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3,031,150

SPEED REGULATING DEVICE FOR A WINDING MACHINE

Filed June 25, 1956

3 Sheets-Sheet 1

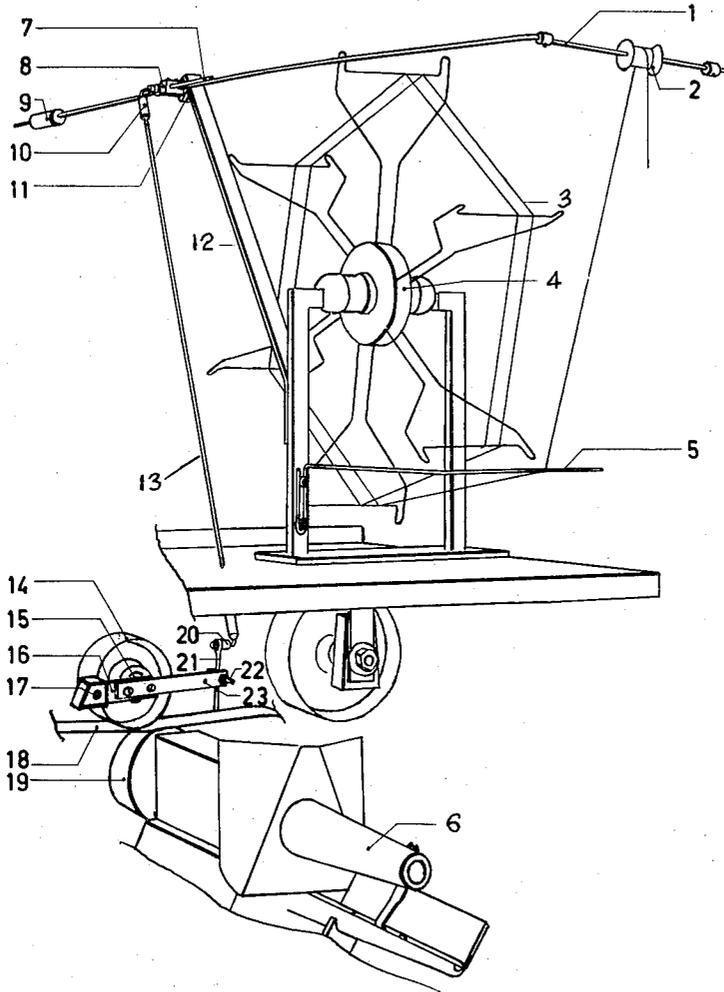


Fig. 1A

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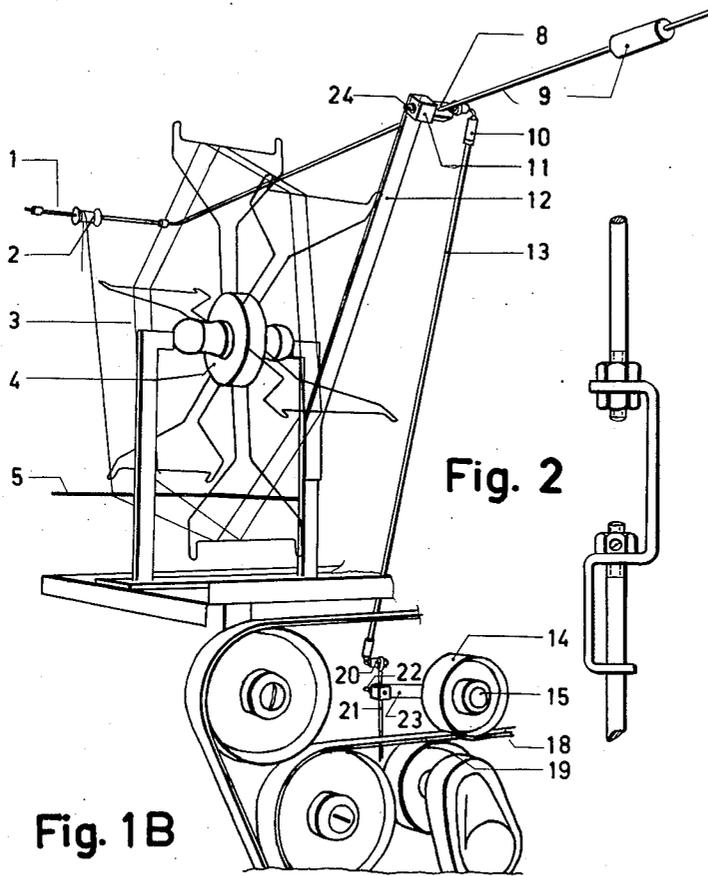


