June 17, 1969 SHIRO FUJITA ET AL 3,449,898

HEATER FOR YARN TWISTER

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FIG. 1

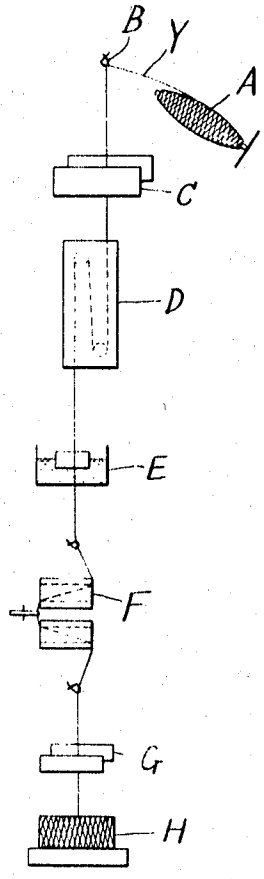


FIG. 2

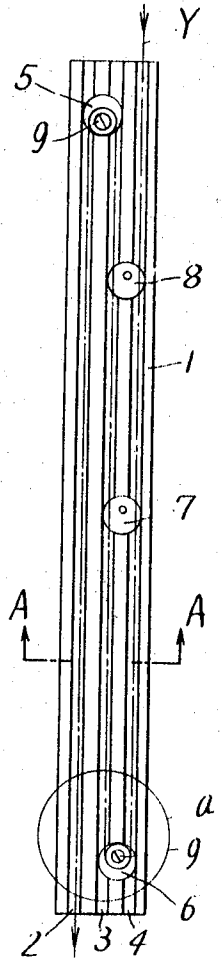
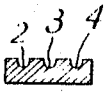


FIG. 3



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FIG. 4

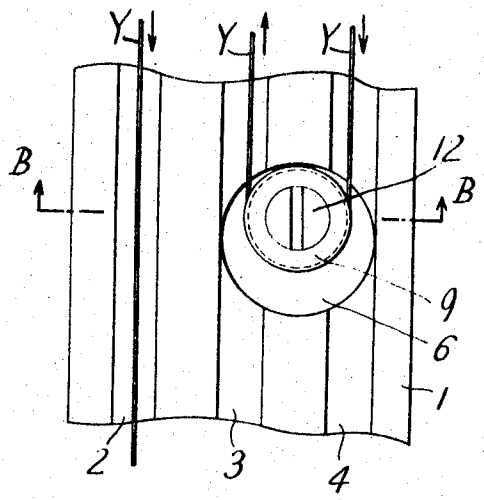


FIG. 5

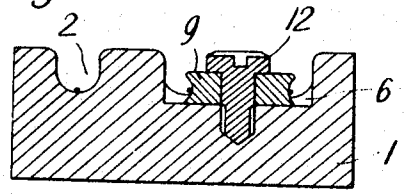


FIG. 6

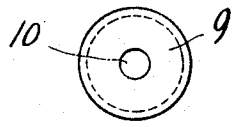


FIG. 7

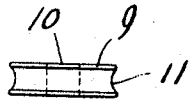


FIG. 8

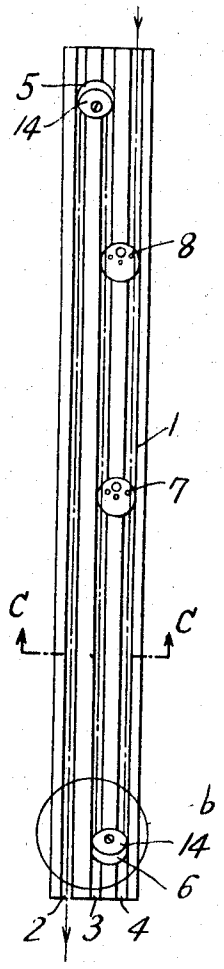
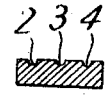


