HIGH-SPEED WIRE-STRANDING MACHINE

Inventor: Dietrich Berges, Marienheide, Germany

Assignee: Barmag Barmer Maschinenfabrik Aktiengesellschaft, Wuppertal, Germany

Filed: Apr. 27, 1970

Appl. No.: 32,040

Foreign Application Priority Data
May 3, 1969 Germany .......................... P 19 22 745.3

U.S. Cl. .................................................................. 57/58.3

Int. Cl. .................................................................. D07h 3/04

Field of Search ..................................................... 57/58.3, 58.32, 58.34

References Cited

UNITED STATES PATENTS
1,870,290 8/1932 Larmuth................................. 57/58.3
2,371,523 3/1945 Jones..................................... 57/58.34
2,671,303 3/1954 Pearce................................. 57/58.3 X

FOREIGN PATENTS OR APPLICATIONS
770,776 3/1957 Great Britain............................. 57/58.32
921,626 3/1963 Great Britain............................. 57/58.32

OTHER PUBLICATIONS
German Printed Publication #1,003,096 2/1957, Werner Cramer
German Printed Publication #1,112,428, 8/1961, Max Steinein

Primary Examiner—Donald E. Watkins
Attorney—Johnston, Root, O'Keeffe, Keil, Thompson & Shurtleff

ABSTRACT

A high-speed wire-stranding machine with a low-noise factor in which the rotor comprising a cylindrical framework is equipped with one or more axially slidable sleeves or closure members adapted to enclose the openings required in the periphery of the rotor for exchanging one or more feed spools mounted within the cylindrical framework, preferably with locking means to hold said sleeves or closure members in their closed position during operation of the machine.

6 Claims, 3 Drawing Figures
HIGH-SPEED WIRE-STRANDING MACHINE

In general, the present invention relates to well-known stranding machines of the type in which individual wires or strands of wire are drawn from their spools and brought together and twisted into a stranded product by means of at least one so-called routing tube or cylindrical rotor, at least one feed spool being arranged within the rotor which must have one or more openings or so-called "zones" for installing and removing the feed spools.

The twisting or stranding machines are usually installed for the production of strands or cables composed of steel, nonferrous metal alloys, light alloys or the like, or even for the twisting together of suitable metal wires or cords in combination with textile materials, such as threads, yarns, cords or the like. Stranding machines are generally constructed in such a manner as to essentially require at least one or several tubular-shaped rotating bodies, each of which is identified herein as a "rotor." The number of such rotors generally corresponds to the number of wires or cords to be added or twisted around a core wire which passes in sequence through each rotor where one or more individual wires or cords are added and twisted around in a single operation. As a rule, the rotors are arranged one behind the other on a common axis of rotation in order to minimize the number of turns or bends in the path of the running strand as it is fabricated. For reasons of stability, each rotor normally contains not more than three feed spools so that the axial length of the rotor can be kept as short as possible and also to avoid intermediate accumulation or storage of extensive lengths of the wires, cords or strands running through the rotor.

In the first instance, the core wire may be a single wire around which individual wires are subsequently wound or twisted to fabricate a strand. In subsequent rotors, however, the partially fabricated strand can become the core wire for application of additional wires. On the other hand, both the core wire and the wires to be added may also be in the form of cords or individually stranded elements. In all cases, the core wire is generally led to the first rotor from a feed spool rotatably mounted in a fixed position externally of the rotor with the spool normally being freely mounted for rotation as driven by the withdrawal of the core wire therefrom, the rate of withdrawal also being influenced by the rotatably driven rotor.

In conventional high-speed stranding machines for the production of wire cables or wire strands, the core wire such as a steel wire is arranged in a path of travel which forms an angle of less than 35° with the axis of the rotor. Under these circumstances and in spite of the wire being carried or driven in a rotating path or envelope through the rotor, no plying of the core wire takes place but instead the wire passes through the rotor without twisting. In order to avoid such twisting in the rotor, it is naturally also desirable to make a suitable choice of materials for each element of the rotor which comes in contact with the wire. Thus, the material in running contact with the core wire and also the hardness of the wire itself plays a role in preventing twisting as well as the angle at which the core wire is conducted with reference to the axis of rotation of the rotor.

