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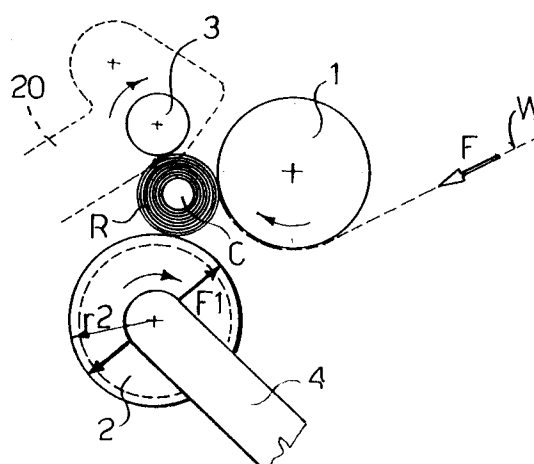
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I-20144 Milano (IT)(54) **Re-reeling machine for sheet material.**

(57) A re-reeling machine for sheet material, such as paper or the like, comprising a group of three rollers (1,2,3) forming a cradle in which winding of the sheet material (W) takes place on a core (C) that is introduced between a pair of rollers (1, 2), the third roller (3) having a variable axis to allow the increase in diameter of the log being made up and discharge of the made up log (R), in which at least one of the rollers (1, 2, 3) has a variable diameter and takes on different diameters during the reel winding stage and during the "exchange" stage, i.e. during introduction of a new core (C) into the winding cradle and discharge of the made up log (R).

FIG. 2**EP 0 638 500 A1**

The present invention relates to a re-reeling machine for sheet material, such as paper or the like.

In particular, the re-reeling machines to which the present invention refers unwind large rolls of sheet material particularly paper, to produce a plurality of logs, of a pre-established diameter, that are subsequently cut cross-wise to the desired length, to obtain rolls of toilet paper, kitchen paper or similar products.

The logs are normally made up on a tubular cardboard core.

The most widely used method at present is so-called free winding between three rollers. This means that the core is introduced, without a support, into the cradle formed by three rollers with parallel axes, which set it in rotation, causing a web of paper to wind onto it. Of the three rollers, two have substantially fixed axes, whilst the third, also called the pressure roller has a mobile axis to allow the diameter of the log being made up to increase and the log to be discharged at the end of winding.

The three rollers turn at a constant speed, which is normally that at which the paper is fed, during winding of the log, whilst for discharge of the finished log and introduction of the new core the most widely used techniques rely on large variations in speed between the rollers. These different roller speeds are necessary to allow translation of the core between the insertion rollers and translation of the log between the discharge rollers.

These large variations in roller speeds, in some cases to the point of stopping a roller, subject the machine structure to considerable stresses, with the resulting risk of breakage, and above all give rise to uneven winding of the reel of paper.

The aim of the invention is to eliminate the above-mentioned drawbacks, related to the variations in angular speed (r.p.m) of the rollers.

The aim is achieved by providing for at least one of the three winding rollers to have a variable diameter.

In this way, the speed of the three rollers can be maintained constant, obtaining a variation in the peripheral speed of at least one of them, as a result of the variation in its own external diameter, thus causing translation of the core in the winding cradle and/or discharge from the cradle of the made up log.

The roller that works both during introduction of the new core and during discharge of the log is conveniently of variable diameter, and this diameter is decreased during the "exchange" stage, that is during core introduction-log discharge.

Obviously all other possibilities are to be considered as coming within the scope of the invention, for example having more than one roller, possibly even all three, with a variable diameter, each

being able to work with its largest diameter or its smallest diameter during the reel winding stage and vice versa during the exchange stage.

The variation in roller diameter is interlocked with a control logic which is responsible for its correct operation during the work cycle.

The variation in roller diameter is conveniently obtained by dividing its mantle into a plurality of longitudinal sectors or tiles that can be moved radially by means of kinematic mechanisms situated inside the roller, which is hollow, from a lowered or closed position, corresponding to the smallest diameter of the roller, to a raised or open position, corresponding to the largest diameter of the roller.