FIG. 9



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FIG. 10

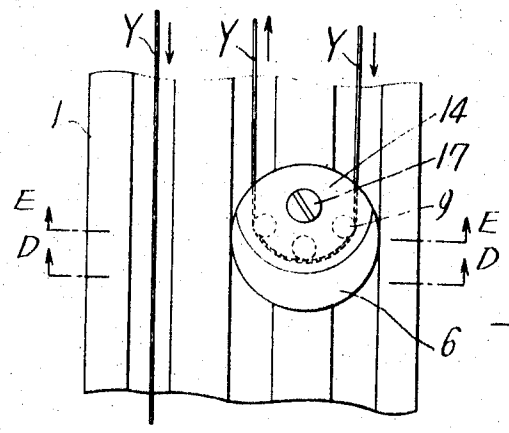


FIG. 13

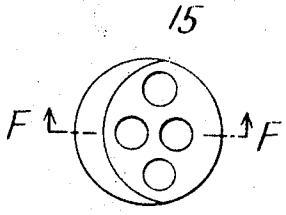


FIG. 14

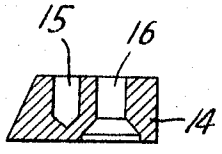


FIG. 11

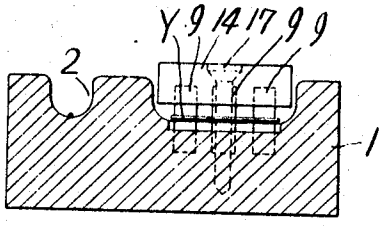


FIG. 15



FIG. 12

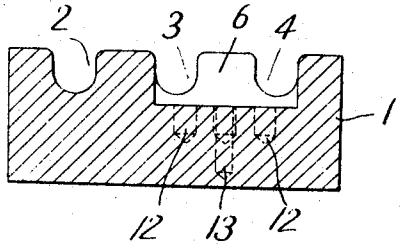
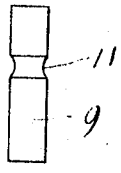


FIG. 16



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HEATER FOR YARN TWISTER

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FIG. 17

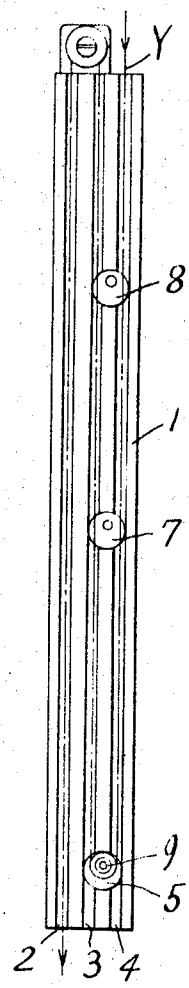
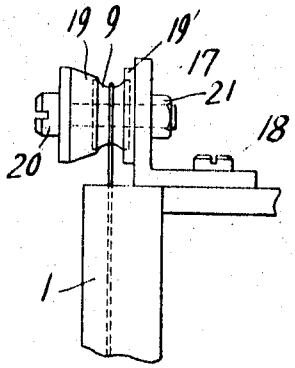


FIG. 18



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United States Patent Office 3,449,898 Patented June 17, 1969

3,449,898

HEATER FOR YARN TWISTER

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Int. Cl. D01h 13/28; D02j 13/00
U.S. Cl. 57—34 7 Claims

ABSTRACT OF THE DISCLOSURE

The invention relates to a heater for thermoplastic yarns in high speed direct twisting type false twister and the like, which is disposed turning means comprising pins, in which yarns are subjected to turn with drawing contact arc having a radius of curvature of from 4 to 7 mm. in contacting positions of the yarns and the pins.

This invention relates to a heater for thermoplastic yarns in high speed direct twisting type false twister (friction type false twister) and the like, and more particularly relates to a heater being disposed turning means comprising pins, in which yarns are subjected to turn with drawing contact arc having a radius of curvature of from 4 to 7 mm. in contacting positions of the yarns and the pins.

As heaters for heat-treating yarns, there have been already suggested cylindrical heaters, plate-shaped heaters and grooved plate heaters. The progress in recent false twisters is so remarkable that the processing speed has increased to be higher. However, in the economical point of view, a processing at a higher speed is required today. In the process for twisting yarns, results satisfactory to some extent have come to be obtained due to improvements in twisting spindles and in the friction type false twisting process. But the method of heat-treating yarns remains merely an improvement in the conventional heater. In case a yarn is passed at a high speed through such heater, the treating time will be so short that no desirable heat-treating effect will be able to be obtained. Therefore, for example, in a false twister, twisting itself at a high speed has become possible due to improvements in the twisting process. However, there is no heat-treating heater to be applied to such high speed processing, therefore, processing must be carried out at a low speed today.

