April 1, 1941. W. F. ASTLEY 2,237,267

METHOD OF MAKING INSULATING YARNS OR ROVINGS

Filed Feb. 14, 1940 3 Sheets-Sheet 1

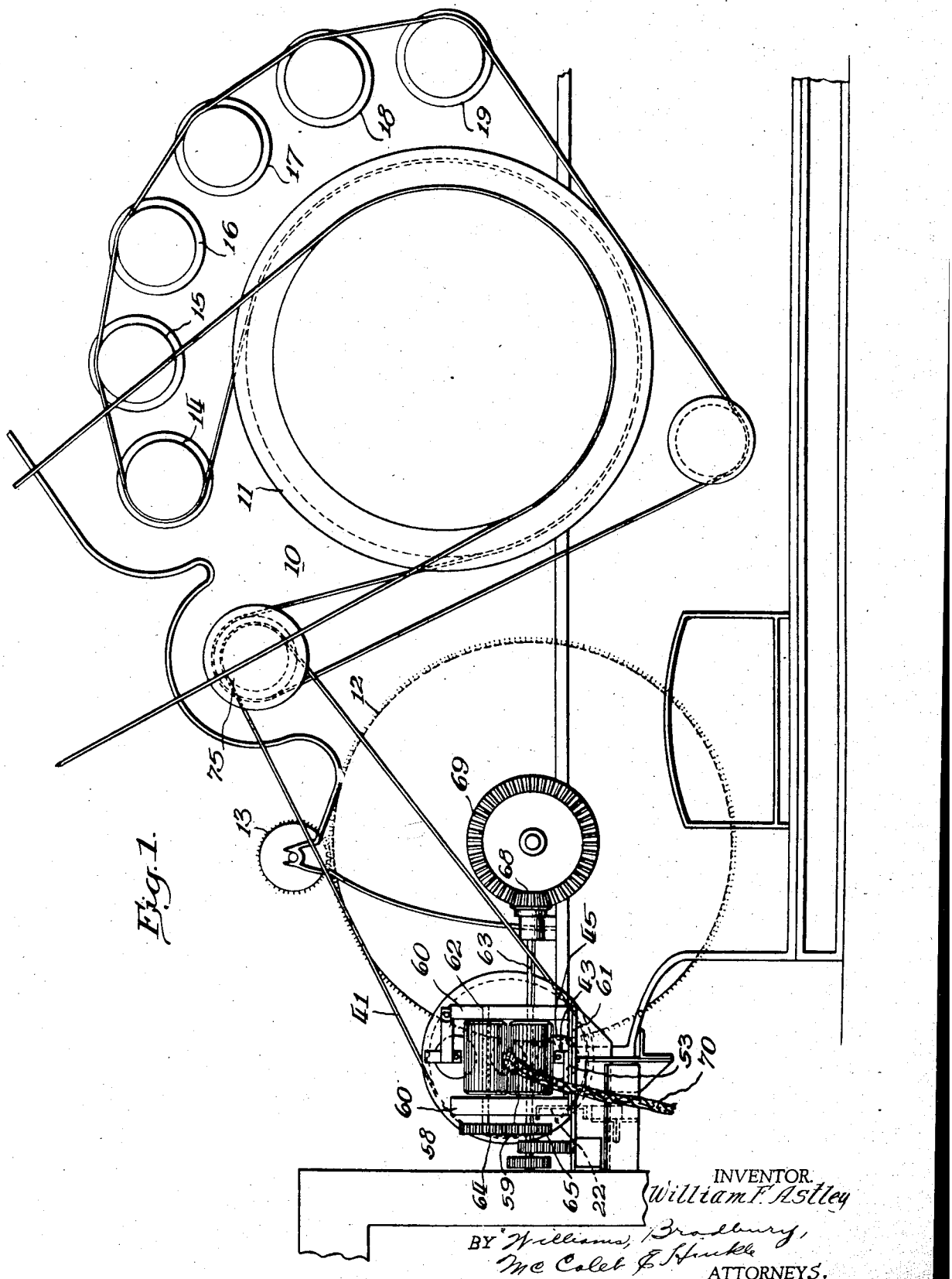


Fig. 1.

