"OPEN END SPINNING ROTOR SHAPED WITHOUT CUTTING, AND A METHOD OF PRODUCING IT"

This invention relates to an open end spinning rotor shaped without cutting or machining and having a collecting groove, and also a method of producing such open end spinning rotor. The invention is related to the invention claimed in our British Application 8319771 published as Specification 2127441.

Hitherto open end spinning rotors have either been turned from the solid or produced as castings which have been brought to their final shape by treating them by cutting or machining. Such a mode of manufacture is very expensive, for which reason efforts were made to achieve a long service life by treating by heat, and coating, the surfaces which were to come into contact with the fibres. However, it is extremely difficult to gain access to the collecting groove, so that the hardening, the subsequent polishing and the coating of this collecting groove can only be carried out with difficulty. It is already known, for avoiding these difficulties, to produce open end spinning rotors by shaping them without cutting (British patent 1.383.194); the starting material was sheet metal which is initially brought to the shape of a dished member by stamping and deep drawing. The dished member is subsequently upset or compressed by shaping or pressing rollers of complementary

shape, and pressed to the final shape required for the rotor. The press rollers extend the whole inner or outer length of

the open end spinning rotor. It has been found that, in this way, it is impossible to manufacture spinning rotors which can be used for spinning; also, the shaping tool for the collecting groove only has a short service life.

Therefore the object underlying the invention is that of providing a spinning rotor which is produced without cutting or machining and which can be used for open end spinning, and also a method of producing such an open end spinning rotor.

A further object of the invention is that of providing a favourable method of balancing such thin walled spinning rotors.

According to the invention it is arranged for the spinning rotor to have, in the vicinity of the collecting groove, a surface which is untouched by shaping tools. In this way it is possible to produce very narrow shapes of collecting groove, which it would otherwise be quite impossible to obtain by means of conventional shaping tools. Moreover, a surface of the collecting groove which remains unaltered during the further processing work imparts good quality to the yarn which is produced. It has been found to be possible to prevent the formation of processing grooves, in the vicinity of the collecting groove, which would adversely affect the yarn produced.

If a sufficiently high degree of plastic shaping work is performed, the spinning rotor will be given, in the vicinity

of its collecting groove, a wall thickness which is greater than the wall thickness of the slide wall lying contiguously of its area. In this way a high cracking speed limit is achieved, so that the spinning rotor becomes stable at high speeds of rotation.

Preferably, by appropriately selecting the shape of the shaping tools, a collecting groove is bent or folded over in such a way that this groove receives a cross-section which progressively widens from the base of the collecting groove in the direction towards the middle of the rotor. This increase in cross-section is such that tangents to the delimiting walls of the collecting groove include with one another progressively larger angles with increasing distance from the base of the collecting groove. Due to the narrow cross-section in the vicinity of the base of the collecting groove, good compression of the fibres is achieved in the collecting groove. The progressively widening cross-sections facilitate a thread draw-off accompanied by low friction, and facilitates propagation of the twist out of the thread draw-off tube to the collecting groove, that is to say into the fibre ring present in this groove.

Provision can be made - for the purpose of conferring increased strength to the open edge which, when certain starting materials are being processed, is liable to deformation at high speeds - for this open edge to receive a reinforcement,

this reinforcement preferably being constituted as a bead formed on the outer circumference of the open edge of the spinning rotor. Such a bead is also advantageous in the case of open end spinning rotors which have been shaped, without machining, in accordance with a known method.

According to the invention, for the purpose of producing such an open end spinning rotor shaped without machining, the dished member, which has been produced previously by stretching, is secured in its radial position, independently of shaping tools, for the second plastic shaping operation, whereupon the circumferential edge of the dished member is compressed in the area between the collecting groove to be formed and the open edge of the dished member, by any kind of plastic shaping procedure, and the area of the collecting groove to be formed is inwardly compressed or upset by plastic shaping carried out "against air" (i.e. in an unsupported manner). Due to the fact that the dished member is secured in place independently of the shaping tools, satisfactory shaping of the collecting groove occurs without the shaping tools coming into contact with the material in the vicinity of the collecting groove to be formed. In this way not only is a collecting groove produced, but the material is also compacted in this area, so that the material is given, in this area, a greater strength and resistance to wear. On the occasion of the second plastic shaping work, by means of which upsetting takes place, no harmful grooves are formed in the vicinity of the collecting

groove. As the area of the collecting groove is mechanically untouched during the whole part of the manufacturing process taking place after formation of the dished member by stretching the material, extremely narrowly shaped collecting grooves can be obtained, which could not be obtained hitherto by reason of the minimum dimensions of the shaping tools necessary. In this way the spinning rotors can be adapted better than hitherto to the particular spinning requirements at any given time. The result of this is a smaller number of thread breakages, improved conditions for spinning thread joins, and improved yarn quality. The surface of the collecting groove or of the whole inner area of the spinning rotor can be made more resistant to wear by a coating, or can be adapted to the particular textile material to be spun. However, good spinning results are also obtained in the case of an unaltered surface structure of the collecting groove, which has not been coated and which, on the basis of the production method according to the invention, does not suffer from any processing defects such as press forming grooves. This results in a satisfactory self-cleaning effect, so that the liability to disturbance in operation of the open end spinning rotor according to the invention is reduced in comparison with other spinning rotors manufactured without cutting.

