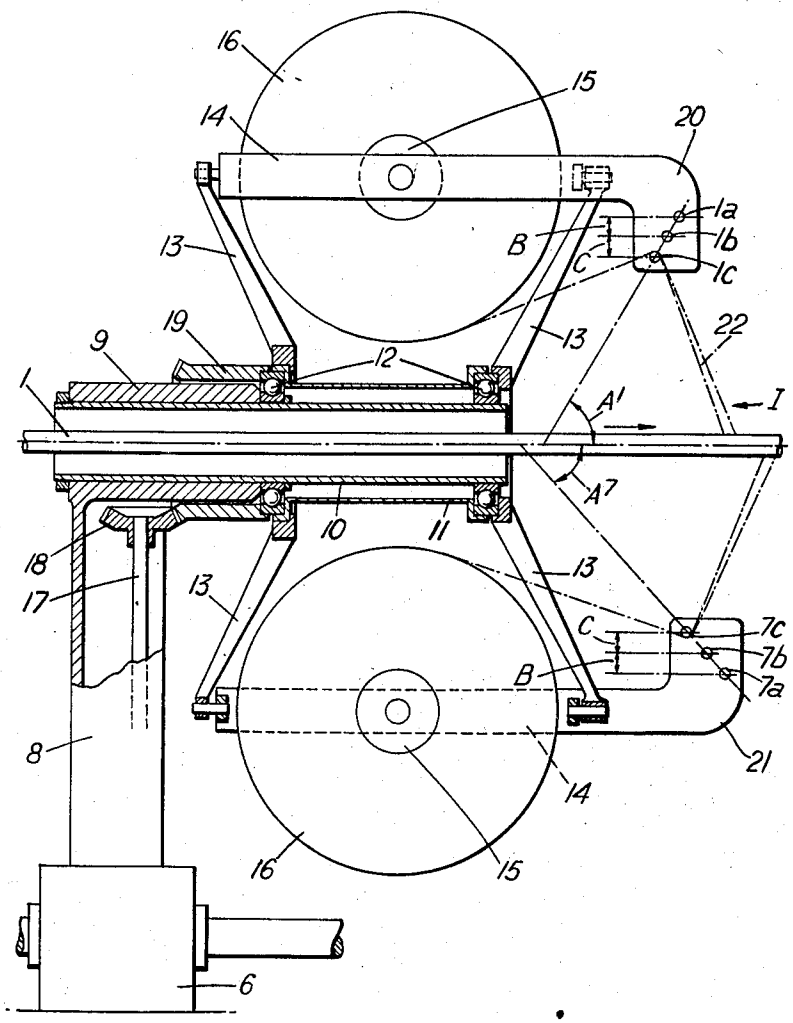
Oct. 6, 1959 G. T. W. GRIEVE ET AL 2,907,164

MACHINE FOR LAPPING STRIPS OF MATERIAL ON ELECTRIC CONDUCTORS AND OTHER ARTICLES

Filed Nov. 26, 1956 3 Sheets-Sheet 1

Fig. 1.



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Fig. 2.

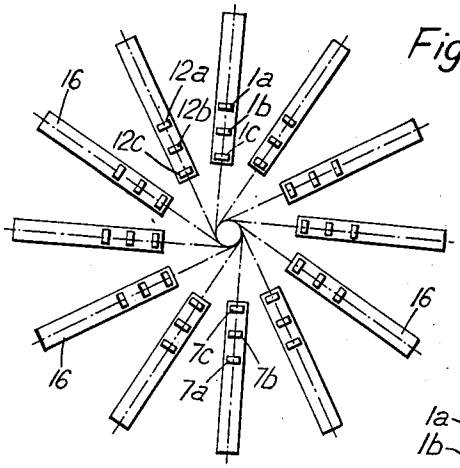


Fig. 3.

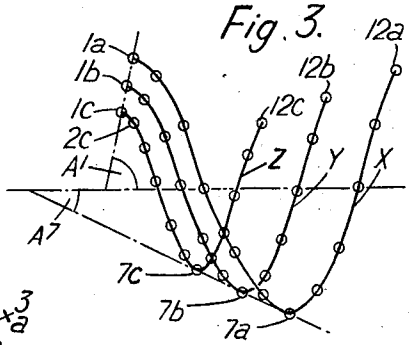


Fig. 4.