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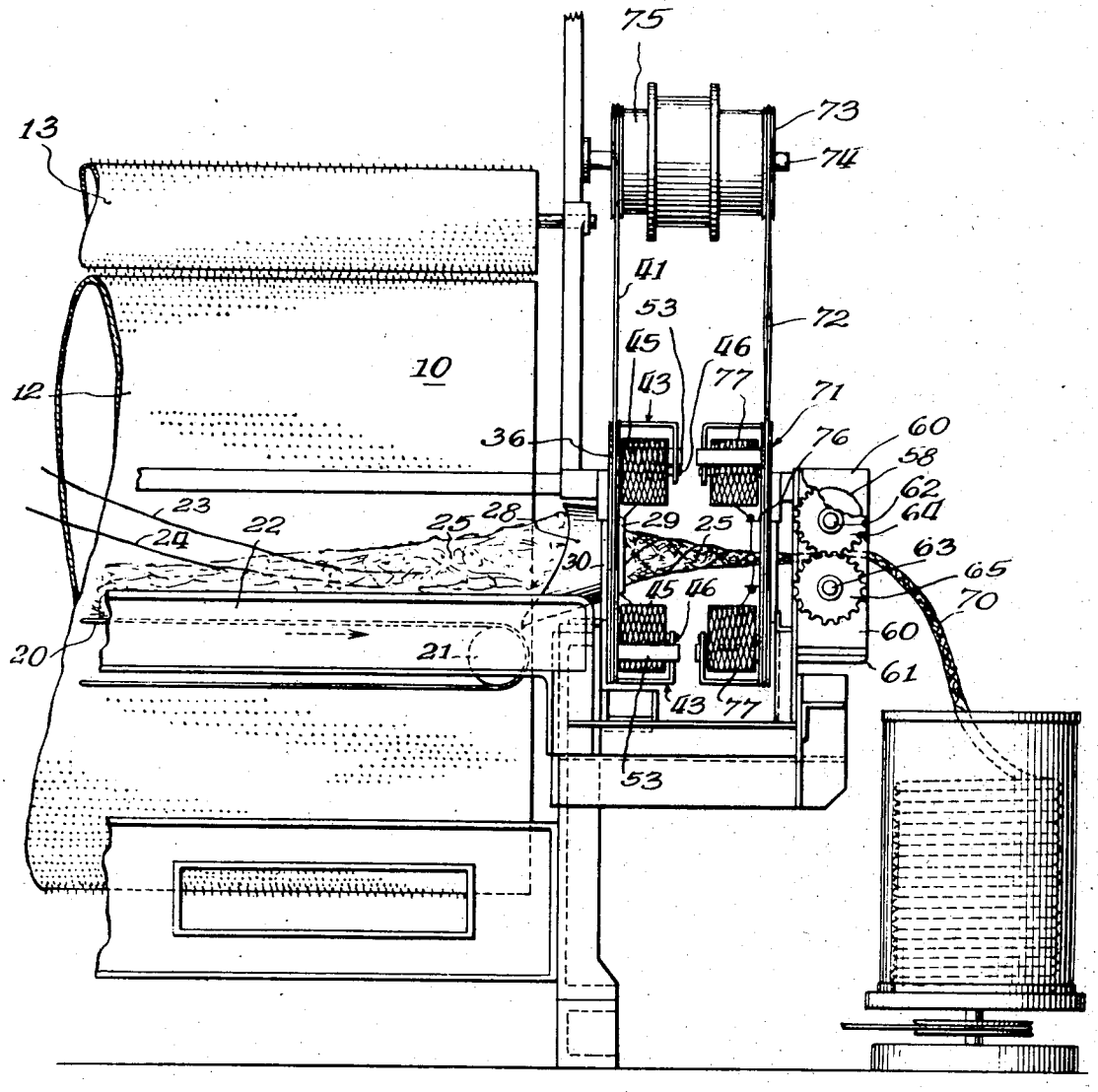
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METHOD OF MAKING INSULATING YARNS OR ROVINGS

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Fig. 2.