By reason of the favourable spinning results due to the surfaces which were obtained during the second plastics shaping operation of converting the dished member to the shape of the final open end spinning rotor, and which were not touched by any shaping tool, both the collecting groove and also the sliding wall of the spinning rotor are preferably formed by plastic shaping work carried out "against air" (i.e. in an unsupported manner).

It has been found that pressing and press forming are particularly advantageous methods for performing the plastic shaping work entailed in upsetting in an unsupported manner; for this reason, and in accordance with a further feature of the invention, the sliding wall of the open end spinning rotor is formed by effecting multistage pressing of the dished member, or by press forming using shaping rollers. However, according to the particular material used, other methods, e.g. drawing, may be found to be advantageous.

When press forming by means of shaping rollers the radially inwardly acting pressure preferably always acts on a limited area of the dished member only, this limited area being displaced axially during the press forming work. Due to this displacement of the pressure, the material in the vicinity of the end of the working stroke is compressed. The result of this is a particularly good fold and material compacting effect in the vicinity of the collecting groove, with a correspondingly improved resistance to wear.

The pressure displacement can be performed in various ways depending on the folding and/or compacting of the material required, in the vicinity of the collecting groove, at any given time; for example, the pressure displacement may occur by alternately changing the direction in which the pressure is displaced. However, according to the invention, it is preferable - with a view to compacting the material in the vicinity of the collecting groove in a particularly satisfactory way - if the pressure displacement continuously takes place, in one or more "waves", from the open edge of the dished member towards the collecting groove.

Open end spinning rotors may be made from various materials, e.g. from sheet aluminium, steel plate, spring steel plate, inoxidable steel plate, or from plates or sheets of non-ferrous metals; synthetic plastics can also be used for this purpose. The ease with which these various materials can be processed varies, so that these different materials require different treatment from one another. For example, it is known that heat has to be introduced for the plastic deformation of a synthetic plastics plate. Also, in the case of materials which can be cold deformed (e.g. metal sheet and plates), it is possible to accommodate to the particular material used at any time if, in accordance with a suitable modification of the method according to the invention, the number of pressure displacements, and/or the pressure exerted in the course of these pressure displacements, is varied in a manner suited to the material selected for the open end spinning rotor.

Also, when roll pressing is performed, the dished member is stretched, and deformation of its open end occurs. It will therefore be advantageous if, in accordance with a further feature of the invention, the spinning rotor is brought, after upsetting, to the required lengthwise dimensions by cutting off the superfluous material at the open edge of the rotor.

The dished member can be held in place, during the plastic shaping work, by means of which upsetting takes place, by means of a stationary support and of a co-operating support, connected to the press rollers, in the area outside the collecting groove; the dished member can be thus held in place by means of rotating or stationary elements, However, it is advantageous if the dished member is secured, during the plastics shaping work, by clamping. For this purpose it is extremely advantageous if the spinning rotor to be formed has a hole in its base, as a result of which the spinning rotor can be secured to a shaft, mounting spindle, base body etc. with appreciably greater ease. This hole is preferably stamped out of the base of the dished member when the latter is being formed. As all working procedures both for the plastics shaping work and also for stamping out the hole are carried out in a single working stroke, it is ensured, in a simple way, that the stamping and plastic shaping work are carried out concentrically of one another. The repeated clamping and centering actions which have hitherto been conventional are thus dispensed with, and considerable time saved. The dished member which has

thus been made, and which has a hole in its base, is then fixed to the stationary support by means of an attachment device extending through this hole in the base of the dished member; this can be carried out with the most simple of means. The device carrying the shaping tool can be appreciably simplified in this way.

As any imbalance in the spinning rotor adversely affects its drive and its service life, it is essential to balance the spinning rotor. Hitherto this is always done by grinding the spinning rotor at its outer periphery. However, in this way the wall - which, in the case of an open end spinning rotor which has been formed without machining, is relatively thin - is weakened; such weakening should be avoided as the strength and stability of the spinning rotor is thus reduced, particularly in view of the high rotor speeds usual at the present time. Therefore, according to the invention, the hole, stamped out of the base of the dished member and required for clamping the latter during the pressing operation, is smaller than is later required for fixing the completed spinning rotor to its holder (e.g. rotor spindle) and, after the final shaping of the spinning rotor, the latter is balanced by shifting the axis of rotation of the spinning rotor into its axis of inertia, the stamped hole, which was initially too small, being enlarged to the required diameter. This balancing method is applicable to any kind of spinning rotor which is produced by plastic deformation.

By reason of the good spinning results which are achieved by a surface unaltered in comparison with the surface of the starting material this surface should remain substantially unaltered, during the whole process of manufacturing the open end spinning rotor, at least in the latter's collecting groove. It is therefore proposed, according to the invention, - for cases where the spinning rotor is to be protected from wear, or is intended to achieve improved spinning characteristics by this coating - that the coating shall be applied to the starting material, and the dished member be only subsequently shaped from the thus coated plane material. In this way, again, the surface structure of the coated starting material remains substantially untouched, during the manufacturing process, in the vicinity of the collecting groove so that, again, good spinning results are achieved. This method is also advantageous in the case of other open end spinning rotors produced by plastic shaping.

