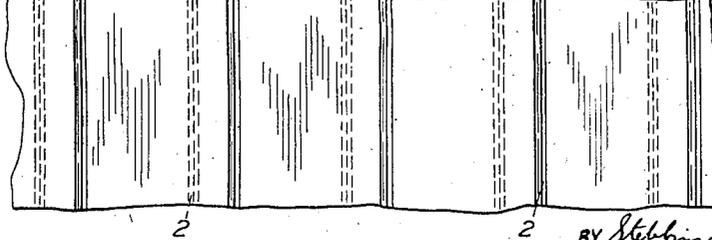
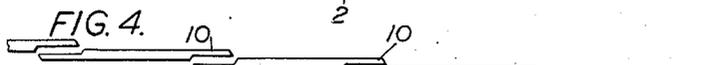
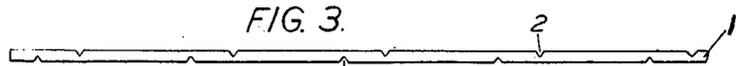
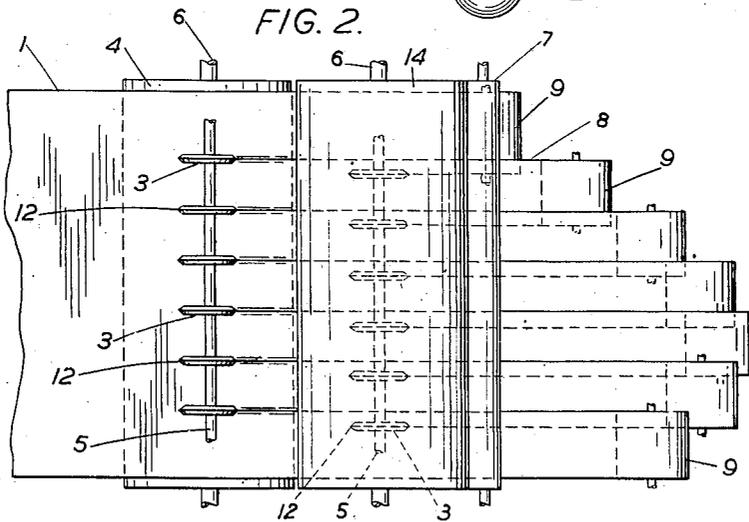
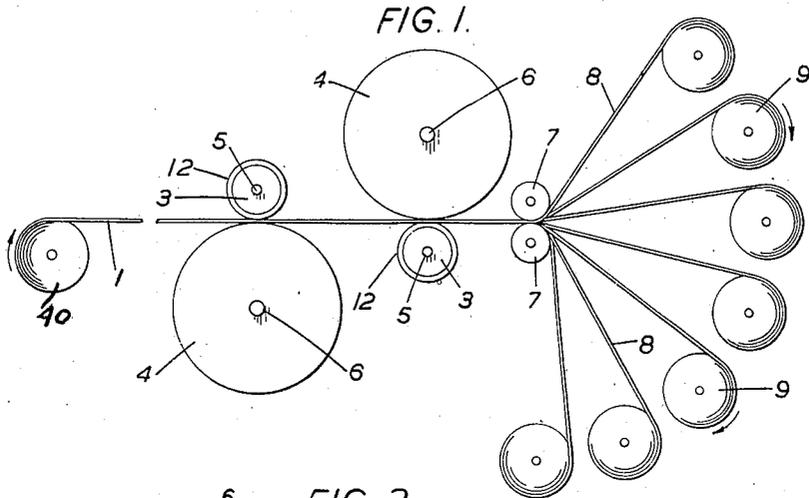


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METHOD AND APPARATUS FOR THE CONTINUOUS
PRODUCTION OF PAPER STRIPS
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2,369,221