Inside of the rotor, there is located at least one feed spool for supplying additional wire or cord to be fabricated in combination with the core wire. This inner feed spool is generally supported in a rotatably mounted cage arranged on the same axis of rotation as the rotor, i.e., so that the rotor can be rotatably driven independently of the cage. The center of gravity of the cage is sufficiently low so that it remains in a stationary position during rotation of the rotor. The feed spool in turn is rotatably supported by its spindle or shaft on this cage, and the wire or cable to be stranded onto the core wire is drawn off this inner feed spool. In the operation of the high-speed stranding machine, the individual wire to be stranded extends from the inner feed spool at the smallest possible angle with the axis of rotation of the rotor and is then picked up by the rotor and driven in a circular path or envelope. In this case, it is also desirable to provide an arrangement such that the stranding wire from the inner feed spool can emerge from the rotor without twisting. Depending upon the desired construction of the final stranded product, several feed spools of the same type are arranged one behind the other in the axial direction of the rotor with the spindles or axes of the feed spools being approximately vertical and perpendicular to the axis of rotation of the rotor. In order to achieve a stable operation, however, the rotor must not be too long, since it is otherwise impossible to suppress vibrations, especially at high rotational velocities.

At the front end of the rotor, i.e., where the core wire and one or more additional wires emerge, there is provided a disc plate containing radially displaced openings through which the individual wires are conducted from the rotor. These openings are generally reinforced with guide pieces, e.g., a diamond or adamantine surface. From their radially separated positions in contact with the disc plate, the individual wires or cords are conducted to a stranding point separated at an interval from the disc plate, this stranding point usually consisting of a single sleeve lined with a hard metal or diamond surface, often in two pieces. In this fixed sleeve, the wires or cords are joined into a strand which is then drawn from the sleeve.

In order to load fully wound feed spools into and also to remove empty feed spools from the cage supported freely within the rotatable tubular body or rotor, it is necessary to provide at least one opening or so-called "window" for each feed spool, the opening being sufficiently large to permit easy passage of the feed spool. Also, in order to service the machine and to facilitate the installation and removal of feed spools from either side of the machine, two or even three windows or openings are preferably distributed around the circumference of the rotor, so that a complete "zone" exists for each feed spool. Accordingly, it has been a practice to construct the rotor as a cylindrical framework with longitudinal crosspieces or crossbars separating the peripheral openings in each window zone. However, the tubular cross section of the rotor is weakened by the peripheral openings and the flexural stiffness of the tube or rotor framework is considerably reduced. The centrifugal forces arising during operation of the rotor tend to cause a certain deformation or warping of the crossbars between the openings, and in order to maintain such deformation within permissible limits, one is forced to reduce the rotational velocity of the rotor. At the present time, the rotors of conventional high-speed stranding machines can only be driven at an uppermost rotational speed of about 2,000 to 3,000 revolutions per minute. Higher speeds would cause a serious weakening of the rotor, and the limitation on rotational velocity correspondingly prevents any increase in the production rate of the stranding operation.

In order to reduce the distortions of the crossbars separating the openings of the rotor around the feed spool positions, it has been proposed in German Pat. No. 955,035 to construct the rotor from tubes which telescope together and reinforce each other. It has been further suggested in German Auslegeschrift No. 1,003,096 that the weakness of the rotor cross section caused by the openings can be compensated by increasing the wall thickness of the crossbars or other portions of the rotor surrounding the openings. With this measure, it is possible to somewhat increase the speed of the rotor and also the production rate of the strands in the stranding operation, but it has also been found that the crossbars or members surrounding the rotor openings result in increasing noise at higher rotational velocities. At the desired higher speeds, such noises are no longer tolerable to service personnel. The design of the machine in this instance arises from the turbulence of air layers on the edges of the crossbars. Also, this air turbulence uses up additional energy which must be furnished by the drive motor of the rotor.

