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H. C. HARRISON

2,115,143

ELECTRICAL CABLE

Filed Sept. 22, 1934

FIG. 1

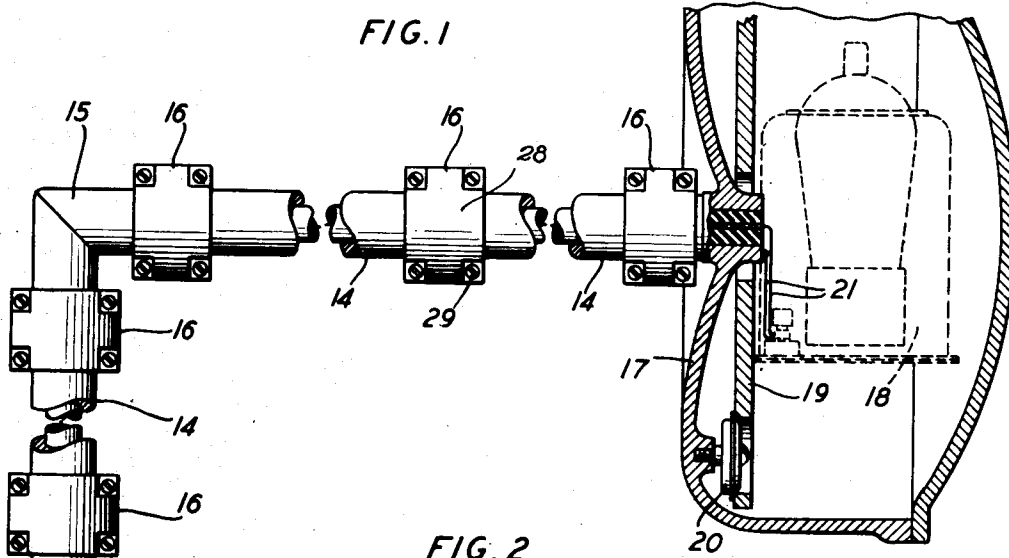


FIG. 2

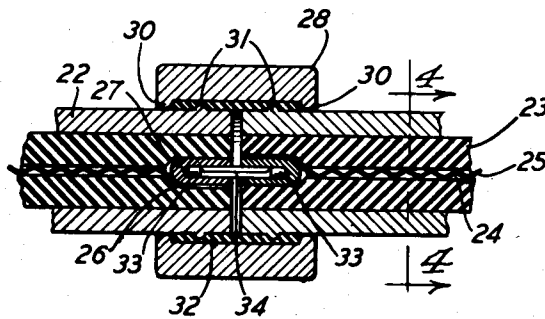


FIG. 3

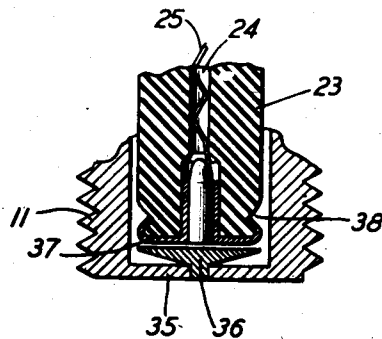
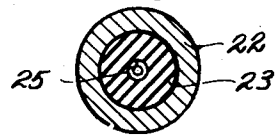


Fig. 4



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ELECTRICAL CABLE

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3 Claims. (Cl. 173-264)

This invention relates to apparatus for transmitting minute changes in electrical potential, such as occur between the plates of a condenser type microphone, over relatively long distances.

One of the difficulties encountered in the use of a condenser type microphone is the transmission over even short distances of the voltage changes induced therein without simultaneously picking up a large amount of voltage changes induced in the line itself. Due to the initial minuteness of the voltage changes induced in such a microphone, it is necessary to use high amplification which further accentuates the stray voltage changes picked up and results in a low signal-to-noise ratio.

The object of this invention is the transmission of minute voltage changes without the addition thereto of parasitic voltage changes induced in the transmission line itself.

