May 19, 1953 L. F. HUNT 2,639,310

OIL FILLED STRAIN INSULATOR FOR DAMPING LINE VIBRATION

Filed June 12, 1950

Fig. 1

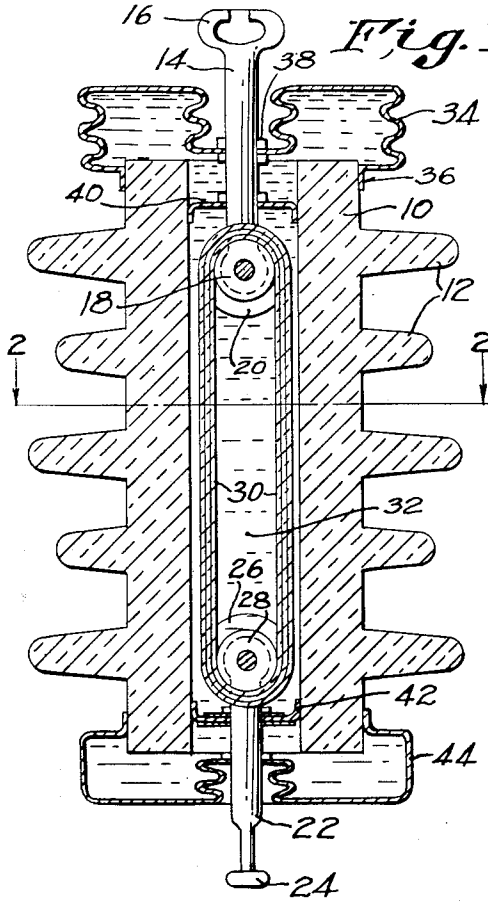


Fig. 2

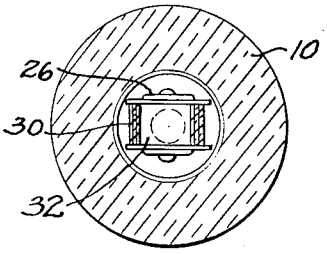


Fig. 3

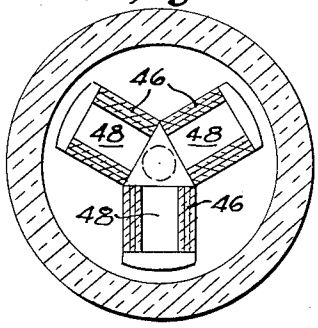


Fig. 4

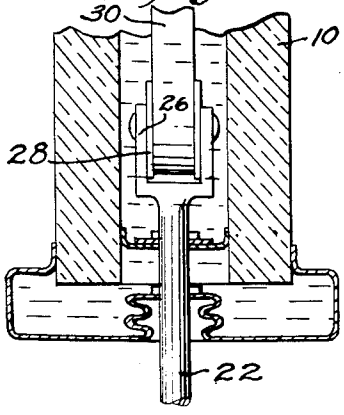
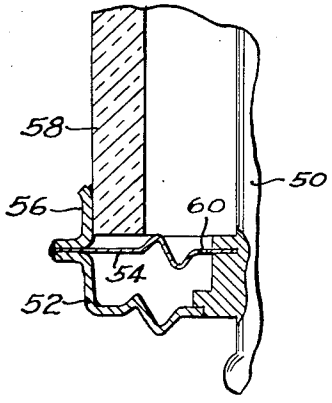


Fig. 5



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Patented May 19, 1953 2,639,310

UNITED STATES PATENT OFFICE

2,639,310

OIL-FILLED STRAIN INSULATOR FOR DAMPING LINE VIBRATION

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Application June 12, 1950, Serial No. 167,539

5 Claims. (Cl. 174—30)

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This invention relates to high voltage insulators, and more particularly to insulators of the oil-filled type used for the support of high voltage transmission line conductors.

It is a principal object of my invention to provide a high voltage transmission line insulator whose design incorporates provisions for damping or suppressing mechanical vibration of a transmission line conductor supported thereby.

A further object of my invention is to provide a high voltage strain insulator of the oil-filled type, in which the dielectric liquid or oil also serves as a viscous medium for suppressing vibrations of a conductor supported by the insulator, whereby a very simple and economical construction is obtained without any sacrifice of the insulating and vibration-damping efficiency of the insulator.

Still another object of the invention is to provide an insulator whose mechanical design is extremely rugged and provides a higher degree of mechanical safety and reliability than known insulators which incorporate numerous separate components all of which are subject to fracture with consequent failure of the mechanical supporting function of the insulator.