Fig. 1B

Fig. 2

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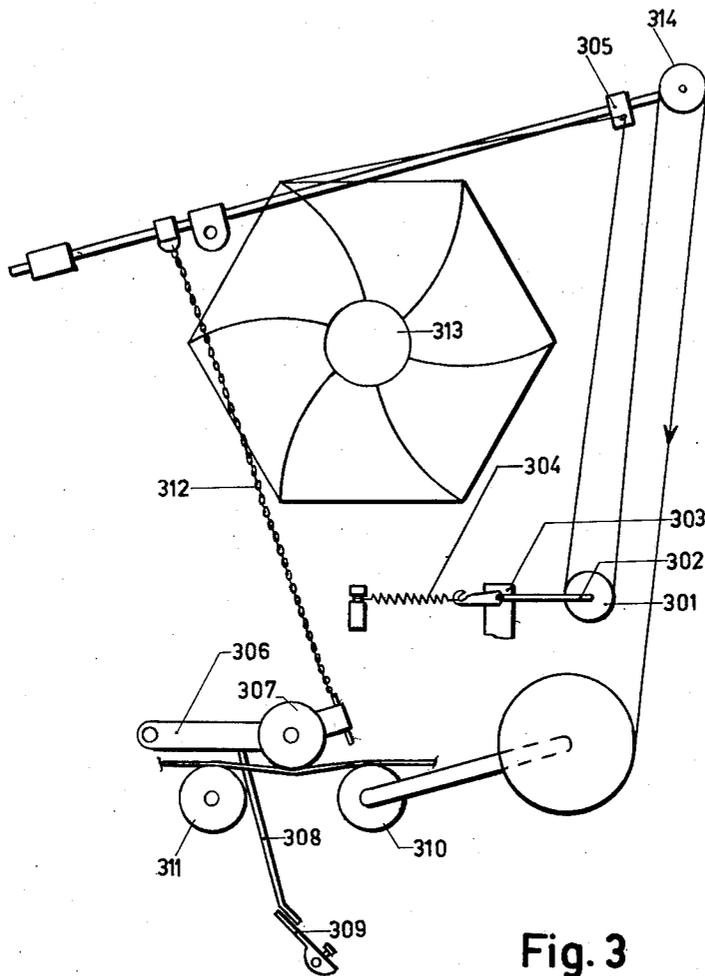


Fig. 3

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SPEED REGULATING DEVICE FOR A WINDING MACHINE

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11 Claims. (Cl. 242-45)

The present invention relates to a device regulating the speed of the spindle of a winding machine, which spindle carries a tube or a bobbin on which a yarn or filament is to be wound, and is driven by means of a pulley against which a motor-driven belt or rope is pressed by means of a second freely rotatable pulley, which latter pulley is able to displace itself in such a direction that, as a result of this displacement, the force by which the rope or belt is pressed against the first-mentioned pulley varies.

In the standard type of winding machine a number of spindles are situated side by side in the same machine. Each of these spindles carries a pulley, and a motor-driven belt runs in the immediate vicinity of the pulleys which are to drive the adjacent spindles. In the immediate vicinity of each of these pulleys there is another pulley, which can rest on the belt or rope, thereby causing this belt or rope to be pressed against the pulley mounted on the spindle, with the consequence that the belt or rope will drive the spindle on which this pulley is mounted. The said pulley resting on the belt is freely rotatable on a journal which is carried by a lever capable of swinging around another journal, the latter journal being supported by the frame of the machine and more or less parallel to the driven spindle. The spindle is brought to a standstill by lifting the freely rotatable pulley away from the belt by means of the lever, and the rotation of the spindle is started by releasing the lever, causing the second pulley to rest on the belt again.