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METHOD OF MAKING INSULATING YARNS OR ROVINGS

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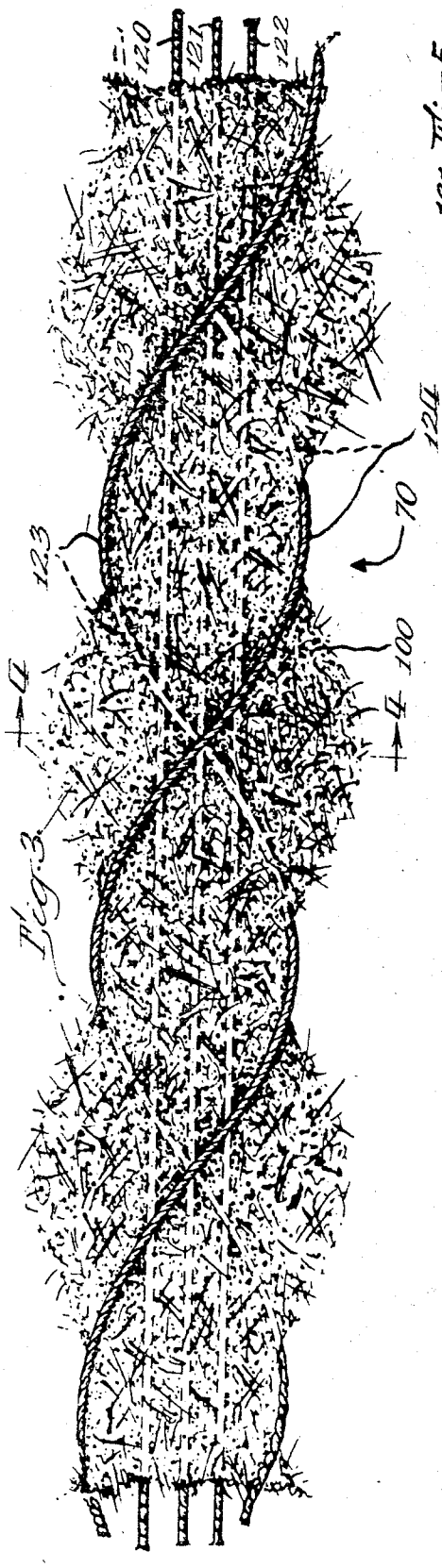


Fig. 3.

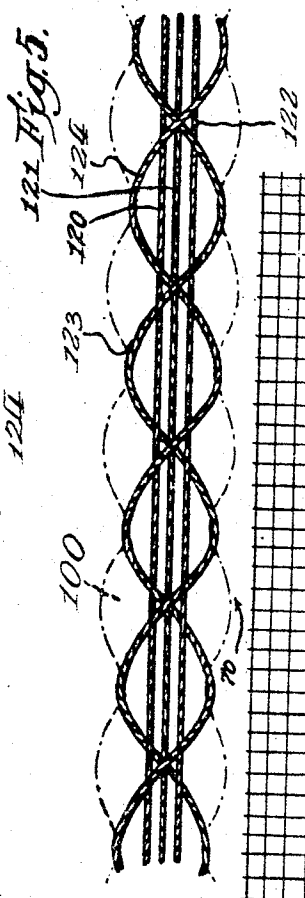


Fig. 5.

