United States Patent

Morikawa et al.

[15] **3,698,652**

[45] **Oct. 17, 1972**

[54] CONTINUOUS WINDING APPARATUS

[72] Inventors: **Kasumasa Morikawa,** Ichihara-shi; **Makoto Kobayashi,** Nikko-shi; **Hiromitsu Sato,** Nikko-shi; **Jun Nakazima,** Nikko-shi, all of Japan

[73] Assignee: **The Furukawa Electric Company Limited,** Tokyo, Japan

[22] Filed: **Oct. 29, 1969**

[21] Appl. No.: **872,305**

[30] **Foreign Application Priority Data**

Nov. 4, 1968	Japan	43/80456
Nov. 4, 1968	Japan	43/80455
Nov. 4, 1968	Japan	43/96022
Nov. 4, 1968	Japan	43/96021
Nov. 4, 1968	Japan	43/96020
Nov. 21, 1968	Japan	43/85472
Oct. 2, 1969	Japan	44/94050
Oct. 6, 1969	Japan	44/95362
Oct. 6, 1969	Japan	44/79872
Oct. 6, 1969	Japan	44/79871
Oct. 6, 1969	Japan	44/79873
Oct. 6, 1969	Japan	44/79874
Oct. 7, 1969	Japan	44/80135
Oct. 11, 1969	Japan	44/96930
Oct. 13, 1969	Japan	44/81669
Oct. 13, 1969	Japan	44/81668
Oct. 14, 1969	Japan	44/97765

[52] **U.S. Cl.** ..... **242/25 A**

[51] **Int. Cl.** **B65h 54/02**

[58] **Field of Search** .242/25 A, 25 R, 18 EN, 18 PW, 242/18

[56] **References Cited**

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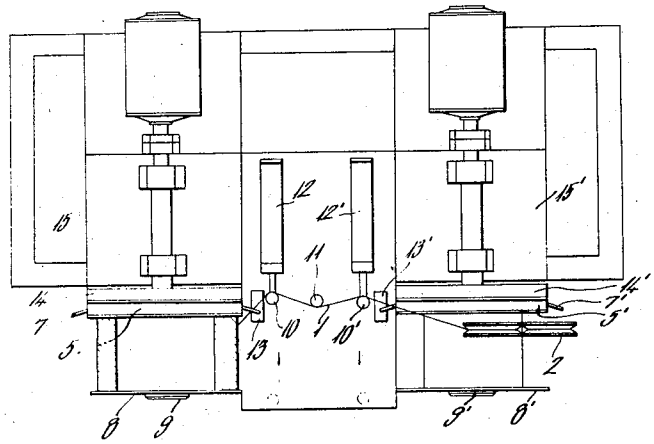
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Primary Examiner—Stanley N. Gilreath
Assistant Examiner—Milton Gerstein
Attorney—Wenderoth, Lind & Ponack

[57] **ABSTRACT**

A continuous wire winding apparatus in which wire such as cable wire is wound continuously at high speed onto alternate spool means. The apparatus has two parallel spool driving shafts spaced from each other in a plane, means for driving the driving shafts, wire traversing means for traversing wire to be wound, and shifting means for shifting wire to be wound between the shafts. Spool means is removably mounted on the shafts, each spool means having flanges thereon, an end plate mounted coaxially with the spool means at one flange of the spool means, and a wire catcher projecting from the circumference of the end plate. A barrel is mounted coaxially with the spool means for having wound thereon the finishing end portion of the wire to be wound, and a cover is non-rotatably mounted around the outside circumferential surface of said barrel for preventing whipping of the free end of the wire. A wire guide means is mounted between the shafts and movable parallel to the shafts for engaging the wire being wound on one spool means and guiding it to the wire catchers on said spool means during transfer to the other spool means. Means is connected to the wire guide means for moving the wire guide means, and wire cutting means is provided adjacent the wire guide means to which the wire being shifted from one spool means to the other is guided for being cut by the guide means and said wire catcher on the one spool means. Wire extending through the traversing means and shifting means is wound on one spool means while being traversed back and forth along the spool means as the spool means is rotated on one of the shafts, and when a predetermined amount of wire has been wound, the shifting means is moved to transfer the wire to the other spool means and the wire is engaged by the wire guide means and guided to the cutting means and cut. The end portion of the cut wire on the one spool is engaged by the wire catcher and caught within the cover on the barrel.

9 Claims, 60 Drawing Figures



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SHEET 01 OF 22

Fig. 1

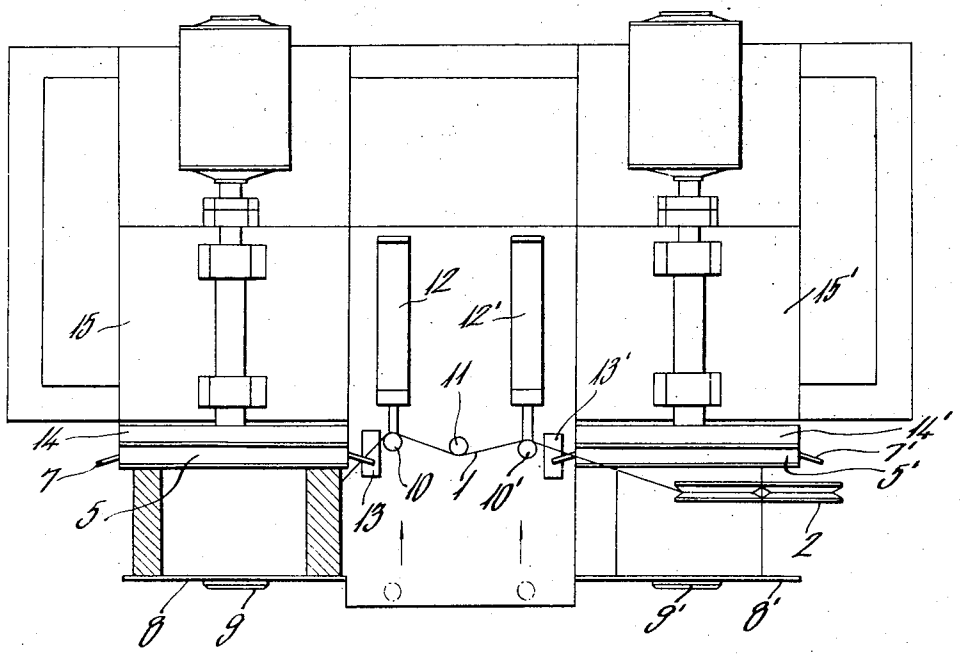
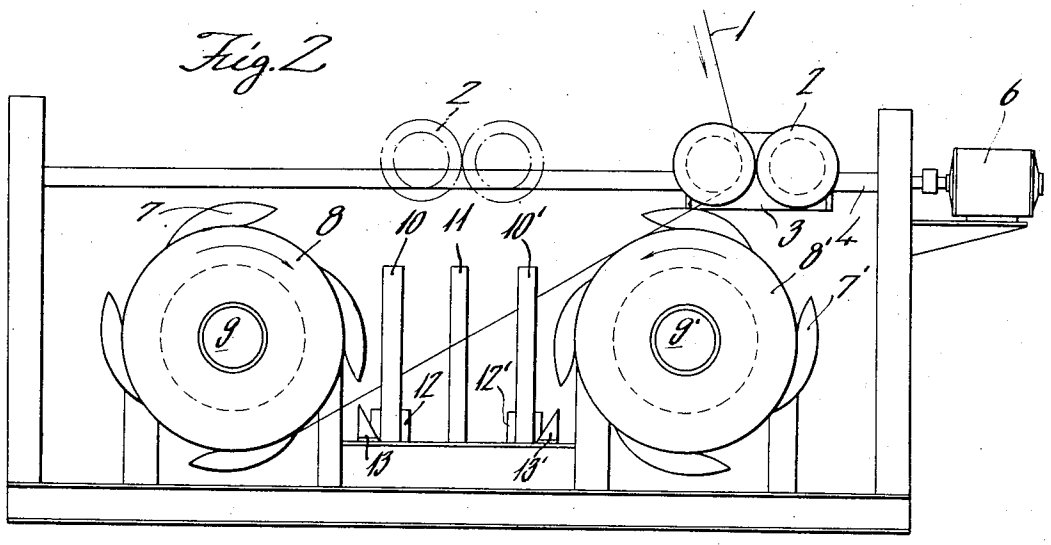


Fig. 2



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HIROMITSU SATO and
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Fig. 3