One object of the present invention is to provide a high-speed wire-stranding machine in which the rotatably driven rotor has a relatively low noise factor even when operated at substantially higher speeds as compared to conventional ro-
tors. Another object of the invention is to avoid any thickening of the crossbars between the peripheral openings around the feed spool positions of the rotor, while at the same time substantially eliminating the above-noted air turbulence along the crossbar. Yet another object of the invention is to provide an improved rotor construction which can be readily adapted to conventional high-speed wire-stranding machines and which continues to permit an easy interchange of feed spools from their normal positions within the rotor, e.g., as mounted in a conventional cage structure. These and other objects and advantages of the invention will become more apparent upon consideration of the following detailed disclosure.

It has now been found, in accordance with the invention, that the conventional high-speed wire-stranding machine having a rotatably driven rotor with at least one large peripheral opening at each spool position can be substantially improved and the noise factor substantially reduced if the elongated cylindrical framework of the rotor is provided with at least one cylindrically shaped closure member which is axially slidable on the rotor over the opening at each spool position to provide a sleeve concentrically encasing the cylindrical framework during operation of the machine. Also, it is especially advantageous for each closure member to be associated with a releasable locking means in order to hold this closure member or sleeve securely over the peripheral opening during operation of the machine. It is also advantageous to provide a closure member which has a greater axial length than its associated peripheral opening in the cylindrical framework. The resulting combination of the rotor structure not only provides high-speed operation with a low noise factor but also permits the incorporation of certain safety features as described more fully hereinafter.

An especially preferred embodiment of the invention is set forth in the accompanying drawings in which:

FIG. 1 is a schematic view of a rotor unit constructed in accordance with the invention with certain portions cut away;

FIG. 2 is an enlarged illustration of the first portion of the rotor shown in FIG. 1, partly in cross section through the axis of rotation of the rotor; and

FIG. 3 is an enlarged cross-sectional view of a preferred tubular guide or conduit for a running wire or cable as arranged within the rotor.

Referring first to FIGS. 1 and 2, there is schematically illustrated the conventional rotor or so-called routing tube 1 which can contain several window zones 2 and 3 in the form of one or more peripheral openings around the circumference of the rotor at different positions along its length corresponding to the positions of feed spools 4 and 5 contained within the rotor. These feed spools 4 and 5 which supply the initial wire or cord to be stranded are rotatably mounted in their respective cages 6 which in turn are arranged within the rotor by means of the pivots or rotatable bearing supports 7 and 8 located concentrically around the axis of rotation of the rotor. The position of the center of gravity of each cage 6 is sufficiently displaced from the rotor axis of rotation that the cage remains in a substantially stationary position while the rotor revolves. This also means that the spindle or shaft of each feed spool 4 and 5 will also be retained in a substantially stationary position, preferably so that the axis of rotation of the feed spool is perpendicular to the axis of rotation of the rotor.

When the rotor 1 is at a standstill, the individual feed spools 4 and 5 are inversed or moved through the removed window or peripheral opening of each window zone 2 and 3, respectively. Any conventional means can be used to interchangeably or removable mount a feed spool in its cage. In order to facilitate the interchange of feed spools, the peripheral opening or openings at each feed spool position must be sufficiently greater than the size of the feed spools as to permit a convenient and rapid manipulation of the heavy spools as they are loaded or removed from the machine. In essence, this requires that the individual loading windows or openings must be proportionately large as measured about the circumference of the rotor, while the width of the crossbars 9 located between individual openings in each zone must be proportionately small, i.e., as measured in the circumferential direction of the rotor or tube 1. Thus, in the conventional construction of the rotor for a high-speed stranding machine, it is practically essential to employ relatively narrow crossbars at relatively large spaced intervals around the circumference of the rotor at each feed spool position, and although these crossbars or struts provide a sufficient reinforcing framework for the cylindrical rotor at relatively low operating speeds, they are bent outwardly at high rotational speeds of the rotor under the influence of centrifugal force and even become permanently deformed after exceeding a certain rotational velocity.

