Aug. 5, 1947. J. C. QUAYLE ET AL 2,425,123

SLITTING OF INSULATING MATERIAL

Filed July 4, 1945 4 Sheets-Sheet 1

FIG. 1.

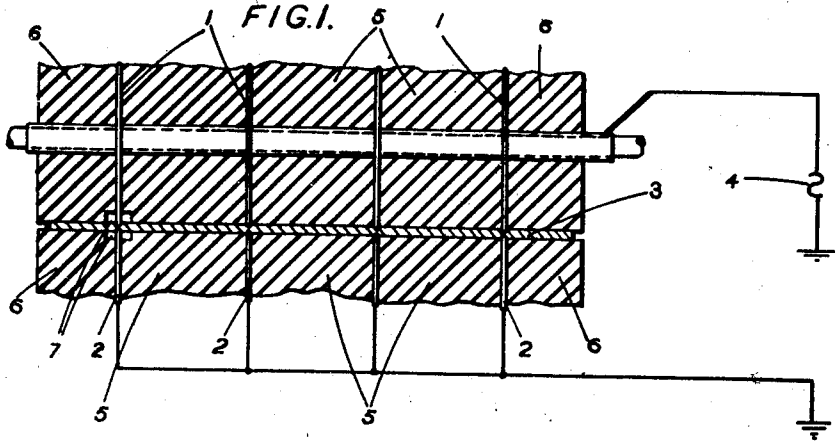


FIG. 2.

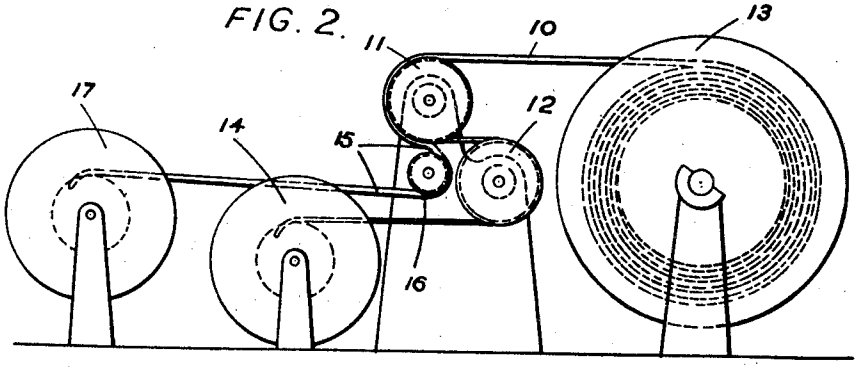
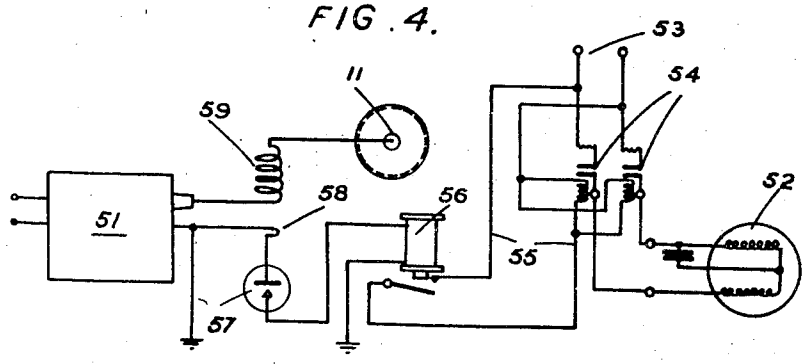


FIG. 4.



