June 30, 1953 M. SCHNEIDER 2,643,719

WEB SLITTING MACHINE WITH MINUTELY VARIABLE CUTTING-ROLL EQUIPMENT

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Fig. 2.

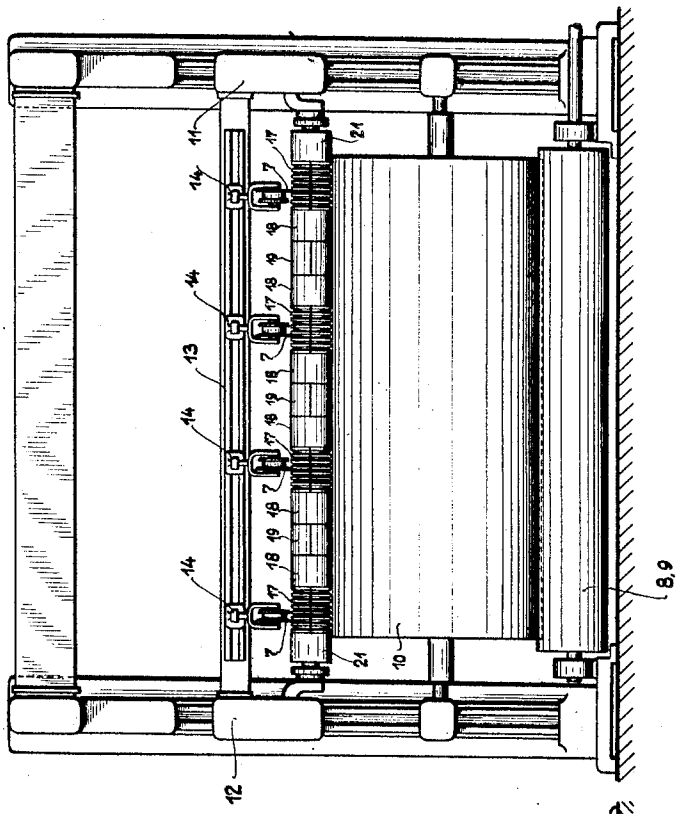
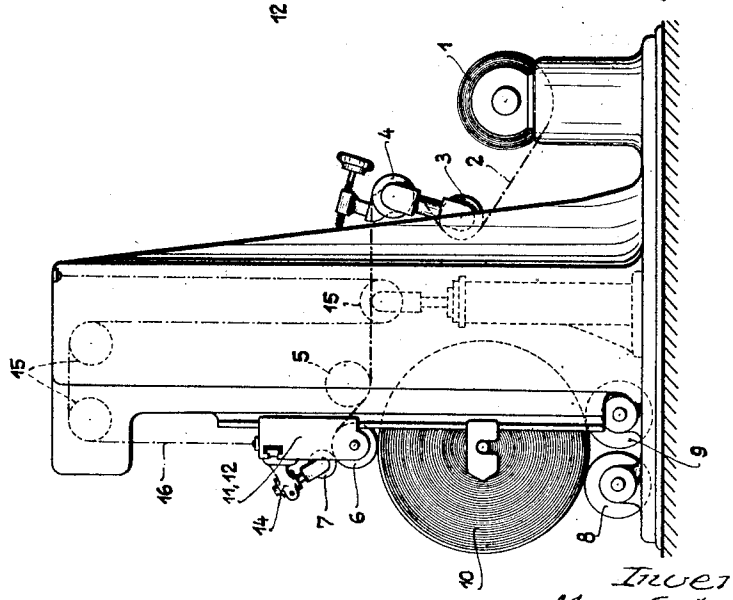


Fig. 1.



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Fig. 6.