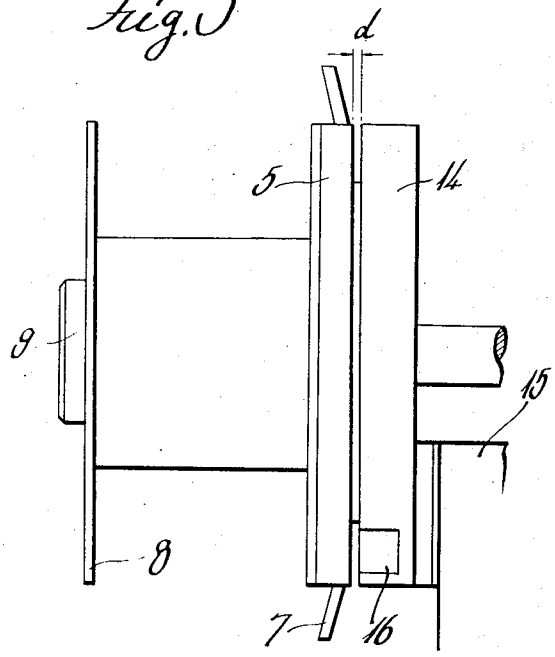


Fig. 4

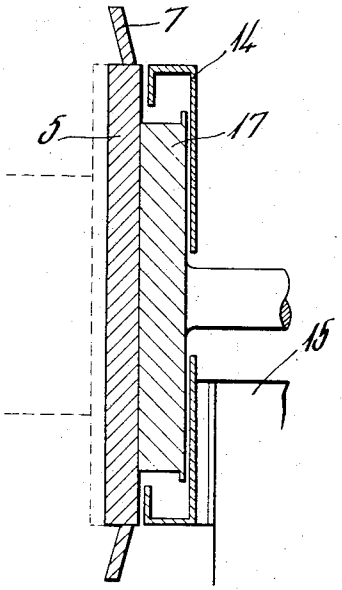
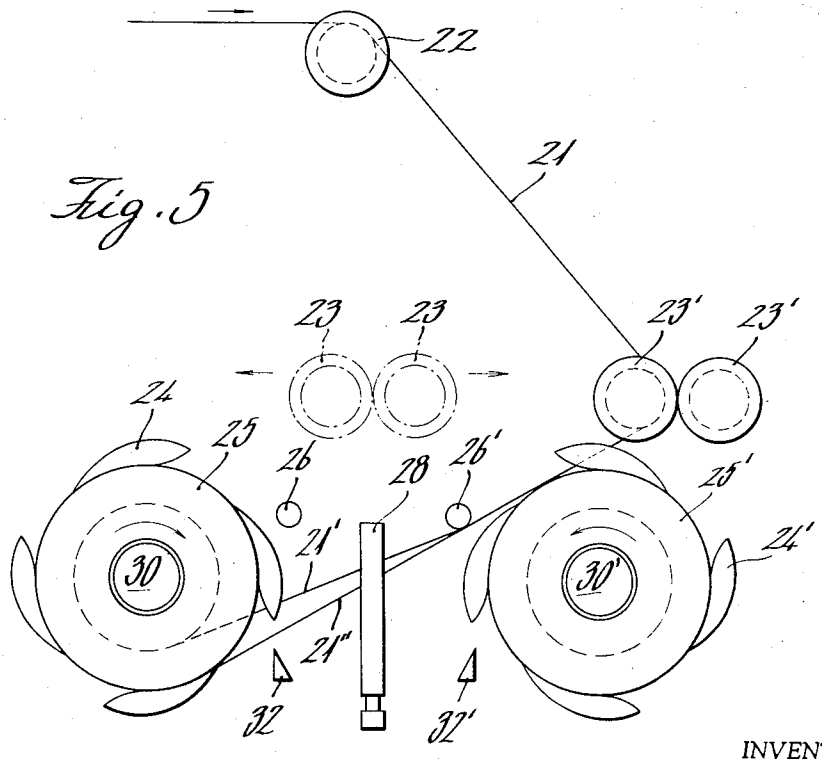


Fig. 5



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Fig. 7

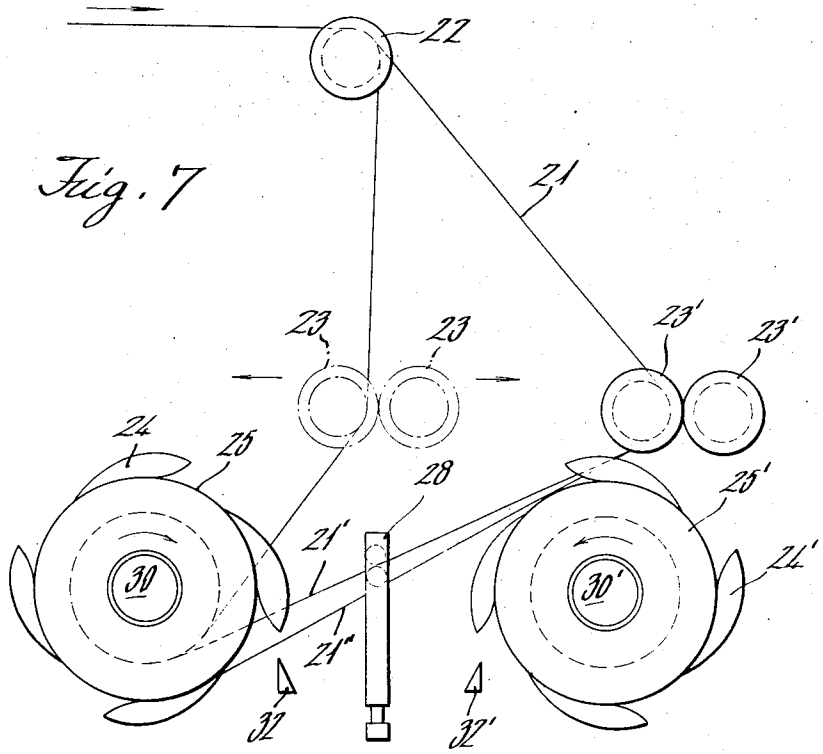
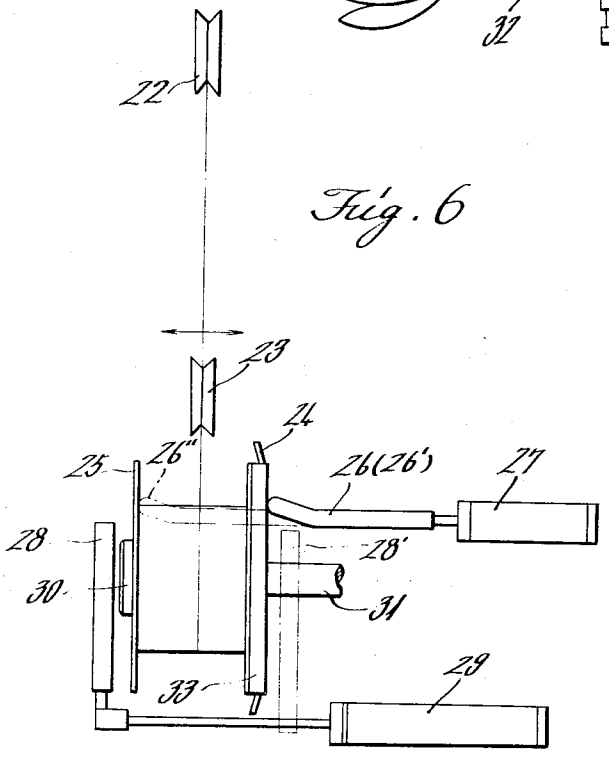


Fig. 6



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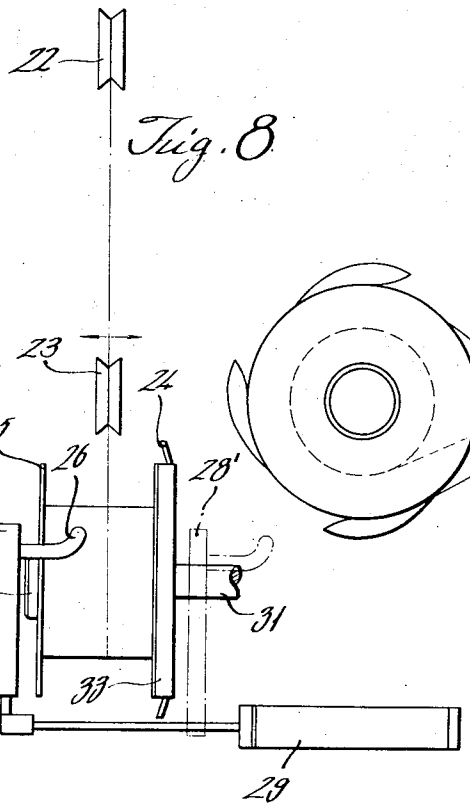


Fig. 8

Fig. 9(a)