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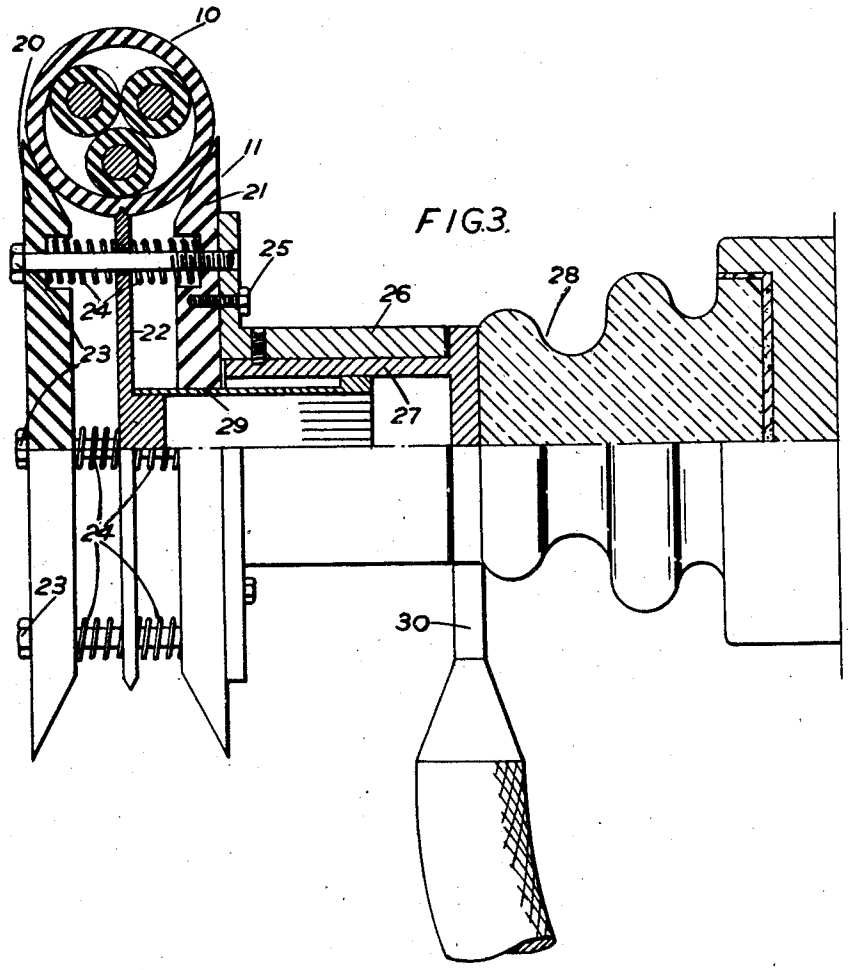

FIG.3.

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SLITTING OF INSULATING MATERIAL

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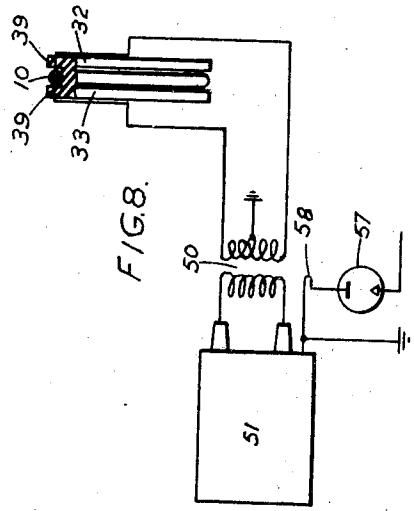

FIG. 8.