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PERCY
DUNSHEATH

INVENTOR

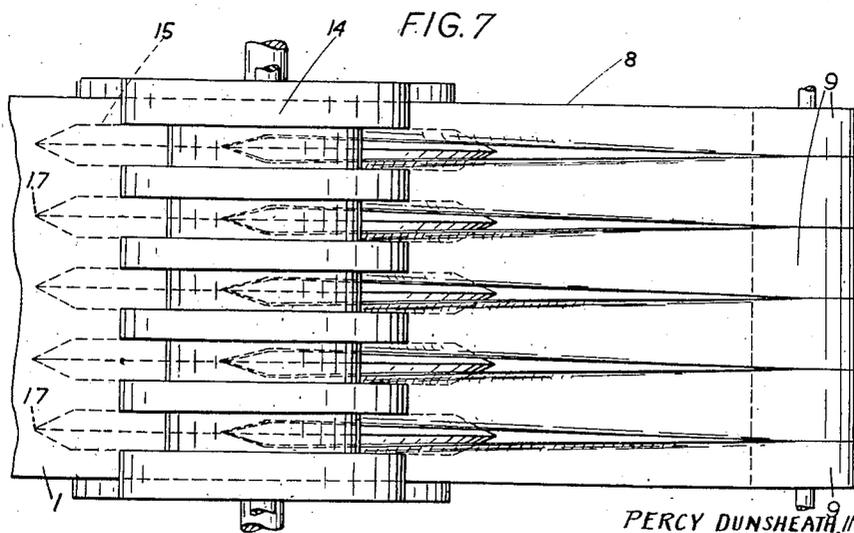
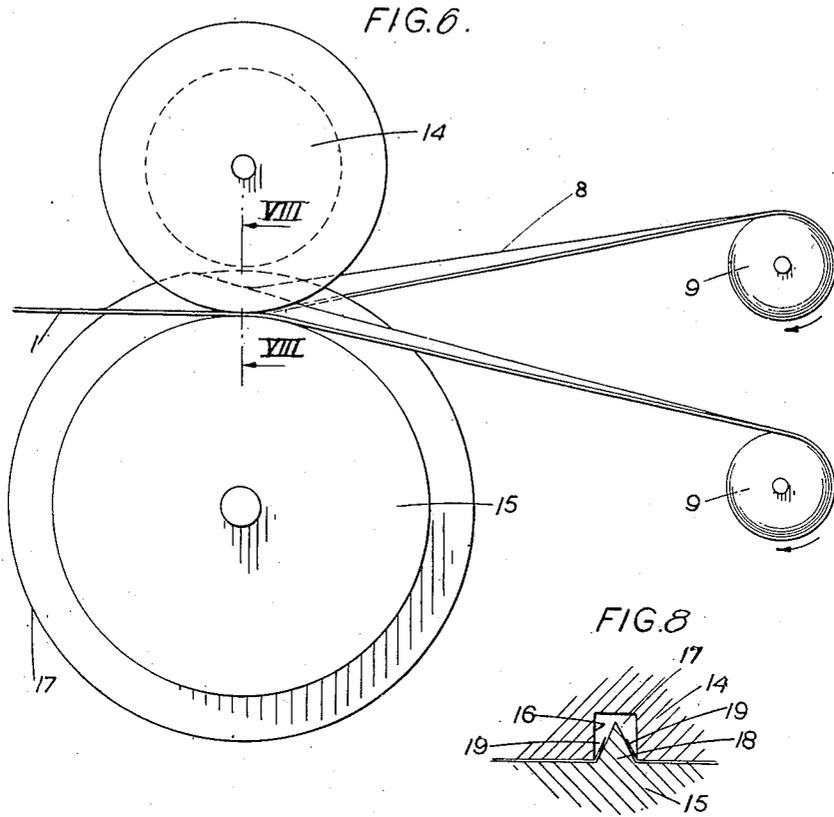
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FIG. 9