A continuous or discontinuous elastic stocking is conveniently provided to close the longitudinal slits that occur in the roller mantle when the tiles are in the raised position.

By way of example, the kinematic operating mechanism of the expansion sectors in the roller mantle comprises a bar disposed coaxially to the roller, on which two threads are provided, right and left respectively, for engagement of corresponding sleeves connected by means of connecting rods to a supporting rod of a respective tile. Thus a relative rotation between the threaded bar and the roller produces an axial movement bringing the sleeves, closer together or further apart, and consequently a radial movement of the longitudinal sectors or tiles of the roller mantle.

Further characteristics of the invention will be made clearer by the detailed description that follows, referring to a purely exemplary and therefore non-restrictive embodiment, illustrated in the attached drawings in which:

Figures 1 and 2 show a schematic view of the group of three winding rollers of a re-reeling machine according to the invention, in two different working conditions during the reel winding cycle;

Figure 3 is an axial section through a variable diameter roller according to the invention, with the mantle sectors shown in the lowered position in the upper half of the drawing and in the raised position in the lower half;

Figure 4 is a cross-section taken along the plane IV-IV of figure 3;

Figure 5 is a schematic view in profile of a single sector of the roller mantle in Figure 4, with a respective crank arm.

In figures 1 and 2, W indicates a sheet material, in particular a web of paper, which, coming from the direction indicated by the arrow F, reaches the first roller 1 of a group of three winding rollers 1, 2, 3. The web W is wound onto tubular cores C, possibly previously spread with adhesive, that come from a special loading channel (not

shown) and are inserted into the winding cradle through the pair of rollers 1, 2. The roller 2 can, for example, be supported by a pair of rocking arms 4, which allow it to move in the direction indicated by the double arrow F1, to regulate the distance between the mantles of rollers 1 and 2. The third roller 3, commonly known as pressure roller, exerts pressure on the log being made up R (Figure 2) and is supported in a per se known manner, by a pair of rocking arms 20, so that it can move to follow the increase in diameter of the reel.

The rollers 1, 2, 3 are all made to rotate at a constant speed, generating the same peripheral speed, in relation to their diameter, this being the speed at which the sheet material W is fed during the winding phase.

During the exchange phase, that is during introduction into the winding cradle of the new core C and discharge from the winding cradle of the made up roll R, it is necessary, or at least preferable, to have different peripheral speeds between the pair of insertion rollers 1, 2 and the pair of discharge rollers 2, 3, in order to cause translation of the core C entering the winding cradle and of the reel R leaving this cradle, respectively.

This is achieved, according to the invention, by providing for at least one of the rollers 1, 2, 3 to have a variable diameter, that is having its mantle constructed in such a way as to grow larger or smaller in order to generate different peripheral speeds under the different conditions, whilst the angular roller speed remains unchanged.

In the exemplary embodiment illustrated in Figures 1 and 2, the variable diameter roller is roller 2, which cooperates with the counter-roller 1 during insertion of the core C and with the pressure roller 3 during discharge of the log R.

In the "exchange" phase (Figure 1) the winding roller 2 takes on the conformation with the minimum diameter (radius r_1) and hence, for the same speed, a lower peripheral speed than that of rollers 1 and 3, thus causing, on one hand, translation of the core C into the winding cradle, rolling on roller 2, and, on the other hand, outward translation of the made up log R, again rolling on roller 2. When the core C has entered the winding cradle, and winding thus takes place between the three rollers 1, 2, 3 (Figure 2), roller 2 increases its external diameter (radius r_2), whilst maintaining the same speed, thus generating a higher peripheral speed, corresponding to that of the other two rollers 1 and 3, throughout the winding cycle.

Of course, besides the roller 2, roller 1 or roller 3 or both may have a variable diameter. In this way, by suitably regulating the diameters of the rollers during the "exchange" phase, greater differences in their respective peripheral speeds can be obtained, with a slight structural complication of the

machine.

Obviously if the arrangement of the rollers 1, 2, 3 were to be different and/or the web of paper W were to come from a different direction, the variable diameter roller(s) will be chosen accordingly.

