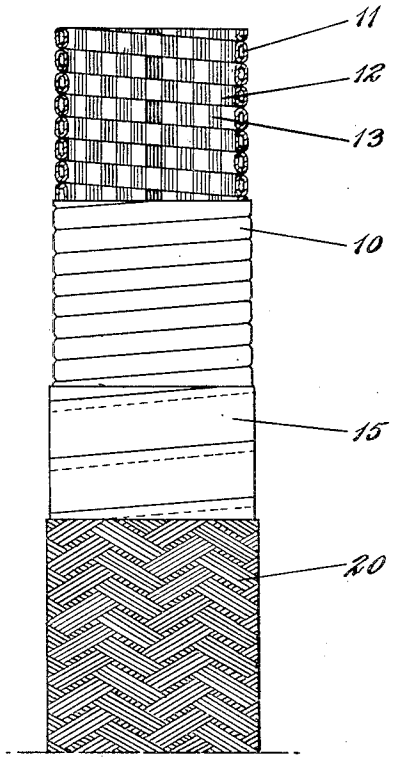
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FLEXIBLE ELECTRIC CONDUIT

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FLEXIBLE ELECTRIC CONDUIT

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2 Claims. (Cl. 174—36)

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This invention has to do with a flexible electrical conduit or tubing intended especially for enclosing conductors that carry current of very high frequency. An example of its use is in aircraft having radar equipment which employs such current.

The present application is a continuation in part of application Serial No. 560,422, filed October 26, 1944, by the same inventor, and now abandoned.

The object attained is the provision of a simple, flexible conduit that is adequately shielded, that is light in weight, that is rugged and resistant to attack by mechanical forces and by moisture, flame, oil spray and other agencies encountered in such wiring installations; and one that can be made economically and in quantity.

A common practice has been to make such a tubing by employing a braided jacket of fine aluminum wire and a spiral armor of interlocked aluminum strip, much like the common flexible conduits made of steel strip. The present invention improves upon this. It uses less metal and is more economically made. It has greater flexibility and better resists moisture and oil spray. It does not have the disadvantageous characteristic which the spiral armor has of forming burrs which damage the interior wires, such burrs being frequently the result of an injury to the armor that would otherwise be of no great moment. Finally, the new construction gives more uniform shielding than do the spiral interlocked turns of metal strip which do not have a uniform engagement, especially when bent or stretched.

The preferred form of the invention is described below in reference to the drawing, which shows the conduit broken down to reveal the three major components and their individual constructions. The three major components are the inner tubing 10 with a protective coating, a spiral wrapping of metal foil 15, preferably aluminum, to give electrical shielding and added flame resistance, and a braided jacket 20, preferably of aluminum wire, to furnish electrical shielding and also armoring.

The inner element 10 is a tube treated to give resistance to moisture, oil, flame and other destructive agencies. In itself it is similar in its physical construction of warp and woof to known forms of "loom" used in electrical wiring, but an improvement in respect to materials has been effected as described below. This tubing is made by wrapping a weft strand 11 helically around a mandrel in close turns, and simultaneously passing longitudinal warp threads over and under the successive turns of strand 11. Several parallel warp threads are grouped and alternate groups 12 and 13 pass outside and inside a given turn of the strand 11. Such a construction follows generally the disclosure of Robinson Patent 1,203,788 and is found to be especially effective as used as an element of this new combination.

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In one form of this tube 10, the longitudinal warp threads are of cotton or rayon, preferably rayon, and the strand 11 is of kraft paper folded or twisted and flattened. This gives a non-metallic tubing of light weight and considerable strength. An improved form is made by using warp threads of fibreglass and one or more helical weft strands of metal wire, preferably aluminum. While heavier, this construction is still light enough for aircraft use and has the advantage of being non-inflammable and of being stronger. It is found that with this improved tubing it is not necessary to use a thimble at the terminal and the so-called pull-out strength is greater than with the other form with which a thimble is used. Depending on conditions of use, either form may be used however, and both are being used in commercial products.

