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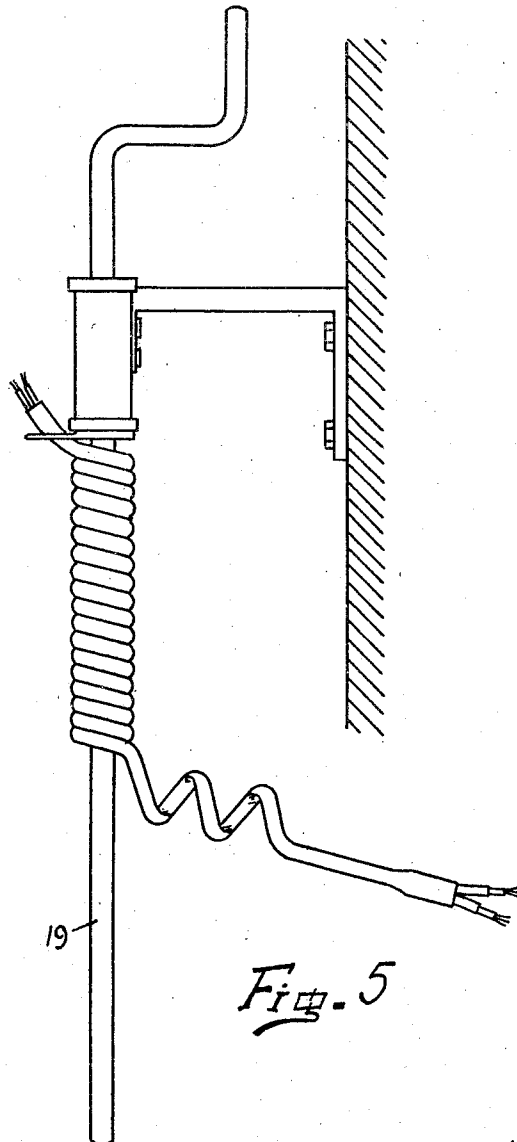
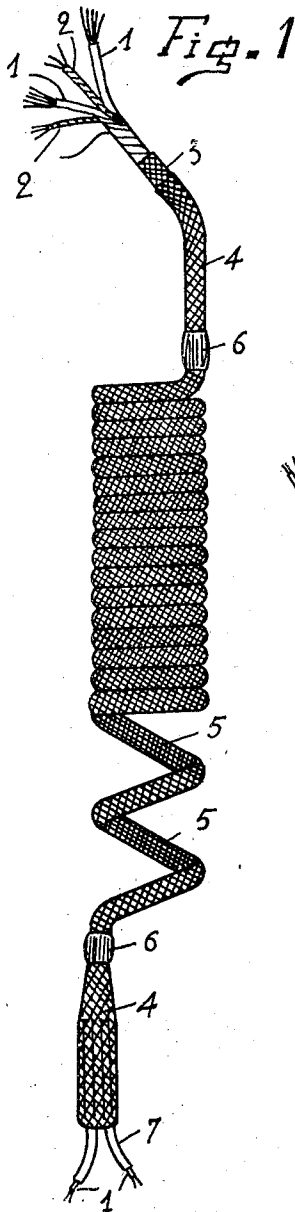
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METHOD AND MACHINE FOR MANUFACTURING ELASTIC HELICAL CONDUCTING CORDS