As a means for solving such problem in the heat-treatment, it has been already generally practiced to elevate the heater temperature or to increase the heater length. However, yarns, specifically thermoplastic synthetic yarns have comparatively so high specific heat that a considerably long time will be required until they are heated to a determined temperature. Therefore, elevating the heater temperature is not a method so effective as a heat-treating process in the high speed processing but is a method wherein a heat-treating irregularity is likely to be occurred in the yarn. Further, in such method, as yarns are treated at a high temperature, such defect that the filaments themselves will be fused together or they will be mapped or broken are likely to be occurred and, due to such thermal properties of the yarns as the melting point, softening point and optimum treating temperature, so high temperatures can not be applied. For such reasons as mentioned

above, in the case of heat-treating yarns at a high speed, the long heater has been generally adapted. However, in applying the long heater, there are many defects that:

(1) it is difficult to control uniformly the atmospheric temperatures of the respective parts in the heater, therefore a special apparatus will be required.
(2) it is necessary to use larger size twister.
(3) cost may be expensive.
(4) an operation may be inconvenient.
(5) degree of heat loss due to heat radiation may be higher.

An object of the present invention is to substantially increase the length of a heater by arranging one or more turning means on (or in) a heater plate and the final ones of them outside the plate so that a yarn to be treated may draw contact arc of a radius of curvature of 4 to 7 mm. at turning and may be smoothly turned in the U shaped form once or several times to be heat-treated by being passed on the heater plate.

Another object of the present invention is to heat-treat a yarn over a substantially long distance under the same conditions by subjecting the yarn to turn several times and pass through a heater.

A further object of the present invention is to provide a compact heater wherein a heat-treatment in a high speed processing can be carried out satisfactorily enough without the longer heater.

A still further object of the present invention is to provide easy control of a heater temperature and to provide simple operation of the heater.

Another object of the present invention is to provide a heater effective to high speed false twisters wherein, even if a yarn is subjected to turn several times and pass through the heater, the progress of the twisting will not be substantially obstructed by the turning means.

A further object of the present invention is to provide a heater which can be simply fitted to a conventional false twister so that the machine may be improved to be a false twister in which a high speed processing can be made.

Other objects will be apparent from the following drawings and specification.

In order to improve various conventional defects, the present invention is to subject a yarn to turn several times on a heater so that the heater length, that is, the effective length of the yarn in contact with the heater plate may be increased substantially.

However, according to experiments, in a method wherein turning means are all provided outside a heater so that a yarn may be subjected to turn several times and pass through the heater, a heat-treatment irregularity and an insufficient setting were occurred and no desirable result was obtained. Because the yarn once heated by the heater is once cooled by the atmosphere and is then heated again, and as the result undesirable influence by the atmosphere will be given. On the other hand when all the turning means were provided on (or in) the heater, desirable results were obtained.

Further, according to experiments, it has been found that, in case one or two turning means in the end part in the direction of the progress of the yarn among several turning means are provided outside adjacently to the heater and all the other turning means are provided on

(or in) the heater, more desirable results will be obtained. Though the details of the reasons, therefore, are not yet perfectly clear, it is thought that, in case all the turning means are provided on (or in) the heater, the yarn will be smoothly treated under substantially the same temperature conditions without coming into contact with the atmosphere. Further, when one or two turning means in the final part are provided outside near the heater, more desirable results will be obtained. It is thought that, in case the yarn advances with turning several times by the turning means on (or in) the heater, some of such influence as of friction heat will be occurred by the friction with the turning means and if the turning means in the final part is placed outside, this influence will be able to be removed. That is to say, it is judged that, in such case, the temperature of the yarn to be treated will be so low that such influence as of the friction coefficient by the friction with the turning means in the initial part provided in the heater will have no bad influence on the yarn and, as the yarn approaches the turning means in the final part, the temperature of the yarn will become gradually so high that, when the yarn is subjected to turn by the turning means under a considerable higher tension, the yarn will be influenced mostly by the friction heat and therefore, if the turning means in the end part is provided outside near the heater and is cooled, whereby influence due to friction heat is removed, as the result, better results can be obtained. Further, the fact that the turning means in the final part is provided near the heater is to reduce as much as possible the influence of the atmosphere on the yarns and the bad influence of the friction heat or the like.