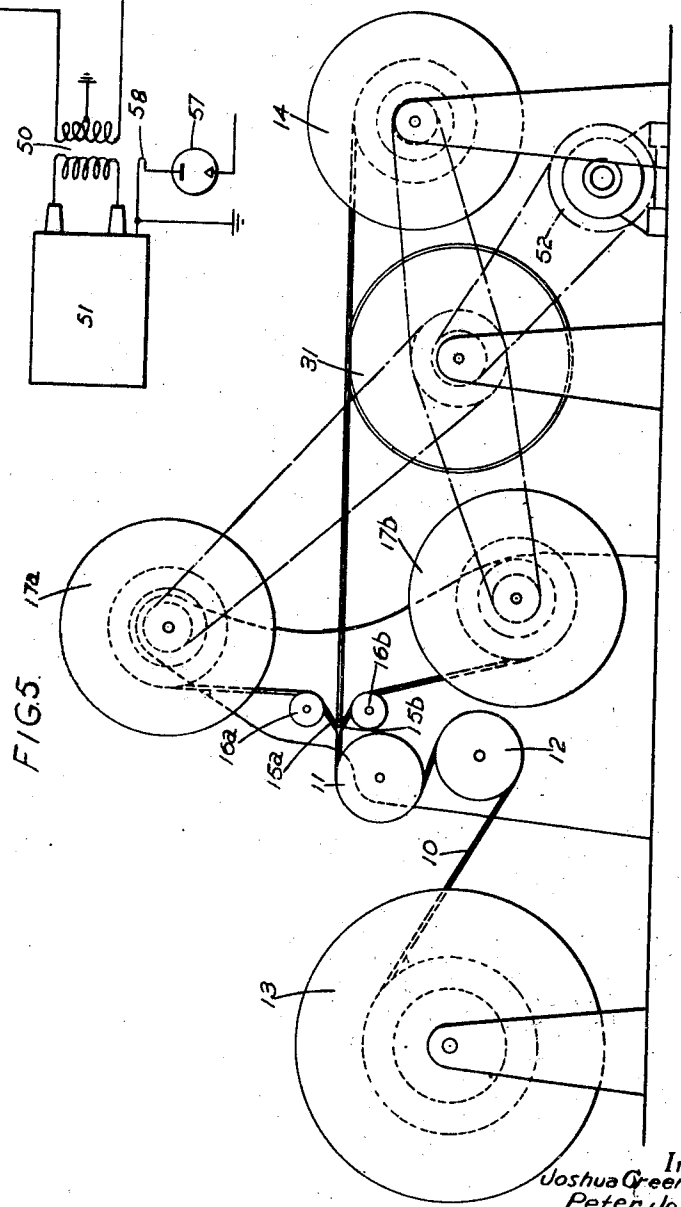

FIG. 5.

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FIG.6.

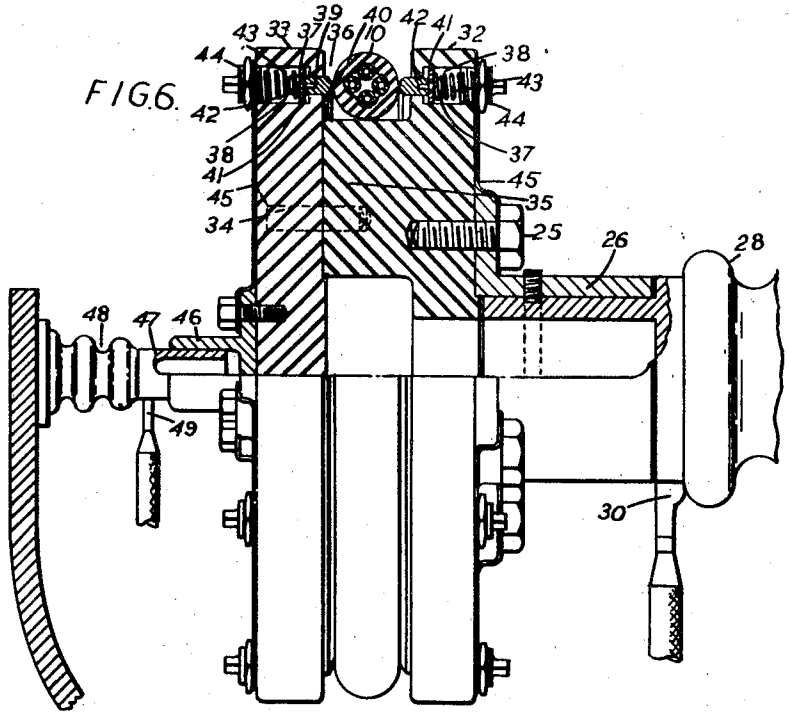
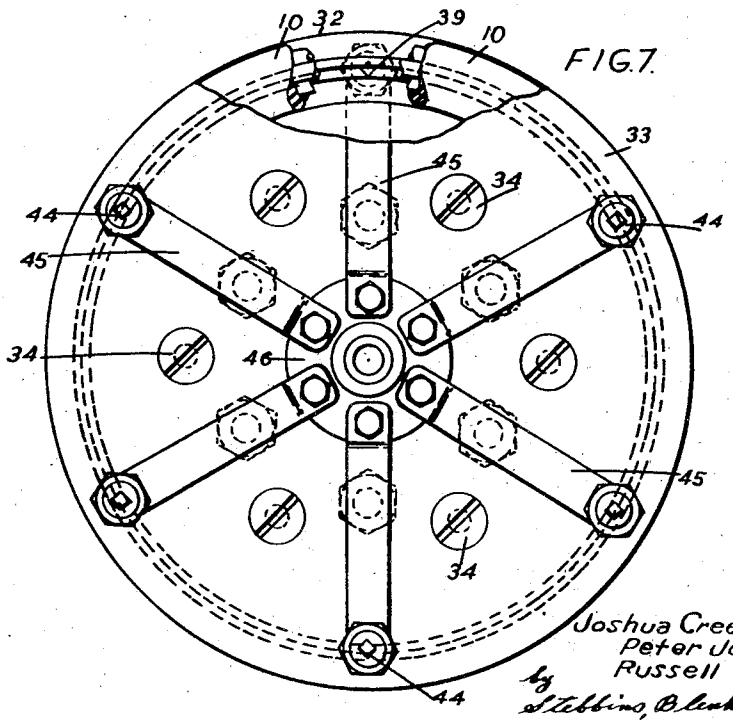