Filed March 25, 1937

3 Sheets-Sheet 1



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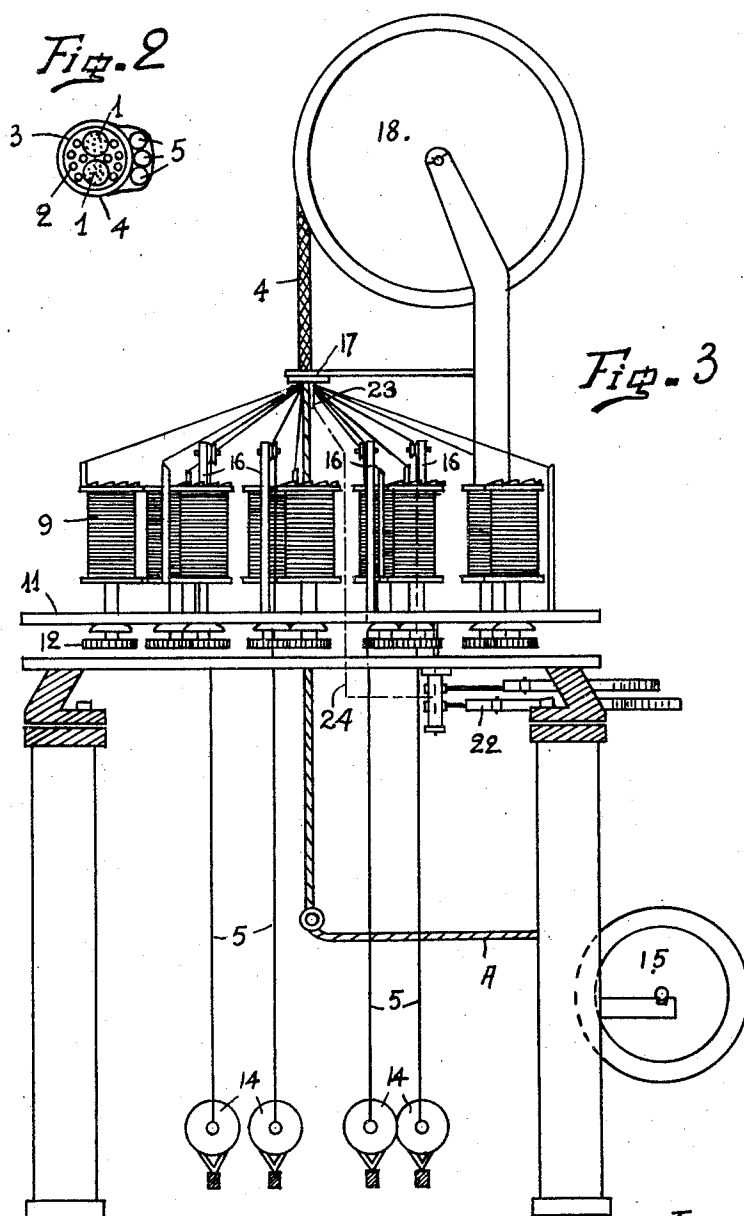
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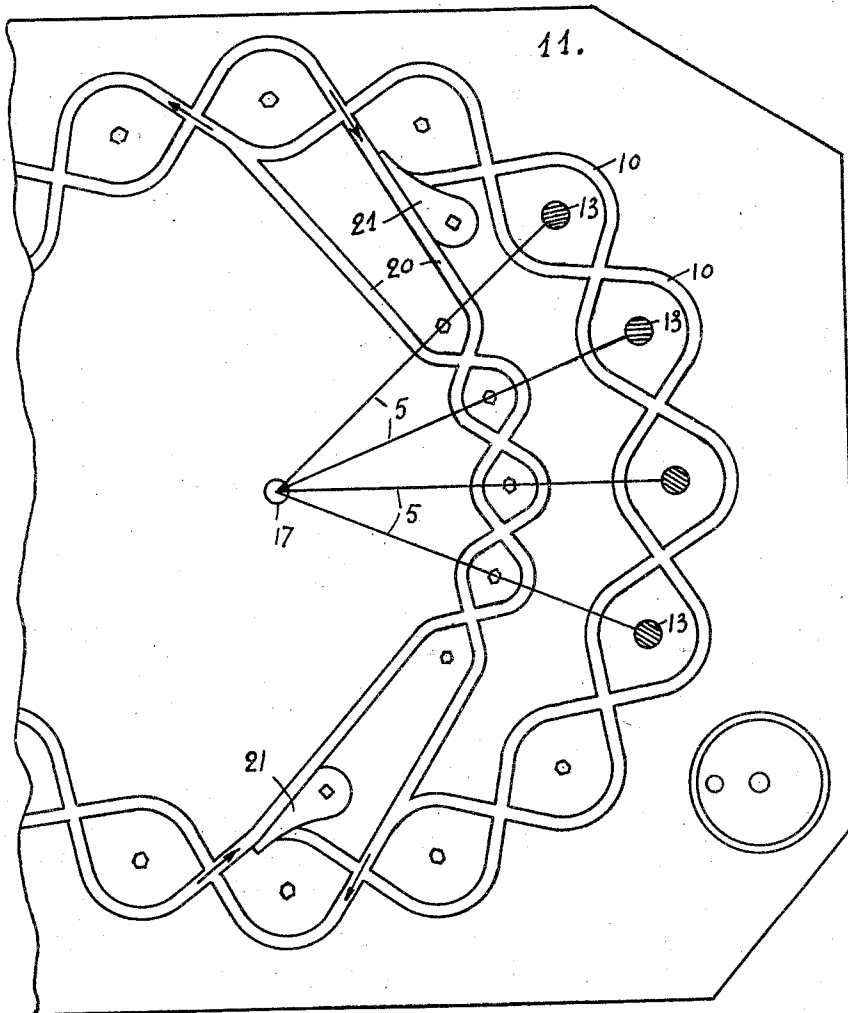
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Fig. 4



