 and has two clamping depressions at 23 and 24 for 5 mm. and 7 mm. wires respectively. The arm 19 has a spring-closed jaw 25 which is pivoted at 26 and has two clamping depressions at 27 and 28 for boots of the same outer diameters for insertion in one size of socket. To clamp the wire 12 in depression 24, the jaw 21 is lifted after the removal of its spring to permit the insertion of the wire, and then the jaw is released to hold the wire firmly against slippage. After the boot 15 is slipped over the end of the wire as far as the wire goes into the boot, and after the arms 18 and 19 of the pliers are appropriately separated as shown in Fig. 3, the jaw 25 is lifted after the removal of its spring to permit the insertion of the boot-enclosed wire in the depression 28 with the jaw 25 against the bead 16, and then the jaw is released to hold the boot firmly against slippage. It will be obvious that then by bringing together the handles of the arms 18 and 19, the boot 15 will be stretched as shown in Fig. 4.

The preferred method of inserting the boot-enclosed end of a 7 mm. wire in the socket 13 is as follows: With the wire and boot gripped by the jaws of the pliers 17 as shown in Fig. 3 and while the pliers close to the position shown in Fig. 4 to stretch the elastic boot the proper amount, the inner surface of the boot 15 slides along the outer surface of the wire, and the outer diameter of the boot is reduced to that at which it may be pushed readily to the bottom of the socket. When the jaw 25 of the pliers is then released and the boot held down in the socket, the boot collapses in the socket to fill the space between the wire and socket together with the depressions, projections and irregularities of the wire and socket. Then when the jaw 21 is released from the wire, the pliers alone may be removed, there being ample space for this purpose between the top of the distributor block 10 and the underside of the bead 16. Con-

nection between the stationary electrode 9 of the distributor and the wire is made by screwing the piercing screw 11 into the electrical conductor of the wire, which may be done while the boot is in stretched condition, but for convenience in operation is done after the boot is collapsed. In either case, the boot snugly fits around the portion of the piercing screw extending into the socket as well as around the wire and inside the socket.

In order that the boot will not cling to the wire in any place in stretching it over the end of the wire or in collapsing from that stretched position, it is preferable to provide suitable lubricant on the inside surface of the boot; and in order that the boot will not cling to the socket at any place upon collapsing therein, it is preferable to apply lubricant to the outside surface also of the boot. This lubricant also fills all remaining air pockets between the boot, wire and socket with insulating material which also acts to reduce or prevent electrical breakdown at high altitudes. This lubricant may be oil or Vaseline or any other material which does not affect the synthetic rubber or other elastic material of which the boot is made, and which is stable under the extreme temperatures likely to be attained by the magneto in service and which is an electrical insulator of suitable characteristics at such temperatures. Such lubricants are well known in the art. Graphite, soap or other substances not insulating when dry or after absorbing moisture, are not suitable for this purpose.

Whereas it has been found without the use of this boot, that electrical discharges or flashovers occur along the socket from the piercing screw 11 to a part of the manifold 14 when the magneto is operating in the rarified atmosphere at an altitude greater than about 35,000 feet, tests with the use of the boot herein described indicate that such electrical discharges are prevented up to an altitude of at least 55,000 feet. In this way carbonization or breakage of the distributor block due to this cause, and dissipation of energy from the magneto due to this cause, are prevented or at least reduced so that the magneto functions properly over longer periods of service and at altitudes greatly exceeding those now possible. Also this boot may be applied to insulated high tension wires of ignition generators already installed on airplanes or other electrical devices or engines intended for operation at great altitudes. Furthermore, the wires so fitted may be readily removed and replaced whenever desired.

It will be understood that while a preferred design of boot and a preferred method of inserting the boot in the socket are herein disclosed, many modifications therein and in the tool for use in such method are possible within the scope of this invention. For instance, the boot may have other appropriate lengths and inner and outer diameters and be of different thickness to provide for different sockets and for different sizes of wire, and also the material of the boot may be of other suitable elastic insulating material as plastic material having the characteristics herein set forth in accordance with the principles herein disclosed. Also the sockets may be in insulating members of high tension apparatus other than the distributors of magnetos. Also the wires may have any suitable kind of insulation for the purpose, and the electrical connector may be of a form other than the piercing screw herein shown. These and other modifica-

tions and changes are intended to be included within the broad terms of the appended claims.

Having thus described my invention, what I claim is:

1. The method of removably and insulatingly sealing or resealing in an electrical device intended to be subjected to rarified atmosphere the space between an insulated high tension wire and an insulator socket in such manner that the wire and seal may be withdrawn from the socket at will, and also sealing the space in the socket around an electric connector for the wire, which consists in enclosing the end of the wire in a permanently elastic insulating boot having a normal inner diameter less than the outer diameter of the wire to be placed therein and a normal outer diameter greater than the inner diameter of the socket adapted to receive the same, then stretching the boot while on the wire to reduce the outer diameter of the boot to that required to enter the socket, then inserting the wire and boot in the socket while maintaining the boot in stretched condition around the wire, and then releasing the entire boot so that it tends to return to normal and fills the space between the wire and socket, said boot and wire being removable at will from the socket by stretching the boot on the wire within the socket until the outer diameter of the boot is reduced to that required to be withdrawn from the socket with the wire therein and inserting a connector in the socket into electrical connection with the wire so that when normal the boot fills the space between the wire and socket and also fills the space in the socket around the connector.

2. The method of removably and insulatingly sealing or resealing in an electrical device intended to be subjected to rarified atmosphere the space between an insulated high tension wire and an insulator socket in such manner that the wire and seal may be withdrawn from the socket at will, and also sealing the space in the socket around an electric connector for the wire, which consists in enclosing the end of the wire in a permanently elastic insulating boot having a normal inner diameter at most substantially equal to the outer diameter of the wire to be placed therein and a normal outer diameter at least substantially equal to the inner diameter of the socket adapted to receive a portion of said wire with said boot thereover, then stretching the boot while on the wire to reduce the outer diameter of the boot to that required to enter the socket, then inserting the wire and boot in the socket while maintaining the boot in stretched condition around the wire, and then releasing the entire boot and inserting the connector in the socket into electrical connection with the wire so that when normal the boot fills the space between the wire and socket and also fills the space in the socket around the connector.

3. In a sealed insulator socket of an electrical device intended to be subjected to rarified atmosphere and containing an insulated high tension wire, a removable permanently elastic insulating boot with a closed end which extends over the end of the wire and which has its inner surface snugly fitting the wire and its outer surface snugly fitting the interior of the socket to thereby fill the space between the wire and socket, said boot when stretched on said wire having an outer diameter at most substantially equal to the inner diameter of the socket, and an electrical connector extending through the boot into

electrical connection with the wire, said boot and wire being removable at will from the socket by stretching the boot on the wire within the socket until the outer diameter of the boot is reduced to that required to be withdrawn from the socket with the wire therein.

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