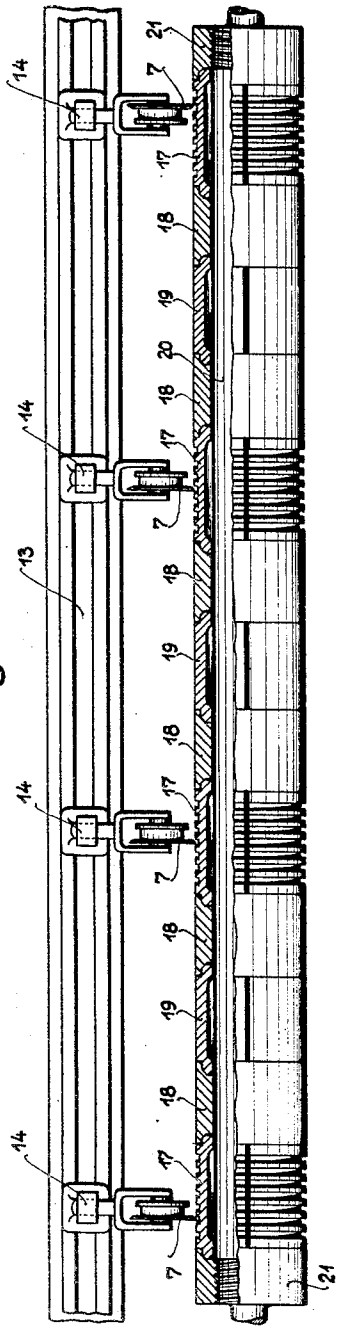


Fig. 8.

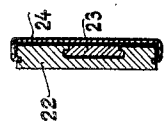
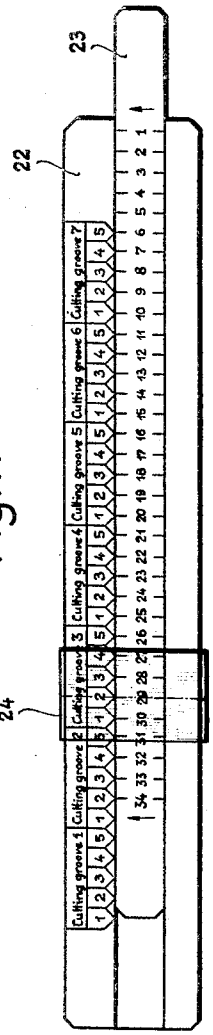


Fig. 7.



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Fig. 5.

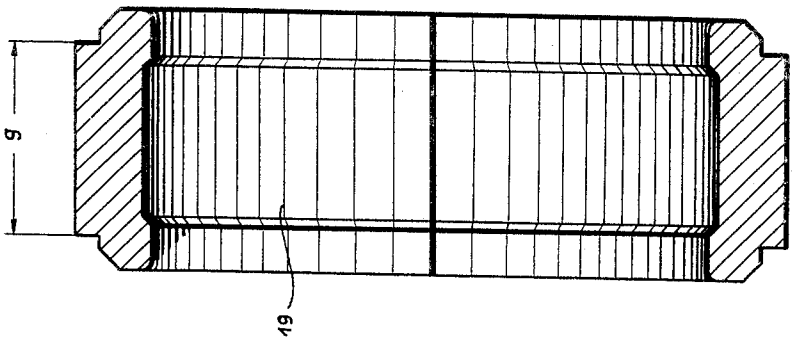


Fig. 4.

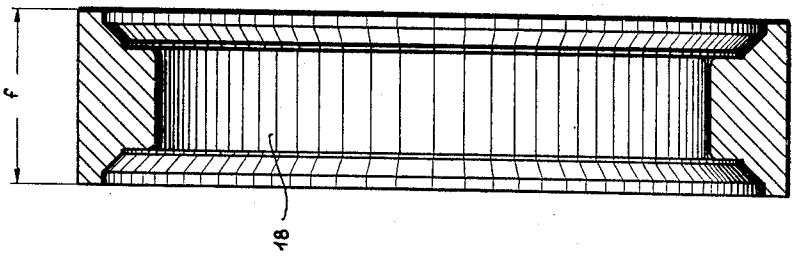
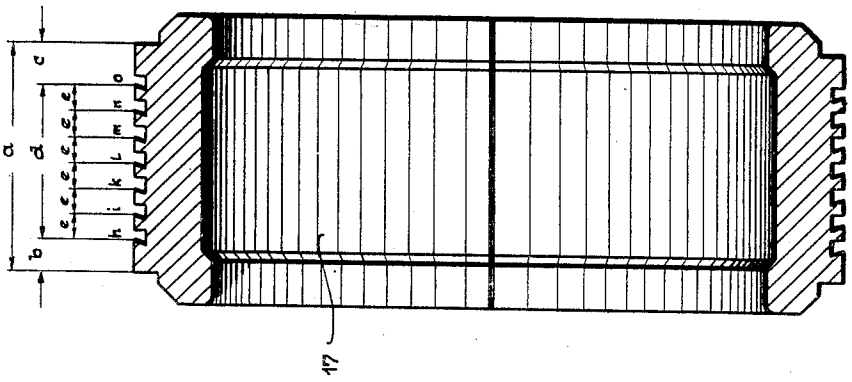