FIG.7.



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Patented Aug. 5, 1947 2,425,123

UNITED STATES PATENT OFFICE

2,425,123

SLITTING OF INSULATING MATERIAL

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Application July 4, 1945, Serial No. 603,162
In Great Britain July 24, 1944

17 Claims. (Cl. 164—17)

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This invention is concerned with the slitting of lengths, e. g., tubes or strips, of electric insulating material and provides an improved method of carrying out this operation. In this method a line of weakening in the length is produced by subjecting it to a concentrated field alternating at high frequency and moving the length forward through this field and thereafter tearing it along the line of weakening. The field is concentrated in a narrow line and produces closely localised heating of the material accompanied by softening and a consequent substantial local reduction of strength. Accordingly, when the material on the two sides of the line of weakening is pulled in opposite or divergent directions it readily tears at that line.

The invention is particularly useful in removing a covering, for instance a sheath of thermoplastic material, such as polyvinyl chloride compound, from an electric wire or cable both hereinafter included in the term "cable" for the sake of brevity. It permits this operation to be performed without injuring or even disturbing the enclosed core, or conductor, or groups of these. There is no penetration of the covering by any part of the apparatus, such as takes place when cutting by a blade or the action of a hot wire.

The method may be carried out by passing the tube or strip first between two electrodes, which are narrow transverse to the direction of movement, and then through tearing means. The latter may be an arrangement of pulling rollers, or may even be the hands of the operator. Appropriate means are provided for feeding high frequency current to the electrodes. In the case of stripping a cable, the conductor or conductors within the covering to be removed may serve as one of the electrodes, the electric field being made to extend radially therefrom to a narrow external electrode, which is preferably in close contact with the outer surface of the covering.

Various forms of apparatus for carrying out the invention will now be described by way of example with the aid of the accompanying drawings, wherein,

Figure 1 is a diagrammatic view, partly in section, of an electrode arrangement for dealing with a flat strip of material,

Figure 2 is a diagrammatic view of one form of cable-stripping apparatus,

Figure 3 is a sectional elevation on an enlarged scale as compared with Figure 2, of the electrode pulley of the apparatus shown in that figure,

Figure 4 is a circuit diagram showing how the high frequency supply is interlocked with the cable movement,

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Figure 5 is a diagrammatic view of a second form of cable-stripping apparatus,

Figures 6 and 7 are, respectively, side and end elevations, partly in section and on an enlarged scale as compared with Figure 5, of the electrode pulley of the apparatus shown in that figure,

Figure 8 is a circuit diagram showing the arrangements for the supply of high frequency current to the electrode pulley shown in Figures 6 and 7.