In order to avoid this deformation of the rotor framework around the feed spool positions, the present invention provides a number of axially slidable or shiftable closure members such as sleeves 10 and 11 which concentrically surround the rotor 1. It is preferably to employ a single sleeve for each window zone corresponding to a feed spool position. The inner circumference of each sleeve 10 and 11 is substantially identical to the outer uniform circumference of the rotor 1 so as to provide a snug fit while still permitting the sleeve to slide relatively easily along the outer circumference of the rotor. Each sleeve is thus applied around the peripheral openings like a snugly fitting bushing, and this complete encasing or encircling of the so-called window zones by a sleeve having an uninterrupted cross section effectively avoids any thickening or broadening of the crossbars 9. Moreover, these sleeves shield or block off the window zones 2 and 3 against the steadily recirculated air so that air turbulence is prevented at these points and the development of noise as well as the energy requirements are substantially diminished. Thus, where the outside air has no access into or through the window or peripheral openings so as to be affected by the rapidly rotating crossbars, there is very little if any relative movement between stationary components of air and its rapidly rotated components. When the sleeve members according to the present invention are in the closed position over the so-called window zones, it has been found that the rotational speed of the machine can be considerably increased while successfully reducing the development of noise to limits which are tolerable to service personnel.

As shown in FIG. 1, it is especially advantageous if the axially slidable sleeve or casing member 10 or 11 exhibits a large width or notch in the opposing surfaces. The use of such a spring locking means 12 is shown by way of example in FIG. 2. Thus, the spring and groove combination 12 can be used to lock the sleeve 10 in place when it abuts the end collar 13 which is mounted in a fixed position on the rotor 1. Each sleeve can be provided with such a spring and groove combination, and other locking means may also be employed to hold the individual sleeves in place, e.g., by using pins inserted into bores of the rotor body so as to innerlock into corresponding recesses of the sleeve under the influence of centrifugal force.

It is preferable to employ a locking means which can be easily released, provided that the sleeve is held firmly against axial movement during operation of the high-speed stranding machine.

Before going further into details concerning preferred features of the machine according to the invention, a brief ex-
3,636,692

A fresh wire 20 to be stranded is drawn off from the feed spool 4 and likewise conducted along the wall of the rotor by means of the guide tube or conduit 21 which can be constructed in the same manner as guide tube 18, i.e., with a hard inner liner. Finally, another fresh wire 22 is drawn off from the feed spool 5 (shown only in FIG. 1) and is conducted through a guide tube similar to tube 21, to the exit end of the rotor 1. At this exit, the rotor framework is connected to a shaft stub 23 which has openings or conduits for the individual wires such that the core wire 15 is drawn from the rotor 1 along its longitudinal axis of rotation while the wires 20 and 22 are spaced radially outwardly from the core wire 15 and preferably at diametrically opposite positions of a common circle. A drive motor 24 is used in a conventional manner to rapidly rotate the rotor 1, e.g., by means of a driveshaft running around collar 13 or by any other suitable driving connection. The three wires 15, 20 and 22 can be jointly withdrawn at any desired speed from the rotor 1 in the longitudinal direction indicated by the arrow, using any conventional draw means, makeup means or other transporting means. The remaining elements of the high-speed stranding machine or individual combinations of such elements are so well known that they are not illustrated in the drawing. For example, the wires can be conducted through one or more additional rotors in which additional zones to be stranded are added in sequential operations or else the wires can be conducted directly to the so-called disc plate and finally to the stranding point which is in a fixed position relative to the rotating disc plate. Alternatively, a few wires can be drawn from a single rotor as shown in FIG. 1 and stranded together to form a core wire which is still sufficiently small to be passed through another rotor for the addition of more wires onto the initially stranded core wire. These and other conventional variations can be made in the stranding process itself without affecting the function of the individual rotors according to the invention.