Fig. 3.



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Patented June 30, 1953 2,643,719

UNITED STATES PATENT OFFICE

2,643,719

WEB-SLITTING MACHINE WITH MINUTELY VARIABLE CUTTING-ROLL EQUIPMENT

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Application April 20, 1950, Serial No. 157,032
In Germany May 30, 1949

12 Claims. (Cl. 164—70)

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This invention relates to a web-slitting machine with a newly invented cutting-roller equipment for slitting any web width lying above a minimum, said cutting roll equipment being adjustable in variable steps—preferably from millimeter to millimeter or multiples thereof—and to a slide rule designed to ascertain the sequence of setting up of the cutting roller portions, by means of which rule the cutting sleeve and cutting groove required in each case as well as the number of spacing rings can be determined according to the widths to be slit.

In conventional cutting rollers for web-slitting machines, non-split cutting sleeves and split spacing rings are used. These have the disadvantage that either the cutting sleeves not in use had to remain on the shaft, thus causing the formation of stripes or identical lines on many prevalently soft and thin types of paper, or that the setting up or removal of the cutting sleeves required dismantling the cutting shaft in a troublesome and time consuming manner.

Arrangements with split cutting sleeves and whole spacing rings have also become known which enable the unused cutting sleeves to be taken out. However, in order to cut any width, a large number of cutting sleeves of various widths with equal spacers or a large number of differently wide spacers with equal cutting sleeves must be provided and such requires a large amount of cutting sleeves or spacers of different widths. Thus, an inconvenient and time-consuming calculation and measuring had to be done in the event of a change of the widths in order to determine the sequence of settings or the cutting sleeves and cutting grooves or the spacing rings to be chosen.

On the contrary, the equipment of the cutting shaft, in accordance with the instant invention, provides only for a limited number of different cutting sleeves of equal widths and equal groove dimensions, whereby, on a single cutting sleeve, the group of cutting grooves is arranged in an unsymmetrical manner, so as to provide a more closely graduated series of cutting edges when a series of cutting sleeves or a series of cutting sleeves and spacing sleeves is used, and in accordance with the desired stepping of the different widths. Thus, the number of types of the heterogeneous cutting sleeves to be provided is equal to the quotient from the cutting groove division and the cutting width step.

The width of the spacing rings, provided in a given case, is equal to the distance from the first and the last cutting edge of the cutting sleeve,

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augmented by a further groove division or equal to a proper fraction i. e. a half or a third of this measure. Further, the dimensions, having a definite ratio, respecting the cutting sleeves and the spacing rings, as well as staggering of the cutting groove groups from one cutting sleeve type to another, performed by a certain measure, form the basis for the use of a slide rule, which is provided by this invention. The slide rule is used to ascertain the sequence of setting up and the necessary cutting sleeve type and cutting groove, as well as the number of spacing rings according to the widths to be slit. The slide rule is constructed so that one part of it is formed in conformance to the number of existing cutting sleeve types and their cutting grooves, while the other part is provided with a division according to the width of the spacing rings.