An additional object is to provide an insulator of the general type mentioned above, in which the transmission line conductor is allowed a limited degree of movement in order to reduce stresses on the insulator, but providing an adequate control of such movement to prevent dangerous vibration of the conductor, and thereby to minimize the danger of breakage, not only of the insulator itself, but of the conductor, due to such vibration.

Yet another object of the invention is to provide an insulating support for conductors or the like in which the control of vibration is accomplished at the point of support itself.

A further object of the invention is to provide a construction of the above type in which the electrical capacity of the device is reduced as compared with prior proposals, whereby reductions in power loss at the insulators are minimized.

The above and other objects and advantages of my invention will best be understood by reference to the following detailed specification of certain preferred and exemplary modes of practicing the same, such specification being read in connection with the appended drawings, forming a part hereof, and in which:

Fig. 1 is a vertical cross sectional view of a preferred form of combined insulator and vibration damping unit,

Fig. 2 is a horizontal sectional view taken on the line 2—2 of Fig. 1,

Fig. 3 is a view similar to Fig. 2, but showing a modified form of the invention,

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Fig. 4 is a fragmentary elevation, partly in section, showing the construction of the lower portion of Fig. 1 as viewed in a direction at 90° to the Fig. 1 viewpoint, and

Fig. 5 is a fragmentary view of a modified form of closure for the tubular rain skirt of the novel insulator.

Referring now to Fig. 1 of the drawings, the improved insulator is shown as comprising a hollow cylindrical tube or rain shield 10 formed of porcelain, glass or other suitable dielectric and provided with the usual spaced annular skirts 12 about its periphery, the precise form of this shield being of little importance to my invention. The function of this tube or housing is to provide a housing for the strain-absorbing portions of the insulator, and to receive a filling of a dielectric or insulating oil in accordance with known principles.

Passing into the upper end of the tube, housing or shield 10 is a metallic strain rod 14 having at its upper end a socket formation 16 for connection with standard insulator supporting hardware, and at its lowered end a reel or drum 18 journaled in a yoke 20. The mechanical connection at the other end of the insulator is provided by a rod or bar 22 extending downwardly from the rain shield 10 and provided with a ball, hook, clevis or equivalent connection portion 24, also as well known in this art. The upper end of this rod or bar terminates in a yoke 26 receiving for rotation therein a second reel or drum 28. Connecting the reels 18 and 28 are one or more strain elements composed preferably of woven glass tapes 30, which absorb tensile stresses between the upper insulator support and the transmission line or other conductive element suspended from the lower rod or bar 22. In order to increase the breakdown voltage of the insulator, the space within the rain shield 10 and surrounding the tapes 30 is filled with an insulating oil 32, the same being chosen in accordance with well known principles of high-voltage insulation. Transformer oil is adaptable for this use.

The tapes 30 referred to above may be constituted by a plurality of separate loops dimensioned so as to nest within one another, or they may be formed in other ways, for example as a single multi-turn loop whose ends are suitably fastened to provide a predetermined distance between the pulleys or reels 18 and 28. The use of woven glass fibers for these tapes provides a high degree of mechanical strength and electrical insulation, together with a limited capacity for stretching, so that the normal distance between the upper support and the lower support may be maintained while permitting a limited amount of extension of the effective length of the insulator assembly under maximum stresses. In

order to suppress the vibration of a conductor supported from the lower connection element 24, the relative motion of the lower end is damped by a combination of the mass or weight of the insulator itself, principally contributed by the ceramic or glass rain shield 10, and a dash-pot vibration-damping mechanism now to be described.

The upper end of the rain shield 10 is closed by a somewhat flexible closure shown in Fig. 1 as a metallic bellows 34, of the type known as a "sylphon" bellows, the same being secured in a gas and liquid-tight manner to rain shield 10 as by soldering at 36, the technique of soldering or otherwise securing such a metallic member to ceramics being well known in the insulator art. The intermediate portion of this bellows encircles the strain rod 14, and is fixedly secured, as at 38, by soldering, welding, brazing or the like, to provide a secure mechanical connection and one which is both gas and liquid-tight. Beneath this connection 38, rod 14 carries a piston or like element 40, also firmly secured to rod 14, but free to move at its periphery, with respect to the internal wall of rain shield 10. The extent to which this piston element may move is governed by the extent to which oil 32 may leak past the same during such movement, a controlled amount of leakage being provided either by close dimensioning of the relative diameter of the piston 40 and the internal diameter of the rain shield, or by providing a small aperture in the body of the piston through which oil may flow to a slight extent.