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UNITED STATES PATENT OFFICE

2,136,743

METHOD AND MACHINE FOR MANUFACTURING ELASTIC HELICAL CONDUCTING CORDS

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Application March 25, 1937, Serial No. 133,093
In France March 23, 1936

11 Claims. (Cl. 96—3)

The present invention relates to the manufacture of conducting cords having the shape of an elastic helix which can be pulled to elongate the cord and which can contract elastically, and in particular, to those wherein the elastic threads are engaged between the interlaced threads of the outer braid.

It is known that to make a braid around a core, two systems of threads are made to circulate in opposite directions along two undulated interlaced paths, and they are then guided to the point of braiding. Said two paths form together a ring of fixed loops separated by the points of intersection. According to the invention, the elastic threads are guided, in the stretched state, into the braiding point through said fixed loops. In this manner each elastic thread is engaged in the column of meshes of the braid, which corresponds to the loop through which it passes.

Often, it is advantageous for the ends of the cut cords not to be elastic. According to another feature of the method according to the invention, the threads of the braid are passed, when forming the braid on the parts of the cord which are to form the nonelastic ends of the cut cords, along a different path, so as to leave the elastic threads outside the braid. It is then an easy matter to fix the elastic threads at the place where they come out of the braid, for example by means of bindings, and to cut the floating parts of said threads.

Furthermore, it is often advantageous to provide the conductors with insulating sleeves which reinforce them at the entry into the electric apparatus, where they nearly always break. It is preferable that such sleeves should be engaged under the outer braid. For this purpose, according to another feature of the invention, the cord is cut before the formation of the braid, its ends are provided with the required sleeves and temporary fasteners, the cords are hooked on to each other to form a substantially continuous cord and the braid is formed about the latter. Then there only remains to cut the braid opposite the points where it is hooked and to remove the temporary fasteners.

As the helical cord should be very flexible, it must not be pinched in the braid. For this purpose, according to another feature of the invention, the braid is formed about the cord and a fixed spacing member, such as a wire, from which the braid becomes disengaged as it comes out of the machine, leaving a clearance between it and the core of the cord. However, when the ends of the cut cords are not to be elastic, it is

preferable for them to be tightly pinched in the braid. For this purpose, according to another feature of the invention, the aforesaid spacing member is withdrawn while the parts of the braid are formed which leave the elastic threads outside.

According to other features of the method of the invention, in order to make the cord flexible and to adapt it to take up the tight helical shape as its natural shape, it is subjected, after the formation of the braid, to a steam bath, and it is wound in a helix with contiguous convolutions on an appropriate former.

The invention also relates to improvements in machines for braiding coverings, for carrying out the above mentioned method. It is known that such machines have bobbins which circulate in opposite directions in two undulated interlaced slots of a platen and which are driven by pinions of which the axes of rotation have a fixed position which is concentric with the loops formed by the interlacing of the two slots. According to the invention, there is provided in addition to the usual roll supplying the core of the cord, rolls supplying the elastic threads and driven at an unwinding speed which is less than that of the core, so that the elastic threads are stretched; certain of the driving pinions are provided with axial passages, and the elastic threads are guided to the braiding point through the said passages, so as to be enlaced by the crossed threads of the braid.

In order to produce parts of the braid along which the elastic threads remain outside, there are provided interlaced slots arranged along the part of the normal slots in the loops of which the elastic threads pass, and which are nearer the centre of the platen, and means enabling the bobbins to be switched to make them circulate either in the outer slots, of which the loops enclose the elastic threads, or in the inner slots which leave said threads outside. Preferably, there is furthermore provided a mechanism for automatically controlling said switching means, as a function of the length of the cord issuing from the machine, either directly or indirectly, that is to say as a function of magnitudes which are substantially proportional to such length, such as the number of revolutions of the machine or even the time elapsed.