Hereafter follows the description of an example of an embodiment of the invention, with reference to the accompanying drawings, wherein;

Fig. 1 shows a side view of the web-slitting machine,

Fig. 2 shows a front view of the web-slitting machine,

Fig. 3 shows a section of a cutting sleeve (male type),

Fig. 4 shows a section of a spacing ring (female type),

Fig. 5 shows a section of a replacement ring (male type),

Fig. 6 represents an example of the cutting-roller equipment,

Fig. 7 shows the front view of the slide rule,

Fig. 8 shows a cross section through the slide rule.

In order to explain the example of an embodiment represented by the figures, the following dimensions are taken as a basis:

Width of cutting sleeve a=45 mm.
Sum of distances $b+c$=15 mm.
Width of group of cutting grooves d=30 mm.
Index of grooves e=5 mm.
Number of cutting grooves=7
Width of spacing rings f=35 mm.
Width of replacement rings g=35 mm.

In the web-slitting machine represented by Figs. 1 and 2, the paper web **2** coming from the roll **1** is conveyed through, over the guide rollers **3**, **4** and **5**, between the cutting roller **6**, described in detail hereafter, and the circular knives **7**, and is finally rewound on the rewinding roll **10** reposing on the bearing drums **8** and **9**. The

drive is performed from the bearing drums 8 and 9 by a motor not shown. The cutting roller 6 resting on the summit of the rewinding roll 10 is supported in the slide blocks 11 and 12 and moves upwardly in accordance with the increasing diameter of the rewinding roll 10, as the web is wound thereon. In the cross beam 13, connecting the two slides 11 and 12, the holders 14 of the circular knives 7 are mounted in a laterally movable manner according to the web widths to be slit. In order to maintain an unchangeable bearing pressure between the rewinding reel 10 and the cutting roller 6, the whole cutting unit is hydraulically relieved through the tension cable 16 led over the guide rollers 15.

The equipment of the cutting roller according to the invention includes a limited number of different, split cutting sleeves 17 (Fig. 3) of an equal width *a*. The index of the cutting grooves *e* and, thereby, also that of the groups *d* of cutting grooves, comprising, the cutting edges *h, i, k, l, m, n* and *o*, is uniform in the different types of cutting sleeves. The difference in kind of the cutting sleeves lies only in the lay-out of the groups of cutting grooves *d*, that is, in the variable distances *b* and *c* of the outer cutting edges *h* and *o* from the cutting-sleeve edges for the particular case. These distances *b* and *c*, the sum of which remains constant, are altered in such a manner that one distance increases by the decrease of another or, reversely, so that the groups *d* of the cutting grooves *e* are arranged by a 1 mm. staggering to each other according to the desired graduation of slitting widths from millimeter to millimeter. Hence with a groove index *e* of 5 mm. taken as a point of departure for this example of embodiment, the number of types of the different cutting sleeves is equal to the quotient from the cutting-groove index and the step of cutting widths; consequently that number is limited to 5 : 1=5 types of distinct cutting sleeves. In Figure 2, four cutting sleeves are illustrated. In this regard, the number of the cutting sleeves utilized accords with the number of the cutters. However, the total number of cutting sleeves provided for use is greater than the number of cutters. Thus, five types of different cutting sleeves are provided, so that, out of ten cutting sleeves, there will be two of each type. The number of types of cutting sleeves results from the quotient out of the cutting-groove division and the step of the cutting width, as will be described. Consequenly, the number of types of the cutting sleeves is determined by the chosen cutting groove division and the cutting width stipulated.

The width of the non-split, uniform spacing rings 18 (Fig. 4) corresponds to the distance between the first and the last cutting edge *h* and *o* of the cutting sleeve, augmented by a further groove index *e* or the product from the number of cutting edges and the groove index; therefore, with reference to the actual example of the embodiment: 30+5=35 mm. or 7×5=35 mm. For the decrease of the cutting points, becoming necessary with a change of the cutting widths in a given case, one or several cutting sleeves are removed and replaced by the split replacement rings, represented in Fig. 5, the width *g* of which corresponds to the width *f* of the spacing rings, so that for this case also the condition of being able to slit from millimeter to millimeter can be complied with. The cutting sleeves 17, the spacing rings 18, and the replacement rings 19 are secured against lateral displacement and tumbling out by being clamped between the end nuts 21 fixed on the tubular core 20 of the cutting roller by means of threads.

