April 18, 1967 M. HEUPGEN 3,314,451

FLEXIBLE METALLIC SHEATHS FOR CABLES

Filed Sept. 18, 1963 2 Sheets-Sheet 1

Fig. 1

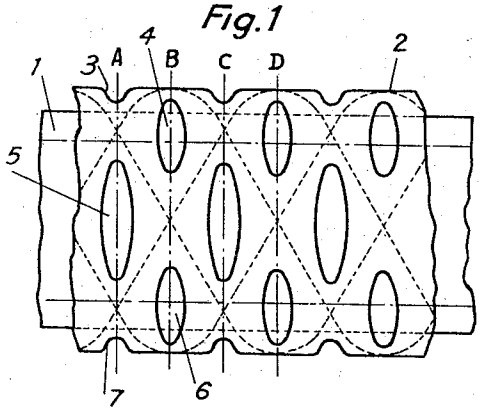
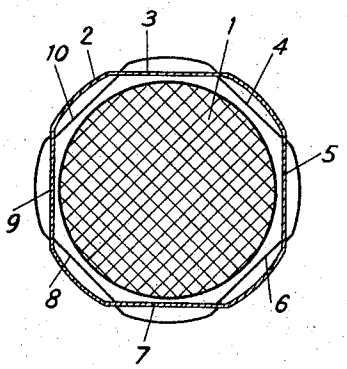


Fig. 2



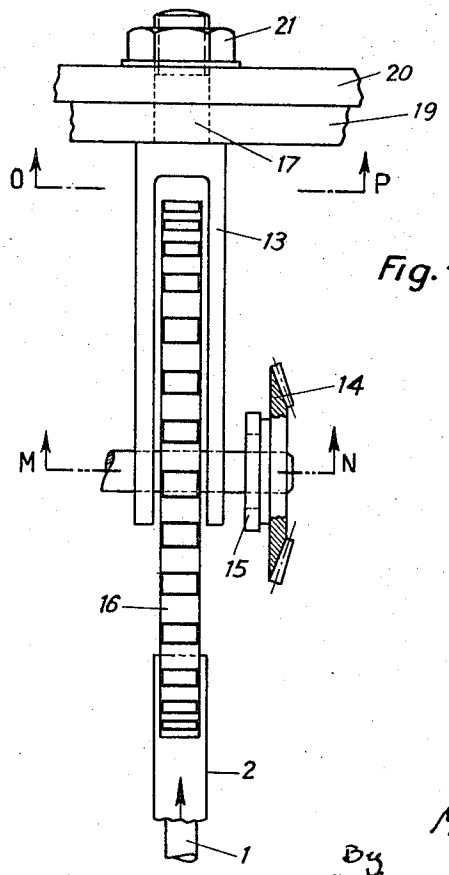


Fig. 4

Inventor
M. HEUPGEN
By Robic & Bastien
attorneys

April 18, 1967 M. HEUPGEN 3,314,451

FLEXIBLE METALLIC SHEATHS FOR CABLES

Filed Sept. 18, 1963 2 Sheets-Sheet 2

Fig. 3

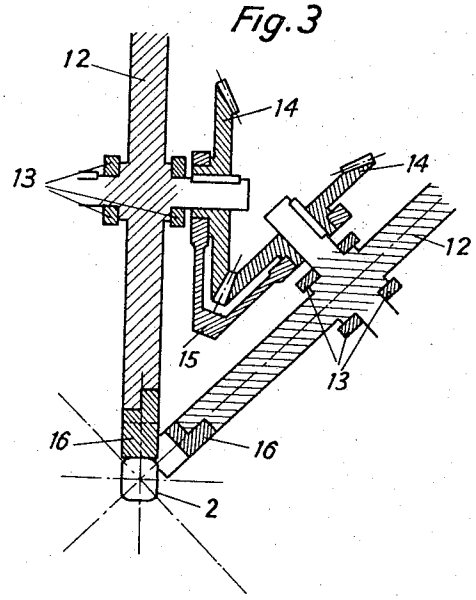
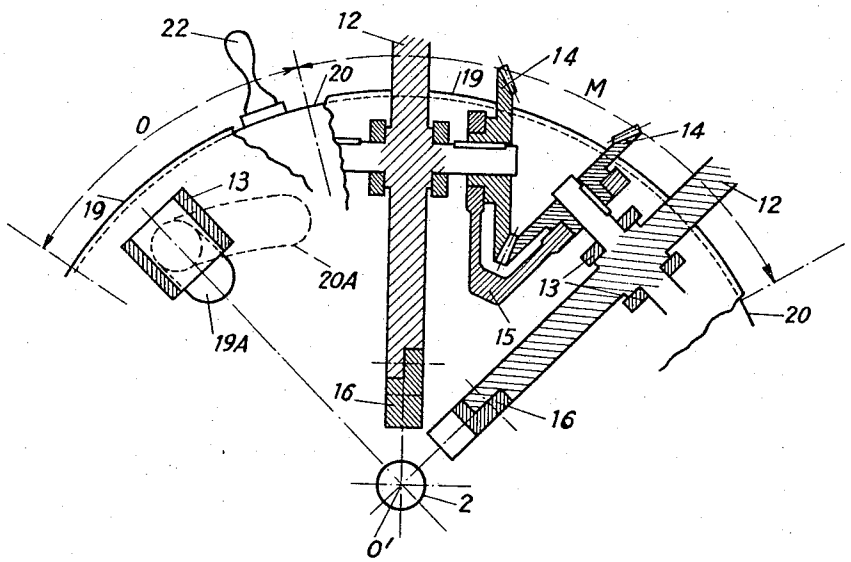


