

[54] **ROTATING INTERMEDIATE STORER FOR THE TWISTING OF STRAND ELEMENTS FOR ELECTRICAL CABLES**

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[22] Filed: **Mar. 17, 1972**

[21] Appl. No.: **235,672**

[57] **ABSTRACT**

[30] **Foreign Application Priority Data**
 Mar. 31, 1971 Germany..... 2116607

A rotating type intermediate storer is provided for SZ-type twisting of strand elements of electrical cables. The rotating intermediate storer comprises two sets of sheaves or rollers disposed at a distance from each other. The sheaves of these sets of sheaves are arranged eccentrically with regard to the axis of rotation of the intermediate storer. For the transition from one set of sheaves to the other, the strand elements are led so that they extend in immediate proximity with the axis of rotation.

[52] U.S. Cl..... 57/34 AT, 57/58.3

[51] Int. Cl..... D07b 3/00, D01h 7/02

[58] Field of Search 57/34 AT, 156

[56] **References Cited**

UNITED STATES PATENTS

3,373,550 3/1968 Symonds 57/34 AT

14 Claims, 7 Drawing Figures

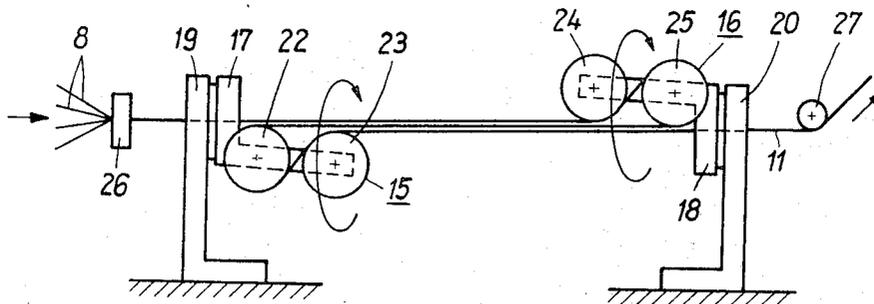


Fig. 1 PRIOR ART

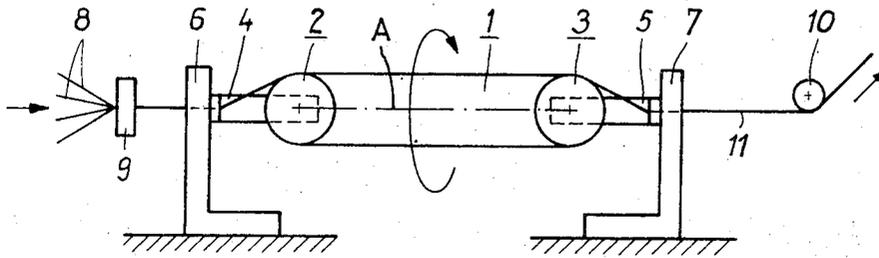


Fig. 2

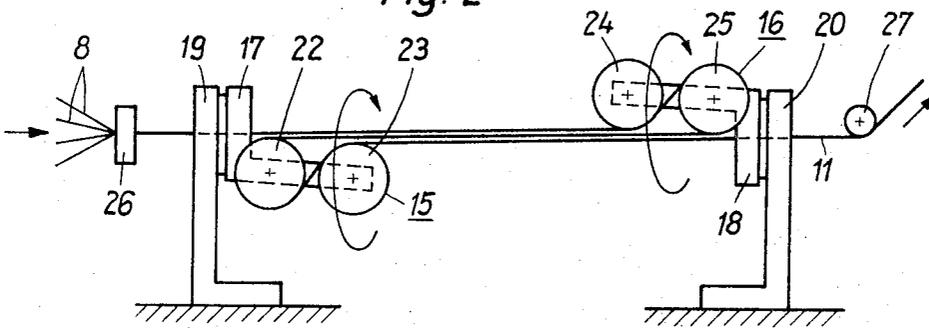
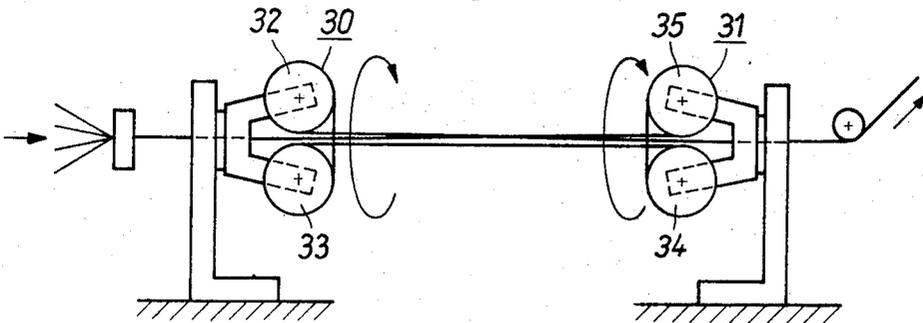
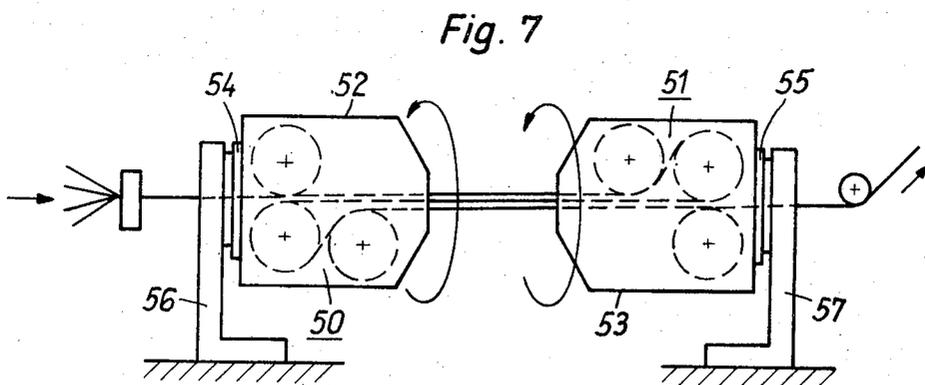
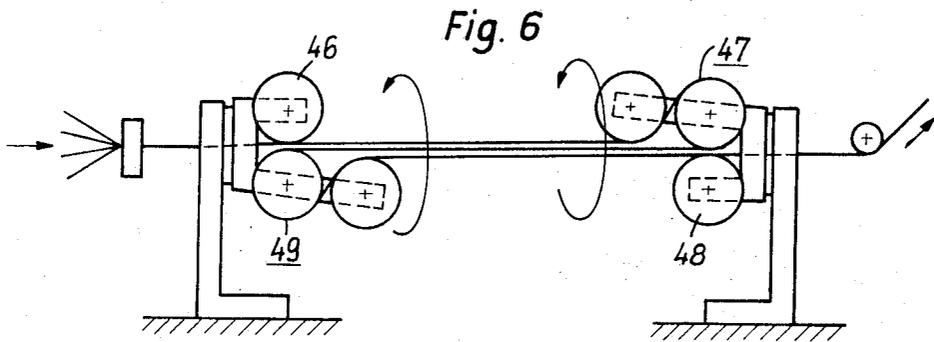
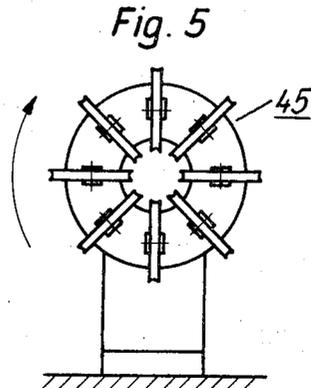
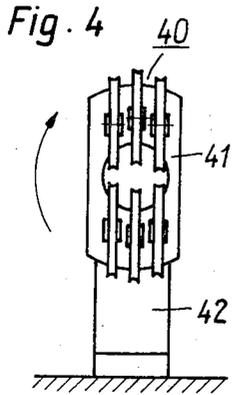


Fig. 3





ROTATING INTERMEDIATE STORER FOR THE TWISTING OF STRAND ELEMENTS FOR ELECTRICAL CABLES

DESCRIPTION OF THE INVENTION

The present invention relates to the twisting of strand elements for electrical cables. More particularly, the invention relates to a rotating intermediate storer for the twisting of strand elements for electrical cables.