Complications in the winding operation will occur when the yarn or filament is to be wound from a skein supported on a reel. As the yarn lies irregularly in the skein, there will now and then be a substantial increase in the force necessary to draw the filament from the skein, perhaps even to such an extent that the filament may break. To prevent breakage of the filament in winding machines drawing filaments from skeins on a reel, the filament is caused to make a detour passing over an arm which, when the filament gets stuck on the reel, moves against gravity or the force exerted by a spring in such a way that the loop in the filament is shortened, the motion of the arm causing the spindle to be brought to a standstill as soon as the unwinding of the reel is hampered by entanglements of the skein. In a certain winding machine of this type the arm controls electrical contacts for this purpose and when the position of the arm corresponds to a loop in the filament of at least a certain pre-determined length, these contacts control a circuit for an electromagnetically controlled clutch in such a way that this clutch couples the spindle which is winding the filament with its driving mechanism. As soon, however, as the filament gets stuck on the reel and the length of the loop is decreased to a certain value the contacts are switched over, causing the clutch to be set free and an electromagnetically controlled brake to be applied, bringing the spindle to a standstill. Inertia will then cause the spindle to go on winding a certain length of yarn, but this length can be provided without breaking the filament by shortening the loop passing over the arm. In another form of such a winding machine the clutch and the brake are controlled by the said arm by pneumatic or hydraulic means, whilst in yet another form a drive for the spindle

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consisting of friction wheels is mechanically caused to become disengaged. It is a disadvantage of this controlling method that a suitable adaptation of the speed of the spindle to the state of the skein cannot be effected, and that in all cases in which the filament gets more or less stuck on the reel the machine is brought to a complete standstill, thus necessitating the intervention of the personnel. This reduces the production of the winding machine and requires a larger number of personnel to attend to these machines. These disadvantages can be overcome by the invention.

According to the invention a winding machine is built in such a way that on its way to the yarn package or bobbin on which it is to be wound, the filament passes through a detour or loop over an arm which is rotatable around a shaft, and which, when no forces are exerted on the arm by the filament is automatically adjusted, as a result of other forces exerted on this arm, in such a position that the detour or the loop has the largest possible length, this arm being coupled to the support of the freely rotatable pulley which presses the belt or cord against the driving pulley of the spindle, this coupling being effected in such a way that when the arm rotates in a direction in which the length of the detour or loop decreases, the corresponding displacement of the freely rotatable pulley in a gradual decrease in the pressure of the belt or rope on the driven pulley on the spindle.

If, in a machine according to the invention, the yarn supply is not disturbed, the said arm will be in a position in which the loop of the filament has its maximum length. The freely rotatable pulley will then press the belt or rope with the maximum possible pressure against the pulley driving the spindle, and this spindle will be rotated at a speed corresponding to the speed of the belt or rope. If stagnation occurs in the yarn supply, the loop will be shortened. The tension in the filament will only be slightly increased as a result of the shortening of the loop except when the arm has completed its full stroke. When the length of the loop decreases, the pressure by which the belt or rope is pressed against the pulley on the spindle will also decrease as a result of the coupling between the arm and the freely rotatable pulley. Consequently an increasing slip will occur between the belt or rope and the pulley driving the spindle, causing a reduction of the rotational speed of the spindle. Experience shows that, as a rule, in those cases in which the unwinding of a reel stagnates a temporary decrease in the unwinding speed suffices to prevent a complete standstill. If, in a machine according to the invention, the unwinding of a filament from a reel is difficult in certain parts of the skein, a provisional decrease in the unwinding speed will occur, without substantial increase in the tension in the filament. In most cases the unwinding will within a short time become easy again, causing the arm to resume its former position, and the loop in the filament to regain its original length. The arm will then permit the freely rotatable pulley to press the belt or rope fully against the pulley driving the spindle, as a result of which this spindle will resume its full rotational speed. If a skein is difficult to unwind, it may happen that the arm is in an intermediate position during the greater part of the time, causing the belt or rope to slip continuously and the spindle to rotate at a decreased speed. Nevertheless such a skein will, as a rule, be unwound without intervention of the personnel. It is a special advantage of this method of regulating the speed of the spindle in accordance with the invention, that the top speed of the spindle can be much higher than in the existing machines for unwinding from reels. It will even be possible to apply such a high rotational top speed of the spindle that the maximum permissible yarn speed can also be reached at the start of the winding of a bobbin or pack-

age, when the diameter of the yarn package is still small. As the diameter of the yarn package increases, an automatic regulation of the speed of the spindle will prevent breaking of the filament which would otherwise inevitably be the result of the high rotational velocity of the spindle.