Fig. 5



Inventor
M. HEUPGEN
By Bodin & Bardiau
Attorneys

United States Patent Office 3,314,451 Patented Apr. 18, 1967

3,314,451

FLEXIBLE METALLIC SHEATHS FOR CABLES

Marcel Heupgen, Jeumont, France, assignor to Forges et Ateliers de Constructions Electriques de Jeumont

Filed Sept. 18, 1963, Ser. No. 309,798
Claims priority, application France, Sept. 28, 1962, 910,685
4 Claims. (Cl. 138—177)

This invention relates to electric cables provided with protective, flexible, metallic sheaths.

It is known that when such sheaths have a strictly cylindrical form they often present insufficient flexibility to permit winding of the so protected cables. This cylindrical form, which is normally obtained in manufacture, must therefore be modified to provide said sheaths with the desirable flexibility.

For this purpose, it has been proposed to form on these metallic sheaths helicoidal undulations by means of turning tools, but the apparatus used for this purpose is complex and in a great number of cases it subjects the sheaths to excessive torsions.

The essential object of the instant invention is therefore to produce, on the sheaths, deformations with such configuration as to make said sheaths very flexible and which may be obtained by a simple and economical process which would not subject the metal to any abnormal mechanical strain.

This is obtained by providing on the electric cable in accordance with the instant invention a flexible metallic sheath the undulations of which are obtained by forming on said sheath indentations, arranged in circles, the indentations of successive circular rows staggered relative to those of the neighbouring rows.

In order to better understand the new arrangement of the cable-sheathing according to the present invention, it will be described hereinafter in more detail with reference to the appended drawings in which:

FIG. 1 represents the undulated cable-sheath;

FIG. 2 is a straight transversal cross-section of a row of indentations of said sheath;

FIG. 3 is a transversal section view of the sheath and of portions of embossing members in working position;

FIG. 4 represents the profile of a wheel performing the undulation and its assembling system;

FIG. 5 represents a transversal section view of different parts of a head of an undulating machine with wheels and embossing teeth being shown disengaged from the sheath.

On FIGS. 1 and 2, **1** represents an insulated cable which can be constituted in many different ways and for this reason it has been represented as a simple cylinder; this cable is protected by a metallic sheath **2** which represents, with relation to its original tubular form, circular, regularly spaced rows A, B, C, D, etc. of a plurality of recesses or indentations, designated by **3**, **5**, **7** and **9**, then by **4**, **6**, **8** and **10** etc.; although the edge contours of these recesses or identations are rounded, they are represented in FIG. 1 by sharp lines for better clarity. It is seen that the recesses or indentations of the circular rows A, C etc. are angularly offset or "staggered" half a step in relation to those of the neighbouring rows B, D etc. The indentations disposed in the indicated manner bring into relief projections on the inside of the sheath corresponding on the external surface thereof to undulations the axes whereof entwine the sheath and follow the doubly-helical dotted lines of FIG. 1 to impart to the sheath an embossed aspect.

Such a configuration is especially advantageous since on the one hand the cable insulation bears on a rounded surface, thus with no risk of deterioration, and on the other, it enables a free longitudinal flow of an insulating fluid which may be used to fill the cable.

In FIGURES 1 and 2, there is represented a sheath the recesses of which show an oblong shape produced by the imprint of a rectilinear tooth positioned transversely of the sheath, but it is evident that this invention comprises sheaths having recesses of any other shape, such as hemispherical or the like.

Now, there will be described the machine and the operation of a head of the machine capable of producing an undulated sheath having four peripheral indentations of the kind described above. FIG. 3 illustrates the principle of such operation. The wheels **12**, of which there are eight in number, are fixed to the frame of the machine by means of forked supports **13** in which they freely turn and are regularly positioned around a sheath **2** to be undulated. Their respective median planes pass through the longitudinal axis of the sheath and define between themselves, in the described case, an angle of 45°. Furthermore, the axles of these wheels are coupled by means of eight bevel gear trains **14** which, for a reason which will be explained later, are arranged to be axially slidable on the axles of said wheels, but maintained geared by means of clamps **15**. The wheels **12** are equipped with removable dented rims **16** which are selected according to the dimension and the nature of the sheath to be undulated. The mounting and the adjustment of this equipment is carried out in such a manner that the teeth of adjacent rims **16** are mutually offset angularly so that at the level of the sheath **2** each tooth of a rim is facing the clearance between teeth of the neighbouring rims. Furthermore, the number of teeth is chosen so that with the desired penetration the sheath **2** will always be in gear with at least one set of the dented rims **16**.