In order to form the braid with play, a fixed wire can be provided which is engaged in the usual braiding eye, so that the braid forms about the core and said wire. When it is desired that certain parts of the braid, in particular those

which are not elastic, should be tighter, said wire can be movable in order to enable it to be withdrawn from the braiding eye. It can be controlled to be withdrawn from the eye and brought back therein, in cooperation with the control of the above mentioned switching means.

The invention will be described in greater detail with reference to the accompanying drawings in which:

Fig. 1 shows a cord produced according to the invention.

Fig. 2 is a transverse section on a larger scale.

Fig. 3 is a diagrammatic elevation of a braiding machine for the manufacture of said cord.

Fig. 4 is a diagrammatic plan view on a larger scale of the platen of said machine.

Fig. 5 is a side view of a winder for completing the cord.

The cord produced according to the invention comprises a core composed of elements to which it is desired to impart the shape of an elastic helix. Said core consists, for example, for the apparatus which are to be supplied with electric current by two wires, of two insulated conductors 1 twisted with a textile filling 2 and which can be surrounded with a braid 3 when the finished cord is desired to have two braids. Said core is surrounded by a braid 4 of which the interlaced threads enclose between them rubber threads 5 along a segment of the cylinder formed by said braid. As the rubber threads are introduced into the braid so as to be stretched when the cord is straight, they contract and impart to the cord a continuous curvature which causes it to take the shape of a helix, as seen in Fig. 1. The size of the convolutions of said helix depend on the flexibility of the cord, the elastic force exerted by the rubber threads and the eccentricity of said threads, that is to say, the distance between the combined tractive force of said threads and the neutral axis of bending of the cord as a whole. The rubber threads are perfectly guided and held between the threads of the braid 4, but without being pressed against the core and consequently without pressing the latter, so that it retains its natural flexibility. The internal movements of the elements of said core which occur when the helix is stretched and when it is allowed to contract, take place freely and do not cause any appreciable wear of the elements of said core, and in particular of the thin wires forming the flexible conductor 1. It has been found that a helix thus formed was in no way damaged by 80,000 complete successive stretchings.

There can be any number of rubber threads starting from one. Each thread can be passed in its column of meshes of the braid, or a plurality of same can be enclosed in one column of meshes.

In order to facilitate the use of said cord as regards its connection to the apparatus with which it is used, it is preferable to leave non-elastic connection ends. For this purpose the rubber threads are cut at a distance from the ends and are retained by bindings 6. Furthermore, in order to reinforce the conductors where they enter the apparatus, they can be provided with sleeves 7 for example made of oil-cloth, engaged a certain distance under the braid 4.

To obtain a cord of this kind, an ordinary braiding machine can be used, shown diagrammatically in Fig. 3, having some modifications according to the invention herein. It is known that this kind of machine comprises two series

of bobbins 9 carrying the braiding threads and circulating in opposite directions along two interlaced undulated paths. Said paths are defined by guide slots 10 provided in the platen 11 of the machine, as shown in Fig. 4. The bobbins are driven in said slots by means of pinions 12 which they carry under the platen 11 and which cooperate with drive pinions, not shown, the axes of rotation of which are fixed and are concentric with the loops formed by the interlacing of the two slots 10. According to the invention, axial passages are provided through a number of said pinions shown diagrammatically at 13 in Fig. 4, and the rubber threads 5 are passed therein. Said threads are fed by rolls 14 which are driven so that said threads unwind at a much lower speed than the core A about which the braid is to be formed. The rolls 14 can be driven mechanically at a speed having the desired ratio with that of the roll 15 supplying the core, or they can be braked so as to suitably tension the rubber threads. The platen is provided with thread guides 16 around which circulate the bobbins 9 and which guide the rubber threads towards the braiding eye 17. In this manner the braiding threads are caused to interlace about the rubber threads, which are each enclosed in a column of loops of the braid.

The cord enclosed in the braid 4 is received either on a roll 18 or in a pot through the instrumentality of a regulator.