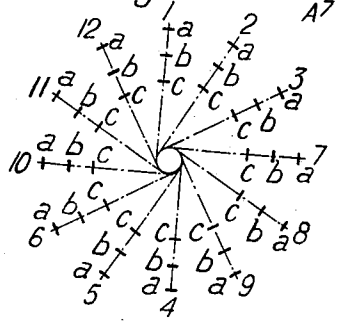
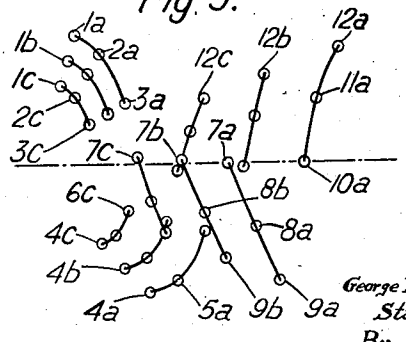


Fig. 5.



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MACHINE FOR LAPPING STRIPS OF MATERIAL ON ELECTRIC CONDUCTORS AND OTHER ARTICLES

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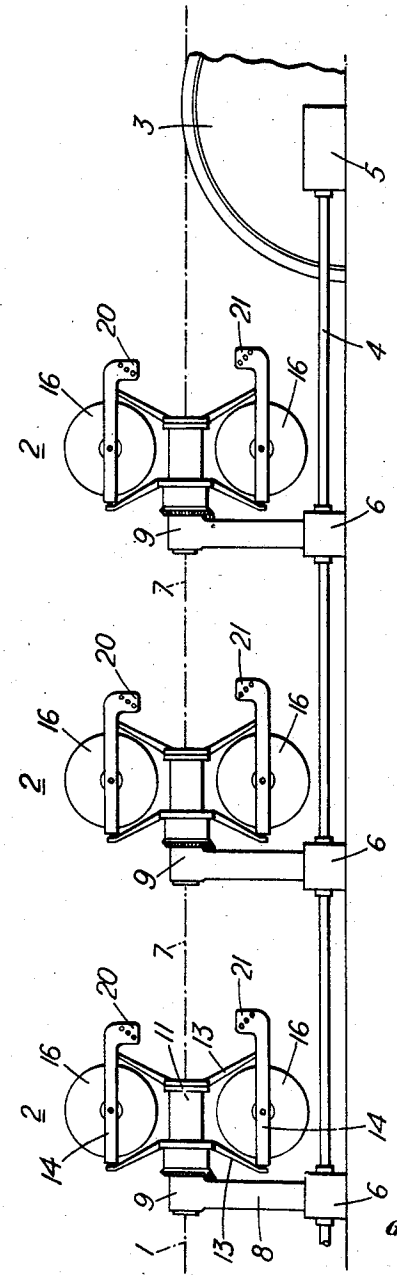


Fig. 6.

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MACHINE FOR LAPPING STRIPS OF MATERIAL ON ELECTRIC CONDUCTORS AND OTHER ARTICLES

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Application November 26, 1956, Serial No. 624,429

Claims priority, application Great Britain November 28, 1955

1 Claim. (Cl. 57—13)

This invention relates to a method and apparatus whereby a number of tapes of paper or other material are simultaneously applied as helical lappings about an electric conductor or other long article (hereinafter included in the term "conductor") to build up superimposed layers of the tape to the required thickness of covering. In such a method one or more (and frequently a large number of) lapping heads each carry a set of flat spiral coils of tape which are arranged in a group about an axis along which the conductor travels while the lapping is performed by the rotation of the heads. From each of the coils a tape is led over a guide to meet the conductor at an appropriate angle and in an appropriate relation to the tapes in the adjacent layers. The angle at which the tape meets the conductor depends upon the width of the tape, the spacing between its adjacent helical edges, (hereinafter referred to as the "gap"), and the pitch length, that is the forward movement of the conductor for each rotation of the head. The diameter of the conductor, or of the conductor with one or more than one tape already applied, must also be taken into account because, for any one width of tape and pitch length, the gap increases as the diameter increases.