The centrifugal forces which are experienced at the high speeds which are usual at the present time may, in the case of various materials, lead to deformation of the spinning rotor under certain circumstances. It is proposed, in accordance with a further modification of the method according to the invention and for the purpose of counteracting this tendency, that the open edge of the spinning rotor be reinforced.

This may be carried out in a simple way, possibly directly after the severing of the superfluous part of the open edge of the rotor, by strengthening this open edge by outward beading. This reinforcement raises the cracking limit speed of the spinning rotor, so that the rotor is suitable for higher operating speeds. A reinforcement of the open edge of the rotor is also advantageous in the case of other open end spinning rotors shaped by plastic forming.

Spinning rotors shaped without machining are extremely economic to produce, and are therefore usually manufactured as so-called "expendable" parts. However, it may be advantageous if spinning rotors obtained without machining also have an improved service life and are uniformly maintained in a specified condition for a long period of time so far as the treatment of the fibres in these spinning rotors is concerned. Instead of coating the starting material, or in addition to this expedient, at least the inner surfaces of the completed spinning rotor may, with advantage, undergo a heat and/or chemical treatment. By means of such a treatment the cell structure of the material will be altered - the hardness being increased and strain in the material being relieved - without, however, the surface quality of the spinning rotor appreciably altering. In this way the good qualities of the spinning rotor remain unaffected insofar as the yarn is concerned. Preferably, the completed spinning rotor is chemically and/or electrochemically de-burred and polished after such a treatment or through such a treatment.

The method according to the invention permits the production, without cutting, of open end spinning rotors which are of only low weight, and yet which are nevertheless resistant to wear; the open end spinning rotors produced can also be operated at high speeds and enable good yarn quality to be obtained. These open end spinning rotors can be made both as expendable ("throwaway") parts, with an increased resistance to wear achieved solely by the plastics shaping operation, and also as parts with a further increased resistance to wear due to a concluding heating and/or chemical treatment.

The invention is further explained below with reference to the accompanying drawings, in which:

Fig. 1 illustrates, in cross-section, the non-cutting shaping of the dished member from which the open end spinning rotor is subsequently produced by roll pressing;

Fig. 2 is a cross-sectional view of an open end spinning rotor during the roll pressing process proposed according to the invention; on the left the spinning rotor has a conventional, open edge and, on the right, the spinning rotor has an edge reinforced by a bead;

Fig. 3 is a cross-sectional view of the area of a collecting groove constituted according to the invention; and

Fig. 4 is a cross-sectional view of an open end spinning rotor during the press forming operation according to the invention.

The production of the open end spinning rotor 1 according to the invention, with a slide wall 10 and with a collecting groove 11 - two embodiments of this rotor 1 being illustrated in Fig. 2 - is explained below with reference to Figs. 1 and 2.

The starting material for production of the open end spinning rotor 1 is a flat sheet of metal or plastics material, which has a sufficiently high cracking speed limit for resisting possible distortion or deformation at the high rotor speeds common at the present time. Further, the material should have good spinning properties. As is known from British patent 1.180.850 various factors play a part in this, for example low tendency to dirtying and to build-up of electrostatic charges, good sliding properties with respect to fibres and so forth. Examples of materials which have been found to be satisfactory are sheet material or aluminium, steel, spring steel, inoxidable steel or non-ferrous metals; however, other metals may also have the required properties in respect of centrifugal force and the fibres. Also, synthetic plastics materials can be used as starting material if these plastics materials have the above-mentioned characteristics and are suitable for non-cutting shaping. Thus, suitable starting materials are polystyrenes (PS-plastics), acrilonitrile butadiene styrenes (ABS-plastics) and cellulose acetates (CAB-plastics). These plastics have the required property of deforming plastically with the application of heat.

For the sake of simplicity a description will now be made, by way of example, of the production of an open end spinning rotor 1, shaped without machining or cutting, from cold rolled fine steel sheet 2 (Fig. 1). For producing the dished member 3 a combined cutting and drawing tool 4 is used, the sheet metal 2 being introduced into this tool 4. The combined cutting and drawing tool 4, known per se, has, as essential tool components, a cutting plate 40 on which the metal sheet 2 to be cut is placed. The cutting plate 40 has a cylindrical opening for receiving a cutting punch 42. The tool 4 has, above the cutting plate 40, a stripper 41 in which the cutting punch 42 is guided; the cutting punch 42 simultaneously serves as a draw ring. In its working area the cutting punch 42 is shaped as a hollow cylinder which comprises, at its outer periphery, a sharp annular cutting edge 420, which co-operates with a cutting edge 400 of the cutting plate 40, this cutting edge 400 also being sharp and annular. The cutting edge 400 coincides with the opening for receiving the cutting punch 42. A blank holder 43 is also arranged in the opening of the cutting plate 40 into which the cutting punch 42 can enter; this blank holder 43 delimits the working stroke of the cutting punch 42. The blank holder 43 is, like the cutting punch 42, in the form of a hollow cylinder; however, for reasons which will be explained below, the inner diameter of the blank holder 43 is smaller than that of the cutting punch 42.

An ejector 44 is mounted in the hollow, cylindrical part of the cutting punch 42; a drawing punch 45 in the hollow, cylindrical part of the blank holder 43 can be moved against the ejector 44. The circumferential surface 421 of the cutting punch 42 nearest the drawing punch 45 and also the circumferential surface 450 of the drawing punch 45 nearest the cutting punch 42 are of rounded shape.