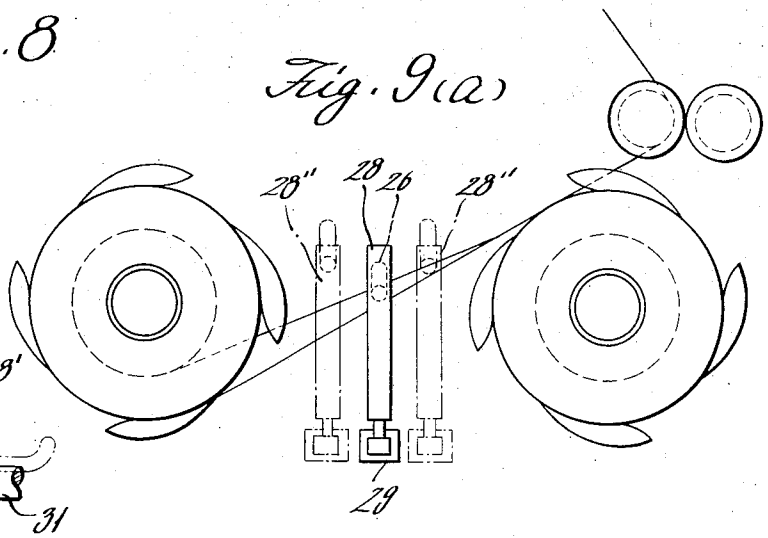


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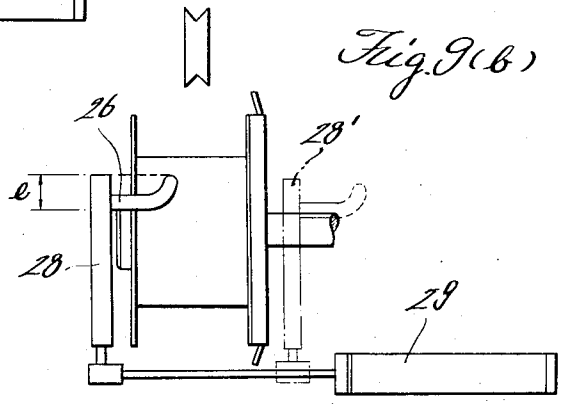
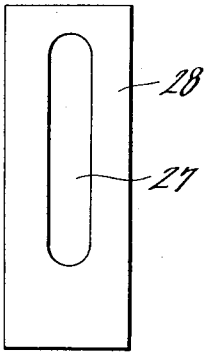


Fig. 11



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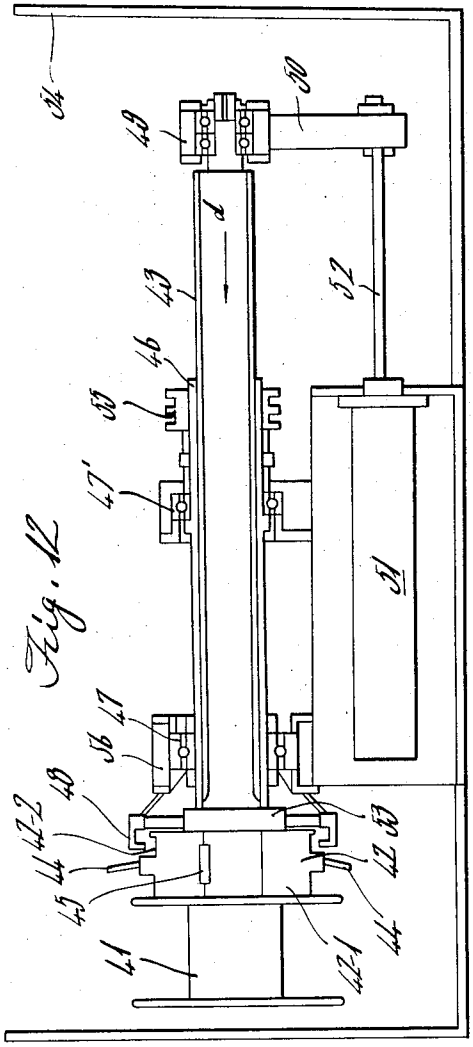


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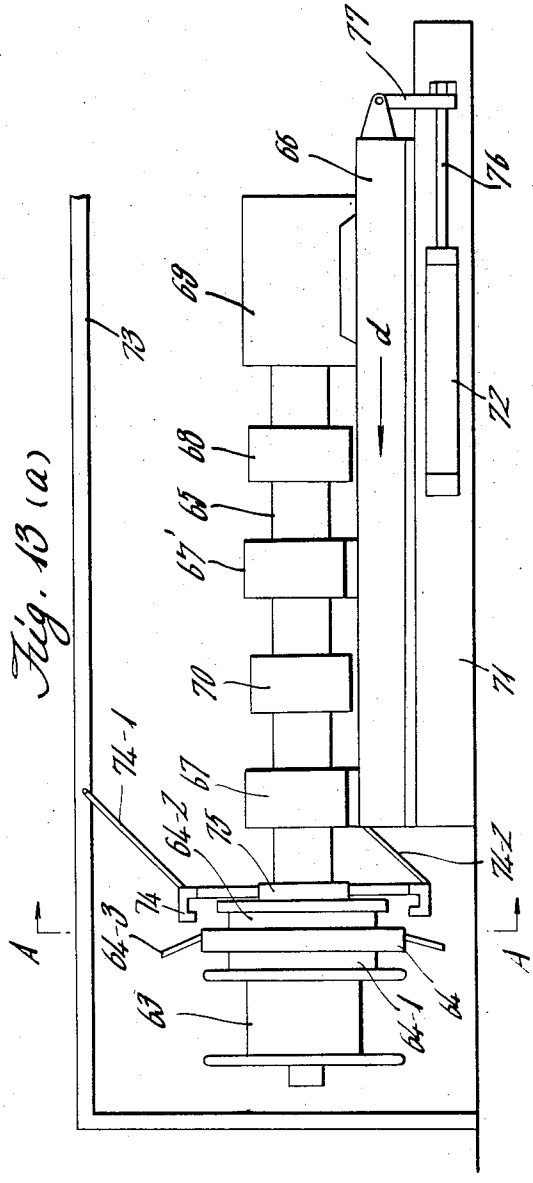


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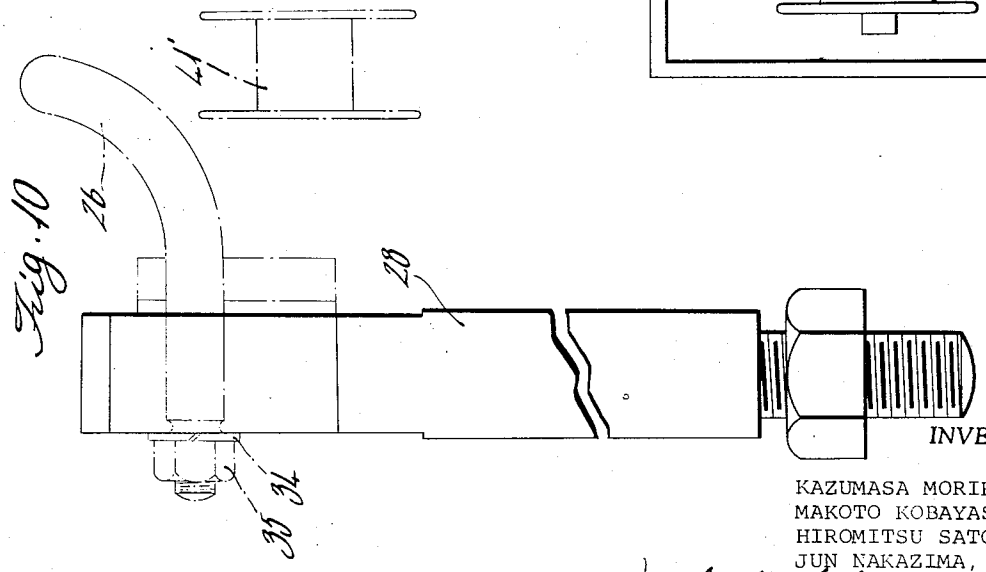


Fig. 10

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Fig. 13 (b)