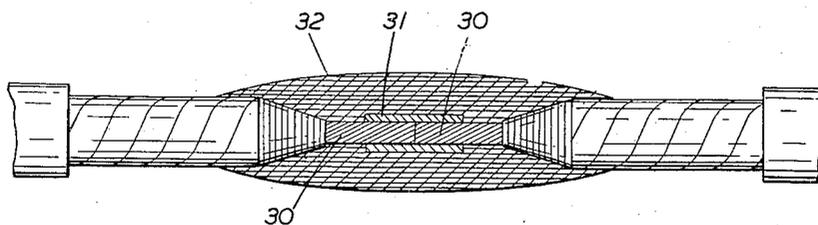


FIG. 10

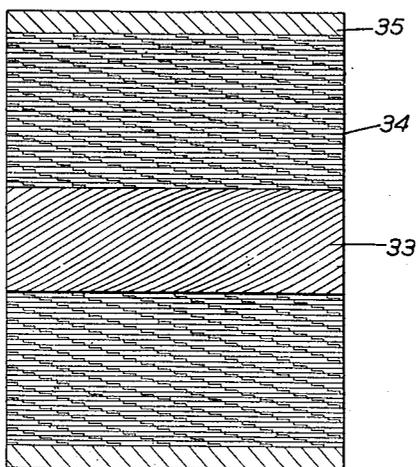
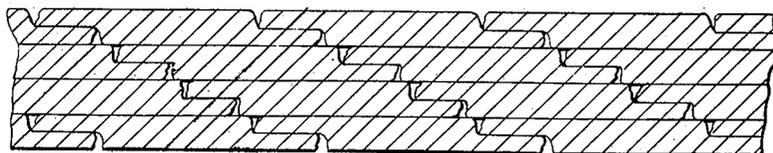