The mutually facing surfaces 440 and 454 of the ejector 44 and draw punch 45 respectively are of a shape which corresponds to that of the spinning rotor 1 to be formed.

Like the cutting punch 42, blank holder 43 and ejector 44, the drawing punch 45 is constituted as a hollow cylinder and, at its inner periphery, has a sharp cutting edge 451 at its end nearest the ejector 44. A perforating punch 46 is guided in the ejector 44, whose inner diameter is of exactly the same size as the drawing punch 45. The perforating punch 46 is of continuously solid construction and has a cutting edge 460 which co-operates with the cutting edge 451.

In the above description of the construction of the combined cutting and drawing tool 4 a description of drive devices and so forth was omitted with a view to describing the essentials of the tool 4 in the simplest possible way. A description now follows of the production of the dished member 3 by means of the tool 4 whose construction was described above:

After the metal sheet 2 has been placed in the tool 4 (position 20), the cutting punch 42 is lowered and, through co-operation of the two circular cutting edges 400 and 420, a sheet metal disc 21 is punched out of the sheet metal 2 and is then received by the blank holder 43. The drawing punch 45, which is initially in the position designated 452, is then moved upwards, the sheet metal disc or blank 21 being pressed to the shape of a dished member 3. In a known fashion this is made possible by virtue of the fact that the outer diameter of the drawing punch 45 is somewhat smaller than the inner diameter of the cutting punch 42, thereby creating the space required for receiving the dished member 3. The round circumferential edges 450 and 421 enable the material to slidingly deform from the initial flat shape of the sheet metal disc 21 to the bent contour. During the deep drawing work performed by the drawing punch 45, the dished member 3 reaches the stationarily arranged perforating punch 46, which had previously been brought from its inoperative position 461 into its working position, which is represented in continuous lines. The perforating punch 46 then punches a sheet metal disc 22 out of the base 31 of the dished member 3 by means of its sharp cutting edge 460 which co-operates with the sharp cutting edge 451 of the drawing punch 45. The semi-finished or finished dished member 3 is thus fed, by the ejector 44 and drawing punch 45, to the perforating punch 46 in a precisely centred position and, during the plastic shaping operation, is held so that the disc 22 can be punched out of it, the

hole 30 appearing precisely centrally of the dished member 3. The disc 22 stamped out of the sheet metal then drops through the bore 453 of the drawing punch 45, whence it can be later removed.

The cutting plate 40 and the stripper 41 are then separated from each other. The ejector 44 pushes the dished member 3 out of the cutting punch 42, so that the latter can be removed from the tool 4. The superfluous open edge of the dished member 3, which was formed in the course of plastic shaping of the plane material (e.g. sheet metal 2), may be cut to the required axial length, possibly in conjunction with the plastics shaping operation and when the latter has ended.

The sheet metal 2 is then pushed to a new position so as to enable a new dished member 3 to be shaped.

According to the material and size or shape of the required spinning rotor 1, another drawing apparatus or extrusion moulding apparatus can be used for the plastics deformation of the plane material, which stretches the material.

The dished member 3 does not necessarily have to be produced from plane material. It is also possible, in dependence on the particular material used, to produce the dished member by the cold extrusion moulding process or by the hot pressing method.

Following the plastic shaping operation, which causes the material of the dished member 3 to stretch, the latter is further treated in a roll press apparatus 5. This roll

press apparatus 5 has a support 50, which comprises a receiving part 51, whose shape is complementary to that of the base 31 of the dished member 3. A threaded bore 52 for a screw 53 is provided centrally in the receiving part 51; the screw 53, when it is passed through the hole 30, which was produced by stamping the disc 22 out of the material of the base 31 of the dished member, co-operates with a disc 54 to clamp the dished member 3 to the support 50 and thus axially (and also radially) locate the dished member 3.

The roll press apparatus 5 also comprises mutually co-operating shaping rollers in the form of a press roller 7 and a backing roller 6.

The backing or shaping roller 6 is of substantially frusto-conical shape, and has an apex angle which corresponds to the required angle of conicity of the slide wall 10 of the finished spinning rotor 1. The backing roller 6 is so dimensioned - or is so positioned in the dished member 3 during the roll pressing work - that it (the backing roller 6) can not come into contact with the subsequent collecting groove 11 during the whole of the roll pressing operation.

The press roller 7 can be moved, relative to the dished member 3, both axially (double arrow 70) and also radially (double arrow 71), and is rotatably mounted on a spindle 72.

The roll press apparatus 5 also has, at the level of what is to become the open edge 12 of the finished open end spinning rotor, a cutting device 8, which can be moved, in the direction indicated by the double arrow 80, radially towards the dished member 3 or, in other words, what is to become the finished spinning rotor 1.

For carrying out roll pressing the spinning rotor 1 is initially fixed, independently of the press roller 7 and of the backing roller 6, on the support 50 by means of the disc 54 and of the screw 53, and is in this way clamped in position. The backing roller 6 is then introduced into the interior of the dished member 3. The backing roller 6 assumes a position, inside the dished member 3, which is such that the whole lengthwise area of what will later be the slide wall 10 of the spinning rotor 1 to be formed, is supported. This means that there is initially a certain radial distance between the backing roller 6 and the inner wall of the dished member 3, so that this wall can be pressed radially inwards towards the backing roller 6. In this way it is ensured that the backing roller 6 never comes into contact with the area of the collecting groove 11 of the open end spinning rotor 1 in the process of formation.