A similar piston 42 or equivalent element is provided for the lower rod or bar 22, it being understood that these pistons are preferably metallic in order to be strong enough to resist the deforming stresses accompanying lengthwise movements of the rods 14 and 22, against the opposition of the oil 32. Also, the lower end of the rain shield 10 is closed by a lower bellows 44 which may be similar to upper bellows 34. It is clear that these respective bellows elements define upper and lower chambers into and out of which the oil 32 is forced during movements of the rods 14 and 22, and hence of the pistons 40 and 42.

From the above description, it will be clear to the skilled worker in this art that the insulator assembly provides a maximum strength, both mechanical and electrical, together with a vibration damping or control, with a minimum number of parts which can be fabricated simply and at relatively low cost. The use of woven glass tapes as the strain resisting element provides sufficient resilience to enable flexing of the transmission line to a limited degree, and thereby to lessen the stresses on the insulator. The damping effect of the dash-pot arrangement controls this resilience in accordance with the weight of the rain shield surrounding the tape-like strain elements. The use of the insulating oil 32 as the viscous medium for the dash-pot provides a great constructional simplicity, reduced cost, and contributes to ease of maintenance.

Fig. 3 of the drawings illustrates a possible modification in which there is employed a plurality of sets of strain tapes 46, three being shown in this figure, each carried by a pulley or reel 48, in place of the singe set of tapes 30 of Fig. 1. In this way, a higher degree of mechanical strength is obtained, where requirements justify the increased complexity, and since the dash-pot portions of the device are located beyond these tapes, the vibration-damping mechanism is in no way complicated by the use of plural strain elements of this type.

Fig. 4 illustrates a side view of the lower portion of the Fig. 1 structure, more clearly to show the arrangement of the yoke 26, pulley or reel 28 and the tapes 30. It will be understood that the function of these reels is to permit free equalization of the stresses in the two passes of the tape or tapes, to achieve a higher ultimate strength than if separate single tape runs were individually anchored to the rods 14 and 22. Tapes themselves may consist of many layers of spun glass fibre ribbons, for example one inch wide and 0.010 inch thick, although other sizes and types of glass tapes may be employed, the particular dimensions being dictated by the application to which the insulator is to be devoted.

It is clear that the dash-pot function may be achieved by other and equivalent means from those above described, without departing from the spirit and teaching of my invention. In Fig. 5, for example, the lower strain rod 50 is shown as fixedly secured to a bottom rain shield closure 52 of flexible construction, such as of sheet metal, there being an independent flexible diaphragm 54 also secured to the strain rod and extending outward for connection with the closure 52 at the periphery thereof. The closure and diaphragm may be soldered or otherwise connected together, and to a flange 56, which in turn is soldered or otherwise tightly secured to the rain shield 58. A metering orifice or aperture 60 is provided in diaphragm 54, so that stresses upon the strain rod or bar will cause oil to flow through this orifice in a controlled manner to achieve the desired damping of vibration.

While I have shown my improved insulator as completely filled with the insulating oil or liquid, it is clear that the advantages can also be obtained if a portion of this space contains gas or air. The advantage of completely filling the device with oil is that the insulator will operate with equal efficiencies in either vertical or horizontal positions.

The above description covers in detail the construction of preferred forms of my invention, but it is to be understood that many changes and modifications in the actual construction may be made without departing from the spirit of my invention as defined in the appended claims.

I claim:

1. A combined high-voltage strain insulator and damping device comprising a hollow cylindrical housing of insulating material, an expansible and contractible closure at each end of said housing, a tension member characterized by high electrical resistance and slight longitudinal resilience extending lengthwise within said housing, strain rods passing through and secured in sealed relation to said respective closures and connected within said housing to opposite ends of said tension member, a body of liquid insulating material in said hollow housing, and vibration damping means comprising a piston element snugly fitting within said housing and fixedly secured to one of said strain rods for cooperative damping action with said body of liquid.

2. The invention in accordance with claim 1, in which said tension member comprises at least one closed loop of woven insulating fibers.

3. The invention in accordance with claim 2 wherein the insulating fibers are glass.

4. An insulator in accordance with claim 1, in which said closures comprise flexible bellows ele-

ments secured to respective ends of said housing.

5. An insulator in accordance with claim 1, in which said vibration damping means comprises a pair of piston elements snugly fitting within said housing and each fixedly secured to a respective one of said strain rods for cooperative damping action with said body of liquid.

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