FIG. 11



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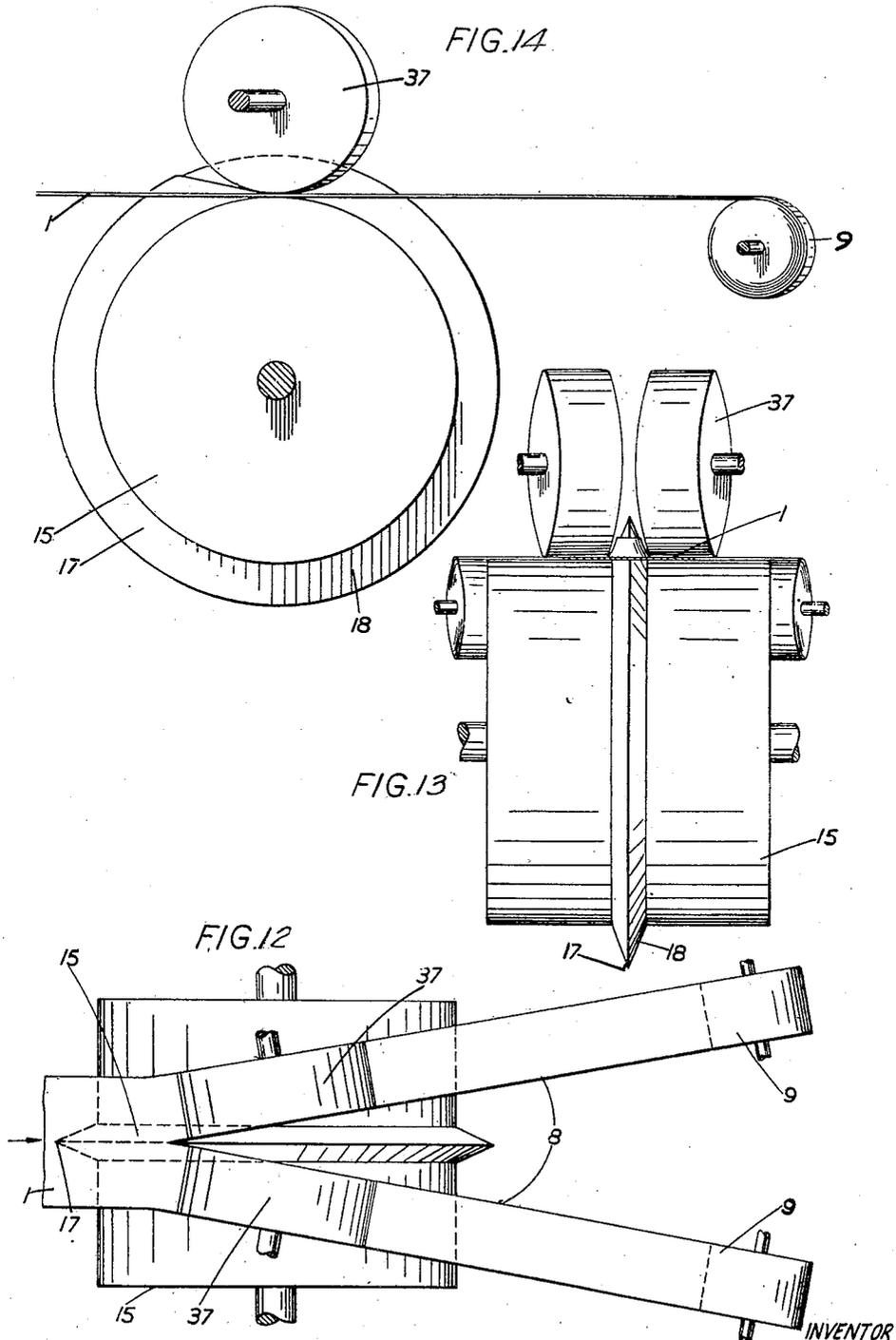
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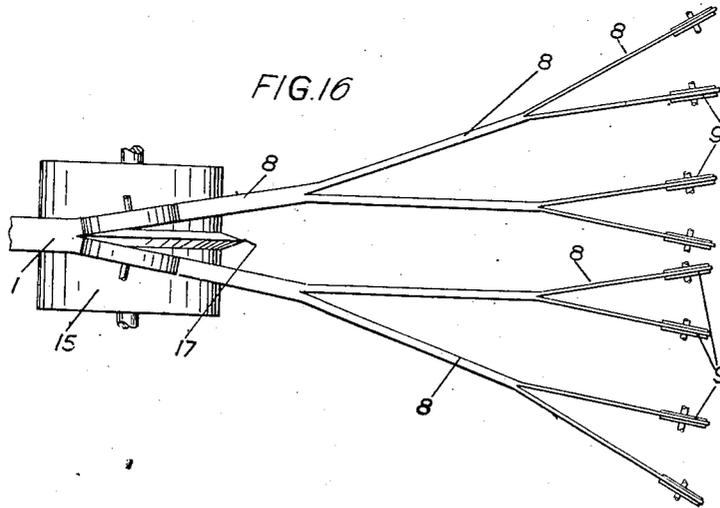
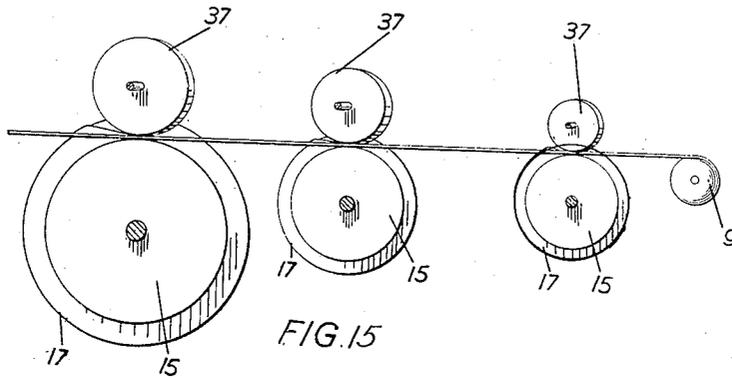
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UNITED STATES PATENT OFFICE

2,369,221

METHOD AND APPARATUS FOR THE CONTINUOUS PRODUCTION OF PAPER STRIPS

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W. T. Henley's Telegraph Works Company
Limited, Westcott, Dorking, England, a company
of Great Britain

Application June 19, 1942, Serial No. 447,647
In Great Britain August 23, 1941

15 Claims. (Cl. 164—65)

This invention relates to improved methods and machines for the continuous production of paper strips. The strips are produced by tearing a sheet of paper and have edges which are thinned down or taper off in thickness and are irregular and are formed of projecting fibres. Such strips are particularly suitable for use as the dielectric of an electric cable or cable joint.