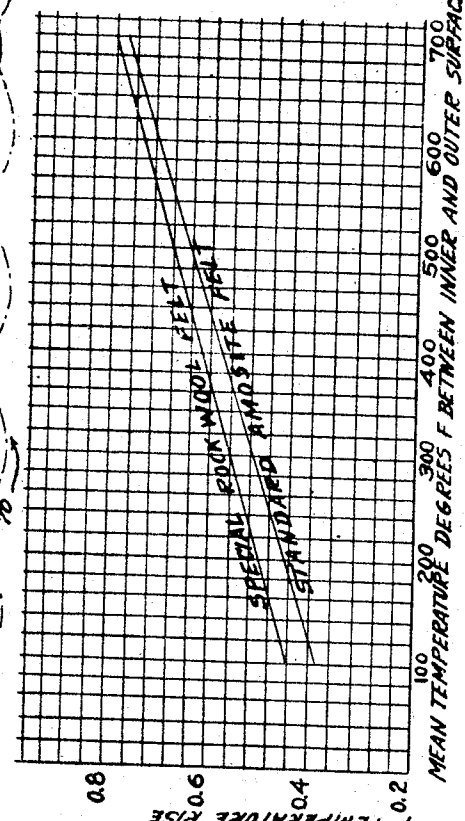


Fig. 6.



Fig. 4.

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UNITED STATES PATENT OFFICE

2,237,267

METHOD OF MAKING INSULATING YARNS OR ROVINGS

William F. Astley, Cicero, Ill., assignor to Union Asbestos & Rubber Company, Chicago, Ill., a corporation of Illinois

Application February 14, 1940, Serial No. 318,795

1 Claim. (Cl. 57—160)

The present invention relates to methods of making insulating yarns or rovings, and this application is a continuation-in-part of my prior application, Serial No. 195,117, filed March 10, 1938, on Machines for making insulation, which will issue as Patent No. 2,191,875.

The insulating yarns or rovings which are made according to the present method form a part of the sheet insulation or blankets covered by my prior application, Serial No. 188,720, filed February 4, 1938, on Heat insulating materials and methods of making the same.

Such insulating blankets have marked advantages over the insulation of the prior art in the provision of an insulation of higher efficiency at lower cost, and such materials may be used in all places where flexible or blanket insulation is applicable.

One of the objects of the present invention is the provision of an improved method of making insulating yarn or rovings adapted to be used in constructing improved and highly efficient insulating material capable of meeting special conditions, such as use at high temperatures, as, for example, up to 750 or 1,000 F.

Another object of the invention is the provision of improved methods for the handling of insulating fibers in the form of asbestos sliver or other loose fibers, and assembling these fibers into an insulating unit yarn or roving of sufficient strength to maintain its individuality so that it may be coiled and later used in building up an insulating blanket.

Another object of the invention is the provision of an improved method of making a chenille roving or yarn of asbestos fibers in the form of sliver, or some other fibers, carried by a core yarn or thread, and with or without spirally wound strands in one or both directions about the roving.

Other objects and advantages of the invention will be apparent from the following description and the accompanying drawings, in which similar characters of reference indicate similar parts throughout the several views.

Referring to the three sheets of drawings accompanying this specification,

Fig. 1 is a diagrammatic side elevational view of the delivery side of one form of machine covered by my prior application, Serial No. 195,117, mentioned above, and adapted to carry out the method;

Fig. 2 is a fragmentary end elevational view of one form of the machine;

Fig. 3 is an enlarged elevational view of the improved chenille roving or yarn constructed according to the present method;

Fig. 4 is a sectional view, taken on the plane of the line 4—4 of Fig. 3, looking in the direction of the arrows;

Fig. 5 is a diagrammatic elevational view of the core yarns or threads and the spirally wound yarns or threads;

Fig. 6 is a reproduction of a curve showing the B. t. u.'s per square ft. per inch thickness per hour per degree of Fahrenheit temperature for a blanket constructed of the present chenille rovings or yarns.

The yarns made according to the present invention are to be carefully distinguished from the insulating materials of the prior art employing ropes, frequently called rovings.