The invention relates to SZ-type twisting of electrical cables. This is a type of twisting in which the strand elements are twisted to form a twisted unit or group with a twist direction which changes from section to section, with an alternate-reverse twist. The particular advantage of this type of twisting is that several twisting operations which have been carried out separately up to now, for example, in the twisting of communication cables, the twisting of conductors to form quads, and the twisting of quads to form basic groups, can be combined in a single twisting operation.

SZ-type twisting is usually carried out by means of rotating section storers, so-called intermediate storers, in which one section of the strand elements, which is of constant or may also be of variable length, is always stored. The strand elements pass through the intermediate storer continuously. The twisting of the strand elements, the direction of which changes from section to section, is here carried out by changes in the speed of rotation and/or direction of rotation of the intermediate storer, or by changing the content stored in the intermediate storer, or the speed with which the strand elements are drawn off.

A storage element proper stores the strand elements in the rotating intermediate storer. The storage element frequently comprises two sets of sheaves or rollers arranged in tandem in the direction of the axis of rotation of the intermediate storer. This is disclosed in German Published Pat. application Nos. 1,510,105, 1,510,109 and 1,590,386, German Pat. No. 1,665,831 and United States Pat. No. 3,373,550. The sheaves of these sets of sheaves are arranged side by side perpendicularly to the axis of rotation of the intermediate storer. That is, the sheaves are positioned predominantly eccentrically relative to the axis of rotation. A symmetrical arrangement favorable for the rotary motion of the intermediate storer is provided by a uniform distribution of the sheaves of each set of sheaves on both sides of the axis of rotation. The sheaves of the sets of sheaves guide the strand elements as they pass through the intermediate storer. The distance of the sets of sheaves from each other essentially determines the capacity of the storer.

In intermediate storers of this type, the strand elements extend, freely suspended at a distance corresponding to about half the diameter of the sheaves, parallel or nearly parallel to the axis of rotation of the intermediate storer. During rotation of the intermediate storer, forces are therefore exerted on the strand elements. The forces depend on the rotational speed of the intermediate storer and are proportional to the distance of the strand elements from the axis of rotation. The forces result in large tension stresses in the strand elements. These tension stresses frequently limit the speed of rotation of the intermediate storer and therefore, when the length of lay of the twisted strand ele-

ments is given, the maximum withdrawal speed of the strand elements.

An object of the invention is to provide a rotating intermediate storer for the twisting of strand elements for electrical cables, particularly of strand elements for communication cables, at an increased manufacturing speed to form a twisted unit with a twist direction which changes from section to section, alternate reverse.

To solve this problem, and in accordance with the invention, the intermediate storer rotates about an axis of rotation, and the storage element proper comprises two sets of sheaves arranged in tandem in the direction of the axis of rotation. The sets of sheaves contain sheaves arranged eccentrically relative to the axis of rotation of the intermediate storer which guide the strand elements as they pass through the intermediate storer. In accordance with the invention, the points of first contact and the points of separation of the strand elements guided over the sets of sheaves are on the sets of sheaves or in the immediate proximity with the axis of rotation.

In the intermediate storer of the invention, the strand elements are guided as they pass through the storage element proper, that is, in the transition from one set of sheaves to the other, in immediate proximity with the axis of rotation of the intermediate storer. Therefore, the centrifugal forces exerted on the strand elements due to the rotary motion, which cause a tension stress in the strand elements, are relatively small, so that the speed of rotation of the intermediate storer, and therefore, for a given length of lay of the strand elements, also the speed of withdrawing the strand elements, can be selected higher than in the previously known twisting arrangements of this type.