The present invention will now be described with reference to the accompanying drawings, in which a preferred form of the invention is described and illustrated.

FIG. 1A is a front view in perspective of a unit with one spindle of a machine according to the invention.

FIG. 1B is a corresponding view from the back of the same part of such a machine.

FIG. 2 shows a detail of a machine according to the invention.

FIG. 3 shows other details of machines according to the invention.

The drawings are related to a cross winding machine, but the traverse frame and the remaining part of the traverse mechanism are only partly shown, as these parts are of no importance for the understanding of the invention. It is obvious that the invention can also be applied in machines winding spools instead of cross wind packages. The application of the invention is, moreover, not restricted to the unwinding of reels; a successful application is possible in any case in which a filament or yarn is to be unwound from a package or the like which has such defects that the force required for the unwinding is likely to increase to an extent which would cause breaking of the filament.

In FIGS. 1A and 1B the same parts are indicated by the same reference numbers.

In the winding machine shown, the yarn is unwound from a skein 3, which is supported on a reel 4. The yarn passes over a small rod 5 and then in a loop around a guide roller 2 on the arm 1 and downwards again to a guide roller (not shown) situated lower in the machine, next through a yarn guide, a tensioning device, and a slub catcher (not shown) to the traverse mechanism, which deposits it on a yarn package. The package is wound on a tube 6, carried by the spindle of the machine. The spindle carries a small pulley 19 at the end opposite to the yarn package. A belt 18 runs along this pulley. This belt can be pressed against the pulley 19 by means of a small pulley 14, which is freely rotatable on a journal 15. The journal 15 is supported by a lever 16 which is able to swing around a journal 17 mounted in the frame of the machine. If no lifting forces are exerted on the pulley 14 by a connecting rod 13 at the opposite end of the arm 1, then the weight of the pulley aided by the force exerted on it by an adjustable spring (not shown) will press the belt 18 against the pulley 19 with a force sufficient to drive the spindle at full velocity. An arm 23 fixed to the lever 16 is provided with a bore near its extremity, in which bore a small rod 21 is fastened by means of a set screw 22. At its end the small rod carries a ball and socket joint 20, by means of which it is coupled to the connecting rod 13. At its other extremity this connecting rod is coupled to a lever 7 by means of another ball and socket joint 10. The lever 7 is fixed, by means of a set screw, in a small block 8, which is able to rotate around a journal 24 carried by another block 11 fixed to a support 12. In a second bore in the small block 8 the arm 1 carrying the guide roller 2 is fastened by means of another set screw. The effective length of the arm 1 can be varied by shifting it through the bore of the small block 8. The tension in the yarn can, moreover, be adjusted by regulating the tension of the spring acting on the lever 16 as well as by shifting the counter weight 9 along the arm 1. When the tension in the yarn increases, the arm 1 will be rotated around the journal 24 in opposition to the effect of the said spring and of the counter weight 9. As a result of this motion a force will be exerted on the connecting rod 13 by means of the lever 7, causing the freely rotatable pulley 14 to be lifted gradually from the belt. This re-

sults in a decrease in the rotational velocity of the spindle. The extent to which the freely rotatable pulley is lifted as a consequence of a given rotation of the arm 1 can be adjusted by shifting the lever 7, which carries the upper ball and socket joint 10, through the bore in the small block 8. The length of the detour of the filament can be adjusted by changing the length of the arm 1 as well as by shifting the small rod 21, which carries the lower ball and socket joint 20, through the bore in the arm 23.

The operation of the winding machine needs little elucidation. As long as the filament runs freely from the reel the tension in this filament will be so slight that the extremity of the arm 1 carrying the guide-roller 2 will remain in its highest position, causing the pulley 14 to exert the maximum pressure on the belt 18. As soon as the unwinding of the filament becomes less easy the guide-roller 2 will be pulled downwards, causing not only the pressure exerted on the belt by the pulley 14, but also the rotational speed of the spindle, to be reduced. In most cases this will be sufficient to enable an entangled part of the skein to be unwound. The machine will go on rotating at a lower velocity until the filament runs easily from the reel again, which causes the arm 1 and the pulley 14 to resume their normal positions. If no further unwinding of the skein on the reel is possible then the arm 1 will be rotated to such an extent that the pulley 14 is completely lifted from the belt, after which the spindle will run on a little as a result of inertia and will then come to a standstill. The length of filament wound whilst the spindle runs out is provided by shortening the length of the loop passing over the guide-roller 2, as a result of which the arm 1 will be drawn a little further downwards.