The variation in diameter of the roller 2 (and of any other rollers) and hence of the relative peripheral speed, will be managed by a control logic that will take into account all parameters relating to the production that is to be carried out.

With reference now to figures 3 to 5, a preferred method of achieving the variation in the external diameter of a roller is illustrated, in particular that of the roller 2, with reference to the exemplary embodiment in Figures 1 and 2.

The roller 2 comprises a tubular body 5 and an outer mantle 6, axially integral with each other.

The mantle 6 is divided into a plurality of longitudinal sectors, or tiles, 7, each supported by a series of spindles 8 that are guided to slide radially in corresponding radial holes 9 in the hollow body 5 of the roller. The inner ends of each series of spindles 8 are fixed to a corresponding longitudinal rod 10 disposed inside the roller.

A bar 11 is provided for movement of the sectors 7 and is disposed coaxially with the inside of the roller 2, and integral with it. The bar 11 has a pair of threads 12, 13, right and left respectively, with which the respective threaded sleeves 14, 15, mounted on the bar 11, engage. In this way, rotation in one direction of the bar 11 relative to the roller 2 causes the sleeves 14, 15 to draw apart axially (upper half of Figure 3), while rotation in the other direction of the bar 11 brings said sleeves closer axially (lower half of Figure 3). The axial movement of the sleeves 14, 15 is converted into a radial movement of the sectors or tiles 7 by means of pairs of connecting rods 16, 17 that connect the sleeves 14, 15 to the opposite ends of each respective supporting rod 10 of a corresponding sector 7.

As an alternative to the connecting rods 16, 17 suitable inclined guides can be provided between the rods 10 or the sectors 7 and the axially moving sleeves 14, 15.

The relative rotation between the threaded bar 11 and the roller 2 can be obtained with a drive motor used as an electric axle and fitted directly on the bar 11, or with a drive motor connected to the bar with reduction units and transmissions, or with an epicycloidal timer, or in any other manner.

Obviously, kinematic mechanisms can be provided to obtain radial movement of the longitudinal sectors 7 of the roller mantle 6.

When the sectors 7 are in the raised position, i.e. in the condition in which the roller has the greatest diameter, longitudinal slits 18 would appear in the mantle 6 (see in particular the right

side of Figure 4). These slits can be closed by means of longitudinal strips of elastic material 19, fixed to the respective ends of adjacent sectors 7, as shown schematically in Figure 4. Alternatively, an elastic stocking that completely encloses the roller mantle can be used.

Naturally the invention is not limited to the particular embodiment described above and illustrated in the annexed drawings, but numerous modifications can be made to the details, without departing from the sphere of protection of the invention itself as defined by the claims that follow.