For forming the collecting groove 11, the press roller 7 is pressed, in the immediate vicinity of the collecting groove 11 to be formed, against the outer wall of the dished member 3 on the side of the latter remote from the base 31.

The support 50 is driven in the direction of the arrow 55, while the press roller 7 and the backing roller 6 are actively or passively (by way of dished member 3) driven in the direction of the arrows 73 and 61. By the pressure, which is one sided in relation to the collecting groove 11 to be formed, applied to the wall of the dished member 3 this wall is pressed radially inwardly only on this side of the collecting groove 11. The other side of the collecting groove 11 is constituted by the substantially radial surface of the base 31. This base 31 is additionally supported by the support means constituted by the receiving part 51, and is therefore resistant to radial or axial deformation.

The collecting groove 11 of the open end spinning rotor 1 is thus produced by folding or pressing "against air" (i.e. in an unsupported manner). Thus, in the course of this plastics shaping action, by means of which the material is compressed, the collecting groove 11 is not touched by the backing roller 6. When the collecting groove 11 has been formed the end 32, nearest the collecting groove 11, of the wall of the dished member reaches the backing roller 6. The slide wall 10 of the spinning rotor 1 to be formed is then produced by further roll pressing performed by means of the press roller 7 against the backing roller 6 in the vicinity of the dished member 3 between this folded area and the open edge 12.

When the spinning rotor 1 has assumed its final shape, the cutting device 8 is moved radially to the spinning rotor 1, and the superfluous open edge 13 is severed from the spinning rotor 1. The spinning rotor 1 is then finished. This spinning rotor 1 is then completely ready for use for many practical applications and, apart from possible de-burring of the open edge, does not require any further processing. Thus, the spinning rotor 1 has, in the vicinity of the collecting groove 11, a surface which remains untouched by the shaping rollers (press roller 7 and backing roller 6). This leads to good spinning results, and also permits very small collecting groove cross-sections.

In the method described above, the collecting groove 11 is initially formed by pressing. In order to compact the material in the vicinity of this collecting groove 11 to a particularly marked degree, and in this way to impart to the collecting groove 11 particularly good resistance to wear, it is advantageous if the press roller 7 - which, in the embodiment described, only extends over a limited lengthwise area of the dished member 3, and can thus only apply pressure to the dished member 3 along this limited lengthwise area - only applies, in the course of the working strokes which it then has to execute, pressure on the wall of the dished member 3 when it is moving towards the folded area, that is to say towards the collecting groove 11 to be formed. The working strokes of the press roller 7 away from the area of the collecting

groove 11 take place without pressure being applied to the wall of the dished member 3. In this way material is accumulated and compacted in the region of the collecting groove 11, which leads to the production of a greater wall thickness, by virtue of which the service life of the spinning rotor 1 is prolonged. The shape of the collecting groove 11 may be affected by appropriate shaping of the receiving part 51 and by a pressing procedure accommodated to this shape.

Fig. 3 illustrates an embodiment of a collecting groove 11 produced in this way. The contiguous base 31 of the open end spinning rotor 1 is of wall thickness a, which it was given during deep drawing in the tool 4, while the slide wall 10 has a wall thickness b which is somewhat smaller than thickness a, this reduced wall thickness b being produced by the roll pressing work. However, this has no disadvantageous effects on the service life of the spinning rotor 1 as, during roll pressing, the material was compacted in this area (slide wall 10), and therefore has an increased resistance to wear. The material is compressed and accumulated in the region of the collecting groove 11. The spinning rotor 1 has, therefore, a wall thickness c which is greater than the wall thickness b of the slide wall 10, which lies contiguously of it in this area, and which is also greater than the wall thickness a in the region of the base 31. The increase in the wall thickness c depends on the extent to which the roll pressing work is carried out, as will be explained in detail below.

In principle, the above-described method can be applied in the case of a number of collecting groove shapes; the drawing or pressing tools, the shaping rollers, and the movements of these components are to be selected and controlled according to the particular collecting groove shape required at any time. The above-described method is particularly suitable for collecting grooves 11 which are offset from the slide wall 10 through altering the cone angle of the inner wall of the rotor.

Fig. 3 shows the area of a particularly preferred form of collecting groove 11. This collecting groove 11 is of a cross-section such that tangents 93, 94 and 95, 96, and 97, 98 (in the plane passing through the rotor axis) to the delimiting walls of the collecting groove 11 include with one another progressively increasing angles, viz. α_1, α_2 and α_3 with increasing distance from the base 15 of the collecting groove 11. It will suffice if only one delimiting wall is angled or convex; the other delimiting wall may, under certain circumstances, be of rectilinear shape as viewed in cross-section. Such a collecting groove 11 permits sufficient compression of the fibres in the fibre ring while at the same time and due to the progressively increasing cross-section of the groove 11, thread draw-off from the collecting groove 11 can take place with only a small amount of friction. This promotes good conditions for spinning thread joins and for the production of good quality yarn.