In accordance with these conditions when one of the wheels **12** is animated with a rotational movement about its own axis, or when a force perpendicular to the plane of the figure is exerted on the sheath **2**, the teeth of the rims **16** will emboss the metal of this sheath producing equidistant staggered indentations, which results in the formation on said sheath of very regular undulations.

It is to be noted that the longitudinal profile of the teeth may be rectilinear or curvilinear.

At the beginning and at the end of the operation, or eventually during the operation or otherwise in order to regulate the depth of penetration of the teeth, the wheels **12** must be simultaneously engaged or disengaged from the sheath by their simultaneous displacement in their respective planes.

For this purpose the head to be undulated is provided with forked supports **13** the bases of which are either hinged in suitable manner or are displaceable in the radial slots of a fixed plate. FIGS. 4 and 5 illustrate an example of this latter embodiment.

According to FIG. 4 the base of the forked supports **13** comprises at its extremity a threaded bolt **17**; this bolt is disposed in slots, directed as will be indicated later, in the juxtaposed plates **19** and **20**. The said plates are concentric to both the sheath **2** to be undulated and to the cable **1**; the plate **19** is rigidly fixed to the frame of the machine while the plate **20** can be angularly displaced relative to the plate **19**. By means of nuts **21** it is possible to lock plate **20** and thus the forked support **13** to the plate **19**.

The slots **19***a* and **20***a* in the respective plates **19** and **20** are shown in the sector O of FIG. 5, which represents a partial sectional view of the undulating head on the plane OP of FIG. 4. It is also shown at **19***a* that the slots in the plate **19** are radial while the slots **20***a* of plate **20** are in spiral form. When the nuts **21** are loosened, the bolts **17** of the forked supports **13** can be guided simultaneously towards the center O' or in the opposite direction depending on whether the plate **20** is rotated in one direction or the other by means of handle **22**.

FIG. 5 represents, in sector M, a partial sectional view of FIG. 4 in the plan MN; the position of wheels **12**, rims **16** and bevel pinions **14** when the plate **20** is in the position illustrated in sector O with relation to plate **19**; so that the teeth are disengaged from the sheath. It will be noted in comparing this view of sector M with FIG. 3 that clamp **15** will permit pinions **14** to slide axially on their shafts while remaining keyed for mutual rotation.

It will be understood that the described process and apparatus can be modified in different ways and be applied to the manufacture of flexible hollow tubes such as are used to sheath flowing fluids, as well as to manufacture of sheaths which contain electric cables, the latter with their sheaths presenting the features of a new industrial product.

I claim:

1. Flexible tubular metallic cable-sheathing comprising; a series of recesses or indentations on the external surface of the sheathing arranged circumferentially in rows about said sheathing, individual recesses or indentations of each said row being staggered with respect to the individual recesses or indentations of the rows immediately adjacent thereto, said staggering of alternate rows thereby defining undulations between said recesses or indentations, whereby said undulations entwine a cable in doubly-helical fashion to enhance the flexibility of said tubular sheathing over that displayed in a non-indented condition.

2. A flexible tubular metallic cable-sheathing as claimed in claim **1**, in which the shape of said recesses

or indentations is that which is produced by the imprint of a rectilinear tooth located in a transversal position with respect to the sheath.

3. A flexible tubular metallic cable-sheathing as claimed in claim **1**, in which the shape of said recess is that which is produced by the imprint of a curvilinear tooth located in a transversal position with respect to the sheath.

4. A flexible tubular metallic cable-sheathing as claimed in claim **1**, in which the shape of said recess is that which is produced by the imprint of a substantially spherical tooth located in a transversal position with respect to the sheath.

References Cited by the Examiner

UNITED STATES PATENTS

176,911	5/1876	Whysall	72—194
344,847	7/1886	Mersereau	138—177
1,685,518	9/1928	Burrows	72—194
1,962,876	6/1934	Reinert et al.	138—177
2,259,433	10/1941	Kitto	138—38
2,265,226	12/1941	Clewell et al.	138—177
2,361,318	10/1944	Orr et al.	138—177
2,640,194	5/1953	Hytte	138—38

SAMUEL ROTHBERG, *Primary Examiner.*

LAVERNE D. GEIGER, *Examiner.*

H. ARTIS, *Assistant Examiner.*