The electrode arrangement for dealing with flat strip, that is shown in Figure 1, essentially comprises a number of pairs of circular electrodes 1 and 2, the number depending upon the maximum number of lines of weakening that is required to be produced. The electrodes 1 and 2 of each pair are rotatable in a common plane about their respective axes which are so spaced as to leave between the peripheral surfaces of the pair a gap equal to or preferably slightly less than the thickness of the flat strip 3 of material to be passed between them. The electrode 2 of each pair is at earth or earthy potential and the other 1 is connected to the high tension side of a source of high frequency supply 4. A field is thus established in the direct line between the electrodes of each pair through the sheet material as it passes between them. As will be seen the circular electrodes take the form of thin metal discs separated by thick discs 5 of insulating material which, with end discs 6, serve to apply a guiding pressure to the strip 3. The assemblies of thin metal discs and insulating discs form a pair of insulating rollers with peripheral electrodes at intervals along their lengths. In some cases it may be preferable to leave the strip in the immediate region of the electrodes free of support by cutting away the edges of the adjacent insulating discs as shown at 7 in Figure 1. Alternatively, the insulating discs of the lower roll of a pair may be so cut away and those of the upper roll be completely dispensed with. It will be appreciated that the disc arrangement has the advantage that rolls with different numbers of and variously spaced, electrodes can readily be built up if a number of insulating discs of different thicknesses are available.

The arrangement shown in Figure 2 is one for stripping a cable 10 following weakening along a single radial line. It consists of a pair of pulleys 11 and 12 around which the cable passes in succession from a supply drum 13. The pulleys are so arranged that the cable makes contact with

each over an arc of about 180°. The second pulley 12, has a metallic surface, preferably concave, so as to fit approximately the shape of the stripped cable. This second pulley serves to make a capacitive connection between the conductor (or conductors) and one high frequency terminal (preferably one at earth or earthy potential). The first pulley 11 comprises a central thin disc of metal and two side flanges of insulating material which serve to locate the cable centrally while guiding it in contact with the edge of the disc. The latter is connected with the second terminal of a source of high frequency supply and serves as the external electrode. The cable is drawn over the two pulleys in succession by a take-up reel 14 and, in the process, is submitted for an appropriate period of time controlled by the speed of take-up to a narrow radially extending high frequency field which locally heats the cable covering and establishes a line of weakening through the covering. Near the point where the cable leaves the electrode pulley 11, the weakened covering 15 is torn from the cable and passes round a third pulley 16 of relatively small diameter and from thence to a second take-up reel 17. In order to obtain an appropriate tearing force the paying out reel 13 will be braked and both take-up reels will be driven, preferably through slipping couplings.

The construction of the electrode pulley and its mounting is more clearly shown in Figure 3. The pulley consists of a pair of flanges, 20 and 21, disposed one on each side of a metal disc 22. The flanges and the disc are held in spaced relationship by set screws 23 passing through them and by helical springs 24 disposed between them and surrounding the set screws 23. The pulley is secured by screws 25 to a flanged bush 26 which is axially positioned but rotatable on a cylindrical metal sleeve 27 mounted on an insulating support 28. The edges of the flanges 20 and 21 are conical so as to form between them a V-groove of which the width is adjusted by the setting of the screws 23 to suit the diameter of the cable to be stripped of its sheath and ensure that the cable is seated symmetrically on the periphery of the disc 22 and given adequate lateral support. The disc has a hub from which extends a tube 29 with a flexible end which makes a wiping contact with the sleeve 27, carrying a high frequency supply terminal 30.

In some cases, particularly for larger sizes of cables, it may be advantageous to provide two lines of weakening at diametrically opposite points so that the cover may be removed in two strips by oppositely acting similar tearing means. To do this, we prefer to use the apparatus shown in Figure 5 of the drawings. In this apparatus the cable is drawn off its supply reel 13 round an earthed pulley 12 and an electrode pulley 11 by a draw-off capstan 31. The electrode pulley 11 is designed to impart to the cable covering two lines of weakening which, as the cable leaves the pulley, lie in a horizontal diametrical plane. Close to the point where the cable leaves the pulley are a pair of small pulleys 16*a* and 16*b* arranged one above and one below the cable. Between these pulleys and the electrode pulley the cable covering is split along the lines of weakening and the upper half is led round pulley 16*a* on to a take-up reel 17*a* and the lower round pulley 16*b* on to a second take-up reel 17*b*. These take-up reels are driven through slipping couplings, the power supplied being sufficient to tear the weakening covering off the cable and reel the two halves as the cable is drawn over the electrode

pulley by the motor-driven capstan 31 which engages the stripped core of the cable. From the capstan the core passes to a third take-up reel 14, also driven through a slipping coupling.