In order to safely prevent any actuation or continued rotation of the stranding machine by way of either one or both of the sleeves 10 and 11 are no longer in their correct closed positions around the feed spool openings or window zones 2 and 3, it is preferable to provide so-called safety contacts 25 and 26 which are actuated by their respective sleeves in order to switch off the current to the drive motor as supplied through the electrical line 27 which may further contain a safety contact switch 28. The line 27 is of course connected as one line supplying current to the drive motor and will be disconnected by actuation of either one of the safety contacts or similar switching means 25 and 26 connected in series in this line. Any type of safety contact or switch can be employed, and as illustrated in FIG. 2, it is possible to arrange a spring-actuated plunger 25a or 26a, which in its normal extended position closes the switch and permits the drive motor to rotate the cylindrical framework of the rotor while the sleeves 10 and 11 are in closed position. Once these sleeves move into an open position, they come in contact with the plunger 25a and 26a, respectively, which are depressed to open a switch in the line 27. It will thus be apparent that the rotor cannot be driven unless both of the safety contacts or switches are closed and this occurs only when both sleeves 10 and 11 are in the correct closed position around the feed spool.

These safety contacts or safety switches 25 and 26 can additionally serve the purpose of detecting imbalances in the rotor operation, for which purpose they must be arranged so closely to the outer surfaces of the rotor 1 that they react and cut off or trip off the electrical current as soon as the vibrations of the rotor exceed a certain predetermined value. Alternatively, this function can also be assumed by still another switch such as 28 while providing a manual switch on the motor 24 itself.

It will be recognized from the foregoing description that the rotor of the invention can be very safely operated in a high-speed stranding machine since the circuit for the drive means can only be closed when each sleeve or closure member has been shoved into its position over the so-called window zones. There is no way in which the machine can be operated while the sleeves are in an open position and permits for loading or removal of feed spools. Most importantly, of course, the sleeves or closure members function in such a manner as to very substantially reduce the noise factor of the many rotors normally required in any commercial operation of stranding machines. At the same time, very high speeds can be achieved with the rotor of the invention without deforming or otherwise impairing the necessary open framework structure of the rotor. The invention thus permits much higher production rates with complete safety and relatively little noise. At the same time, however, the individual elements of the rotor are easily assembled and placed in operation while maintaining a rapid and simple interchange of feed spools.

The invention is hereby claimed as follows:

1. In a high-speed wire-stranding machine in which at least one feed spool is supported within a rotatably driven rotor comprising an elongated cylindrical framework having at least one large peripheral opening at each spool position for interchanging feed spools, the improvement which comprises at least one cylindrically shaped closure member which is axially slidable on said rotor over the opening at each spool position to provide a sleeve concentrically encasing the cylindrical framework during operation of the machine.

2. A wire-stranding machine as claimed in claim 1 wherein each closure member is associated with a releasable locking means to hold it securely over the peripheral opening during operation of the machine.

3. A wire-stranding machine as claimed in claim 1 wherein said closure member has a greater axial length than its associated peripheral opening in the cylindrical framework.

4. A wire-stranding machine as claimed in claim 1 including safety contact means externally of said rotor to engage the rotating drive of said rotor in response to axial movement of each closure member uncovering its associated opening.

5. A wire-stranding machine as claimed in claim 1 wherein guide tubes are mounted inside of said cylindrical framework for conducting the wires to be stranded.

6. A wire-stranding machine as claimed in claim 5 wherein said guide tubes are provided with a hard, wear-resistant inner lining.