A feature of the invention is a transmission line comprising a conducting outer shell and a central lead, the capacity between the shell and lead being substantially constant regardless of the amount of vibration imparted to the line from external mechanical sources.

Another feature is the method of making such a line.

Still another feature is the mechanical coupling between adjoining sections of the line which permits an adjustment to be made between the ends of the line, and which also serves, to some extent, as a mechanical filter.

In its preferred form this invention comprises sections of heavy pipe shrunk upon a rigid insulator in the center of which is formed a hole. A helical lead is drawn through the hole and is held therein by its own radial resiliency. The sections are clamped together to form a continuous line and novel terminals are provided at the ends of the helical lead in each section whereby an electrical connection may be established readily and quickly therebetween.

For purposes of illustration, this invention will be described with reference to an electrical pressure gauge used to measure and record rapidly fluctuating high pressures, such as occur in internal combustion engines.

In the drawing which accompanies this specification and forms a part thereof:

Fig. 1 is a view of an electrical pressure measuring device using a lead made in accordance with this invention;

Fig. 2 is a section through a joint in the lead and through a portion of the lead itself;

Fig. 3 is a section through the pick-up of the

pressure measuring device showing the connections between the pick-up and the lead; and

Fig. 4 is a cross-section through the lead showing the helical central conductor.

Referring now more particularly to Fig. 1, 10 is a condenser type transmitter, the housing 11 of which is threaded to enable it to be screwed into a suitable port in an internal combustion engine, or other variable gas pressure device. The housing is secured to a shank 12 provided with an angular or irregular surface 13 by which shank 12 may be gripped when housing 11 is being screwed into its port. The lead proper is comprised of substantially straight sections 14 of any desired length and elbows 15 connected by a novel joint 16, to be hereinafter described in detail. The lead terminates in a shielded housing 17 within which is resiliently supported an amplifier 18, the support comprising a heavy plate 19 secured to housing 17 through resilient mountings 20. Plate 19 and resilient mountings 20 are so designed as to constitute a mechanical filter to exclude vibrations from the amplifier. Short, slightly flexible leads 21 connect the amplifier to the external leads.

The novel lead and joint are shown to better advantage in Fig. 2. The rigid external shell 22 may be circular or polygonal in cross-section. It is preferably made circular, however, in which case standard heavy iron or brass piping may be used. Within shell 22 is a rigid insulating material 23, such as micarta. The insulating material is held fixedly within shell 22 by shrinking shell 22 over it. The configuration of the insulating material may be of any desired design, i. e., cylindrical, prismatic, fluted, etc. It is important, however, that a continuous cylindrical aperture 24 be formed throughout the length of the insulating material. Such an aperture may readily be formed, before the material is covered with shell 22, by molding, or by cutting the material into short sections and drilling each section. Insulating material 23 is preferably coextensive with shell 22.

Within aperture 24 is a helical wire 25 which comprises the central conductor of the lead. A method of forming the conductor is as follows: A resilient wire of lesser diameter than the diameter of aperture 24 is wound into a helix the outside diameter of which is larger than the diameter of aperture 24. One end of the helix is then drawn through the aperture and in doing so the helix is lengthened and compressed transversely so that it is held immovably in the aperture, by reason of the reaction of its own resili-

ency, against the walls of the aperture. The aperture at the end of the section is enlarged and the ends 26 of helix 25 are firmly fixed in place in aperture 24 by placing a closely fitting plug 27 into the enlarged end and compressing the wire between plug 27 and insulation 23.

Connections between adjacent sections of the lead are made by clamping together two halves of a split bushing 28 by means of screws 29 (Fig. 1), or other adjustable fasteners. Bushing 28 is made with an inside bead 30 at each end, and outer shells 22 are likewise made with external beads 31 near their ends, the beads of the bushing being spaced farther apart than the beads of the two adjacent shells. Between beads 30 is a resilient bushing 32, preferably made of rubber, the purpose of which is to absorb some of the vibrations which would ordinarily be transmitted from one section to the next. Beads 30 of bushing 28 contact shell 22 and hence form an electrical connection between adjacent shells. Beads 30 likewise cooperate with beads 31 to prevent the sections from pulling apart.