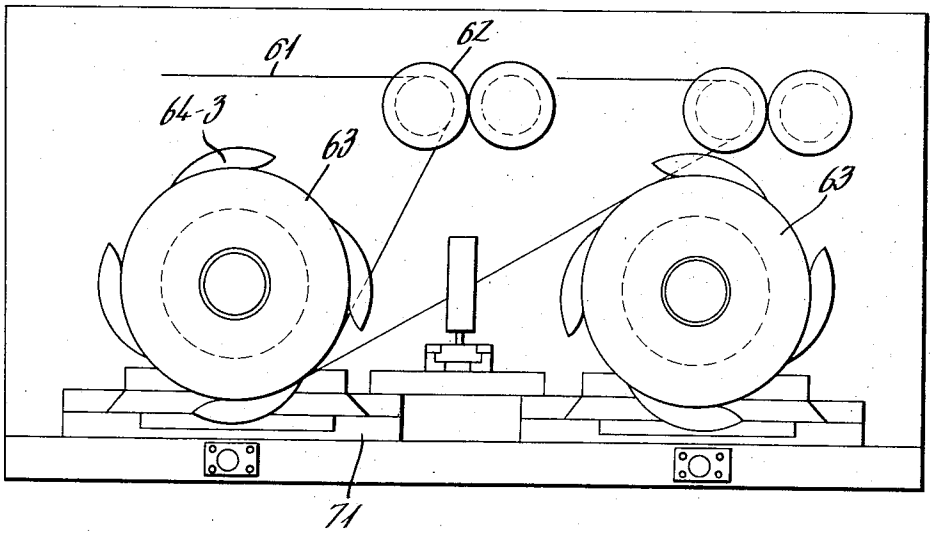
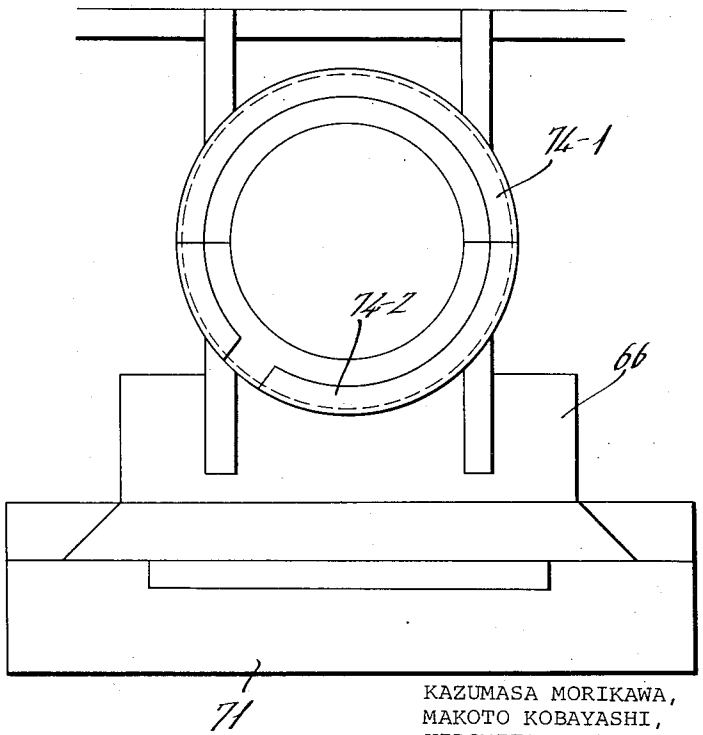


Fig. 14



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Fig. 15

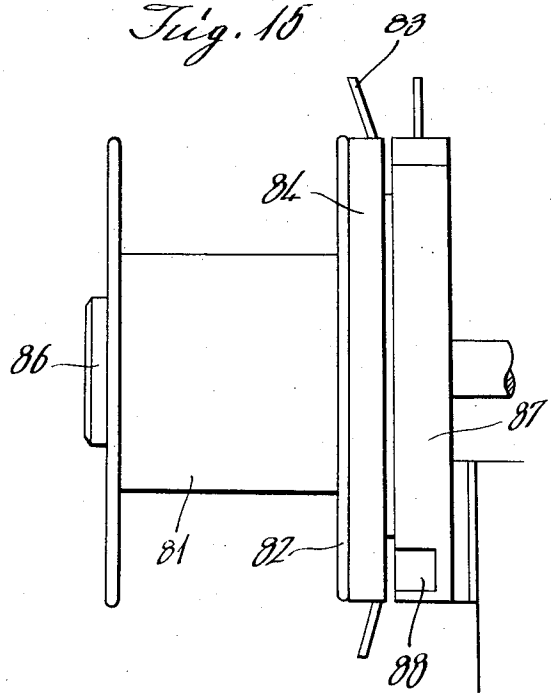


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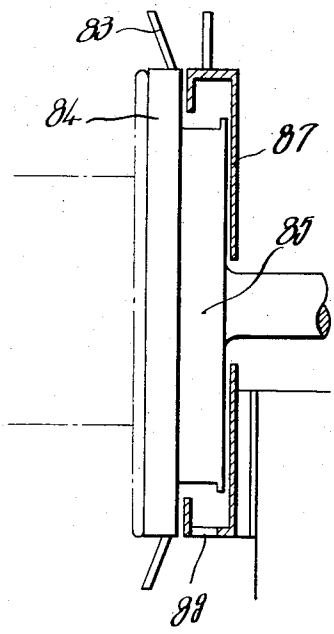


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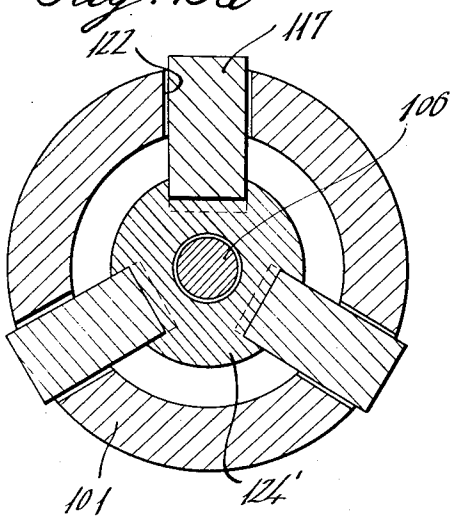
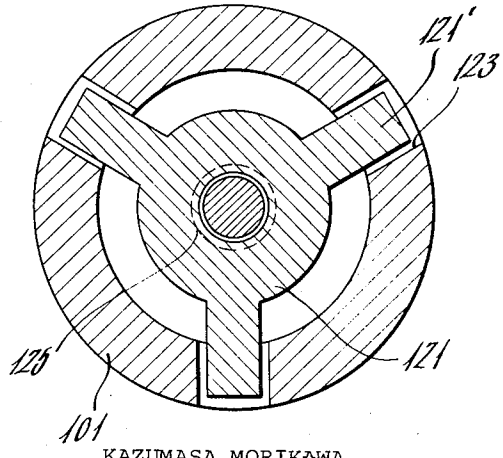


Fig. 19b



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Fig. 17b

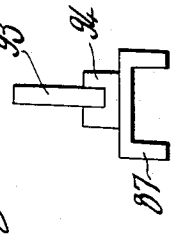


Fig. 17a

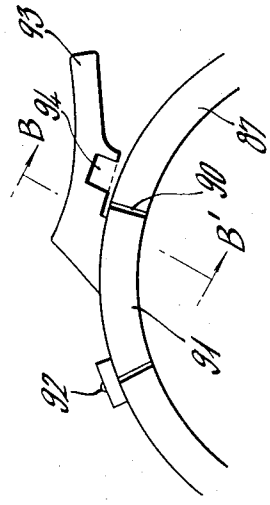
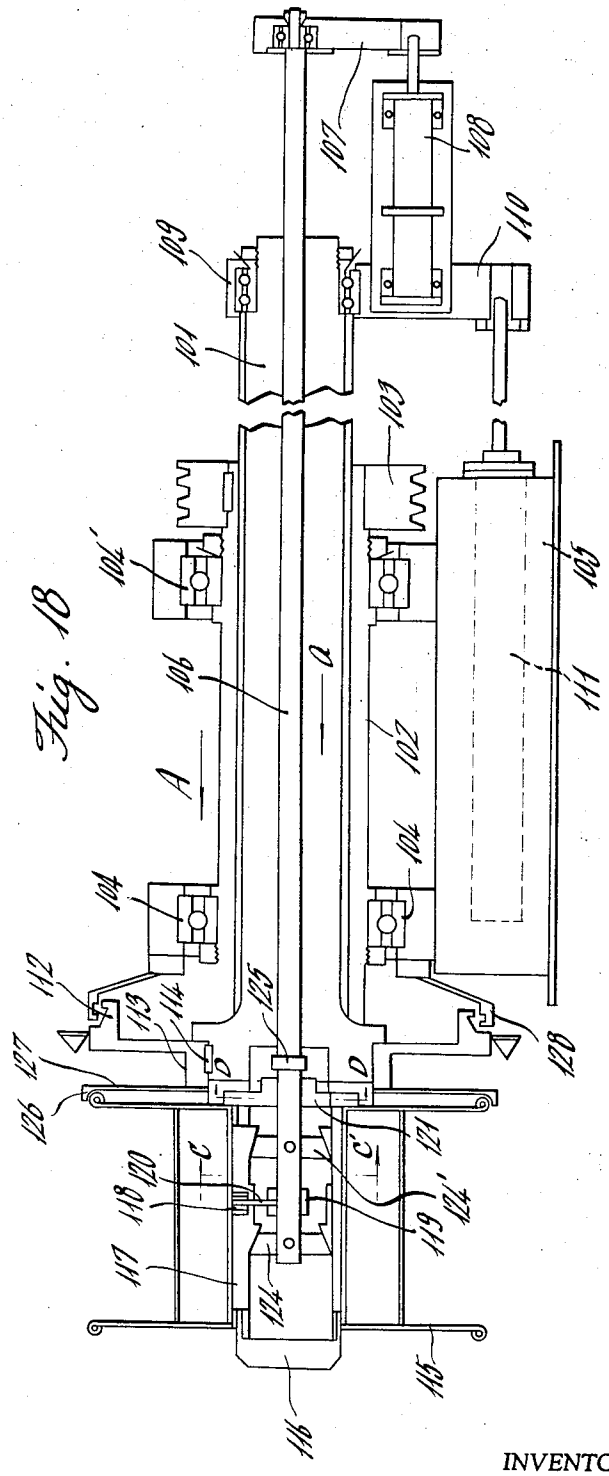