When a piece of cord thus formed is taken, it freely takes the shape of a very open and rather irregular shaped helix. This is due to the rigidity of the cord which the rubber threads cannot yet bring into the shape of a regular helix having contiguous convolutions. It will be noted, that to take the shape of a helix the cord must not only curve itself in the direction of the radius of the helix, which curvature would give flat convolutions, but also receive a certain twisting so that the ends of each convolution are offset by the thickness of the convolution. To make the cord flexible, it is subjected to a steam bath for three or four minutes. When it comes out of said bath the helix has a greater resemblance to its final shape. To bring it into said shape, it is wound by means of a winder shown in Fig. 5 and of which the former 19 has the inner diameter of the final helix. From this time on, the elements of the core are shaped and would tend to retain the shape of the helix having contiguous convolutions with a certain elasticity, very small it is true, even if there were no rubber. Such natural elasticity is therefore added to that which is due to the rubber threads.

In order to facilitate the removal of the rubber threads from certain parts of the braid, which should be at the ends of the cut cords, there is provided in the section supplied with rubber thread, in addition to the ordinary guide slots 10, other slots 20 the path of which passes inside the path of the slots 10. The bobbins 9 are engaged in the slots 10 or in the slots 20 by means of switch points 21 arranged at the entrance of said slots, as seen in Fig. 4, considering the arrows which indicate the direction of circulation of the bobbins in the two slots.

Said points can be controlled automatically, by a system of rods 22, Fig. 3, which is not shown in detail, in view of the fact that its effect is merely to cause the points 21 to swing and

its control can be obtained by any well known means, as a function of the length of the cord issuing from the machine so that the points direct the bobbins towards the slots 10 while the length which is to form the helix is covered with the braid, and towards the slots 20 while the length which is to form the nonelastic ends of the cords is covered with the braid. This control can either be direct as a function of the length of the cord, for example, obtained by a transmission from the receiving roll 18, or indirectly for example, as a function of the number of revolutions of the machine or of the time, considering that the cord issues from the machine at a substantially constant speed.

When it is desired to provide the ends with elements, such as the sleeves 7, engaged under the braid 4, it is convenient to form said braid over said elements. For this purpose, they are arranged on the cord before the formation of said braid, after the core has been cut into desired lengths. The ends of the conductors 1 are then provided with appropriate hooks or fasteners, by means of which said cut cords are hooked on to each other to form a continuous train of cords. It is said core which is made up of a train of cords which is then passed in the braiding machine, which entirely encloses it in the braid 4. The switching mechanism must then operate strictly as a function of the length of the cord issuing from the machine, so that the parts which are free from rubber correspond accurately with the ends of the cut cords. After this, after having secured, in the same way as in the preceding mode of operation, the rubber threads by bindings 6 where they come out of the braid, the floating parts of the rubber threads are cut, the braid 4 is cut opposite the hooked ends of the cords, said ends are unhooked and the hooks are removed.

When it is desired to make a plurality of rubber threads pass in the same column of meshes of the braid, they are all passed through the central orifice 13 of the same driving pinion and on the same thread guide 16, so that they all pass in the same loop of the interlaced slots 10.

To give the cord more flexibility, to thus increase its elasticity and at the same time to reduce its internal wear, there can be arranged in the centre of the platen 11 a wire 23 extending upwardly, parallel to the core A, into the braiding eye 17, so that the braid 4 is formed about the core and said wire. As said wire remains on the machine, the braid 4 is disengaged therefrom immediately after its formation, as the cord issues from the machine, and there is thus created a certain clearance between said braid and the core. At the non-elastic ends, it is preferable, on the contrary, for the braid to press tightly against the core, and for this purpose, when these parts are braided, that is to say while the bobbins circulate along the slots 20, said wire can be caused to descend slightly, so that it is brought out of the eye 17. The braid is then directly formed on the core A.

Said wire can be made to move downwards and upwards in synchronism with the swinging of the points 21, by the same mechanism 22, by means of a suitable connection, diagrammatically shown at 24.

It is, moreover, obvious that the invention has only been described and illustrated herein in a purely explanatory and no way limitative manner and that modifications of detail can be made therein without altering its spirit.

Referring again to Figs. 3 and 4, it should be pointed out that in accordance with the conventional art of braiding, there is a set of bobbins which always travel in the same direction and give threads arranged in parallel helices, and another set of bobbins which work in the same manner but in the opposite direction. Considering a loop formed of sections of two crossed guiding slots 10, as around an axial passage 13 for a rubber thread 5, Fig. 4, the one side of such loop, formed of the one guiding slot section, always guides bobbins travelling in one direction, while the other side, formed of the other guiding slot section, always guides bobbins travelling in the other direction. Consequently, such loop gives a row of braid meshes formed of an inner layer of parallel threads and an outer layer of parallel threads, directed crosswise to those of the inner layer. This is the case of every row of meshes, but where a rubber thread is passed through a loop of guiding slots, this rubber thread becomes enclosed between the inner layer and the outer layer of the corresponding row of meshes.