Claims

1. A re-reeling machine for sheet material comprising a group of three rollers (1, 2, 3) with parallel axes, forming a cradle in which the sheet material (W) is wound around a core (C), introduced between a pair (1, 2) of such rollers, a roller (3) of the three having a mobile axis to allow the increase in diameter of the log being made up and discharge of the made up log (R), characterized in that one of said rollers (1, 2, 3) has a variable diameter, taking on different diameters at least in the winding phase and in the exchange phase, that is during introduction of a new core (C) and discharge of the made up log (R).
2. A re-reeling machine according to claim 1, characterized in that of the three rollers (1, 2, 3), the roller with a variable speed is the one (2) that cooperates with the other rollers (1, 3) for introduction of the core (C) into the winding cradle and discharge of the made up log (R), respectively.
3. A re-reeling machine according to claim 2, characterized in that said variable diameter roller (2) takes on a smaller diameter during the exchange stage and a larger diameter during the winding stage.
4. A re-reeling machine according to any one of the preceding claims, characterized in that said rollers (1, 2, 3) all turn at a constant speed.
5. A re-reeling machine according to any one of the preceding claims, characterized in that the peripheral speeds of said rollers (1, 2, 3) are constant and the same as each other and as the speed at which the sheet material (W) is fed during winding of the log (R), whilst in the exchange stage the peripheral speed of at least one of the rollers (1, 2, 3) is different from that of the others.
6. A re-reeling machine according to any one of the preceding claims, characterized in that at least one of said pair of rollers (1, 2) has a mobile axis to vary the center distance between the rollers.
7. A re-reeling machine according to claim 1, characterized in that the variation in diameter of at least one of said rollers (1, 2, 3) is obtained by providing for the respective mantle (6) to be divided into a plurality of longitudinal sectors (7), that can be moved radially with respect to the body (5) of the roller to pass from a lowered or retracted position, in which the diameter is smaller, to a raised or extended position, in which the diameter is larger.
8. A re-reeling machine according to claim 7, characterized in that said body (5) of the roller (1, 2 or 3) is hollow inside and houses means (8-17) for radially moving said sectors (7).
9. A re-reeling machine according to claim 8, characterized in that said means for radially moving the sectors (7) comprise a bar (11) that is coaxial with the roller (1, 2, 3), provided with two threads (12, 13), a right-hand thread and a left-hand thread, for engagement of the respective sleeves (14, 15), whose axial sliding motion is transformed, by means of connecting gear (8, 10, 16, 17), into a radial movement of said sectors (7).
10. A re-reeling machine according to claim 9, characterized in that said sectors (7) are each supported by a series of spindles (8) guided in radial holes (9) provided in said hollow body (5) of the roller, whose inner ends are fixed to a respective longitudinal shaft (10) having the ends connected to said sleeves (14, 15) by means of respective connecting rods (16, 17).
11. A re-reeling machine according to any one of claims 7 to 10, characterized in that provision is made for longitudinal elastic strips (19), disposed between adjacent sectors (7), to cover the longitudinal slits (18) that are formed in the mantle (6) of the variable diameter roller (1, 2, 3), when said sectors (6) are in the raised position.
12. A re-reeling machine according to any one of claims 7 to 10, characterized in that the mantle (6) of the roller (1, 2, 3) is covered by an elastic stocking.

13. A re-reeling machine according to any one of the preceding claims, characterized in that the change in diameter of said at least one variable diameter roller (1, 2, 3) is interlocked with a control logic.