Fig. 18



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Fig. 20a

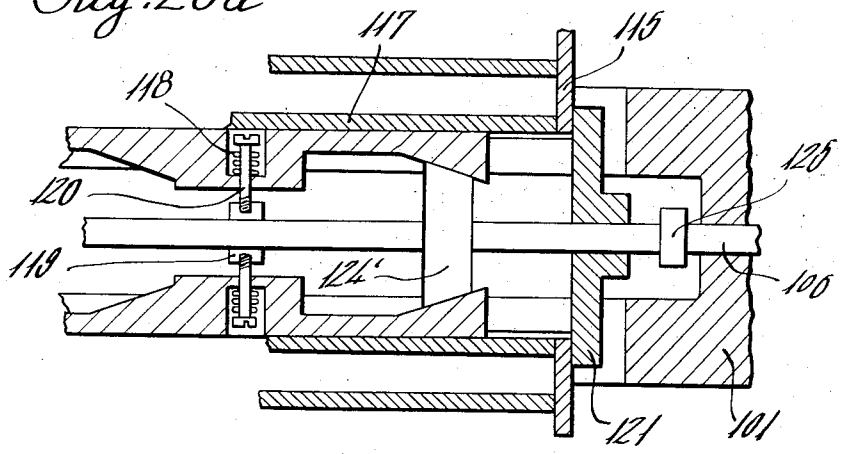


Fig. 20b

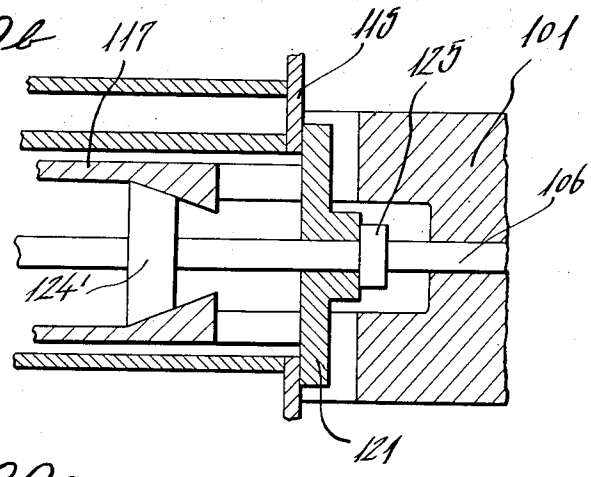
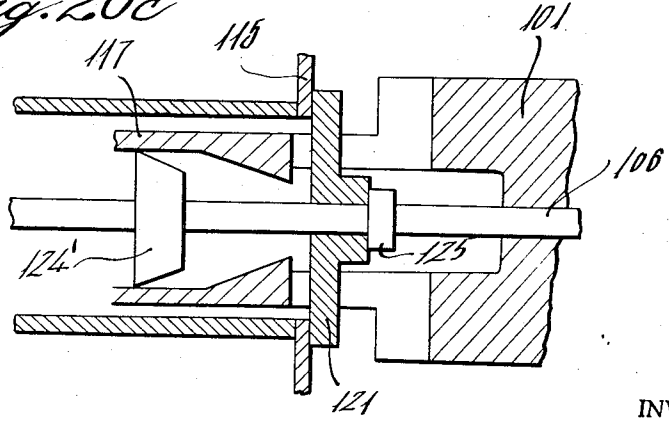


Fig. 20c



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Fig. 21

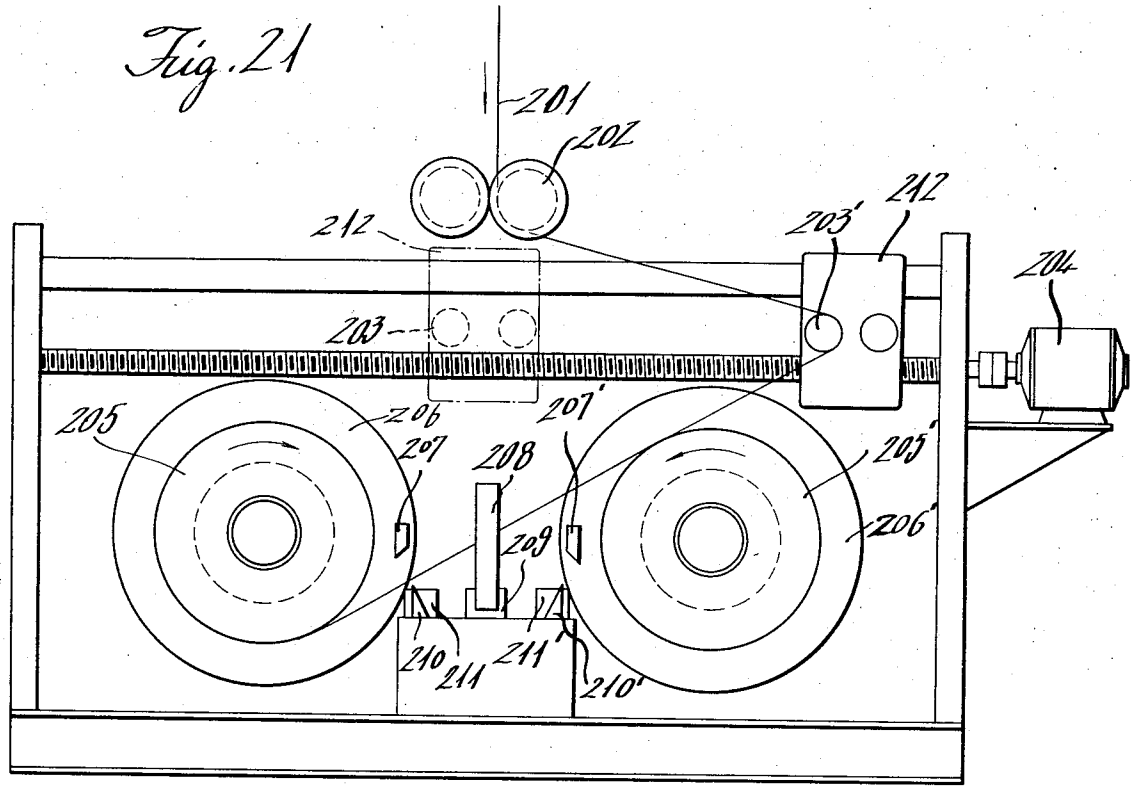
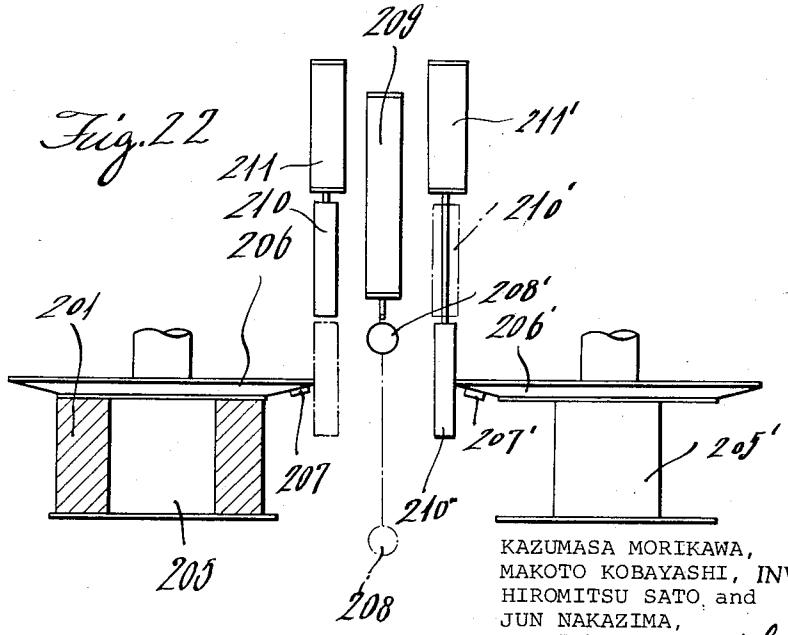