I claim:

1. Method for the manufacture of elastic helical conductive cord lengths having a core, a braid about same, longitudinal resilient threads enclosed in the thickness of said braid at one side thereof and nonelastic ends, said method comprising stretching resilient threads, causing a core member and the stretched resilient threads to run in parallel relation, so braiding yarns about relatively long spaced sections of the running core member as to guide some of the yarns outside said threads and other yarns between said threads and said core member, so braiding the yarns about relatively short intervening sections of said core member as to guide all of said yarns between said threads and said core member, and severing the braided cord at the last named sections.

2. Method for the manufacture of elastic helical conductive cord lengths having a core, a braid about same, longitudinal resilient threads enclosed in the thickness of said braid at one side thereof and nonelastic ends, said method comprising stretching resilient threads, causing a core member and the stretched resilient threads to run in parallel relation, braiding yarns about relatively long spaced sections of the running core member loosely and so as to guide some of the yarns outside said threads and other yarns between said threads and said core member, braiding the yarns about relatively short intervening sections of said core member tightly and so as to guide all of said yarns between said threads and said core member, and severing the braided core at the last named sections.

3. Method for the manufacture of elastic helical conductive cord lengths having a core, a braid about same, longitudinal resilient threads enclosed in the thickness of said braid at one side thereof and insulating sleeves engaged on their ends under said braid, said method comprising connecting core lengths into a continuous core member, stretching resilient threads, causing said core member and the stretched resilient threads to run in parallel relation, so braiding yarns about the running core member as to guide some of the yarns outside said threads and other yarns, between said threads and said core member, severing the braid and resilient threads at the connected ends of said core lengths and disconnecting the latter.

4. Method for the manufacture of elastic helical conductive cords having a core, a braid about same and longitudinal resilient threads enclosed in the thickness of said braid at one side of the
5 cord, said method comprising stretching resilient threads, causing a core and the stretched resilient threads to run in parallel relation, so braiding yarns about the running core as to guide
10 some of the yarns outside said threads and other yarns between said threads and said core, and subjecting the braided core to a steam bath.

5. Method for the manufacture of elastic helical conductive cords having a core, a braid about same and longitudinal resilient threads enclosed
15 in the thickness of said braid at one side of the cord, said method comprising stretching resilient threads, causing a core and the stretched resilient threads to run in parallel relation, so braiding
20 yarns about the running core as to guide some of the yarns outside said threads and other yarns between said threads and said core, subjecting the braided cord to a steam bath, and winding the cord after said bath into a helix having the desired final diameter.

6. Braiding machine for the manufacture of elastic helical conductive cords having a core, a braid about same and longitudinal resilient threads enclosed in the thickness of said braid at one side thereof, comprising braiding means
30 which include bobbins, pinions adapted to rotate on fixed spindles and to drive said bobbins and axial passages through the spindles of part of said pinions at one side of the machine, a roll carrying a cord core, means for unwinding said
35 core from said roll and for supplying same to said braiding means, rolls carrying resilient threads, and means for unwinding said threads from said rolls at a lower unwinding speed than said core and for supplying same to said braiding means in a stretched state and through said axial passages.
40

7. Braiding machine for the manufacture of elastic helical conductive cords having a core, a braid about same and longitudinal resilient threads enclosed in the thickness of said braid
45 at one side thereof and along relatively long spaced sections of the cord, comprising braiding means which include a platen, two interlaced guiding slots in said platen and forming a generally circular series of loops, two other interlaced
50 guiding slots in said platen and forming another series of loops arranged along a segment of said circular series and radially inside thereof, switching means adapted to connect the first named
55 slots at the ends of said segment either to their sections extending through said segment or to the second named inner slots, bobbins adapted to travel in said guiding slots, pinions adapted to, rotate on fixed spindles in the centres of said
60 loops and to drive said bobbins and axial passages through the spindles of those pinions which are arranged in the loops comprised in said segment of outer guiding slots, a roll carrying a cord core, means for unwinding said core from said roll and for supplying same to said braiding means, rolls carrying resilient threads, and means for unwinding said threads from said rolls at a lower unwinding speed than said core and for supplying same to said braiding means in a stretched state and through said axial passages.
70