Basic number	80	115	150	185	220	255	290	325	360	395
Number of spacing rings	1	2	3	4	5	6	7	8	9	10
Basic number	430	465	500	535	570	605	640	675	710	745
Number of spacing rings	11	12	13	14	15	16	17	18	19	20
Basic number	780	815	850	885	920	955	990	1,025	1,060	1,095
Number of spacing rings	21	22	23	24	25	26	27	28	29	30
Basic number	1,130	1,165	1,200	1,235	1,270	1,305	1,340	1,375	1,410	1,445
Number of spacing rings	31	32	33	34	35	36	37	38	39	40
Basic number	1,480	1,515	1,550	1,585	1,620	1,655	1,690	1,725	1,760	1,795
Number of spacing rings	41	42	43	44	45	46	47	48	49	50

For determining the sequence of settings, a slide rule (Fig. 7) is provided, by means of which and by the aid of the above calculating table the required cutting sleeve and cutting groove as well as the number of the spacing rings for the slitting width desired can be ascertained. The slide rule (Fig. 7) consists in a guide 22, provided with graduations according to the number of extant cutter sleeves and cutting grooves, and of a slider 23 gliding in the guide 22, the graduation of which slider corresponds to the width *f* of the spacing rings 18, and in a cursor 24 arranged slidably over both parts. The table contains a series of basic numbers of widths capable of being taken at will and which increase each time by one width of a spacing ring 18, as well as the corresponding number of spacing rings.

The slide rule is applied as follows: The cursor 24 of the slide scale is set, with its hairline, on the initial cutting sleeve and cutting groove to be chosen to one's liking. From the width of web to be slit, the next basic width number lying below it in the calculating table is deducted and the resulting difference, having been read on the slider 23, is brought to coincide with the adjusting hairline on the cursor 24. The right or left arrow of the slider 23 then indicates, on the guide 22, the immediately following cutting sleeve and cutting groove that immediately follows. The number of the spacing rings is taken from the calculating table; indeed, it corresponds to the number placed under the basic width number of the table when the latter is deducted from the number indicating the width to be slit. Attention should be paid to the fact that if the left arrow of the slider 23 is the indicating one, the number of spacing rings is to be augmented by 1.

In order to explain the use of the slide rule and the table, an example is given below for the complete equipment of a cutting roll, with figures according to this example.

Suppose that a paper web having a total web width of 650 mm. has to be slit into single strips of 249, 153, and 203 mm. widths respectively and to be rewound, while the remaining strips of a total width of 40 mm. will fall off as trimmings. The set-up has to be done on principle from the left, that is, it may begin with any cutting sleeve and any cutting groove whatsoever.

First of all, begin with the set-up for the strip of 249 mm. of width. As mentioned previously, any cutting sleeve whatever out of the five avail-

able types may be chosen and be mounted, as the first cutting sleeve, on the tubular core **20** of the cutting roller. Of this cutting sleeve, any cutting groove may be chosen as well in order to serve as the first cutting point (in this case, for the trimmings).

The cutting sleeve type **2** (and its groove **3**) having been chosen as the first cutting sleeve, the hairline on the cursor **24** of the slide rule has to be adjusted to the cutting groove **3** of the cutting sleeve **2**, as depicted in Figure 7.

The width of the strip to be cut being 249 mm., the next smaller basic number is located on the table and is deducted from the width of strip (249—220=29). The difference is 29. This number 29 is read on the slider **23** and brought under the hairline of the cursor **24**. The left-hand arrow, marked by +1, of the slider **23** shows now, on the guide **22** of the slide rule, the next cutting-sleeve type **1** to be fixed on the tubular core **20**, as well as the cutting groove **2**. The space between the first and the second cutting sleeve will be filled up by spacing rings **18**, the number of which can also be seen from the table; indeed, it corresponds to the number read before from the table. In this case, the number of spacing rings is indicated as 5, the number in the column below 220, and has to be augmented by 1, as the left-hand arrow of the slider indicates 5, which results in 5+1=6 spacing rings.