With either form of tubing there is applied an outer coating which gives resistance to moisture, oil, flame and, if desired, fungus growth as well. For moisture, oil and flame resistance, under some conditions of use, a bituminous saturant and pitchy flame retardant coating may be used, especially with the form employing cotton or rayon and paper. The materials suitable for this purpose are well known in this art. An improved saturant and coating for either form of tubing consists of an organic saturant and a number of layers of a lacquer, both being resistant to moisture, oil and flame and of sufficient toughness and flexibility to avoid cracking upon bending at all temperatures of use. Such saturants and lacquers are available on the market to meet these specifications. An example of the saturant is a modified glycerol phthalate resin with suitable additives such as a drying oil and a dryer. An example of the lacquer is one made of ethyl cellulose, an organic acid, glycerol alkyd, petroleum and resins and oils. From the standpoint of the combination which is the invention, the particular constitution of the saturant and coating is not critical and alternative ways of affording equivalent protection in the degree desired may be employed, either in the form of a saturant or coating or both or by use of materials in the tubing which gives the desired degree of resist-

ance to flame, oil and moisture, or other agencies, without more. For use where fungus growth is a factor, a fungicide is added to the lacquer coating and to the saturant used with it, such as a pentachlorophenol in an amount, for example, equal to about 3% by weight of the lacquer and about 12% of the saturant in the case of the illustrative materials already described.

Over this fibrous tubing, thus treated, is a helical wrap 15 preferably of aluminum foil strip. The turns have a large overlap. This serves as an electrical shielding element. It gives uniformity of shielding because bending of the tubing does not cause the turns to open up or permit magnetic leakage. Continuity of the shielding is maintained.

Around the aluminum foil wrap is a protective jacket 20, preferably of braided aluminum wire which affords further shielding. Other metals may be used, for example, copper. This braided jacket is made according to known braiding practice. It is desirable to use a number of "ends" and to have a close braid giving as high as 95% coverage, calculated in the standard way. This jacket, snugly fitting over the aluminum foil wrap, holds the latter in place and gives mechanical protection to the whole as well as an electrical shielding effect.

There may be an additional jacket or coating around the braided wire jacket 20; and such a construction is not to be deemed excluded by the reference herein to the braided wire jacket as an outer protective jacket, since the function of the latter in relation to the interior construction remains the same. This additional jacket may take the form of a braid of cotton, rayon or the like, or a coating of rubber or rubber compound, natural or synthetic, or the like. A synthetic resin extruded over the wire braid may also be used, such as a polyvinyl chloride resin containing a plasticizer and other additives according to known practice in the compounding of such resin coatings.

In the foregoing, a preference has been stated for aluminum as the metal used for the weft thread of the tubing, for the foil shield and for the braided armor and shield. This is on the basis of its light weight and, for most purposes, its adequate strength and conductivity, the latter property being most significant in relation to the shielding effect of the foil shield and the braided shield. Where a higher degree of shielding is desired and weight tolerances permit, copper foil is used for the foil shield and copper wire for the braided shield. Copper wire may also be used in the weft thread of the tubing. Such copper wire in either place is preferably tinned. The weight may be reduced by using nylon in place of fibreglass in the warp threads of the tubing, with some reduction in flame resistance although not to the extent involved in the use of rayon or cotton, and to a substantial degree the greater strength of the fibreglass-wire tubing is still attained.

Modifications may be made embodying the novel idea of means exemplified by the construction here described, and are intended to be included within the following claims.

I claim:

1. A flexible electrical conduit for high frequency electrical conductors comprising a flexible inner woven tubing comprising a fibreglass warp and a metal weft, a moisture, flame and oil resistant saturant and coating for said tubing, a shield of overlapped turns of metal foil surrounding said coated tubing, and a jacket and shield of braided metal threads around said foil shield.

2. A flexible electrical conduit for high frequency electrical conductors comprising a flexible inner woven tubing comprising interwoven fiberglass and metal strands, together with means for imparting resistance to moisture and oil, a moisture, flame and oil resistant saturant and coating for said tubing, a shield of overlapped turns of metal foil surrounding said coated tubing, and a jacket and shield of braided metal threads around said foil shield.

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