Fig. 22



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Fig. 23

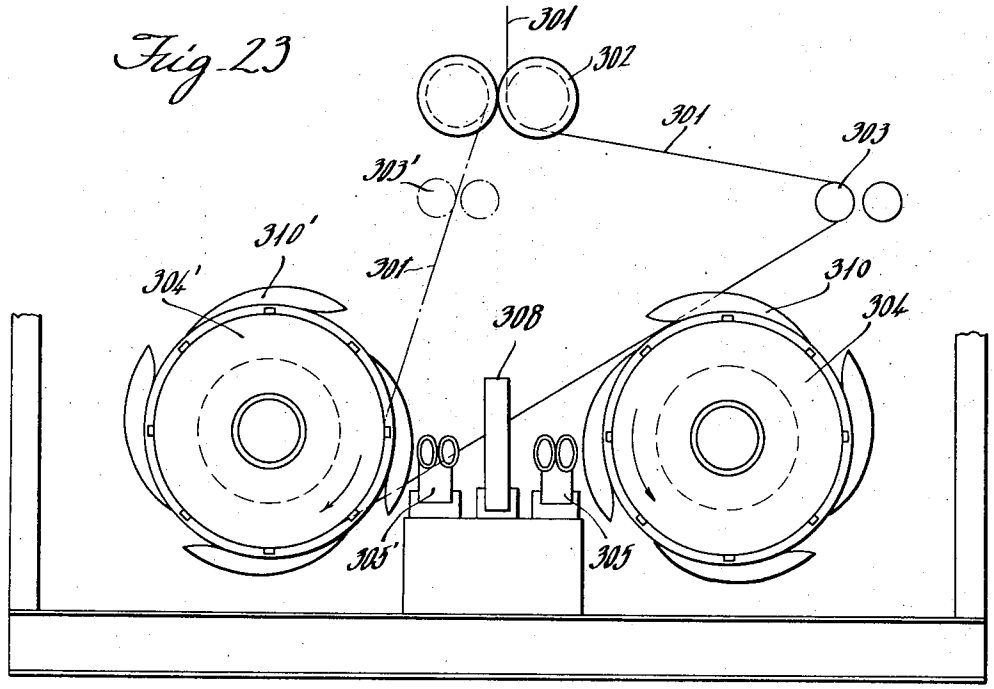


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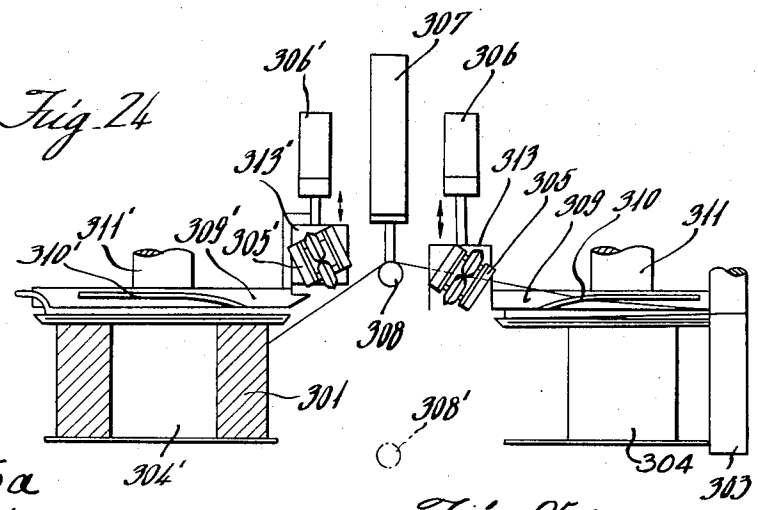


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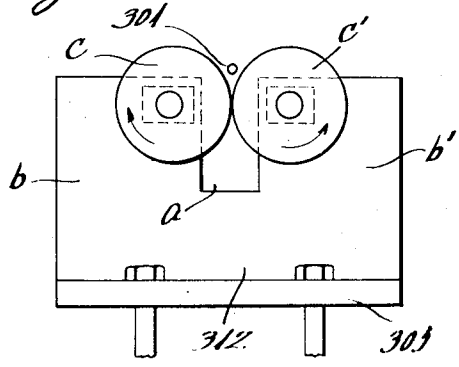
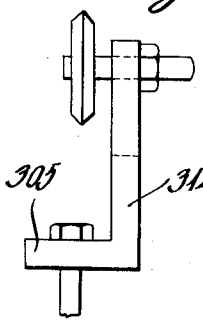


Fig. 25b



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Fig. 26a

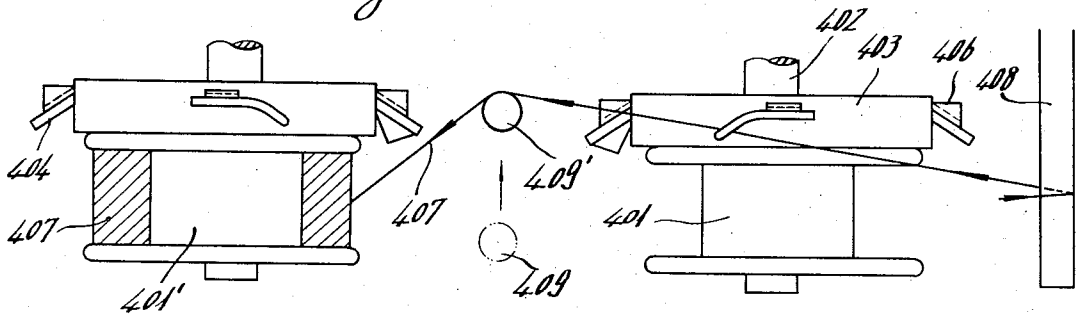


Fig. 26b

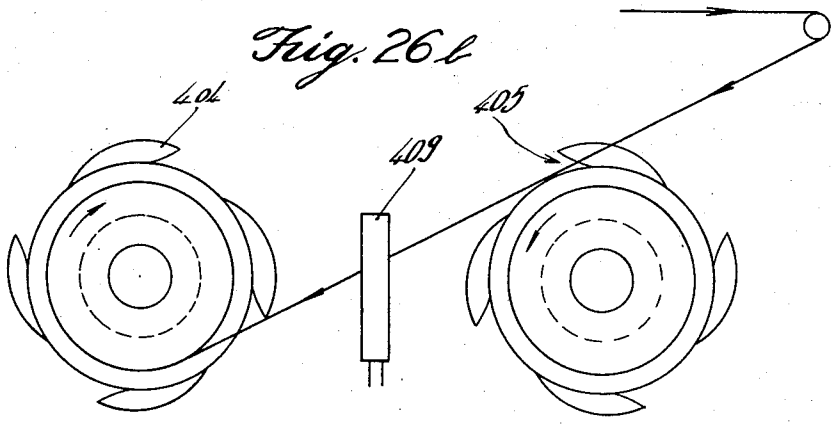


Fig. 27a

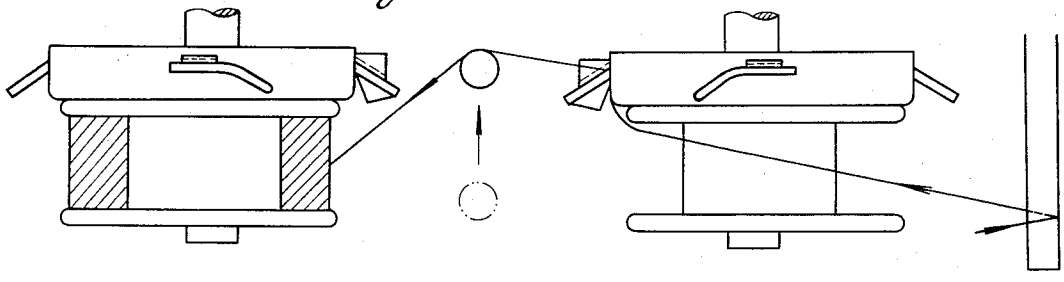
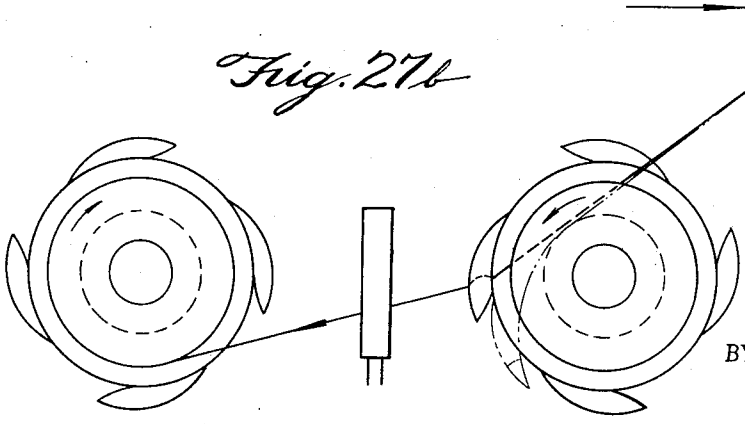