A preferred construction of the electrode pulley suitable for use in the apparatus described in the preceding paragraph is shown in Figures 6 and 7. It comprises a pair of flanges 32 and 33. The former is rotatably mounted on an insulating support 28 in the same way as the flange 21 of the pulley described with reference to and shown in Figure 3. The two flanges 32 and 33 are not adjustable but the flange 33 is secured by screws 34 to the face of an annular boss 35 on the flange 32. The external wall of this boss forms the bottom wall of the pulley groove 36 of which the width is somewhat greater than the diameter of the cable 10 to be stripped. The depth of the groove is of the same order. In the inside face of each flange is an annular recess 37 having a mean diameter approximating to the mean diameter of the pulley groove 36 and a depth of from one third to one half the flange thickness. On the opposite side of each flange are a number of cylindrical recesses 38 which extend to a depth approximately equal to three quarters of the flange thickness. These recesses are six in number (but there may be more or fewer than six) and are distributed uniformly around the pulley axis at a radius equal to the mean radius of the annular recess in the opposite face. In each annular recess 37 is inserted a ring electrode 39 which is made a sliding fit in its recess 37. Its rear face is flat and its exposed front face is of ridge shape to provide a blunt knife edge 40 of circular form. The ring is retained in its recess by plates 41 each of which is a sliding fit in its recess 38 and is secured to the ring by a screw 42. The two rings 39 are pressed towards one another by springs 43, one in each cylindrical recess between the plate 41 and the end face of screw plug 44 constituting an adjustable abutment by which the pressure exerted on the cable 10 by the two electrodes can be made uniform and adjusted in intensity. The ring electrode in the flange 32 is electrically connected with the terminal 30 through each spring 43, its abutment 44, strip conductor 45 and the flanged bush 26. The other ring electrode is similarly connected with a smaller flanged bush 46 in which is slidably positioned a plug 47 mounted on an insulating support 48 and carrying a second terminal 49. The terminals 30 and 49 are connected as shown in Figure 8 to opposite ends of the centre-earthed secondary of a high frequency transformer 50 whose primary is connected across the output terminals of a high frequency generator 51.

It is advantageous to arrange that the control of the supply of high frequency energy to the electrode discs or pulley is interlocked with the control of the movement of the strip or cable, through the apparatus, so that heating and movement are initiated simultaneously and terminated simultaneously, thus avoiding waste of the high frequency energy and overheating of the covering, and possibly of insulation within the covering, which will occur if the high frequency supply is maintained while the strip or cable is stationary in the apparatus. In the arrangement shown in Figure 4, the motor 52 driving the take-up reels 14 and 17 of the apparatus shown in Figure 2 is fed from a source of supply 53 through contactors 54 which are closed on completion of a contactor control circuit 55 by a relay 56, the supply to which is obtained from a rectifier 57

whose anode connected to a loop 58 energised by a coil 59 in the supply line from the oscillator 51 to the electrode pulley 11.

This arrangement is equally applicable to the cable stripping apparatus described with reference to and shown in Figures 5, 6 and 7, as will be apparent from Figure 8, which shows the rectifier 57 energised from the primary of the coupling transformer 50. The output from the rectifier is utilised in the same way as shown in Figure 4.

What we claim as our invention is:

1. A method of slitting a length of electric insulating material, which comprises moving the length forward through a concentrated high frequency alternating electric field to heat and weaken the material along a narrow line, and thereafter tearing the material along the line of weakening.

2. A method of slitting a strip of electric insulating material, which comprises feeding the strip through a high frequency electric field which extends substantially normal to the surface of the strip and is narrow in a direction transverse to the direction of movement of the strip, to heat and weaken the material along a narrow line, and causing the parts on opposite sides of the line to proceed in divergent directions on leaving the electric field, thereby separating the strip along the line of weakening.