According to the present invention, the pins are made of a material having higher wear-resistance, lower friction coefficient and little temperature variations. At least 3 of the pins are arranged in the turning means wherein yarns are subjected to turn with drawing smooth contact arc having a radius of curvature of 4 to 7 mm. This radius of curvature of between 4 to 7 mm. is critical in this invention. If the radius of curvature is less than 4 mm. or more than 7 mm. the twist given is not satisfactory and sufficient effects of the heat treatment or uniformity of the finished yarn cannot be obtained.

According to the present invention, it is necessary to dispose turning means for the heater such that yarns draw smooth contact arc having a radius of from 4 to 7 mm. It is undesirable to be drawn contact arc having a radius of curvature of less than 4 mm. or more than 7 mm. by the yarns. For example, the twist to be given yarns is about 5% per one turning means less than a twist to be given yarns by a false twister without turning means, and sufficient effects of the heat treatment and uniform yarns can be hardly obtained, when a heater for a friction type high speed false twister is used and yarns draw contact arc having a radius of the curvature of less than 4 mm. or more than 7 mm. on the turning means of the heater. Further, better results in various points of view can be obtained, when the turning means are formed of one pin made of sapphire.

The present has been made on the basis of the above described our finding. According to the present invention, there is provided a heater for yarn twister which comprises a heater plate and turning means said turning means being disposed said heater plate and being comprised of pins made of materials high wear-resistance, low friction coefficient and little temperature variation to permit the formation of a smooth contact arc having a radius of curvature of from 4 to 7 mm. in contacting positions of the yarns and pins.

The present invention shall be explained concretely with reference to the drawings of respective embodiments in the following. However, it is needless to say that the present invention is not limited to them. In the drawings, the same parts are represented by the same corresponding numerals.

FIGURE 1 is a sketch of a heater of the present invention as applied to a friction type false twister.

FIGURES 2 to 7 show the first embodiment of the present invention with the heating member, lagging and protector removed to show only the essential parts of the heater.

FIGURE 2 is a plan view of the heater while passing a yarn as seen from the front side.

FIGURE 3 is a sectioned view on line A—A in FIGURE 2.

FIGURE 4 is a magnified plan view of the part *a* in FIGURE 2.

FIGURE 5 is a sectioned view on line B—B in FIGURE 4.

FIGURE 6 is a plan view of a pin.

FIGURE 7 is a side view of the pin.

FIGURES 8 to 12 show the second embodiment of the present invention showing only the essential parts of the heater in the same manner as in the first embodiment.

FIGURE 8 is a plan view of the heater while passing a yarn as seen from the front side.

FIGURE 9 is a sectioned view on line C—C in FIGURE 8.

FIGURE 10 is a magnified plan view of the part *b* in FIGURE 8.

FIGURE 11 is a sectioned view on line D—D in FIGURE 10.

FIGURE 12 is a sectioned view of only the heater plate in the section on line E—E in FIGURE 10.

FIGURE 13 is a plan view of bottom surface of a pin fitting.

FIGURE 14 is a sectioned view on line F—F in FIGURE 13.

FIGURE 15 is a plan view of a pin.

FIGURE 16 is a side view of the pin.

FIGURES 17 and 18 show the third embodiment of the present invention showing only the essential parts of the heater in the same manner as in the first and second embodiments.

FIGURE 17 is a plan view of the heater while passing a yarn as seen from the front side.

FIGURE 18 is a magnified side view of the upper end part of the heater shown in FIGURE 17.

In FIGURE 1, a yarn Y, for example, of thermoplastic synthetic fibers is pulled out of a cone A, is passed through a guide B and is wound up on a bobbin H through a feed roller C, heater D, cooler E, direct twisting type false twister F and delivery roller G. The yarn Y will be twisted by the false twister F between the false twister F and feed roller C, will be heat-treated in the heater D, will be cooled by air and the cooler E and will be untwisted between the twister F and delivery roller G to be a stretched yarn.