It is obvious that the arm 1 and the pulley 14 can be coupled by other means than by a connecting rod. In some forms of the invention a wire, a strip or a chain 312 (FIGURE 3) is applied instead of the connecting rod, these means having the advantage that the forces will be transferred in one direction only. Consequently, when the machine is running, movements of the arm will be transferred to the pulley, but movements of the pulley, caused by the stop motion whilst bringing the spindle to a stop when the package has reached the desired size or the yarn breaks or runs out, will not be transferred to the arm, so that this motion of the said pulley will not be impeded by the relatively large moment of inertia of the arm. In some forms the adjustment of the transmission ratio between the arm 1 and the lever 16 is effected by altering the point of application of the connecting rod, or its equivalent, on the lever 16.

The presence in the immediate vicinity of the circumference of the reel of the rod 5 or a similar thread guide over which the filament runs is not absolutely necessary for the application of the invention but nevertheless it has its advantages. As a rule, the distance between the guide-roller 2 and the reel is relatively large. Let us suppose that in a machine which possesses no rod 5 the filament gets entangled in a certain part of the skein. This part will then rotate with the reel until the smallest distance to the roller 4 is reached, after which, as the result of its inertia, the reel will continue to rotate a little further. Should the filament now be suddenly freed from the entanglement of the skein, as will often be the case when the filament is no longer drawn tangentially from the reel but more or less radially, then a relatively large amount of filament will become available, permitting the arm 1 suddenly to resume its initial position. The pulley 14 will then exert its full pressure on the belt again, causing the spindle to run at its maximum velocity. This is highly undesirable directly after the unwinding of the filament has been hampered by entanglements of the skein as it causes sudden jerks to be applied to the filament, especially as in many cases an entanglement in the fila-

ment in the skein will be speedily followed by further entanglements, so that for some time afterwards slow unwinding is desirable. When the machine possesses a thread guide such as rod 5 situated in the immediate vicinity of the circumference of the reel, then, if the filament is freed from an entanglement in a part of the skein which is at that moment situated in the immediate vicinity of the rod 5, or has even moved slightly beyond this rod, the length of filament freed will in every case be insufficient for the arm 1 to return completely to its position of rest. Consequently, after a filament has been freed from an entanglement the speed of the spindle will still remain relatively low, until a part of the skein is reached where the filament is sufficiently free to be unwound with only a very small filament tension. Preferably the said guide, formed by the rod 5, is adjustable, so that an adaptation to various reel diameters will be possible.

It is a special advantage of a winding machine according to the invention that existing winding machines can be adapted for the application of the invention by adding only a relatively small number of simple parts.

The speed control system according to the invention permits substantially higher top speeds in yarn winding machinery. If the spindle in such a high-speed winding machine is brought to a stand-still owing to the fact that the yarn is entangled in the skein and no longer unwinds freely, it is quite possible that the length of yarn provided by shortening the detour as a result of a movement of the control arm is insufficient to permit the spindle to run out without breaking the yarn. In order to prevent such undesirable breaking the yarn on its way to the yarn package runs (see FIGURE 3), according to the invention, to and fro between at least one guide 301 on the frame of the machine and at least two guides 305, 314 supported by the control arm (see FIG. 3). A considerably larger amount of yarn will then, as the result of the movement of the control arm, become available, whilst, moreover, a smaller tension in the yarn will be required for the speed control of the machine. FIG. 3 shows such a tackle-shaped disposition of the yarn.