3. A method of stripping an electric cable having a core including at least one conductor, of a covering of insulating material, which comprises moving the cable through a high frequency electric field which extends substantially radially through the covering and is narrow in a circumferential direction, to heat and weaken the covering along a narrow line extending longitudinally of the cable, and removing the covering by causing the core and covering to proceed in divergent directions on leaving the electric field.

4. A method of stripping an electric cable having a core including at least one conductor, of a covering of insulating material, which comprises moving the cable through a high frequency electric field which extends substantially radially through the covering and is narrow in a circumferential direction, to heat and weaken the covering along a narrow line extending longitudinally of the cable, and tearing the weakened covering from the core by separately reeling the covering and the core after their passage through the high frequency field.

5. Apparatus for slitting a length of electric insulating material, comprising a pair of electrodes and means for establishing between them a concentrated high frequency electric field, means for moving the length of material forward through the field, which is narrow, in a direction transverse to the direction of movement, compared with the material, and means for causing parts of the material on opposite sides of a line of weakening produced in it by the heating effect of the field, to diverge one from the other as the material leaves the field, whereby to tear the material along the line of weakening.

6. Apparatus for slitting a length of electric insulating material, comprising a pair of circular electrodes with thin peripheral edges, rotatable substantially in the same plane about their respective axes with a gap between them, means for establishing across said gap a concentrated high frequency electric field, means for passing the material lengthwise between the electrodes whereby to produce in it a line of weakening by the heating effect of said field, and means for tearing the length along the line of weakening as it leaves the said field.

7. Apparatus for slitting a length of electric insulating material, comprising a pair of insulating rollers rotatable about their respective axes with a gap between them for the passage of said material, a pair of circular electrodes of approximately the same overall diameter as said rollers, housed one in each roller and having thin peripheral edges which in the region of the said gap are in close proximity to one another, means for establishing a concentrated high frequency electric field between the said electrodes, means for passing the material lengthwise between said rolls whereby locally to subject it to the heating effect of the said field and to impart a line of weakening thereto, and means for tearing the said length along the line of weakening as it leaves the said field.

8. Apparatus for dividing a sheet of electric insulating material into a number of strips, comprising a pair of rolls, between which the sheet is passed, each roll having a peripheral surface consisting of a number of axially short, circumferentially extending, conductive surfaces separated by surfaces of insulating material, the conductive surfaces of one roll being in alignment with those of the other roll, means for establishing a concentrated high frequency electric field between each conductive surface of one roll and the neighbouring conductive surface of the other roll, and means on the delivery side of the rolls for causing the section of the sheet to one side of each field, as it leaves the rolls, to travel in a sharply divergent direction to the direction of travel of the neighbouring section or sections, thereby tearing it therefrom.

9. Apparatus for imparting a line of weakening to an insulating covering of an electric cable comprising at least one conductor by passing it through a concentrated high frequency field extending radially outwardly from the cable conductor or conductors to an external electrode, comprising a pair of pulleys around which the cable passes in succession, one of the pulleys having a metallic surface for providing a capacitive connection between one terminal of a source of high frequency electric supply and the cable conductor or conductors and the second pulley comprising a central thin disc of metal and a pair of side flanges of insulating material for locating the cable centrally while guiding it in contact with the edge of the said disc which is connected with the second terminal of the source of high frequency supply and forms the external electrode.

10. An electrode pulley for use in apparatus for imparting a line of weakening to a cable covering by passing the cable through a concentrated high frequency electric field extending radially outwards through the covering, comprising a metallic disc and a pair of flanges of insulating material disposed one on each side of said disc and held in spaced relationship thereto by spring force and by screw-threaded members extending between the two flanges and passing through and supporting the said disc, the edges of the insulating flanges being shaped to form between them a V-groove of which the width is adjusted by the setting of said threaded members, whereby to ensure that the cable to be treated is seated symmetrically on the periphery of the disc and given adequate lateral support.