One of the most important distinctions between the insulating ropes or yarns of the prior art and the present insulating units is that the fibers of the prior art devices are twisted in such manner that the fibers become more unidirectional than the fibers in the present unit. Being twisted and aligned with each other, the fibers are more dense and compact in the devices of the prior art, like the strands of a rope.

The rovings or yarns of the prior art also tend to remain separate units when they are assembled side by side in flexible insulation because of their twisted and compacted condition, which is the result of an effort to provide such rovings or yarns with sufficient tensile strength for weaving and maintaining their form in the insulation.

The insulating yarns or rovings of the present invention have no predetermined shape, and they comprise the carded and open asbestos fibers in the form of "sliver," which is the form having the highest volume, the lightest weight, and the greatest insulating value.

Referring to Fig. 3, this is an enlarged illustration of an insulating yarn, chenille, or roving constructed according to the invention. It comprises a mass of asbestos fibers 100 in the form of the carded and open sliver, the fibers extending at random in all directions, and projecting from the assembly, which may be indicated by the numeral 70.

These fibers are preferably grouped about one, two, or three core yarns or threads 120, 121, and 122, the number of core yarns depending upon the size of the chenille roving.

I have called my insulating unit or yarn a chenille roving for the reason that its loose fibers are assembled about a core yarn, and they pro-

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ject from the yarn at random in various different directions, giving the appearance of a chenille yarn or roving.

In some embodiments of the invention, with a smaller assembly of fibers, only one core yarn 121 may be employed; or, if the assembly is slightly larger, the second core yarn 122 may be employed.

In the embodiment illustrated in Fig. 3, three core yarns have been employed, and any number of core yarns may be used. The present chenille rovings, having their fibers projecting at random in all directions, have the characteristic that these fibers are adapted to intermingle and become a part of other adjacent insulating units of the same character. This tends to make an insulating blanket constructed of these yarns or chenille rovings of practically continuous structure and homogeneous characteristics.

The insulating fibers preferably employed in the present material consist of asbestos fibers known to the trade as Amosite. In this form of the material it is adapted to be used for temperatures up to 750 degrees F. Other fibers which may be similarly treated and used in this material are specially processed mineral wool fibers, such as rock wool in any of its conventional forms, and when the material is constructed with mineral wool it may be used for temperatures from 750 to 1,000 degrees F.

Sheets or blankets of insulating materials may be constructed according to the present method, including fibers of practically any kind, such as any of the known animal, vegetable, or mineral fibers, including fur, feathers, cotton, wool, linen, etc., irrespective of the tensile strength of the fibers when assembled into an insulating unit, because the method of weaving contemplates the use of insulating units having practically no tensile strength, and the threads employed are used primarily for interlacing and securing the fibers together, rather than to provide tensile strength during the weaving operation.

The material is best understood by considering also its mode of manufacture, which will be described briefly. The fibers, such as Amosite asbestos fibers, are first carded, shortened, and fluffed out, or opened by a carding machine, which may be of conventional construction, except that the fibers in the fluffed or open condition are deposited upon a conveyor belt, disposed at the bottom of a trough, so that there is a constant stream of the carded and opened fibers coming from the discharge end of the machine.

A plurality of cords, threads, or strands of suitable material are then fed from spools on the machine longitudinally into the stream of opened and carded Amosite fibers, these threads or strands comprising the cords 120, 121, 122 in Fig. 3. The cords become immersed in the carded and opened fibers and emerge from the machine with it. At the point of discharge from the carding machine it is provided with a special arrangement which is adapted to wrap spirally about the loose Amosite fibers a plurality of insulating cords, such as the cords 123, 124 of Fig. 3, and the cords embrace some of the loose Amosite fibers and bind them to the cords 120—122, but a large portion of the fibers, that is, most of the Amosite fibers, still hang loosely together and project beyond the spiral cords 123, 124 in such manner that the insulating unit of Fig. 3, which is indicated in its entirety by the numeral 70, is of irregular shape.