As mentioned at the outset, various materials are suitable as the starting material for the production of the spinning rotor 1; in addition to the above-mentioned metal sheets of aluminium, steel, spring steel or non-ferrous metals, plates of various synthetic plastics material, or other materials, may also be found to be suitable. The criteria for the suitability of these materials is their amenability to non-cutting shaping operations, their behaviour and properties with respect to the fibre materials, and their resistance to deforming and wear during spinning. Deep drawing, drawing, pressing and forming are suitable for effecting the plastic deformation work.

It has been shown that this area which has been left untouched by the shaping rollers 6, 7 is of critical importance for achieving good spinning results. Even collecting grooves whose surfaces are, in the hitherto conventional fashion polished, and which only exhibit irregularities of the order of magnitude of about 1 µm have not led to such good results - in respect of resistance to tearing, uniformity of the yarn, number of areas of increased cross-section (slubs) or areas of reduced cross-section in the yarn, number of yarn breakages, amenability to spinning thread joins, and self-cleaning capability - as collecting grooves 11 which are produced in the above described way. Tests have shown that the surface of the collecting grooves produced according to the method described have a relatively great roughness of the order of magnitude of 15 µm. The surface of the finally folded-over collecting groove

11 somewhat resembles the surface of an orange having mutually closely adjacent, differently shaped "islands" of different elevation and size. It is assumed that these "islands" - which, during the production of the plane material (e.g. sheet metal 2), serving as starting material, by rolling or by pressure applied in some other way, have been given a relatively smooth surface - reduce friction between the spun yarn and the collecting groove by reason of the spaces between the "islands", and in this way improve the qualities of the yarn produced. It is therefore possible, in many instances, to dispense with the operation of coating the rotor surface for improving the yarn quality.

As the production of open end spinning rotors 1 in accordance with the above-described method is extremely cost-effective these rotors 1 can be produced, without further treatment, as so-called throwaway (expendable) components. However, it is entirely feasible to provide a surface coating or other surface treatment such as is often required in the case of open end spinning rotors whose shape has been produced by cutting (machining).

If a surface coating is required because, for example, while the supporting material has good stability and resistance to deformation in spinning operation, it has unfavourable properties insofar as the quality of the spun yarn is concerned, the starting or plane material (e.g. sheet metal 2) provided as supporting material can be provided with a suitable coating.

In order to achieve both the advantages of the coating operation and also the advantages of the above-described surface, this coating is, if possible, applied to the material before this plane material undergoes non-cutting shaping. For example, a cold rolled fine gauge steel sheet can receive a zinc coating by anodic galvanization. After the coating this sheet metal, known as "Zincorblech" is, in the above-described way, given the shape of the spinning rotor 1 by stamping, plastic shaping, and roll pressing.

In the case of an open end spinning rotor 1 produced from a coated plane material the surface in the area of the collecting groove 11 to be formed is, also, not subjected to any mechanical treatment which could affect the surface structure. The spinning rotor 1 has, therefore, in the vicinity of its collecting groove 11, a surface which is substantially unaltered from the unshaped plane material.

The ease with which the plane material to be treated can be pressed to the shape of the spinning rotor 1 differs from material to material. It is therefore appropriate if the number of pressure displacements, which corresponds to the number of working strokes of the press roller 7, and/or the pressure applied to the material of the dished member 3 is varied according to the material selected for the open end spinning rotor 1. This affects the shape of the collecting groove 11. Furthermore, certain materials, e.g. synthetic plastics materials, require the application of heat for enabling

drawing and roll pressing to be carried out at all. In order to increase the resistance to wear of the open end spinning rotor in comparison with the plane material (e.g. sheet metal 2) serving as starting material a heat treatment and/or chemical treatment and/or electrochemical treatment of the inner surfaces of the completed spinning rotor 1 can be carried out instead of coating the starting material or in addition to the latter. All known methods (hardening, quenching, annealing for the relief of strain in the material, nitriding, etc.) can be used for this, as these methods do not increase the resistance to wear through mechanical working applied to the surface but by diffusion. It is also possible to so chemically treat the spinning rotor 1 that the edge surface 12 resulting from the severing action carried out on the completion of roll pressing is de-burred and the inner surfaces of the spinning rotor 1 polished (e.g. by the so-called "Carbochem" method in the case of carbon containing steels).

It is not absolutely necessary to specially compact the material in the vicinity of the collecting groove 11 in the case of a plane material which has a higher resistance to wear, whether this high resistance is intrinsic to the plane material or is the result of coating or of a heat treatment and/or chemical or electrochemical treatment applied later. In such a case it is not necessary, when roll pressing is carried out in such a way that the radially inwardly acting

pressure is always applied only to a limited lengthwise area of the dished member 3, that the pressure displacement always takes place from the open end of the dished member to the area of the collecting groove 11, as was described above. Indeed, the pressure displacement in the axial direction may take place alternately in the two directions along the wall of the dished member ("oscillating" motion), so that the movements of the press roller 7 in both directions along the wall of the dished member are working movements.