8. Braiding machine for the manufacture of elastic helical conductive cords having a core, a braid about same and longitudinal resilient threads enclosed in the thickness of said braid,
75 at one side thereof and along relatively long

spaced sections of the cord, comprising braiding means which include a platen, two interlaced guiding slots in said platen and forming a generally circular series of loops, two other interlaced
5 guiding slots in said platen and forming another series of loops arranged along a segment of said circular series and radially inside thereof, switching means adapted to connect the first named slots at the ends of said segment either
10 to their sections extending through said segment or to the second named inner slots, bobbins adapted to travel in said guiding slots, pinions adapted to rotate on fixed spindles in the centres of said loops and to drive said bobbins and axial passages through the spindles of those pinions
15 which are arranged in the loops comprised in said segment of outer guiding slots, a roll carrying a cord core, means for unwinding said core from said roll and for supplying same to said braiding means, rolls carrying resilient threads, means for unwinding said threads from said rolls at a lower unwinding speed than said core and for supplying same to said braiding means in a stretched state and through said axial passages, and a mechanism adapted to control said switching means responsive to a variable which increases proportionately to the length of the braided cord issuing from the machine.
25

9. Braiding machine for the manufacture of elastic helical conductive cords having a core, a braid about same and longitudinal resilient threads enclosed in the thickness of said braid at one side thereof, comprising braiding means which include bobbins, pinions adapted to rotate on fixed spindles and to drive said bobbins, axial passages through the spindles of part of said pinions
35 at one side of the machine, a braiding eye and a spacing member engaged in same, a roll carrying a cord core, means for unwinding said core from said roll and for supplying same into said braiding eye close to said spacing member so that the braid is formed about said core and spacing member, rolls carrying resilient threads, and means for unwinding said threads from said rolls at a lower unwinding speed than said core and for supplying same to said braiding means in a stretched state and through said axial passages.
40

10. Braiding machine for the manufacture of elastic helical conductive cords having a core, a braid about same and longitudinal resilient threads enclosed in the thickness of said braid at one side thereof, comprising braiding means which include bobbins, pinions adapted to rotate on fixed spindles and to drive said bobbins, axial passages through the spindles of part of said pinions at one side of the machine, a braiding eye and a spacing member adapted to be alternatively engaged into same and withdrawn from same, a roll carrying a cord core, means for unwinding said core from said roll and for supplying same into said braiding eye and, when said spacing member is engaged in the latter, close to said spacing member, so that the braid is then formed about said core and spacing member, rolls for carrying resilient threads, and means for unwinding said threads from said rolls at a lower unwinding speed than said core and for supplying same to said braiding means in a stretched state and through said axial passages.
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11. Braiding machine for the manufacture of elastic helical conductive cords having a core, a braid about same and longitudinal resilient threads enclosed in the thickness of said braid, at one side thereof and along relatively long spaced sections of the cord, comprising braiding
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means which include a platen, two interlaced guiding slots in said platen and forming a generally circular series of loops, two other interlaced slots in said platen and forming another series of loops arranged along a segment of said circular series and radially inside thereof, switching means adapted to connect the first named slots at the ends of said segment either to their sections extending through said segment or to the second named inner slots, bobbins adapted to travel in said guiding slots, pinions adapted to rotate on fixed spindles in the centres of said loops and to drive said bobbins, axial passages through the spindles of those pinions which are arranged in the loops comprised in said segment of outer guiding slots, a braiding eye and a spacing member adapted to be alternatively engaged into same and withdrawn from same, a roll carrying a cord core, means for unwinding said core from said roll and for supplying same into said braiding eye

and, when said spacing member is engaged in the later, close to said spacing member, so that the braid is then formed about said core and spacing member, rolls carrying resilient threads, means for unwinding said threads from said rolls at a lower unwinding speed than said core and for supplying same to said braiding means in a stretched state and through said axial passages, and a mechanism adapted to control said switching means and said spacing member, so that the latter is engaged into said braiding eye when the bobbins are switched on to said segment of outer guiding slots, thereby to enclose said resilient threads into a relatively loose braid, and is withdrawn therefrom when said bobbins are switched on to said inner slots, thereby to form a relatively tight braid and to leave said threads outside thereof.

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