The present invention relates to a heater to be applied for false twisters or the like.

The first embodiment of the present invention shall be explained with reference to FIGURES 2 to 7. A heater plate **1** made of hard almite-plated aluminum is heated from its back surface by such proper means as electric heat by Nichrome wires, a heating liquid, steam and the like. On the surface of the plate **1** are parallelly made three grooves **2**, **3** and **4** for yarn paths of a U-shaped (see FIGURES 3 and 5) cross-section of a radius of about 2 mm. In this case, the plate **1** is about 1 m. long and about 15 mm. thick and is used as a heater for a false twister.

Between the grooves **2** and **3**, a recess **5** is made. In the drawing, a pin **9** to be turning means is provided with each of the recesses **5** and **6**. Further, recesses **7** and **8** are made in preparation for fitting the pins in the case of varying the length of the yarn in contact with the heater **1** in response to the fineness, kind and processing speed of the yarn to be treated.

As shown in FIGURES 6 and 7, the pin **9** forming a turning means is in the form of a cylinder made of sap-

phire, for example, about 11 mm. in the outside diameter, about 3.5 mm. in the diameter of a center hole **10** and about 4 mm. long, and has an annular groove **11** for a yarn path of a radius of about 0.5 mm. in the central part of the outer surface.

The fitting of said pin **9** to the heater plate **1** shall be explained with reference to FIGURES 4 and 5. The recess **6** is a circular hole ranging over the grooves **3** and **4** on the heater plate **1** and deeper than the lowest part of the groove. Such cylindrical pin **9** made of sapphire and having such outside diameter that the yarn Y may run through the center of each of the grooves **3** and **4** as is shown in FIGURES 6 and 7 is inserted into said recess **6**. A screw **12** is passed through the center hole **10** and is screwed into the heater plate **1** to fix the pin **9**. In such case, the pin **9** is provided in such position that the yarn Y running through the grooves **3** and **4** may run just through the annular groove **11**. The center hole **10** of the pin **9** is made to fix the screw in this case but is not always necessary. The pin **9** may be fixed to the heater plate by any other method. Further, the annular groove **11** is made to stabilize the running state of the yarn but is not always necessary. In the case of the drawings, the pin **9** is provided vertically to the heater surface but may be inclined by an angle of several tens of degrees. The cross-section of the pin can be properly selected to be circular, meniscus-shaped, elliptic or cylindrical so as to have an arc with which a smooth contact of the yarn is possible in the range of the radius of curvature of 4 to 7 mm. Further, the outside diameter need not be constant but the pin may be tapered.

As shown in FIGURE 2, the yarn Y will pass downwardly through the groove **4**, will be turned by the pin **9** provided in the recess **6** and will pass upwardly through the grooves **3** and will again pass downwardly the groove **2** and, meanwhile, the yarn Y will be heat-treated in contact with the heater plate **1**. Therefore, in this case, the yarn Y will be substantially heat-treated in a distance about 3 times as large as the heater length. It is to prevent the yarn parts running in different directions adjacently to each other from coming into contact with each other that the grooves **2**, **3** and **4** are made on the heater plate. In case they are not likely to come into contact with each other, a plane or curved grooveless heater plate may be used.

In the drawing two turning means are provided to turn the yarn twice. However, numbers of turning means less than 10 may be provided to bend the yarn several times.

The second embodiment of the present invention shall now be explained with reference to FIGURES 8 to 16. The second embodiment is fundamentally different from the first embodiment in respect that the turning means are composed of three pins but is the same in the other respects which shall not be explained in detail again.