It is not absolutely necessary - and will also depend on the plane material to be treated - for the pressing operation to start in the vicinity of the collecting groove 11 to be formed. Indeed, it is entirely feasible for the press roller 7 to commence its pressing working in the vicinity of the open edge 12 and to continue its working steps in the direction of the region of the collecting groove 11 to be formed, the working strokes proceeding in the direction of the cone angle of the backing roller 6 (naturally, this is also true in instances where roll pressing commences in the vicinity of the collecting groove 11 in process of formation). In order to ensure that, in the case of roll pressing commencing at the open edge 12, the backing roller 6 will always lie in the working area, this backing roller 6 must be axially shifted in step with the progress of the shaping work, thereby ensuring that roll pressing always takes place in a controlled manner.

It is also possible to provide a press roller 7 which extends the whole area in which shaping pressure is to be applied, that is to say from the open edge 12 to the vicinity

of the area to be bent or folded down. In this case, the press roller 7 only has to be moved in the radial direction, while the backing roller 6 is moved axially in step with the progress of the work.

While carrying out roll pressing it is not, as a rule, possible to entirely avoid lengthening and deforming the open edge of the spinning rotor 1. Also, treatment by roll pressing is only possible along the whole length of the spinning rotor 1 if this length is greater than has to be treated during the roll pressing operation. For this purpose, during the above-described method, the dished member 3 is, during deep drawing, initially stretched beyond the length required for the spinning rotor 1 to be formed. The superfluous open edge 13 is therefore cut off at least once when the roll pressing work is being concluded and in conjunction with this roll pressing work, this cutting action being performed by means of the cutting device 8 of the roll press apparatus 5. However, if it should be found to be appropriate a superfluous edge portion 13 may also be cut off when the spinning rotor 1 is still in process of being shaped or even prior to the commencement of the roll pressing work, that is to say between the plastic shaping process, e.g. deep drawing, and the roll pressing work.

In the description given above it has been assumed that the dished member is not moved axially during the roll pressing work, whereas the shaping rollers (backing roller 6 and press roller 7) are moved axially. Also, in the case of the embodiments

described, the position of the cutting devices 8 and 81 is adjustable in the axial direction. Naturally, the reverse arrangement is possible in which the shaping rollers 6 and 7 and also the cutting devices 8 and 81 are held axially stationary and the necessary movements to be carried out relative to the dished member 3 obtained by an axial movement of the support 50.

Open end spinning rotors 1 are usually fixed on a shaft (British patent 1.383.194) or base body (U.S. patent 4.339.911, Fig. 1) by means of screws or other axially arranged attachment means. The way in which the hole 30 required for this is stamped out of the base 31 of the dished member 3 during the plastic shaping work has been described above. Naturally, it is also possible to punch out the sheet metal disc 21 from which the dished members 3 are made by plastic shaping separately from this shaping work, and also to stamp out the discs 22 from the sheet metal for forming the holes 30 independently from the above-mentioned first stamping (punching) action and also independently of the shaping work. However, considerable time is saved by carrying out these working steps in a single procedure, and it is therefore particularly advantageous. Not only does the hole 30 serve for the subsequent attachment of the spinning rotor 1 to its shaft or base body, but it also enables the dished member 3 to be held and secured in the roll press apparatus 5 in a particularly simple way during the whole of the roll pressing work.

In order to avoid the necessity of balancing the spinning rotor 1 by the removal of material from the latter which, in the case of the thin cross-sections of spinning rotors shaped with the use of cutting, would lead to unsatisfactory reductions in the cross-section thickness of the rotor, provision is made for balancing the spinning rotor 1, after the required shape of the latter has been arrived at, by shifting its axis of rotation into its axis of inertia. For this purpose the size of the hole 30 required for clamping the spinning rotor and punched out of the base 31 of the dished member 3, is initially smaller than is later required for mounting the spinning rotor 1 on its spindle, etc. The hole 30 is then enlarged to the required diameter when the above-described balancing operation is carried out. Such a method is known in principle (see separately printed booklet from "Werkstatt und Betrieb", Carl Hauser Zeitschriftenverlag GmbH, Munich 27, 92, year 1959, volume 3, page 5, Fig. 9 - B_1), and is therefore not described in detail here.

In any case it is not necessary for the completed open end spinning rotor 1 to have a hole 30 in the base 31 (U.S. patent 4.339.911, Fig. 1, or U.S. patent 4.319.449, Figs. 1 and 3). In this case provision can be made, for securing the spinning rotor 1 in the roll pressing apparatus 5 independently of the backing roller 6 and press roller 7, of an axially adjustable central spindle sleeve (not shown) which passes axially into the inner space of the dished member 3 and is brought into abutment on the base 31 of the dished member

3, so that this spindle sleeve presses the dished member 3 firmly against the receiving part 51. The backing roller 6 can then be mounted on this spindle sleeve.

It is important that the open end spinning rotor 1 shall have adequate resistance to deformation in operation of high speeds. The spinning rotor 1 is reinforced in the area of its greatest diameter by the area folded round the collecting groove 11. In order to make the open edge 12 stable at high operating speeds this edge 12 has, as shown in Fig. 2 (right-hand side) a reinforcement in the form of a bead 14 on the outer periphery of the open edge 12 of the spinning rotor 1. As is clear from Fig. 2, the open edge 12 of the rotor 1 is thus provided with this bead by exerting pressure on the open edge from a succession of different directions (see arrows 9, 90, 91 and 92). If required, the formation of this bead can be preceded by a cutting action performed by means of a radially movable cutting device 81 (see double arrow 82), with a view to achieving a specific bead 14. Other ways of reinforcing the open edge 12 of the spinning rotor are readily possible; for example this edge 12 can be folded round, can be rolled inwardly instead of outwardly, or a ring can be placed on the edge 12.