The strand elements in immediate proximity with the axis of rotation of the intermediate storer are guided in another embodiment of the invention by the following feature. The distance of the axes of the sheaves of the set of sheaves onto which the strand elements run upon entering a set of sheaves and from which the strand elements run off upon leaving a set of sheaves from the axis of rotation of the intermediate storer corresponds to about half the diameter of the sheave involved. This distance is preferably greater than half the diameter of the sheave involved.

In another embodiment of the invention, each set of sheaves comprises at least one pair of sheaves disposed eccentrically relative to the axis of rotation of the intermediate storer. The sheaves of the pair of sheaves are arranged in tandem in the direction of the axis of rotation. In an intermediate storer of this type, the strand elements run over one sheave of a pair of sheaves into a set of sheaves and leave the set of sheaves via the other sheave of the pair of sheaves.

If the storage element proper of the intermediate storer having such an arrangement of the set of sheaves comprises only two pairs of sheaves, it is advisable to arrange the pairs of sheaves on opposite sides of the axis of rotation.

If pairs of sheaves are used for the sets of sheaves of the storage element proper, the sheaves of the pair of sheaves can also be arranged on opposite sides of the axis of rotation, eccentrically relative to the axis of rotation.

Each set of sheaves of the storage element proper preferably comprises several pairs of sheaves in order

to provide the largest possible capacity of the storer. To accomplish this, the pairs of sheaves of each set of sheaves can be arranged, in accordance with another embodiment of the invention, in one or several planes passing through the axis of rotation. However, it is also possible to arrange the pairs of sheaves of each set of sheaves in parallel planes. In any event, it is suggested that the pairs of sheaves be distributed uniformly about the axis of rotation.

In order to limit the points of change of the twist which occur as the cable passes through the rotating intermediate storer to as short a distance as possible, it is advisable to provide an additional deflection sheave for the first and the last of the pairs of sheaves guiding the strand elements. The strand elements are completely or partially led around the additional deflection sheave immediately upon entering the intermediate storer and immediately upon leaving the intermediate storer. The points of first contact and separation of the strand elements are on or in immediate proximity with the axis of rotation.

As hereinbefore mentioned, especially high rotational speeds may be realized with the intermediate storer of the present invention. It is therefore advisable to surround the rotating intermediate storer with a closed envelope of rotational symmetry. This causes a reduction of the friction resistance exerted on the rotating intermediate storer by the surrounding air. Two individual closed cylindrical cages may be utilized instead of an envelope enclosing the entire intermediate storer. Each of the cages encloses a corresponding one of the two sets of sheaves. The cages are provided with openings for the strand elements on the axis of rotation. The envelope or envelopes can rotate with the groups of sheaves. The function of the envelope is further improved thereby.

In order that the invention may be readily carried into effect, it will now be described with reference to the accompanying drawings, wherein:

FIG. 1 is a schematic diagram of a known rotating intermediate storer;

FIG. 2 is a schematic diagram of an embodiment of the rotating intermediate storer of the invention;

FIG. 3 is a schematic diagram of another embodiment of the rotating intermediate storer of the invention;

FIG. 4 is a schematic diagram of part of another embodiment of the rotating intermediate storer of the invention;

FIG. 5 is a schematic diagram of part of another embodiment of the rotating intermediate storer of the invention;

FIG. 6 is a schematic diagram of still another embodiment of the rotating intermediate storer of the invention; and

FIG. 7 is a schematic diagram of a modification of the embodiment of FIG. 6.

FIG. 1 shows a rotating intermediate storer of known design as described, for example, in German Published Pat. application No. 1,510,109. The storage element proper 1 of the intermediate storer comprises two sets of sheaves 2 and 3, which are arranged on parallel axes and comprises several sheaves arranged side by side. The set of sheaves 2 is rotatably supported in a frame 6 via a mounting 4 and the set of sheaves 3 is rotatably supported in a frame 7 via a mounting 5. The mount-

ings 4 and 5 are driven synchronously by a transmission, not shown in detail in the figures.