To establish electrical contact between adjacent central leads, plugs 27 are centrally apertured at 33 and a cylindrical spring 34, formed by bending a thin, rectangular piece of resilient metal to an almost closed cylinder, is inserted into apertures 33 of the adjacent plugs.

The pick-up, shown in Fig. 3, is a condenser type microphone. The end of housing 11 is closed off by a relatively thick diaphragm 35 which is capable of withstanding, and responding to, large pressures. A plug 36 is secured to the center of diaphragm 35 to make use of the portion of the diaphragm having the greatest amplitude of vibration and to thus secure the maximum possible initial signal strength. The fixed plate of the condenser may be formed from a thin, metal disc 37 secured to the insulating material 23 by spinning the edge of the disc into a groove 38 in the material. Contact between central lead 25 and disc 37 may be established by providing disc 37 with a sleeve, for example, by extruding, which projects into the enlarged end of aperture 24, and forcing a plug into the sleeve to bind the end of wire 25 between the sleeve and the plug. The diameter of the insulating material 23 is reduced at the transmitter to avoid contact between disc 37 and housing 11, which, if permitted, would short-circuit the transmitter and render it ineffectual.

In operation, the transmitter 10 is screwed into its port in the device to be tested, and in doing so shank 12 is rotated relative to adjacent section 14. Due to the novel construction of the joint, this does not result in a twisting of the lead, nor is the fixed capacity of the lead affected in any way. Outer shell 22 simply rotates within split bushing 28, and plug 27 rotates about cylindrical spring 34, the relative distance between the helical wire 25 and outer shell 22 remaining constant throughout the twisting. Each section 14 can likewise be rotated relative to its adjacent section without appreciably affecting the electrical constants of the system. It is, therefore, pos-

sible by means of the elbows, joints and interchangeable sections, to position the amplifier with respect to transmitter 10 in any manner suitable to the circumstances of the case. For convenience, the amplifier may be suspended from a tripod (not shown).

When the test is completed, the transmitter is unscrewed from its port, and split bushings 28 of joints 16 may be separated to divide the lead into a number of easily portable separate sections.

The entire system is remarkably free from the electrical disturbances usually arising out of the relative vibration of its component parts because such relative vibration has been reduced to a minimum. Outer shell 22 is made inherently rigid and the construction of the helical lead likewise makes for great rigidity. Vibrations of the amplifier itself are reduced by virtue of the filtering action of the joints and the amplifier support.

Besides reducing the amount of extraneous noise introduced into the system, the novel helical construction of the central lead is also responsible for a reduction of the amount of leakage between the lead and the outer shell. This is due to the substitution of a line contact for a surface contact between the central lead and the supporting insulating material so that the major portion of the surface of the lead is surrounded by air.

It is understood that although this invention has been described with reference to a tester for internal combustion engines, it is not limited to such use, nor to the form shown, but is adaptable generally to all electrical transmission systems wherein the capacity effect between the conductors of a lead is important and it is desired to keep such capacity effect constant.

What is claimed is:

1. A cable comprising a helical conductor, a rigid insulator surrounding the helical conductor and tending to reduce the diameter of the helix, and a second conductor comprising a rigid electro-conductive casing shrunk upon the insulator, whereby the capacity between said conductors remains substantially constant under various conditions of vibration of the cable.

2. A cable of the type described comprising a helical conductor, a rigid apertured insulator surrounding the conductor and contacting the conductor continuously along a portion only of its surface, and a second conductor comprising a rigid casing immovably fixed upon said insulator, whereby the capacity between said conductors remains substantially constant under various conditions of vibration of the cable.

3. A cable comprising a resiliently compressible inner conductor, a rigid insulator surrounding the compressible conductor and tending to deform it, and a second conductor comprising a rigid electro-conductive casing firmly engaging the insulator along its outer surface, whereby the capacity between said conductors remains substantially constant under various conditions of vibration of the cable.

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