The width of strip to be cut next is 158 mm. The hairline of the cursor **24** will now be adjusted to the cutting groove **2**, found out above, of the cutting-sleeve type **1**.

Of the width of strip to be cut, the next smaller basic number (150) of the table will be deducted (158—150=8). The difference is 8. The number 8 of the slider **22** will be brought under the hairline of the cursor and the right-hand arrow of the slider indicates the cutting-sleeve type **4** and its cutting groove **3** to be mounted now on to the tubular core **20**. The number of the spacing rings is shown under the basic number 150 taken before from the table, that is, 3 spacing rings.

The width of strip to be slit next is 203 mm. The hairline of the cursor **24** will be adjusted now on the cutting groove **3** of the cutting-sleeve type **4** found out last (Figure 5).

From the strip width of 203 mm. the next smaller basic number (185) of the table (Fig. 6) has to be deducted (203—185=18). The difference is 18. The number 18 of the slider **23** will be brought under the hairline of the cursor and the right-hand arrow now indicates the last cutting sleeve, that is, the cutting groove **7** of cutting-sleeve type **2**.

The number of spacing rings to be ascertained from the table will only have to be increased by 1 when the left-hand arrow of the slider indicates. The reason for this will be explained by the following limit case: If, for instance, the slitting be done on the cutting groove **7** of the cutting-sleeve type **5** and the difference resulting from the basic number of the table and of the strip width to be slitted be 1, the left-hand arrow of the slider indicates the cutting groove **1** of the cutting-sleeve type **1**. That means consequently that the cutting point on the last cutting groove of the preceding sleeve passes to the first cutting groove of the following sleeve. Since the division on the slider **23** corresponds to the width of a spacing ring, said passage or "leap" is too "short" by one spacing-ring width, so that in indicating by the left-hand arrow, one spacing-ring width has to be added.

The possibility of application of the cutting-shaft equipment according to the invention is not limited to the dimensions of the cutting sleeves and spacing rings taken as a point of departure for an example of one embodiment, nor to the graduation of the slitting widths and to the number of grooves, but extends, on the contrary, also to any other number of grooves, index of grooves and graduation of slitting widths whatever, regardless of the selected measuring unit. Thus, limitation is sought only in accordance with the terms and spirit of the appended claims.

What is claimed is:

1. A cutting roller equipment for web-slitting machines designed to slit running webs of paper, carton or the like, in any width whatever above a minimum, said equipment being adjustable in steps, for instance from millimeter to millimeter, comprising a roller and individual cutting sleeves arranged in spaced fashion on the roller, each of said sleeves being of equal width and having cutting grooves of equal width, the cutting grooves on each cutting sleeve being variably spaced with respect to the outer edges of the sleeve.

2. In a cutting roller equipment for web-slitting machines designed to slit running webs of paper, carton or the like, in any width whatever above a minimum, said equipment being adjustable in steps, for instance from millimeter to millimeter, a number of cutting sleeves of equal width, each of said sleeves having cutting grooves of equal width, and edge portions of different widths so that the cutting grooves of one sleeve are variably spaced with respect to the edge portions of said sleeve.

3. A cutting roller equipment for web slitting machines designed to slit running webs of paper, carton or the like, in any width whatever above a minimum, said equipment being adjustable in steps, for instance from millimeter to millimeter, wherein the cutting grooves on the sleeves are of the same width and are variously spaced on the sleeves according to the desired graduation by edge portions on each sleeve of unequal width.

4. A cutting-roller equipment for web-slitting machines designed to slit running webs of paper, carton or the like, in any width whatever above a minimum, said equipment being adjustable in steps—for instance from millimeter to millimeter—wherein the sum of the distances of the outward cutting edges on a cutting sleeve from the cutting-sleeve edge lying nearest in each case is constant and the sleeves have outer non-cutting spaces of variable width, and spacing rings adapted to be placed between the sleeves, said rings being of the same width as the sleeves.