As illustrated in FIGURES 15 and 16, the pin **9** is a bar made of sapphire, for example, about 3 mm. in the diameter and having a shallow annular groove **11** of a radius of about 0.5 mm. in the central part of the outer surface. Fitting this pin **9** in the recess **6** on the heater plate **1** shall be explained. The fitting method is applied similarly in the other recesses. The recess **6** ranges over the grooves **2** and **4** on the heater plate **1** and reaches a position deeper than the deepest parts of the grooves **3** and **4** in which are made holes **12** for holding the pins and a screw hole **13**. (See the preparatory holes **7** and **8** on the heater plate in FIGURE 8 and see FIGURE 11 and 12.) The pin **9** is inserted into each of the three holes **12** in the recess **6** and is fixed with a fixer **14** at the upper end. This fixer **14** shall be explained with reference to FIGURES 13 and 14. It is a conical trapezoidal metallic body provided with pin holding holes **15** and a screw passing hole **16** on the lower surface and made smaller toward the lower part (or upward in FIGURE 14) to an eccentric body so that, when it is fitted to the heater plate, the yarn may easily pass. Then, this fixer **14** is placed on the pins **9** inserted in the holes **12**, the pins **9** are inserted into the holes **15** and then a screw **17** is screwed into the screw hole **13** in the plate through the screw passing hole **16** to fix the three pins **9**. It is needless to say that the pin holding holes **15** and the holes **12** are provided in respectively corresponding positions. It is also natural that the annular groove **11** on the pin **9** is made on a level coinciding with that of the yarn running through the grooves in the plate **1**. In fixing the pin **9**, any other method than by using the fixer **14** can be used. The same as in the first embodiment, the annular groove **11** on the pin **9** is not always necessary. Further, the pins **9** to be used need not be all of the same shape and size so long as a smooth yarn path of a radius of curvature of 4 to 7 mm. is only formed by three or more pins. Also, the same as in the first embodiment, it is possible to alter the shape of the pin.

Further, for the material can be properly used not only sapphire but also such wear-resistant material low in the friction coefficient as hard glass or metals.

The third embodiment of the present invention shall be explained with reference to FIGURES 17 and 18. This embodiment is fundamentally different from the first and second embodiments in respect that the turning means in the final part is provided near the heater plate but is the same in the other respects. The turning means provided on the heater plate **1** is formed of one pin in the case of the drawings but may be formed of three or more pins as in the second embodiment. For the turning means provided near the upper end of the heater plate **1** is used the same wear-resistant material low in the friction coefficient and giving a radius of curvature of 4 to 7 mm. as of the pin **9**. An L-shaped supporter **17** is fixed to the upper end of the heater plate **1** with a screw **18**. The pin **9** is fixed to said supporter **17** through auxiliary bodies **19** and **19'** with a bolt **20** and nut **21**. The position of fitting the pin **9** should be near the upper end of the plate or preferably within 5 cm. from the upper end of the plate between extensions of the grooves **2** and **3**. Further, the size of the pin **9** and passing the yarn through the center parts of the grooves **2** and **3** are the same as in the pin **9** on the heater plate **1**. The yarn Y will pass downwardly through the groove **4**, will be turned by the turning means provided in the recess **5**, will pass upwardly through the groove **3**, will be further turned through the pin **9** provided near the upper end of the plate **1** and will pass downwardly through the groove **2**. Therefore, the direction of the yarn is turned reciprocally by +180 degrees and −180 degrees by each turning means while thus passing through the grooves **2**, **3** and **4**, the yarn Y will be heat-treated. Therefore, it will be substantially heat-treated in a length about three times as large as the heater length. In this case, as the turning means in the final part is provided outside the heater plate **1**, a very favorable result will be obtained.

What is claimed is:

1. A heater for a yarn twister which comprises a heater plate and turning means operatively connected thereto, said turning means being disposed on the heater plate and including at least three (3) pins, each of said pins made of materials having high wear-resistance, low friction co-efficient and low temperature variation, said pins being arranged to permit formation of a smooth contact arc having a radius of curvature between 4 and 7 mm. with respect to the contacting positions of the yarns and the pins.

2. A heater as described in claim **1** wherein the turning means for the running yarn are provided near the outside of the heater plate.

3. A heater as described in claim **1** wherein the grooves for yarn paths are made on the surface of the heater plate.

4. A heater as described in claim **1** wherein the turning means are comprised of a pin made of sapphire.

5. A heater as described in claim **1** wherein two turning means are provided.

6. A heater as described in claim 1 wherein the heater plate is made of almite-plated aluminum.

7. A heater as described in claim 1 wherein the direction of the yarn is turned reciprocally by +180 degrees and −180 degrees by the turning means.

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LOUIS K. RIMRODT, *Primary Examiner.*

U.S. Cl. X.R.

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