Several methods and machines have been devised by me for the production of the paper strips with edges as described above. In these methods the production of a line of weakening of the paper generally will immediately precede the tearing; they may, in some cases, appear to be a single operation. In one of the methods the line of weakness is produced by scoring and then the paper is torn so as to be separated in the region of this line. By scoring is intended to indicate either a cutting through part of the thickness of the paper, or the overstraining of the fibrous structure of the paper along a line by the sharp edge of a knife.

All the methods of preparing the required edge may include the moistening of the paper to a small extent with water shortly before the tearing takes place. This has the effect of loosening the interengagement of the fibres so that they slide apart more readily when being torn, producing a more open edge.

The invention will be described further with the aid of the accompanying drawings.

Figures 1 and 2 are a side elevation and plan respectively of one form of machine for scouring and tearing a sheet of paper in the manner shown in Figures 3-5.

Figure 3 represents, on a much enlarged scale, one edge of a portion of sheet of paper after it has been scored by the machine shown in Figures 1 and 2.

Figure 4 represents the sheet of paper of Figure 3 after tearing into strips has been effected, and

Figure 5 is a plan view of the paper strip shown in Figure 3.

Figures 6 and 7 are a side elevation and plan respectively of an alternative form of machine for scoring and tearing a sheet of paper in the manner shown in Figure 8. Fig. 8 is a cross-section on the line VIII—VIII of Figure 6.

Figure 9 is a longitudinal section of a cable joint.

Figure 10 is a similar view of a short length of cable, and

Figure 11 is a much enlarged view representing

a few layers of the paper dielectric of the cable shown in Figure 10.

Figure 12 is a plan view of a further alternative form of machine.

Figure 13 is an end elevation, looking in the direction of the arrow shown in Figure 12.

Figure 14 is a side elevation.

Figure 15 shows in side elevation a number of the tearing devices constructed in accordance with Figure 12, and

Figure 16 is a view in plan showing the manner in which the strips of paper are caused to diverge when several tearing devices arranged as in Figure 15 are used.

In each of the figures the machines are shown diagrammatically.

Referring first of all to Figure 3, a sheet of paper 1 is provided on each side of the sheet with a series of cuts 2 which extend approximately half way through the thickness of the sheet. The cuts on each side of the sheet are spaced equidistantly but the two sets of cuts are staggered in relation to each other and are so arranged that adjacent cuts on opposite sides of the sheet are disposed a short distance apart (say $\frac{1}{8}$ of an inch). The two sets of cuts form parallel lines as will be seen from Figure 5.

The two sets of cuts are produced by the co-operation of rotating disc knives 3 with smooth metal rotating cylinders 4 arranged as shown in Figure 1. It is usually desirable to be able to form a number of individual strips of paper simultaneously from a wide sheet and, for this purpose, the machine is provided with an appropriate number of disc knives 3 mounted on shafts 5 as shown in Figure 2. The knives have sharp edges 12. The cylinders 4 are mounted on shafts 6 and their length is somewhat greater than the width of the sheet 1. As will be seen from Figure 1 one set of disc knives 3 is disposed upon one side of the sheet 1 and the other set upon the opposite side. Each set of disc knives in co-operation with its cylinder 4 is arranged to make a straight cut or score in the surface of the sheet of paper, the depth being approximately equal to half the total thickness of the paper, as the sheet passes through the machine. After the cuts have been made on both sides of the sheet 1, the latter passes between a pair of cylindrical rollers 7 and just in front of these the sheet is torn into a number of separate strips 8 by passing on to a series of rollers 9 having their axes lying on the arc of a circle, the centre of which is approximately at the point of tearing which is just in front of the nip of the rollers 7. The arc of the

circle lies in a vertical plane. In plan the rollers 9 overlap each other slightly as will be seen from Figure 2, the separate strips being taken off to the roller 9 in a progressively upward or downward direction from one edge of the sheet or the other.