If the skein to be unwound is seriously entangled, rapid variations of the unwinding speed may occur, which will cause oscillations of the stop motion feeler, should such a device be present in the winding machine. These oscillations may unnecessarily activate the stop motion mechanism, causing the machine to be brought to a standstill; they may also cause the yarn to break. This problem becomes important in machines according to the invention, because in these machines unusually high yarn speeds are permissible. According to the invention the undesirable consequences of the rapid variations in the unwinding speed are avoided by mounting at least one of the guides which support the yarn on its way through the detour elastically on that part of the machine in which it is mounted. This part can be either the frame or the arm. The variations in the unwinding speed are then compensated by rapid movement of such elastic supports. The speed control arm is unable to follow such rapid variations in the unwinding speed as its moment of inertia and the moment of inertia of the system coupled with this arm are far too high. An example of such an elastic mounting of a yarn guide on the frame of the machine is shown in FIG. 3. The yarn guide is formed by a small pulley 301 which is freely rotatably mounted on a lever 302, this lever being capable of swinging in a bearing 303 mounted on the frame of the machine. A spring 304 determines the position of rest of the lever, and permits it to swing elastically in its bearing 303. The moment of inertia of this pulley and its supporting lever is much lower than the moment of inertia of the speed control system of the machine, and consequently the elastic yarn guide is capable of following variations in the unwinding speed which are so rapid that they cannot be followed by the arm of the control system.

The application of a special yarn guide 5 in FIG. 1A

for the purpose of preventing jerks in the yarn when it is suddenly freed from an entanglement in the skein has already been described. Another, still more effective arrangement according to the invention for preventing such jerks will now be described. According to this arrangement the reel is unwound whilst rotating in the same direction in which the speed control arm will rotate whilst shortening the loop in the yarn, the yarn running directly from the skein to a guide supported on the speed control arm, which guide moves in the vicinity of the circumference of the reel. A disposition of this type is also shown in FIG. 3. It may be derived from this figure that arm and reel 313 will rotate together in the same direction when the yarn cannot be freed from the skein, and during this movement the yarn will pass over a guide which is always situated near the circumference of the reel at the point where the yarn is entangled in the skein.

The high speeds permitted by the new control system also cause complications in the operation of the stop motion mechanism. The irregularities in the unwinding of the reel at such high speed will cause vibrations of the feeler arm of the stop motion mechanism, which will sometimes cause the stop motion mechanism to stop the machine unnecessarily and which, moreover, will sometimes cause the yarn to be broken. These complications can be avoided by applying a special stop-motion mechanism according to the invention. The movable support carrying the freely rotatable pulley which presses the belt or rope against the driving pulley of the spindle, which support is coupled to the speed-control-arm supporting the loop in the yarn, is also provided with a special coupling device such as an arm, which activates a stop motion mechanism of the winding machine, causing it to lift the freely rotatable pulley from the belt or rope, when the support of the freely rotatable pulley, being displaced in the direction towards the belt, moves beyond the position corresponding to the highest possible winding speed under normal working conditions. In FIG. 3 this new stop motion mechanism is shown schematically. For the sake of clearness the arm supporting the loop of the yarn, is shown rotated around a vertical axis through an angle of 90° with respect to the frame supporting the spindle. The lever 306 which supports the freely rotatable pulley 307 carries an arm 308 which, when the lever is rotated sufficiently in a clock-wise direction, touches a lever 309, causing this lever to rotate in a similar way as it would be rotated by a stop motion feeler which establishes the absence of yarn tension, should the yarn break or run out. When the yarn breaks or runs out the speed control arm will, as a result of the influence of its counterweight and of the spring pressing the freely rotatable pulley on the belt, at any rate temporarily, be rotated to such an extent that the corresponding rotation of the arm 308 will activate the stop motion mechanism so as to cause it to lift the freely rotatable pulley from the belt or rope. The construction of the stop motion mechanism is not described in detail, as various types of these mechanisms are well known to those skilled in the art.