In the covering of electric cable conductors it is desirable to maintain the dimensions of the gap within predetermined limits, the lower limit being that which will permit the cable to bend without the gap closing completely. It is also desirable not to increase the pitch length to such an extent as to interfere with the bending properties of the cable nor to increase the tape width to too great an extent for the same reason. It will be appreciated that for a given width of paper to be lapped with a given pitch length, there is a range of diameters for which the dimensions of the gap will be within the prescribed limits, and that further application of the same tape at a diameter above the maximum in that diameter range will produce a gap exceeding the predetermined maximum dimension. With further increase of the diameter it thus becomes necessary to decrease the pitch length, that is to increase the speed of rotation of the head in relation to the longitudinal speed of the conductor. To meet all those conditions it has been the practice to provide for a wide range of adjustment of the relative speeds, usually by means of a variable ratio gear in the drive to each head in conjunction with a change gear in the drive to the capstan which draws the conductor through the machine, and this has necessitated adjusting the relative position of some or all the guides for the group of coils carried by a head. One guide may remain fixed and all the others are adjusted relative to it. There has also been required to be made available a large range of widths of tape.

The adjustment thus required is a longitudinal displacement of all or all but one of the guides, that is a movement parallel with the axis of the machine. The guides of a group associated with a head are angularly spaced about the axis of the machine and the adjustment required for each guide is a movement through a distance which is different for each guide. If the guides are spaced equi-angularly about the axis, these distances form an arithmetical progression. In such a machine the adjustment of the guides requires that separate attention should be given to each, or to all but one, of them and the adjustment of a group is a lengthy process requiring skill and careful manipulation. An object of this invention is to provide an arrangement in which the width of tape can be altered without it being necessary to alter the setting of the guides.

In the improved machine in accordance with the invention there is provided, for each coil which may be mounted in a head, a set of guides fixed against longitudinal movement in relation to the head, and, in the drive to the head, a gear providing predetermined speed ratios corresponding in number to the number of guides in the set. By a gear providing a number of predetermined speed ratios there is intended an arrangement which is different from a continuously variable gear which, by its nature, would provide, within predetermined limits, for an infinite number of speed ratios. The guides of each set are so positioned that they lie one in each of a corresponding number of helical paths about the machine axis. These helical paths may be continuous or non-continuous. The corresponding guides in all the sets are mounted at the same radial distance from the machine axis, and the guides in each set are spaced apart, in a direction parallel to the machine axis, by amounts which increase in the form of arithmetical progressions throughout the series of sets. In order to accommodate the smaller spacing between the guides in the sets which are nearest to the head it is necessary in all the sets to place each guide at a greater radial distance from the machine axis than the preceding guide. The guides in the first set may be aligned in a direction which is radial to the machine axis or which makes an angle with the machine axis. The directions of alignment of succeeding sets of guides are at progressively decreasing angles with the part of the machine axis which extends forward therefrom. Each set of guides will be mounted on a bracket which is part of, or is fixed on, a forward extension of a coil-supporting member by means of which a coil is mounted in the head. The brackets and/or extension may be appropriately different lengths and/or shapes to locate the sets of guides in the required relative positions in relation to the machine axis and longitudinally in relation to one another.

The change-speed gear drive to each head will usually be previded by a gear box incorporated in the head construction. Where there are several heads in one machine the speed of each head can be adjusted, without affecting that of the other head or heads. The head speeds may be graded along the machine. Alternatively, the heads may be divided into two or more groups of heads with a change-speed gear incorporated in the drive to each group. The drive to the capstan may be through a fixed or change-speed gear. For any one lapping operation, each head is set-up by selecting the appropriate gear and width of tape and by leading the tape from each coil over the appropriate guide in the set which is associated with the coil, in accordance with the diameter of the conductor to be covered and the required dimensions of the gaps. For the shortest pitch length the guide used will be the one which brings nearest to the head the point of engagement between the tape and conductor. As the conductor diameter increases, the width of the gap increases. In order to maintain the gap dimension within required limits with a larger diameter of conductor, it is preferable to use a wider paper and lead it over another guide to bring the point of application

further from the head while at the same time altering the gear drive to decrease the speed of rotation of the head. We may, however, use a wider tape without altering the speed of the head or maintain the same width of paper while increasing the head speed.