The tearing of the sheet 1 into separate strips 3 takes place in the region of a pair of adjacent cuts on opposite sides of the sheet and the general effect of the tearing is represented by Figure 4. It will be seen from that figure that between adjacent cuts on opposite sides of the sheet the sheet is torn into two portions 10, 11 having approximately half the thickness of the original sheet, each individual strip thus having a central portion of a thickness equal to that of the original sheet and a portion at each end having a thickness approximating to half that of the original sheet. The thinner portions 10 form continuations of the upper parts of the strips and the other portions 11, continuations of the lower parts of the strips. The sheet 1 is drawn off from a rotatably mounted paper roll 40 by the rollers 9 being driven in the direction of the arrows shown in Figure 1.

Figure 4 is intended only to show the general effect of the tearing action and although the portions 10 and 11 have been shown in that figure as being symmetrical and with straight edges and sharp corners, it will be understood that in practice the surfaces at these places will be rough and irregular, the tearing action causing the fibres of the paper to be drawn out and to project from those surfaces. Furthermore the tapering may be more gradual than that shown in the figure.

The machine just described is particularly suitable for use with sheets of paper made in two plies, in which case there is a substantial separation of the two plies combined with a dragging out of fibres. The action takes place more effectively if the region to be torn is moistened before tearing.

The outer edges of the sheet, of course, will not be torn so that the individual strips having those edges will be discarded. The machine shown in Figures 1 and 2 provides for the production of five strips simultaneously, each strip having two torn edges.

In the machine shown in Figures 6-8 inclusive, the sheet 1 of paper is cut or scored in parallel lines and on one side of the sheet only and immediately after this has been effected the sheet is torn into separate strips. The machine as shown comprises an upper cylinder 14 having an appropriate number of axially spaced circumferential grooves 16 in its periphery, the grooves being of rectangular cross-section. The machine also has a lower cylinder 15 provided on its surface with a number of circumferential projections 18 having sharp edges 17 which stand up from the surface of that cylinder and enter the grooves 16 in the upper cylinder 14. In the machine as shown there are five sharp edges and five grooves and the cross-section of each circumferential projection, as seen in Figure 8 is triangular.

As will be seen from Figure 8, the width of the projection 18 at its base is substantially equal to that of the groove 16 and the total length of two sides of the projection is substantially greater than the width of the groove. As the sheet 1 approaches the machine it is engaged on its underside by the edges 17 of the projections 18 and when the sheet enters the nip of the two cylinders 14 and 15, the sheet is held on the two

opposite sides of a groove and the portion of the paper lying between those parts and over a projection 19 is scored or weakened by the sharp edge 17 and that portion of the paper is then immediately afterwards torn in the neighbourhood of the weakened part by being stretched over the projection 18. In Figure 8 the adjacent torn edges are represented by the reference numerals 19. The tearing of the sheet in this manner produces two separate strips, the adjacent edges of which are thinned down and are rough due to the fibres being pulled out by the stretching process. The separate strips are wound on to two sets of rolls 9, one set being placed above the other.

Instead of using a continuous sharp edge such as that shown at 17, a discontinuous one may be used, the edge being serrated and formed of a number of fine teeth.

In the machines already described the torn paper strips are caused to diverge in the vertical direction. In the machine shown in Figures 12-16, the strips are caused to diverge laterally and lie in a horizontal plane.

Referring first of all to Figures 12-14, there is shown a machine which to a certain extent resembles that shown in Figure 6 in so far as both machines make use of a rotatable lower cylinder 15 having on its surface a circumferential projection 18 provided with a sharp edge 17. Co-operating with the lower cylinder 15 are two rotatable upper cylinders 37 having friction surfaces, for example, they may each be covered with a layer of rubber. The two upper cylinders, as will be seen from Figure 12, do not lie parallel with the path of travel of the sheet 1 but have their axes disposed obliquely to that path, the adjacent faces of the cylinders diverging outwards by a small angle in the direction in which the sheet moves. The cylinders 37 are also so arranged that the points of contact between those cylinders and the lower cylinder 15 lie in the central vertical planes of the upper cylinders. Although reference has been made to "points of contact" there will be in fact a certain amount of compression of the rubber on the cylinders 37 so that contact between the upper and lower cylinders will take place over lines or areas rather than at points.