When a winding machine comprises a number of spindles arranged side by side, at least some of them being provided with a speed control system according to the invention, the control system of one spindle will, as a rule, also influence to a certain extent the speed control of the other spindles or at least that of the spindle adjacent to it. This is a result of the fact that the freely rotatable pulley 307 which presses the belt or rope against the driving pulley 310 of the spindle the speed of which must be controlled, also influences the tension of the belt or rope, so that the pressure of the belt or rope on the other driving pulleys will also be increased. The spindle adjacent to the spindle the speed of which is to be regulated, and situated at that side of the latter spindle where the freely rotatable pulley 307 rests on the belt or rope, is especially apt to be influenced by the position of this freely rotatable pulley. According to the invention this

undesirable influencing of the speed control of other spindles in the same machine is prevented by causing such a freely rotatable control pulley to rest on the belt or rope between the driving pulley 310 of the spindle the speed of which is to be controlled, and another freely rotatable pulley 311, the axis of rotation of which is supported in an unvarying position in the frame of the machine. Such an auxiliary freely rotatable pulley is shown at 311 in FIG. 3. If a rigid coupling system joins arm and pulley, advantages similar to those resulting from the application of a wire, strip or chain as coupling means will be obtained if the coupling system contains a device, which, in the normal relative working positions of the coupled parts permits relative movement of these parts in one direction only.

What I claim is:

1. A speed control device for automatically regulating the rotational speed of each of a plurality of take-up spindles of a filament winding machine, said control device comprising, in combination, a variable slip coupling for each take-up spindle of said machine, said slip coupling including a driven pulley secured to each said spindle, a constant speed driving belt guided adjacent to said pulleys and adapted to drive the same, and a pressure roller pressing said belt against a respective one of said pulleys, the force of each pressure roller controlling the rate of speed transmitted by the belt to the respective pulley, an arm supporting said pressure roller, mounting means pivotally mounting each said arm adjacent to said respective spindle, a plurality of filament take-off reels, a speed control bar for each of said reels, mounting means pivotally supporting each said bar at an intermediate point thereof to define a two arm lever, one arm of each said lever constituting a guide for guiding the filament from the take-off reel to the take-up spindle, so as to form a filament loop between said arm and said spindle, balancing means acting upon the other arm of each said lever to pivot the lever for controlling the length of said loop, connecting means connecting said other arm of each said lever to the pressure roller supporting arm for controlling the pivotal position of said pressure roller supporting arm and the pressure exerted by said roller upon said belt by the pivotal position of said lever, whereby the filament tension between the guide and the take-up spindle pivots each lever against the action of said balancing means so as to adjust the roller pressure acting on said belt for controlling the rotational speed of said spindles.

2. A speed control device according to claim 1 wherein said connecting means comprise a rigid rod pivoted on one end to the respective lever arm and on the other end to said roller supporting arm.

3. A speed control device according to claim 1 wherein said connecting means comprise a flexible transmission between the respective lever arm and the pressure roller supporting arm, said flexible transmission transmitting the pivotal movement of the lever to said roller supporting arm only in the direction for lifting the pressure roller relative to the belt.

4. A speed control device according to claim 3 wherein said flexible transmission comprises a chain.

5. A speed control device according to claim 1 wherein said balancing means comprise a counter-weight supported by said other arm.

6. A speed control device according to claim 5 and comprising mounting means supporting said counter-weight adjustable along the length of said other arm.

7. A speed control device according to claim 1 and further comprising a bar secured to said pressure roller arm for pivotal movement in unison with said roller arm, said bar being pivotally linked to said connecting means for transmitting pivotal movement of said lever to the roller arm, said bar being axially displaceable relative to the roller arm for varying the effective distance between the lever and said roller arm thereby correspondingly varying the pressure of the roller as a function of the lever position.

8. A speed control device according to claim 1 wherein a plurality of guide pulleys are interposed between the guide arm and the take-up spindle for looping the filament over said pulleys, one of said guide pulleys being supported by said guide arm.

9. A speed control device according to claim 8 and further comprising elastic mounting means supporting another one of said plurality of guide pulleys on the lever, the elastic force of said mounting means being less than the forces of the balancing means and the filament tension acting upon said pivotal lever for controlling the pivotal position thereof.

10. A speed control device according to claim 1 and further comprising a rotary pulley and mounting means supporting said pulley on the machine with its rotational axis in a fixed position, said rotary pulley guiding the belt on the same side as said driven pulley and said pressure roller being disposed between said two pulleys on the opposite side of the belt.

11. A device according to claim 1 wherein the pivotal support arm for the pressure roller mounts a control arm for controlling a stop motion device of the winding machine to lift the pressure roller from the belt in response to the support arm of the pressure roller being pivoted toward the belt into a position causing a winding speed in excess of a predetermined winding speed.

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