5. A cutting-roller equipment for web-slitting machines designed to slit running webs of paper, carton or the like, in any width whatever above a minimum, said equipment being adjustable in steps—for instance from millimeter to millilimeter—comprising cutting sleeves, each sleeve having groups of cutting groups formed between the edge non-cutting spaces, the width of the groups of groups being constant and the width of the edge non-cutting spaces being variable, the number of types of the varied cutting sleeves being equal to the quotient from the cutting-groove index and the cutting-width step.

6. A cutting-roller equipment for web-slitting machines designed to slit running webs of paper, carton or the like, in any width whatever above a minimum, said equipment being adjustable in steps—for instance from millimeter to milli-

limeter—in which the number of types of the individual cutting sleeves is equal to the quotient from the cutting-groove index and the cutting-width step, and spacing rings adapted to be placed between the sleeves, the rings being of the same type and width as each other.

7. A cutting roller equipment for web-slitting machines designed to slit running webs of paper, carton or the like, in any width whatever above a minimum, said equipment being adjustable in steps—for instance from millimeter to millimeter—in which the groups of cutting grooves on the individual, varied cutting sleeves are arranged in a staggered way one to another by varying the widths of the non-cutting outer portions of the sleeves according to the desired graduation, and the width of the spacing rings is equal to the distance from the first to the last cutting edges of the cutting sleeve, augmented by a further index of grooves, or equal to a proper fraction of this measure.

8. A cutting-roller equipment for web-slitting machines designed to slit running webs of paper, carton or the like, in any width whatever above a minimum, said equipment being adjustable in steps—for instance from millimeter to millimeter—in which the sum of the distances of the outward cutting edges on a cutting sleeve from the cutting-sleeve edge lying nearest in each case is constant, and the width of the spacing rings is equal to the distance from the first to the last cutting edge of the cutting sleeve, augmented by a further groove index, or is equal to a proper fraction of this measure.

9. A cutting-roller equipment for web-slitting machines designed to slit running webs of paper, carton or the like, in any width whatever above a minimum, said equipment being adjustable in steps—for instance from millimeter to millimeter—wherein the number of types of the varied cutting sleeve is equal to the quotient from the cutting-groove index and the step of the cutting width, and the width of the spacing rings is equal to the distance from the first to the last cutting edges of the cutting sleeve, augmented by a further groove index, or is equal to a proper fraction of this measure.

10. A cutting-roller equipment for web-cutting machines, designed to slit running webs of paper, carton or the like, in any width whatever above a minimum, said equipment being adjustable in steps—for instance from millimeter to millimeter—wherein the groups of cutting grooves limited by the first and the last cutting edges on the individual, cutting sleeves are of the same width and the non-cutting edges of the sleeves are of varied width, split replacement rings adapted to be substituted for removed sleeves on the roller equipment, the width of the split replacement rings to be set up in place of the removed cutting sleeves, corresponding to the width of the spacing rings, and the shape of the replacement rings corresponding to the shape of the cutting sleeves.

11. A cutting-roller equipment for web-cutting machines designed to slit running webs of paper, carton or the like, in any width whatever above a minimum, said equipment being adjustable in steps—for instance from millimeter to millimeter—wherein the sum of the distances of the outward cutting edges on a cutting sleeve from the cutting-sleeve edge lying nearest in each case is constant, spacing rings between the cutting sleeves, and split replacement rings adapted to replace removed cutting sleeves, the width of the split replacement rings to be set up in place of the removed cutting sleeves corresponding to the widths of the spacing rings, and the shape of the replacement rings corresponding to the shape of the cutting sleeves.

12. A cutting-roller equipment for web-cutting machines designed to slit running webs of paper, carton or the like, in any width whatever above a minimum comprising cutting sleeves, split spacing rings between the cutting sleeves, and split replacement rings adapted to be set up in place of removed cutting sleeves, said equipment being adjustable in steps—for instance from millimeter to millimeter—wherein the number of types of the varied cutting sleeves is equal to the quotient from the cutting-groove index and the cutting-width step, and the width of the split replacement rings to be set up in place of the removed cutting sleeves corresponds to the width of the spacing rings, the shape of the replacement rings corresponding to the shape of the cutting sleeves.

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