As the sheet 1 is drawn through the machine it is scored or weakened and is then torn over the edge 17 of the lower cylinder 15 and the separate strips 3 so formed are drawn apart or caused to diverge laterally by the upper cylinders 37, the strips being subsequently wound up on the rollers 9. The rollers 37 or 9 may be driven rollers.

In Figure 15 there are shown three lower cylinders 15 each having a sharp edge 17, each cylinder co-operating with a pair of upper cylinders 37. In this arrangement, the process of scoring or weakening, followed by tearing, is repeated, thus each strip 3 when formed is further subdivided into two narrower strips. The two strips of a pair are caused to diverge in the manner already described and as shown in Figure 16 and all the strips lie in the same horizontal plane.

As already indicated above, in each case, the paper may be moistened in the region at which the paper is to be torn, before actual tearing takes place. It will also be necessary or desirable to provide the supply roll 40 with some convenient form of adjustable frictional device to prevent overrunning of that roll and to control the tension in the paper.

It has already been indicated above that paper having edges produced by the present invention may be used as the wrapped dielectric at a cable joint as well as for the dielectric of a cable. In Figure 9 there is shown a joint made between two lengths of cable, each having a single conductor. The joint is enclosed in a metal ferrule 31 and the conductors, ferrule and adjacent paper dielectric of the two cable lengths are provided with an insulating wrapping 32 of paper. The latter consists of strips of paper applied helically and having edges prepared by any of the methods described above. In this figure no attempt has been made to illustrate the individual strips forming the wrapping.

In Figure 10 there is shown a cable having a single central conductor 33 enclosed in a paper wrapped dielectric 34 consisting of several layers applied helically and each consisting of a strip of paper having its edges prepared by the machine shown in Figures 1 and 2 and Figure 11 is a much enlarged view representing a few layers of the cable dielectric. The latter figure shows very approximately the kind of effect produced at the edges by the tearing action showing a thinning down of the paper caused by the dragging out or loosening of the fibres. The figure also shows the filling up to a large extent of the gaps which would normally exist between adjacent convolutions. The dielectric 34 is enclosed in a lead sheath 35 in the usual manner.

For the insulation of an electric cable or cable joint consisting of helically applied strips of paper, strips of considerable length are required. The machines described above provide simple means for the continuous production of paper strips of considerable length having thinned down and irregular edges formed of projecting fibres, thus facilitating the manufacture of cables and joints in which the helical spaces normally occurring between the adjacent turns of a strip are largely occupied by the projecting fibres at the edges of the strip.

What I claim as my invention is:

1. A machine for the continuous production of paper strips having thinned down irregular edges formed of projecting fibres, the said machine comprising a supply device for a rolled sheet of paper and a scoring device comprising at least two pairs of cooperating cylinders for producing on opposite sides of the sheet closely spaced parallel lines of weakening, each pair of cooperating cylinders consisting of a rotatable cylinder having a smooth surface and a rotatable cylinder having a sharp edge projecting from its periphery, and means for deflecting at least some of the strips out of the plane of the path of travel of the sheet through the machine.

2. A machine for the continuous production of paper strips having thinned down irregular edges formed of projecting fibres, the said machine including a supply device for a rolled sheet of paper and a scoring and tearing device comprising a pair of cooperating rotatable cylinders one having a circumferential groove and the other a circumferential projection with a sharp edge entering the groove, the two cylinders being so disposed as to weaken the sheet and then tear it into strips by stretching the sheet over the projection.