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FIG. 1

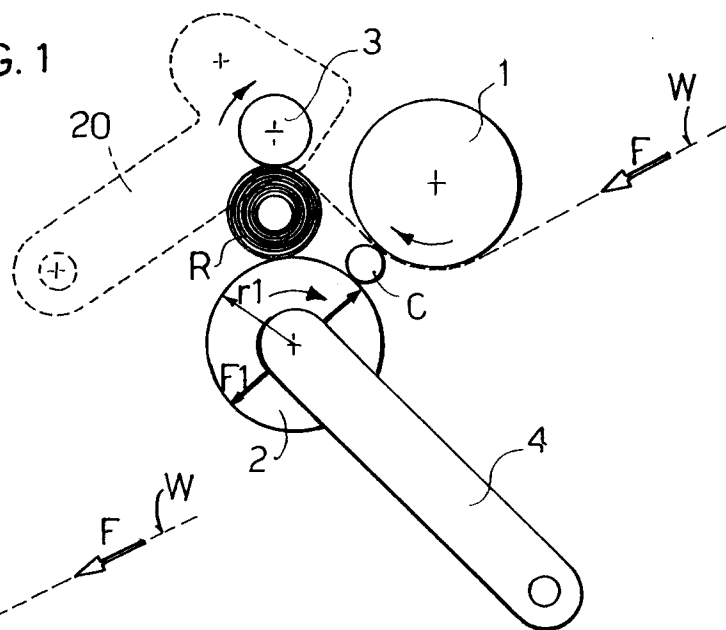


FIG. 2

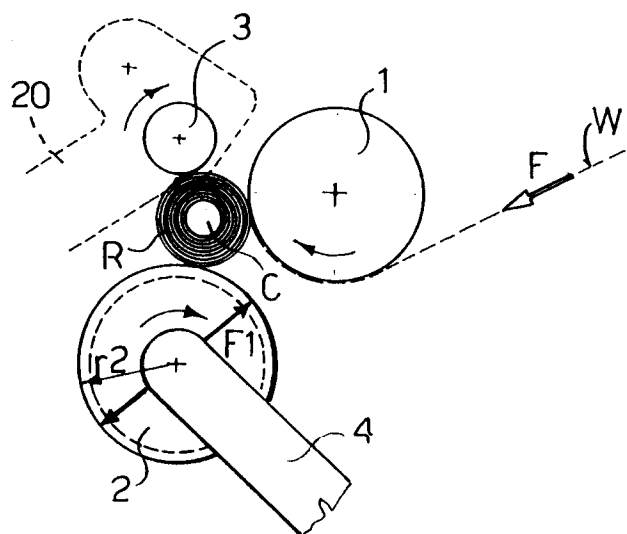
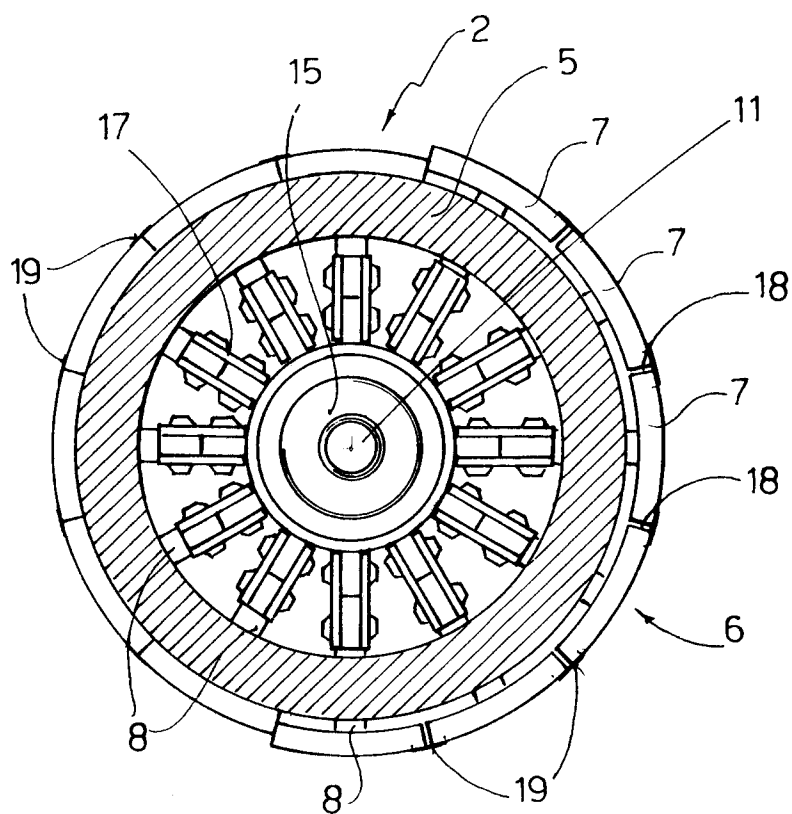
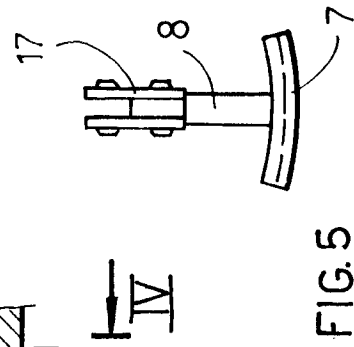
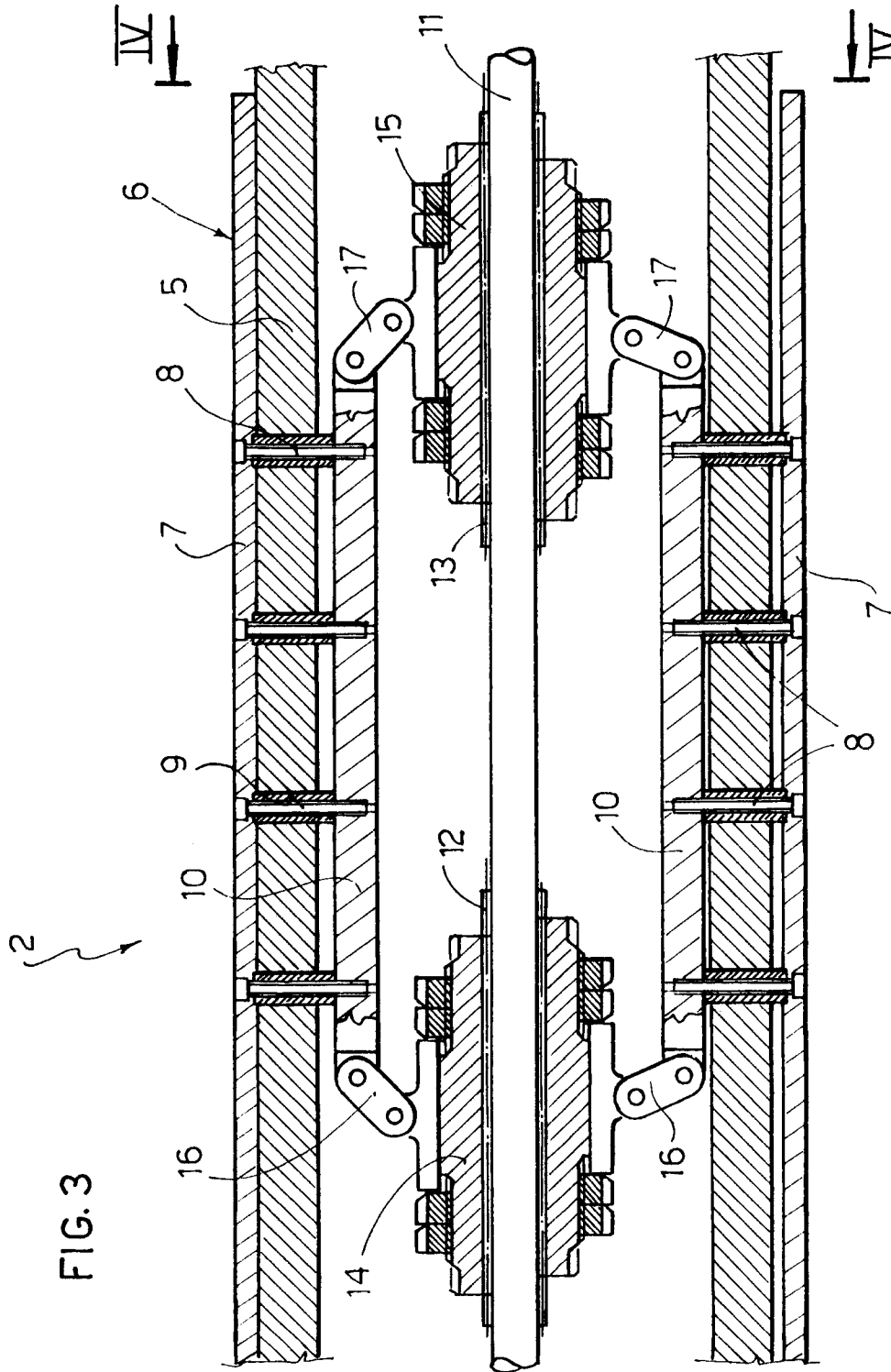


FIG. 4







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EUROPEAN SEARCH REPORT

Application Number

EP 94111550.3

DOCUMENTS CONSIDERED TO BE RELEVANT			EP 94111550.3
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. 6)
A	<u>EP - A - 0 524 158</u> (PERINI) * Fig. 4 * --	1	B 65 H 19/30 B 65 H 18/20 B 65 H 27/00
A	<u>FR - A - 2 686 077</u> (CLECIM) * Fig. 2 * --	7, 8	
A	<u>US - A - 3 791 659</u> (HARDIN) * Fig. 1, 2 * ----	7, 8	
			TECHNICAL FIELDS SEARCHED (Int. Cl. 6)
			B 65 H
The present search report has been drawn up for all claims			
Place of search VIENNA		Date of completion of the search 11-10-1994	Examiner LOSENICKY
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	