The production of a spinning rotor 1 was described above, by way of example, by roll pressing; however, other plastic shaping methods are utilisable. The essential pre-requisite for obtaining the advantages referred to above is that, during

the plastic shaping work, the starting material is initially stretched, as a result of which a surface is obtained which resembles that of an orange. This surface is not to be destroyed in the course of the further processing work. In the course of this further processing the dished member undergoes a plastic shaping action which upsets the material; at least the collecting groove 11 does not experience any contact with any shaping tool.

A description will now be given, with reference to Fig. 4, of the procedure whereby the dished member 3 undergoes a multistage press forming operation "against air" (i.e. in an unsupported fashion), the whole surface of the open end spinning rotor to be manufactured comprising a surface untouched by shaping tools.

The dies 57 with the dished members 3 placed in them lie on a baseplate 56. For centering the dished member during the press forming work the die 57 has a centering pin 58 and a centering shoulder 59. The centering pin 58 passes through a hole 30, located centrally in the base 31 of the dished member, to the inside of the dished member 3, while the centering shoulder 59 engages round the outer periphery of the dished member 3.

Above the dies 57 is a carrier plate 74, which carries a number of shaping rings 75, 76 and 77. Each shaping ring 75, 76, and 77 is assigned a different working position I, II and III, into which the dies 57 can be successively brought in a suitable manner. The shaping rings 75, 76 and 77 are each of different shape, so that in three steps or stages

they can plastically shape the dished member 3 into an open end spinning rotor 1 by a pressing action.

Initially the dished member 3, which was formed by a plastics shaping operation giving rise to stretching, is placed in the die 57 located in working position I, the radial position of the dished member 3 being precisely located by means of the centering pin 58 and centering shoulder 59. In a first working stroke, which is delimited by abutment columns 78 and 79 fixed on the carrier plate 54, the upper end 32 of the dished member 3 is radially inwardly pressed to some extent. The carrier plate 74 is then raised to its previous position, the shaping ring 75 again releasing the dished member 3. If necessary the shaping ring 75 may be assigned, for this purpose, a stripper (not shown). In a suitable way, for example by means of a feed device (not shown), the die 57 is, together with the dished member 3, then brought into working position II, while a new die 57 is, together with a new dished member 3, brought into the working position I. Both dished members are then subjected to a second working stroke. In working position I the dished member 3, present at that time in that position, is again prepared for the work to be performed in working position II, while the pretreated dished member in working position II is subjected to a further plastic shaping action by the shaping ring 76. After the pretreated dished members have again been released by the shaping rings 75 and 76 the dies 57, together with the dished members, are again brought into the next working position II and III respectively

by a feed movement, while a new die 57 together with a new dished member 3 are brought into working position I. In the course of the working stroke which then follows, the dished members 3 present in working positions I and II undergo plastic shaping in the manner already described, while the pretreated dished member in working position III receives the final rotor shape. The finished spinning rotor 1 is taken from the die present in working position III and can then be fed for further processing, that is to say for cutting off the superfluous edge, for reinforcing the edge, for balancing, etc., as was described in connection with the spinning rotor 1 produced by roll pressing.

As Fig. 4 shows, press forming takes place "against air" (i.e. in an unsupported manner). In the embodiment illustrated a three-stage progressive tool is provided for this purpose; however the number of working steps entailed in plastically shaping the dished member 3 for forming the spinning rotor 1 is not of critical importance. During the whole of this plastic shaping operation, which causes upsetting of the material, the inner surface of the dished member 3 is not subjected to the action of any shaping tool, so that the surface which was produced by the plastics shaping work, which causes stretching of the material and which took place during formation of the dished member 3, is not destroyed in the course of this second plastics shaping work, which causes upsetting of the material.

The shape of the collecting groove 11 is determined by the shape of the die 57, in particular the centering shoulder 59 of the latter, and also of the shaping rings, in particular of the last shaping ring 77. It is also determined by the axial delimitation of the press-forming movement controlled by means of the abutment columns 78 and 79.

The above-description shows that forming procedures may be modified in a large number of ways. Further modifications are possible by the interchange of features with one another or by the replacement of these features by their equivalent, and also by combinations of these features, and fall within the ambit of the present invention.

CLAIMS

1. An open end spinning rotor obtained by non-cutting shaping work, with a collecting groove, characterised in that the open edge of the spinning rotor has a reinforcement.

2. An open end spinning rotor according to claim 1, characterised in that the reinforcement is constituted as a head provided at the outer circumference of the open edge.

3. An open end spinning rotor according to claim 1, characterised in that the reinforcement is constituted as a ring placed at the outer circumference of the edge.

4. A method for producing the open end spinning rotor according to any of claims 1 to 3, characterised in that the open edge of the spinning rotor is reinforced.

5. A method according to claim 4, characterised in that during plastic shaping of a starting material into the final shape of the spinning rotor its fibre sliding wall is brought to an excessive length and that after this plastic shaping the open edge of the spinning rotor is reinforced by beading.

6. A method according to claim 5, characterised in that the beading is effected in the outward direction.