3. A machine for the continuous production of paper strips having thinned down irregular edges formed of projecting fibres, the said machine comprising a pair of cooperating rotatable cylinders one having a groove in its periphery and

the other an annular projection with a sharp edge entering the groove and of substantially triangular shape in cross-section, the dimensions of the projection in cross-section being such that the total length of its two sides is substantially greater than its width.

4. A method of manufacturing paper strips having thinned down irregular edges with projecting fibres by producing a line of weakening in a sheet of paper and then immediately stretching the sheet across the line of weakening to tear it into strips having thinned down irregular edges formed of projecting fibres.

5. A machine for the continuous production of paper strips having thinned down irregular edges formed of projecting fibres, the said machine comprising a supply device for a rolled sheet of paper and including a scoring and tearing device comprising a rotatable cylinder having a circumferential projection with a sharp edge and a pair of cooperating rotatable cylinders for gripping the sheet of paper on opposite sides of the circumferential projection.

6. A machine for the continuous production of paper strips having thinned down irregular edges formed of projecting fibres, the said machine comprising a supply device for a rolled sheet of paper and including a scoring and tearing device comprising a pair of axially spaced rotatable cylinders, a third rotatable cylinder cooperating with the pair of cylinders and having an annular projection with a sharp edge projecting into the space between the pair of cylinders, the latter being so disposed in relation to the third cylinder as to grip a sheet of paper on opposite sides of the projection and to tear it into strips and to lead off the strips in laterally diverging directions.

7. A machine for the continuous production of paper strips having thinned down irregular edges with projecting fibres, the said machine comprising a supply device for a rolled sheet of paper, means for producing laterally, closely spaced parallel lines of weakening upon opposite sides of the paper sheet and means for tearing the sheet along the lines of weakening, the tear extending from one line to the other.

8. A method of manufacturing paper strips having thinned down irregular edges with projecting fibres by producing laterally, closely spaced parallel lines of weakening upon opposite sides of the paper sheet and tearing the sheet along the lines, the tear extending from one line to the other.

9. A machine for the continuous production of paper strips having thinned down irregular edges with projecting fibres, the said machine comprising a supply device for a rolled sheet of paper and means for scoring laterally, closely spaced parallel lines upon opposite sides of the paper sheet and means for tearing the sheet along the lines, the tear extending from one line to the other.

10. A method of manufacturing paper strips having thinned down irregular edges with projecting fibres by producing laterally, closely spaced parallel lines of weakening upon opposite sides of the paper sheet and tearing the sheet along the lines, the tear extending from one line to the other, and wetting the sheet only in the region in which it is to be torn before tearing is effected.

11. A method of manufacturing paper strips having thinned down irregular edges with projecting fibres by scoring them to produce laterally, closely spaced parallel lines of weakening upon

opposite sides of the paper sheet and tearing the sheet along the lines, the tear extending from one line to the other.

12. A machine for the continuous production of paper strips having thinned down irregular edges with projecting fibres, the said machine comprising a supply device for a rolled sheet of paper and a pair of cooperating rotatable cylinders, one having a circumferential groove and the other a sharp edge entering the groove, the two cylinders being so disposed as to weaken the sheet and then tear it into strips by stretching the sheet over the projection.

13. A machine for the continuous production of paper strips having thinned down irregular edges with projecting fibres, the said machine comprising a supply device for a rolled sheet of paper, means for producing a line of weakening in the paper sheet and means for leading off the strips in laterally diverging directions to tear the sheet along the line of weakening.

14. A machine for the continuous production of paper strips having thinned down irregular edges with projecting fibres, the said machine comprising a supply device for a rolled sheet of paper, means for producing a line of weakening in the paper sheet and means for stretching the sheet across the line of weakening to tear the sheet into strips.

15. A machine for the continuous production of paper strips having thinned down irregular edges formed of projecting fibres, the said machine comprising a supply device for a rolled sheet of paper, means for producing a line of weakening in the paper sheet and for tearing the sheet into strips, comprising means for gripping the sheets upon opposite sides of the line of weakening and for leading the strips off in laterally divergent paths.

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