The strand elements 8 such as, for example, conductors of a communication cable, to be twisted by the known intermediate storer enter the intermediate storer via a laying top 9 and are successively led around the individual sheaves of the sets of sheaves 2 and 3. They finally leave the intermediate storer as a twisted unit 11 via a deflection sheave or roller 10. The twisting of the strand elements 8 in a direction that changes section by section to form the twisted unit 11 is accomplished in a known manner by changing the speed and/or the direction of rotation of the intermediate storer section by section, or by changing the distance between the sets of sheaves, or by changing the drawing-off speed of the strand elements.

In the known rotating intermediate storer shown in FIG. 1, the strand elements are guided, as they pass through the storage element proper 1, at a distance from the axis of rotation A of the intermediate storer greater than, or at most one-half, the diameter of the sheaves of the sets of sheaves 2 and 3. Corresponding to this distance, centrifugal forces are exerted on the strand elements as they pass through the storage element proper 1 by the rotation of the intermediate storer. This results in a tension stress in the strand elements. This tension stress limits the speed of rotation of the intermediate storer and thereby the manufacturing speed of the twisting operation, and is substantially reduced in the intermediate storer of the invention, as shown in FIGS. 2 to 7.

The intermediate storer shown in FIG. 2 comprises, similarly to the known intermediate storer of FIG. 1, two sets of sheaves 15 and 16, which are rotatably supported in frames 19 and 20 by mountings 17 and 18. In contrast to the known intermediate storer, each set of sheaves of FIG. 2 comprises a pair of sheaves. The pair of sheaves 22 and 23 and the pair of sheaves 24 and 25 are arranged in tandem in the direction of the axis of rotation of the intermediate storer. The pairs of sheaves are situated on opposite sides of the axis of rotation of the intermediate storer. The sheaves are arranged eccentrically relative to the axis of rotation of the intermediate storer in a manner whereby the distance of the sheave axes from the axis of rotation of the intermediate storer corresponds approximately to one-half the diameter of the sheave involved. In the present instance, this distance was chosen somewhat larger than one-half the sheave diameter.

The strand elements 8 are guided over the sheaves of the two pairs of sheaves in such a manner that the point of first contact and the point of separation, which are obtained upon entry into a pair of sheaves and upon leaving a pair of sheaves, are in immediate proximity with the axis of rotation. This results in the guiding of the strand elements as they pass through the intermediate storer, during their transition from one set of sheaves to the other set of sheaves, in immediate proximity with the axis of rotation of the intermediate storer.

Upon entering into the intermediate storer via a laying top 26, the strand elements 8 first enter the set of sheaves 16 and, in the process, run over the deflection sheave 24. The strand elements leave the set of sheaves 16 via the sheave 25 and subsequently enter the set of sheaves 15 via the sheave 22. In the set of sheaves 15, the strand elements are guided similarly as in the set of

sheaves 16. The strand elements leave the set of sheaves 15 via the sheave 23 and leave the intermediate storer as a twisted unit 11 via the deflection sheave 27.

In the embodiment of the intermediate storer of FIG. 3, the guidance of the strand elements in immediate proximity with the axis of rotation of the intermediate storer is achieved by each set of sheaves 30 and 31 having a pair of sheaves. The sheaves 32 and 33 of the set of sheaves 30 and the sheaves 34 and 35 of the set of sheaves 31 are arranged on opposite sides of the axis of rotation in eccentric relation to said axis. As they pass through the intermediate storer, the strand elements are first led over the sheave 35, then cross the axis of rotation and are looped around the sheave 34, then run parallel or nearly parallel to the axis of rotation of the intermediate storer to the set of sheaves 30 and are looped around the sheaves of said set of sheaves in a manner similar to that of the sheaves of the set of sheaves 31.

In order to obtain a storage capacity as large as possible for the intermediate storer in question, it is advisable to construct each storage element not of only two pairs of sheaves but of several pairs of sheaves. Two examples for this are shown in FIGS. 4 and 5, wherein one set of sheaves is shown in each instance, as viewed in the direction of the axis of rotation of the intermediate storer.