Fig. 27b



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HIROMITSU SATO &
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Fig. 28a

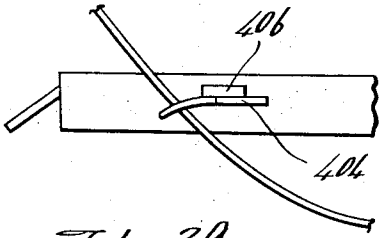


Fig. 28b

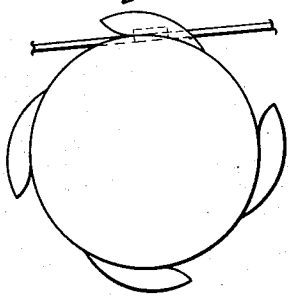


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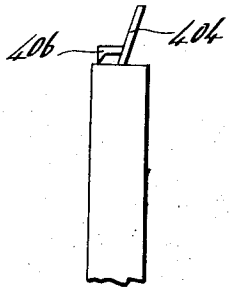


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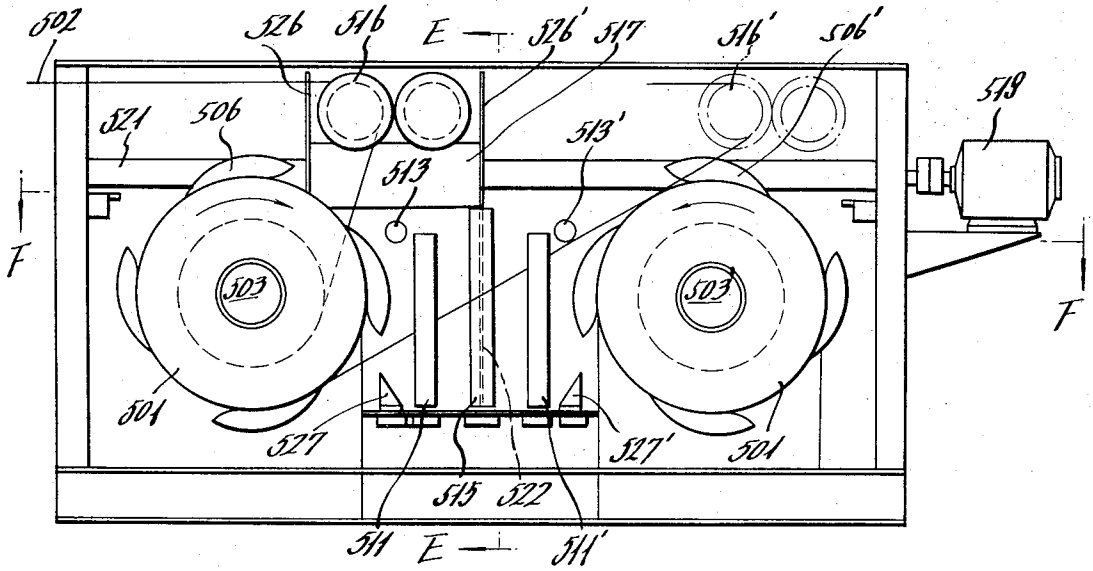
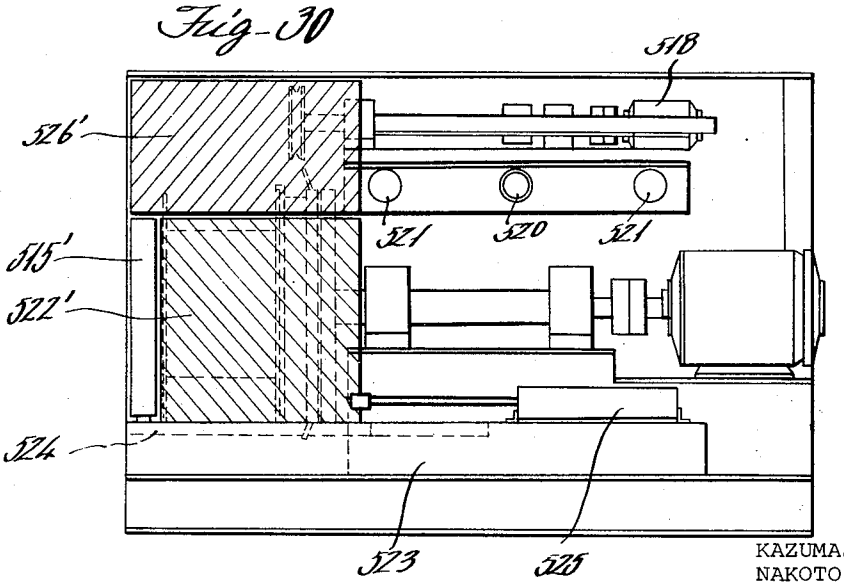


Fig. 30



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Fig. 31

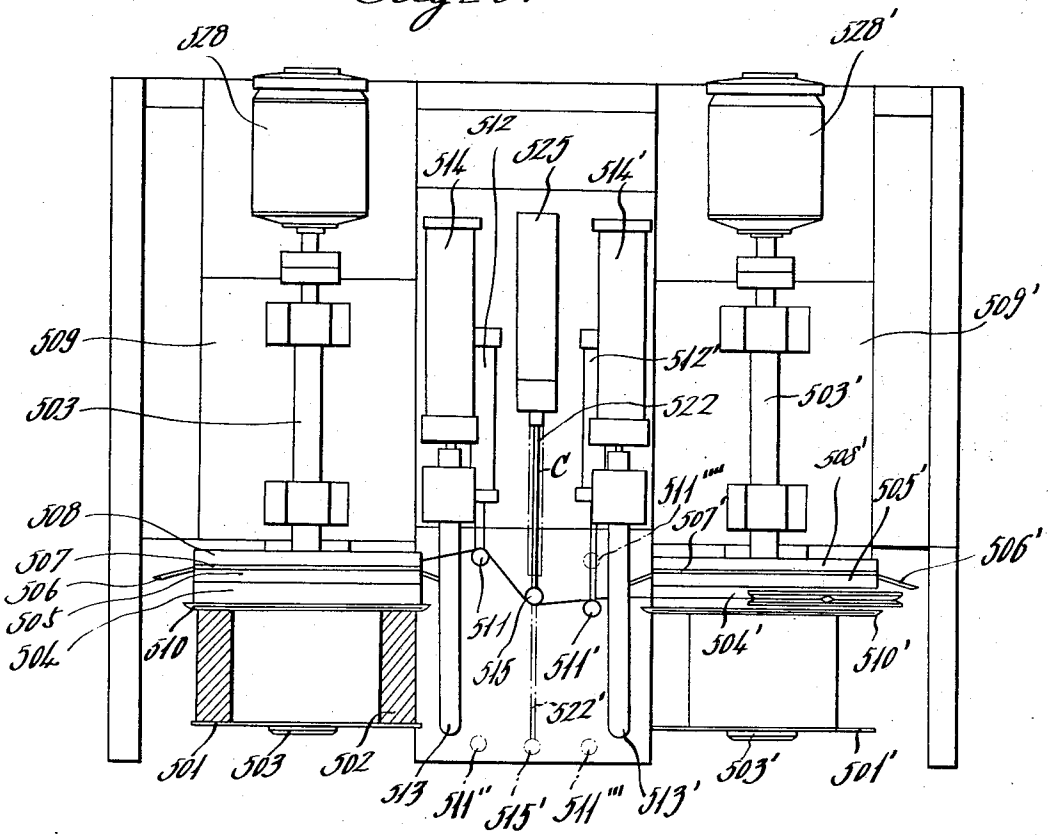
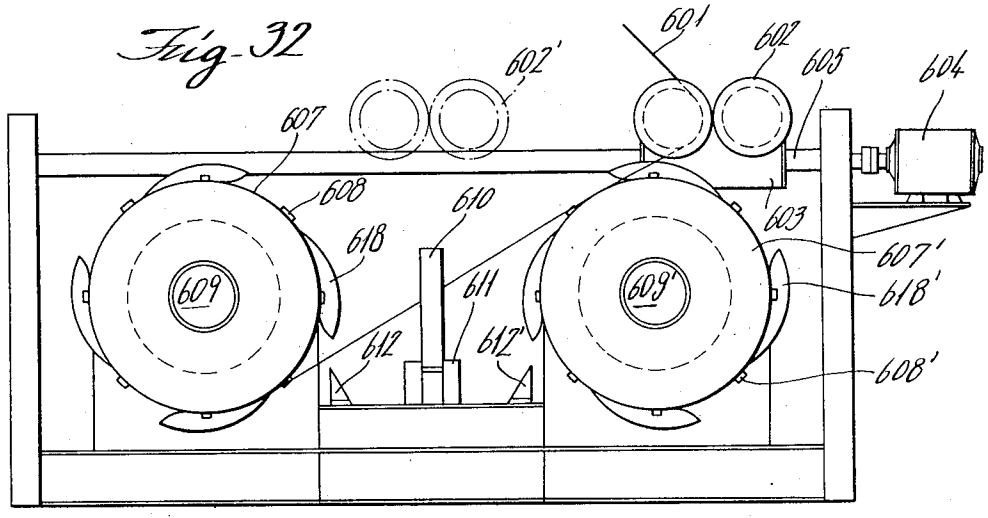