For all practical purposes a satisfactory product can be obtained by building up to a predetermined maximum diameter a covering of superimposed helical lappings of tape on a conductor of not less than a predetermined minimum diameter by the successive use of a relatively small number of widths of tape, in such a manner that the narrowest tape is used for the inner part of the covering and the widest tape is used for the outer part of the covering and each width of tape is applied with a constant pitch length throughout a diameter range which corresponds to a range of dimensions of gap within predetermined minimum and maximum limits. The improved machine is particularly suitable for building up a covering on a conductor in this manner because each of the lapping heads provided with preset guides can be arranged to operate at a relatively small number of speeds corresponding to the small number of widths of tape to be used.

The invention is further described and illustrated, by way of example, with reference to the accompanying diagrammatic drawings, wherein:

Figure 1 is a side view, partly in section, of part of a machine for applying a lapping of paper tapes to an electric cable conductor;

Figure 2 is a view of part of the arrangement shown in Figure 1, as seen in the direction of the arrow **1** in Figure 1;

Figure 3 is a diagram illustrating the arrangement of the sets of fixed guides, and of the guides in each set, in relation to one another and to the machine axis, drawn to a scale which has been enlarged in the direction of the machine axis;

Figure 4 is a view similar to a part of Figure 2, illustrating another arrangement of guides;

Figure 5 is a diagram, similar to that shown in Figure 3, but relating to the arrangement shown in Figure 4; and

Figure 6 diagrammatically represents the relative arrangement in one machine of a number of the devices represented in Figure 1.

Referring first of all to Figure 6, a machine for applying lappings of paper tape to an electric cable conductor **1** comprises several lapping heads **2** of which three are shown. The conductor **1** is drawn through the common axis of rotation of the heads **2** by a capstan **3** which is driven from a main shaft **4** through a fixed ratio gear box **5**. Each head **2** is driven from the main shaft **4** through a gear box **6** which is directly associated with the head. Each head **2** is designed to apply a maximum of twelve paper tapes to the conductor **1**, in the case of the extreme lefthand head in Figure 6, or, in the other cases, to the core **7** consisting of the conductor with the covering of paper tapes which has been applied by the preceding head or heads. In the case illustrated, each gear box **6** provides three speeds and a neutral position.

Each head **2** comprises a vertical support **8** mounting at its upper end **9** a fixed hollow spindle **10** which extends horizontally from the support **8** in the direction of movement of the conductor **1**. A sleeve **11** is mounted concentrically with the spindle **10** on end bearings **12** which permit the sleeve to rotate on the spindle. The sleeve **11** supports twelve carrier spindles **14** which are parallel with the machine axis and are carried by two radial arms **13** mounted one at each end of the sleeve. On each carrier spindle **14** there is mounted a carrier **15** for a flat coil **16** of paper tape. The drive to the sleeve **11** is provided by a shaft **17** extending from the gear box **6**, having fixed to its upper end one toothed wheel **18** of a bevel drive, of which the other wheel **19** is fixed to the sleeve **11**.

For the purpose of illustration there is shown in Figure 1 and on each of the heads **2** in Figure 6, only two coils **16** and the means for supporting them. In Figure 2 however the radial and relative angular positions of twelve coils are illustrated diagrammatically. The coil mounting arrangements are such that each coil **16** is mounted with its two parallel faces symmetrically about a plane which is substantially parallel with, and slightly off-set from, a plane passing through the machine axis. Each of the carrier spindles **14** is rotatable about its axis on the radial arms **13** and the spindles are coupled together to permit them to be turned simultaneously about their axes to adjust the setting of the planes of the coils **16**.

To the forward end of each carrier spindle **14** is fixed a bracket, which extends inwards approximately towards the machine axis. In Figure 1 two of these brackets **20** and **21** are shown. On the bracket **20** is supported a set of three guides **1***a*, **1***b* and **1***c*. Each guide is a roller, freely rotatable on its axis. The guide roller axes are parallel to one another and to the coil axis. On the other bracket **21** are shown similar guides **7***a*, **7***b* and **7***c*. Also each set of rollers, as indicated in Figure 2, is offset from the machine axis in a manner similar to the associated coil, so that in the passage of a tape **22** from a coil and over a roller guide **1***c* to the surface of the conductor, or covered conductor, the center line of the tape lies in a plane which is tangential to the surface at the point of application of the tape.