The set of sheaves 40 of FIG. 4 comprises six pairs of sheaves rotatably supported in a frame 42 by a mounting 41. The individual pairs of sheaves are constructed in the same manner as the pair of sheaves of FIG. 2. They are uniformly distributed about the axis of rotation and are arranged in parallel planes. Three pairs of sheaves each are situated above and below the axis of rotation of the intermediate storer. The pairs of sheaves of the embodiment of FIG. 4 are arranged so that the distance from the axis of rotation of all points of first contact and of separation of the strand elements on the sheaves of the pairs of sheaves is approximately the same upon entering and leaving a set of sheaves.

In the set of sheaves 45 of FIG. 5, eight pairs of sheaves designed similarly to the sheaves of FIG. 2 are distributed uniformly about the axis of rotation of the intermediate storer and are positioned in several planes through the axis of rotation. The distance of the sheave axes from the axis of rotation is the same for the respective, corresponding sheaves of the pairs of sheaves.

In the intermediate storer of the invention shown in FIGS. 2 to 5, the distance between the respective laying top and the first deflection of the strand elements at the sheave in question of the set of sheaves first passed is relatively large. This can have a detrimental effect on the length of the change-of-twist points which are produced in the twisting process. It is therefore advisable to provide one additional deflection sheave each for the first and the last pair of sheaves carrying the strand elements. The strand elements are led completely or partially around the additional deflection sheave immediately upon entering the intermediate storer and immediately before leaving the intermediate storer. The points of first contact and separation of the strand elements are on or in immediate proximity with the axis of rotation. FIG. 6 shows an embodiment of this arrangement. In the embodiment of FIG. 6, the deflection sheave 46 is provided with the pair of sheaves 47 and

the deflection sheave 48 is provided with the pair of sheaves 49.

FIG. 7 shows an intermediate storer, each of the rotating sets of sheaves 50 and 51 of which are enclosed by an envelope of rotational symmetry such as, for example, a cylindrical cage 52 and a cylindrical cage 53, respectively. The cages 52 and 53 reduce the air resistance which must be overcome during the rotation of the sets of sheaves. The cages 52 and 53 can be connected in fixed relation to the frames 56 and 57. It is advisable, however, to connect the cages 52 and 53 to the respective sheave mountings 54 and 55 so that they rotate with the corresponding sets of sheaves. Under some circumstances, it may be advisable to drive the cages 52 and 53 so that they rotate independently of the sets of sheaves at the same speed of rotation or at a speed deviating from that of the set of sheaves.

While the invention has been described by means of specific examples and in specific embodiments, it should not be limited thereto, for obvious modifications will occur to those skilled in the art without departing from the spirit and scope of the invention.

I claim:

1. An intermediate storer rotating about an axis of rotation for twisting strand elements for electric cables, in particular strand elements for communication cables, to form a twisted unit with a direction of twist which changes from section to section, said intermediate storer having a storage element proper comprising two sets of sheaves arranged in tandem in the direction of the axis of rotation, each set of sheaves having sheaves disposed eccentrically relative to the axis of rotation and guiding the strand elements in a plurality of turns around said sheaves as they pass through the intermediate storer, the distance of the axes of the sheaves of the sets of sheaves onto which the strand elements run when entering a set of sheaves and from which the strand elements run off when leaving a set of sheaves from the axis of rotation of the intermediate storer being approximately equal to one-half the diameter of the sheave involved the points of first contact and last separation of the strand elements led over the set of sheaves are on the sets of sheaves in immediate proximity with the axis of rotation and the path of the strand elements travelling between sets of sheaves is substantially parallel to the axis of rotation.

2. A rotating intermediate storer as claimed in claim 1, wherein each set of sheaves comprises at least one pair of sheaves (30, 31) having sheaves (32, 33; 34, 35) arranged on opposite sides of the axis of rotation eccentrically relative to said axis of rotation.