It is partially spirally shaped, due to the tightening action of the cords 123; but it has practically no tensile strength for the purpose of weaving, and has only sufficient tensile strength so that it may be coiled in a receptacle, such as a cylindrical can, the can rotating as the insulating unit 70 emerges from the carding and wrapping machine, so that the unit is coiled therein.

Referring to Figs. 3 and 4, the core yarns 120—122 and spiral cords or threads 123, 124, used for weaving and wrapping the Amosite or other fibers, preferably comprise a plurality of separate twisted strands. These may be twisted in the same or opposite direction to their own twist, with or without one or more yarns of steel, bronze, or brass in the center as a core for increasing the tensile strength of the cord.

The separate strands of the cords 120—124 are preferably made of long asbestos fibers capable of withstanding the high temperatures to which the sheet insulation or blanket is to be subjected, and a small amount of cotton or other fiber may be included for improving the weaving characteristics of the fibers used.

Referring to Fig. 5, this is a diagrammatic illustration of the interlacing arrangement of the three internal longitudinal cords and the two spirally wrapped cords. In some embodiments of the invention more or less of these cords may be used, and cords may also be spirally wrapped in opposite direction, if desired, but a minimum amount of such wrapping cords is preferably employed.

In order to illustrate the method of manufacture of the present insulating yarns or chenille rovings, Figs. 1 and 2 are included, showing one type of machine which may be used for carrying out the method.

It should be understood, however, that the fibers and core yarns may be assembled upon a table or any other support, and the fibers and core yarns may be brought into intimate contact with each other by drawing them through a condenser or funnel or other tapered article, or by rubbing the fibers into intimate contact with the core yarns with the hands or otherwise.

Referring to Fig. 1, 10 indicates in its entirety the conventional carding machine, which includes the usual carding cylinders 11 to 19. The carding machine is adapted to take the fiber or sliver at the right hand end of Fig. 1 and card it, and it is deposited at the left hand side of the carding cylinder 12 in Fig. 1 upon a conveyor belt 20 (Fig. 2), which is disposed in a trough between the carding cylinder 12 and a baffle or side board 22 in such manner that it is adapted to support the amount of carded sliver which is deposited upon the belt 20, and the belt 20 moves toward the right, as indicated by the arrow in Fig. 2, constantly feeding the sliver toward the right in Fig. 2.

The carding machine is provided with one or more, preferably a plurality, of ordinary reels for supporting cords 123, 124, which may be fed into the sliver 70 from the left of Fig. 2 so that the cords 123, 124, which may be provided with thin wires of steel or other suitable material and formed out of asbestos threads, are adapted to be embedded in the sliver and fed toward the right with it after the threads have once been started. At the right hand of the carding machine in Fig. 2 the machine is provided with an attachment, one form of which is shown in Fig. 2.

Referring to Fig. 2, this attachment is mounted

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It might be expected without a more careful study of the operating conditions that the inductance of the coils 9 and 10 would have a pronounced effect on the shape of the current wave. Such, however, is actually not the case as will be shown from the following illustration. As an example of values which might be encountered in practice, a voltage rise of 1000 kilocycles per microsecond is considered to be about the steepest wave-front and it may be expected to reach its peak in about one microsecond. Assuming that a 10 micro-microfarad capacitor is employed, a current of 10 amperes will flow in the capacitor which will produce a field of approximately 100 oersteds inside a coil having 20 turns per inch. Consider now an equivalent sine wave having a frequency of 250 kilocycles per second. In this case, the sine wave will reach a peak in one microsecond which is the time assumed for the surge voltage under consideration to reach its peak. The reactance of the capacitor would be about 64,000 ohms under such conditions while the inductance of each of the magnetizing coils 9 and 10 would be in the order of 2 to 4 microhenries, giving a reactance of only 3 to 6 ohms, which is obviously negligible as compared to the reactance of the capacitor.