11. An electrode pulley for use in apparatus for imparting a line of weakening to a cable cover-

ing by passing the cable through a concentrated high frequency electric field extending radially outwards through the covering, comprising a central metallic disc and a pair of flanges of insulating material with bevelled edges which co-operate to form a V-groove, means for maintaining said disc and said flanges coaxial with one another and in spaced relationship, an electrically insulated support, an axial extension on one of said flanges rotatably positioned on said support, and an axial extension on said disc passing through said axially extended flange and making a sliding electrical connection with said support.

12. An electrode pulley for use in apparatus for imparting a line of weakening to a cable covering by passing the cable through a concentrated high frequency electric field extending radially outwards through the covering, comprising a central metallic disc and a pair of flanges of insulating material with bevelled edges which co-operate to form a V-groove, means for maintaining said disc and said flange coaxial with one another and in spaced relationship, comprising a plurality of screws passing through said disc and engaging said flanges for adjusting the spacing thereof and pairs of helical springs, threaded one pair on each screw, one spring on each side of said disc, for pressing said flanges outwards from said disc.

13. Apparatus for imparting lines of weakening to and on opposite sides of an insulating covering of an electric cable by passing the cable through concentrated high frequency electric fields extending substantially radially through the covering, comprising a pulley with a peripheral groove of which the side walls are of insulating material and provided each with an annular recess facing the middle of the groove, a pair of ring-shaped electrodes housed one in each of said annular recesses, and means for pressing said electrodes into engagement with the surface of a cable as the cable is drawn over the pulley.

14. Apparatus for imparting lines of weakening to and on opposite sides of an insulating covering of an electric cable by passing the cable through concentrated high frequency electric fields extending substantially radially through the covering, comprising a grooved pulley with flanges of insulating material forming the side walls of the groove and provided each with an annular recess facing the middle of the groove, a pair of ring-shaped electrodes, one housed in each of said annular recesses, a plurality of retaining plates for each electrode secured to the rear face thereof and each housed in one of a plurality of cylindrical recesses extending from the outer face of the flange to and beyond the bottom of the annular recess in the inner face of the flange, and means for pressing each electrode inwardly towards the middle of the groove, said means comprising a plurality of coil springs housed in said cylindrical recesses and each disposed between the retaining plate therein and an adjustable abutment for varying the pressure exerted by the spring.

15. Apparatus for imparting lines of weakening to and on opposite sides of an insulating covering

of an electric cable by passing the cable through concentrated high frequency electric fields extending substantially radially through the covering, comprising an insulated support, a grooved pulley rotatably mounted on said support, said pulley having flanges of insulating material which form the side walls of the groove and are provided each with an annular recess facing the middle of the groove, a pair of ring-shaped electrodes, one housed in each of said annular recesses, and means for pressing said electrodes into engagement with the surface of a cable as the cable is drawn over the pulley, means for electrically connecting said insulating support with the adjacent one of said electrodes, a second insulated support located on the opposite side of the pulley to the first said support, and means for electrically connecting said second support with the electrode adjacent thereto.

16. Apparatus for imparting a double line of weakening to and on opposite sides of an insulating covering of an electric cable by passing the cable through concentrated high frequency electric fields extending substantially radially through the covering, comprising a grooved pulley in which the side walls of the groove are of insulating material and each house a ring electrode adapted to engage the surface of the cable as it is drawn over the pulley, and a source of high frequency electric supply, and a transformer having a centre-earthed secondary for coupling said source to said electrodes, one of said electrodes being connected to one end of said secondary and the other of said electrodes to the other end of said secondary.

17. In apparatus for imparting a line of weakening to a length of electric insulating material drawn by a motor-driven pulling device through a concentrated high frequency electric field established between a pair of electrodes connected across a source of high frequency supply, electromagnetically actuated contactors for controlling the running of the motor, a relay controlling the energization of the control circuits of said contactors, and a tube rectifier for supplying current to operate said relay, said rectifier having its anode inductively coupled to the high frequency supply line to one of the electrodes, whereby said relay operates to close said contactors when said electrodes are energised, and operates to open said contactors when the supply of high frequency energy is cut off from said electrodes.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,023,316	Hurwitz	Apr. 16, 1912
2,177,299	Fredrickson	Oct. 24, 1939
2,324,068	Crandell	July 13, 1943
2,391,086	Crandell	Dec. 18, 1945