3. A rotating intermediate storer as claimed in claim 1, wherein the distance of the axes of the sheaves from the axis of rotation of the intermediate storer is greater than one-half the diameter of the sheave involved.

4. A rotating intermediate storer as claimed in claim 3, wherein each set of sheaves comprises at least one pair of sheaves (15, 16) arranged eccentrically relative to the axis of rotation of the intermediate storer, the sheaves (22, 23; 24, 25) of the pair of sheaves being arranged in tandem in the direction of the axis of rotation.

5. A rotating intermediate storer as claimed in claim 4, wherein the pairs of sheaves of each set of sheaves (45) are in at least one plane passing through the axis of rotation.

6. A rotating intermediate storer as claimed in claim 4, wherein the pairs of sheaves of each set of sheaves (40) are in parallel planes.

7. An intermediate storer rotating about an axis of rotation for twisting strand elements for electric cables, in particular strand elements for communication cables, to form a twisted unit with a direction of twist which changes from section to section, said intermediate storer having a storage element proper comprising two sets of sheaves arranged in tandem in the direction of the axis of rotation, each set of sheaves having sheaves disposed eccentrically relative to the axis of rotation and guiding the strand elements as they pass through the intermediate storer, each set of sheaves comprising two pairs of sheaves (15, 16) arranged on opposite sides of the axis of rotation, the points of first contact and last separation of the strand elements led over the set of sheaves being on the sets of sheaves in immediate proximity with the axis of rotation.

8. An intermediate storer rotating about an axis of rotation for twisting strand elements for electric cables, in particular strand elements for communication cables, to form a twisted unit with a direction of twist which changes from section to section, said intermediate storer having a storage element proper comprising two sets of sheaves arranged in tandem in the direction of the axis of rotation, each set of sheaves comprising at least one pair of sheaves disposed eccentrically relative to the axis of rotation and guiding the strand elements as they pass through the intermediate storer, the sheaves (22, 23; 24, 25) of said pair of sheaves being arranged in tandem in the direction of the axis rotation, each set of sheaves further comprising a plurality of said at least one pair of sheaves, the latter mentioned pairs of sheaves of each set of sheaves (40, 45) being distributed uniformly about the axis of rotation of said intermediate storer, the distance of the axes of the sheaves of the sets of sheaves onto which the strand elements run when entering a set of sheaves and from which the strand elements run off when leaving a set of sheaves from the axis of rotation of the intermediate

storer being approximately equal to one-half the diameter of the sheave involved, such that the points of first contact and last separation of the strand elements led over the set of sheaves are on the sets of sheaves in immediate proximity with the axis of rotation.

9. A rotating intermediate storer as claimed in claim 8, further comprising a pair of additional deflection sheaves, each of said sets of sheaves having a first and last pair of sheaves (47, 49) guiding the strand elements, each of said first and last pair of sheaves having an additional deflection sheave (46, 48), the strand elements being at least partially led around each additional deflection sheave immediately upon entering the intermediate storer and immediately before leaving the intermediate storer, said points of first contact and last separation of the strand elements with the sheaves being in immediate proximity with the axis of rotation.

10. A rotating intermediate storer as claimed in claim 9, wherein said points of first contact and last separation of the strand elements with the sheaves are on the axis of rotation.

11. A rotating intermediate storer as claimed in claim 9, further comprising a closed envelope of rotational symmetry surrounding the intermediate storer.

12. A rotating intermediate storer as claimed in claim 11, wherein the envelope rotates with the sets of sheaves (50, 51) about the axis of rotation of the intermediate storer.

13. A rotary intermediate storer as claimed in claim 9, further comprising a pair of closed cylindrical cages having openings for the strand elements and wherein each set of sheaves (50, 51) is surrounded by a corresponding one of the cylindrical cages (52, 53) on the axis of rotation.

14. A rotating intermediate storer as claimed in claim 13, wherein the cylindrical cages (52 and 53) rotate with the sets of sheaves (50, 51) about the axis of rotation of the intermediate storer.

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