The guide rollers **1***a*—**1***c* in the first set, that is on the bracket **20**, and which are nearest to the lefthand end of the head **2**, are arranged with their axes spaced apart in a plane which makes an acute angle A with the machine axis on the righthand side of that plane. The guides, such as **7***a*—**7***c*, of the remaining sets are arranged at the same radial spacing, B and C, as those of the first set, **1***a*—**1***c*, but the longitudinal spacing between the guides in a set changes progressively from the first to the twelfth set, that is, the angle A progressively changes. Moreover the sets of guides are individually mounted at progressively, and longitudinally varying positions. In the arrangement, as shown in an exaggerated manner in Figure 3, the first guides (**1***a*—**12***a*) of the sets are located on a helical path X, and similarly the other guides (**1***b*—**12***b*) and (**1***c*—**12***c*) are located on two other helical paths Y and Z. Moreover the longitudinal spacing between X—Y and Y—Z increases from set **1***a*—**1***c* to set **12***a*—**12***c*. The arrangement of the guides may be such that the outer guide **1***a* of the first is nearer the lefthand than the inner guide **1***c*, so that the angle A is an obtuse angle, and in this case it may be that the corresponding angle of the final set **12***a*—**12***c* is an acute angle, while in an intermediate set the corresponding angle is a right angle. Where the right angle exists, the helical paths, such as those shown in Figure 3, will cross at the position of that intermediate set of guides.

It is preferable not to arrange the sets of guides in the arithmetical sequence 1(*a*—*c*), 12(*a*—*c*) as shown in Figures 2 and 3, but to arrange them in a broken helical form as indicated in Figures 4 and 5. The longitudinal locations of the sets are maintained, as are the progressive variations of the longitudinal distances between the guides in the sets, but the sets themselves are transposed into the order 1, 2, 3, 7, 8, 9, 4, 5, 6, 10, 11, 12.

Each head is primarily intended for applying three widths of paper, the narrowest for the smallest diameter conductor or covered conductor and the widest for the largest diameter. For the narrowest tape the highest speeds of rotation are used with the tape passing over the guide roller (such as **1***c*) in each set which is nearest the machine axis. For the widest paper, the lower speeds are used with the paper passing over the outermost guide roller (such as **1***a*).

Each head **2** may be provided with means for automatically maintaining constant tension in the tape **22** as the coil **16** of tape is expended and this may comprise arrangements operating on the coil **16** or coil holder **15** itself with or without tension controlling means operating on the paper tape **22** in its passage between the coil **16** and a roller guide.

The improved machine has the advantage that, because no adjustment of the guides is required when the speeds and/or paper widths are altered, the guides can be very accurately and permanently located by a rigid supporting structure such as described. In practice the position of each guide roller in a bracket **20** is accurately determined and the roller is then permanently and firmly mounted on the bracket in that position. Due to this permanent rigid structure there can be avoided any errors which may arise due to wearing of the relatively movable surfaces present in an arrangement of adjustable guides or due to inaccurate setting of adjustable guides by manual operation. The limited number of speeds simplifies the gear drive. It is also an advantage not to have to maintain a supply of tapes of a wide range of widths.

What we claim as our invention is:

Apparatus for simultaneously applying superimposed helical layers of tape as a covering about a longitudinally extending member, comprising a rotatable lapping head

and, mounted in said head, a number of coil-carrying supports in radial distribution about the axis of rotation of the head, a set of at least two tape-guides mounted on and fixed in relation to each support, and each tape guide providing a path of approach of a tape to the member from a coil carried by the support, driving means to provide the rotation of the lapping head and longitudinal movement of the member along the axis of that rotation, each tape-guide in each set of tape-guides being at the same radial distance from the axis of rotation of the head as one of the tape-guides in each of the other sets, all the guides which are equidistant from that axis lying on a helical path about that axis, the number of such helical paths, corresponding to the number of guides in any one set and, in each set, the guides being separated in a direction parallel to the axis of the head by distances which progressively change from a set to another.

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