In Fig. 5 I have illustrated diagrammatically an electrical circuit diagram including suitable apparatus which may be employed for measuring the degree of magnetization of the magnetic links used in carrying out my invention. In accordance with the arrangement illustrated, I provide a sensitive moving coil instrument of the d'Arsonval type and substitute the magnetized link to be measured for the usual magnet of the instrument. Under such conditions, the deflection of the instrument pointer will be proportional both to the degree of magnetization and the current flowing in the moving coil circuit of the instrument. It is obvious then that if the moving coil current be maintained at some constant value, the instrument indication will be proportional to the magnetization of the magnetic link and the scale may be calibrated to read in direct proportion to the maximum rate of change of voltage or the crest value of the current which flows in the capacitor circuit.

Referring more particularly to Fig. 5 of the drawing, I have illustrated a d'Arsonval type measuring instrument 20 having a scale 21 and a field structure 22 comprising pole pieces 23 and 24 between which rotates the usual moving coil element 25. The magnetic circuit is arranged to receive one of the magnetic links, such as 9 for example, the degree of magnetization of which is to be measured. A source of unidirectional current 26 may be employed for energizing the moving coil 25 of the instrument. An electrical instrument, such as a milliammeter 27, is preferably connected in the circuit with the moving coil 25 for indicating the magnitude of the current flowing in the moving coil and the rheostat 28 may also be included in this circuit to provide for adjusting the current to a predetermined value. An element 29 composed of relatively permeable material may be provided to shield the instrument 20 from extraneous magnetic fields.

The markings on the scale 21 are made proportional to the magnetizing force which is in turn proportional to the magnetizing current and in this case corresponds to the current which flows in the capacitor circuit. The pointer deflection is proportional to the magnetization of the magnetic link. In actual calibration, the markings on the scale may be checked by inserting in the instrument magnetic links which have previously been subjected to known magnetizing forces and observing the pointer deflection.

In operating the measuring apparatus of Fig. 5 it is necessary only to set the milliammeter current, as indicated by the scale of the instrument 27, at the required value, insert the magnetic link in position in the field structure 22 and obtain the reading from the scale 21 of the measuring instrument 20. By the use of such apparatus the degree of magnetization of the link may rapidly be determined with a degree of accuracy which is satisfactory for the usual system conditions. I wish to point out that while this particular method of and apparatus for measuring the magnetization of the magnetic links commends itself from the standpoint of simplicity, it forms no part of my invention and other well known methods and apparatus also may be employed.

The advantages obtained in the use of my invention will be evident from the following example. Assume that an electric power company operating a long transmission line supported by many towers wishes to determine with a minimum initial capital expenditure for instruments the maximum rate of rise of a surge voltage that may be impressed on the system. This may be accomplished by placing one of the units, such as illustrated in Fig. 2, at each of various points over the system, care being taken to have each magnetic link suitably marked with some identifying character to indicate the number of the tower arm to which it is adjacent. Only a single measuring instrument, such as illustrated in Fig. 5, is necessary and this may be permanently located in the testing laboratory or suitable location in one of the company's buildings. After the surge is over or at various times a patrolman makes a tour of the transmission line system to remove the magnetic link elements to the place where the measuring instrument 20 is located. The magnetic links are then tested in the instrument and a record made of the tower arm number corresponding to each element and the instrument reading obtained by testing each of the links. After testing, the magnetized elements may be remagnetized to their fullest extent in any suitable manner and they, together with any elements which did not become demagnetized because they were not subjected to a surge voltage, may be replaced in their original positions and used over again. This may be repeated from time to time by using the same magnetic links over and over again and employing only one instrument to make all the tests.

In accordance with the provisions of the patent statutes, I have described the principles of operation of my invention together with the apparatus which I now consider to represent the best embodiment thereof but I desire to have it understood that the apparatus shown and described is only illustrative and that the invention may be carried out by other means.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. The method of determining the steepness of wave-front of a non-recurring voltage surge on an electrical conductor, which comprises deriving a current proportional to the rate of change of

Insulating Yarns or Rovings (Method of Making) (US Patent 2,237,267, 1941)
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said voltage surge with respect to time, and then measuring the maximum value of said current.

2. The method of measuring the maximum rate of change of a non-recurring voltage wave with respect to time consisting in charging a capacitor with said voltage, and measuring the maximum value of the charging current of the condenser.

3. The method of measuring the steepness of wave-front of an electric non-recurring voltage surge, which comprises the steps of demagnetizing a permanent magnet by means of a flux derived from a current proportional to the derivative of the surge voltage wave with respect to time, and then measuring the strength of such permanent magnet.

4. The method of measuring the maximum rate of rise and fall of a non-recurring voltage surge on an electrical conductor, which comprises deriving a current proportional to the first derivative of said voltage surge with respect to time, influencing the degree of magnetization of two permanent magnet elements in relatively opposite directions at any instant in accordance with the magnitude of said current, and then measuring the strength of said permanent magnets.

5. The method of measuring the maximum rate of change of a non-recurring voltage surge with respect to time which comprises deriving a current from said voltage surge proportional to the first derivative of said voltage surge with respect to time, demagnetizing a field of residual magnetism by the influence of said current, and measuring the resultant magnetic field.

6. In a device for determining the steepness of wave-front of a non-recurring voltage surge on an electrical circuit, a capacitor supplied with a voltage proportional to said voltage surge, and means for determining the maximum value of the charging current of the capacitor.

7. In a device for measuring the maximum rise and fall of a non-recurring voltage surge on a conductor, an electrical circuit comprising a capacitor adapted to be charged by a voltage proportional to said voltage surge, and means in circuit with said capacitor for measuring the positive and negative crest values of the charging current of said capacitor.

8. In apparatus for giving a permanent indication of the steepness of wave-front of a non-recurring voltage surge that has occurred on a conductor, a circuit comprising a capacitor element and a magnetizing member adapted to be subjected to said voltage surge, a magnetic element of high magnetic retentivity positioned to be responsive to the magnetic flux produced by said magnetizing member, and means calibrated with said magnetic element and responsive to the magnetic flux retained by the magnetic element after the occurrence of the surge.

9. In a device for measuring the steepness of wave-front of a non-recurring voltage surge, a capacitor supplied with a voltage proportional to said voltage surge, a current conducting coil adapted to be energized by a current proportional to the charging current of said capacitor, a magnetic element of high magnetic retentivity adapted to be subjected to the magnetic field produced by said coil, and means for measuring the degree of magnetization of said magnetic element after the occurrence of the surge.

10. In a device for measuring the maximum rate of rise of a non-recurring voltage surge on an electrical conductor, an electrical circuit comprising a capacitor element and a magnetic flux producing member adapted to be subjected to said voltage surge, a permanent magnet element of high magnetic retentivity and initially magnetized substantially to saturation, said permanent magnet element being positioned to have its magnetism reduced by the influence of the current in said magnetic flux producing member, and means for measuring the residual magnetism of said permanent magnet element after the surge is over.

11. In a device for measuring the maximum rate of change in the magnitude of a non-recurring voltage surge before and after the peak is reached, a capacitor supplied with a voltage proportional to said voltage surge, a plurality of magnetic field producing elements adapted to be energized by a current proportional to the charging current of said capacitor, a plurality of permanent magnet elements of high magnetic retentivity, and having an initial residual magnetization produced by a magnetizing force of sufficient value substantially to saturate the material composing said magnets, one of said permanent magnet elements being arranged to be subjected to the magnetic field of one of said field producing elements, and the other of said permanent magnet elements being arranged to be subjected to the magnetic field of the other of said field producing elements, the arrangement of said permanent magnet elements relative to said magnetic field producing elements being such that at any instant and for a given direction of current flow in said field producing members the magnetic fields of said members have relatively opposite effects on the induction of said permanent magnet elements when compared with the initial polarities of said magnet elements, and means for measuring the degree of magnetization of said permanent magnet elements after the occurrence of said surge.

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