Fig. 32



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Fig. 33

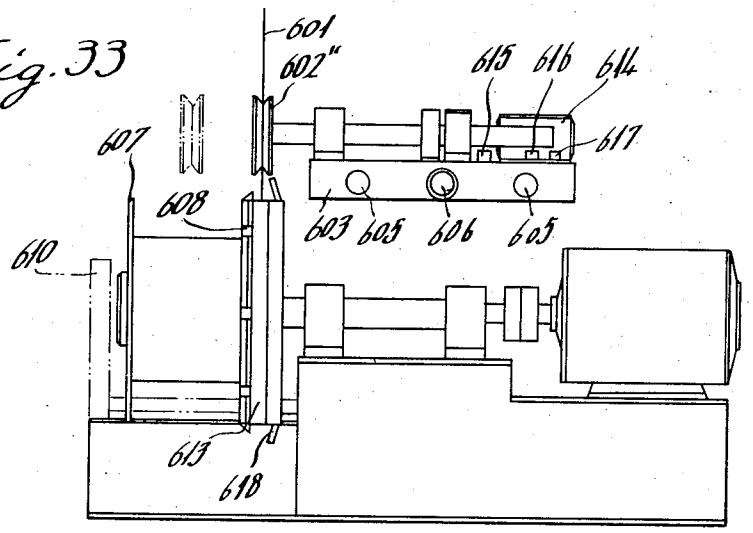


Fig. 34

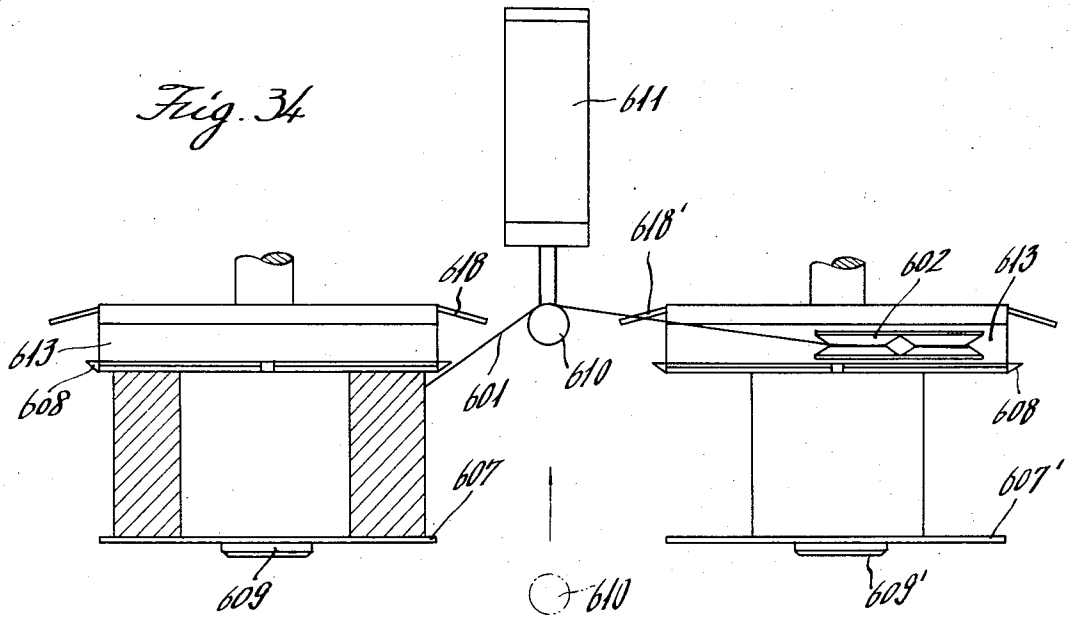
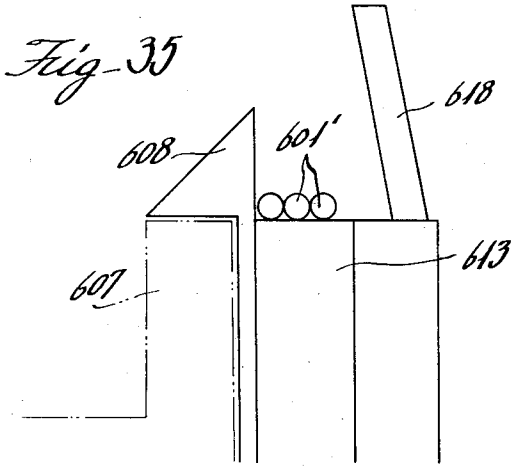


Fig. 35



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Fig. 36

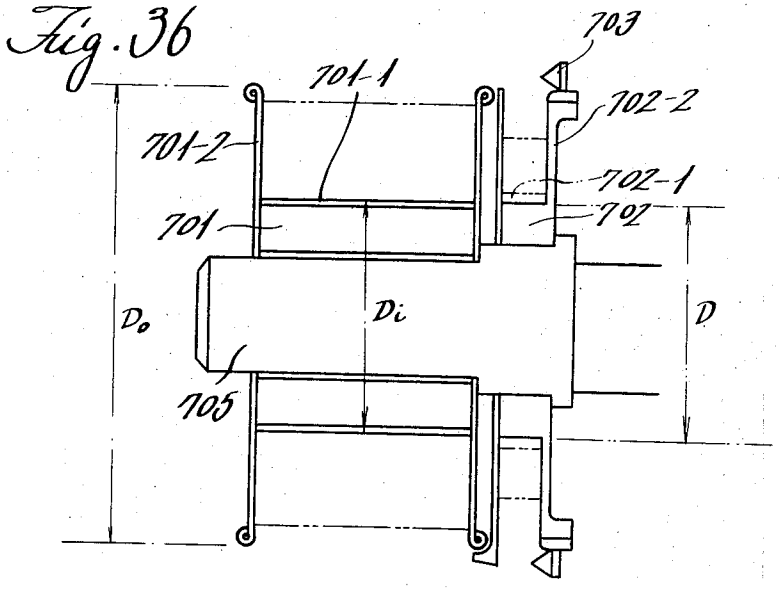
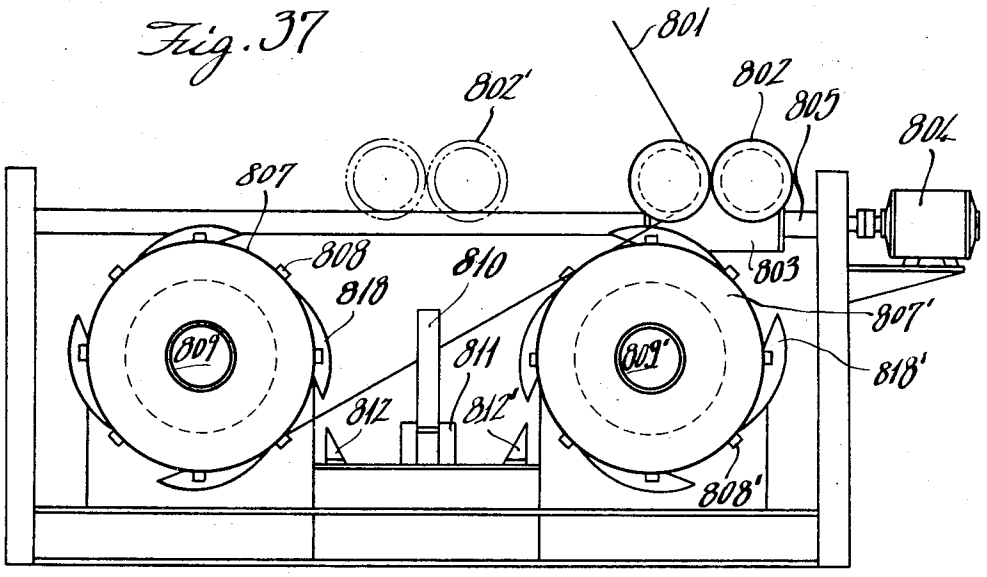


Fig. 37



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Fig. 38

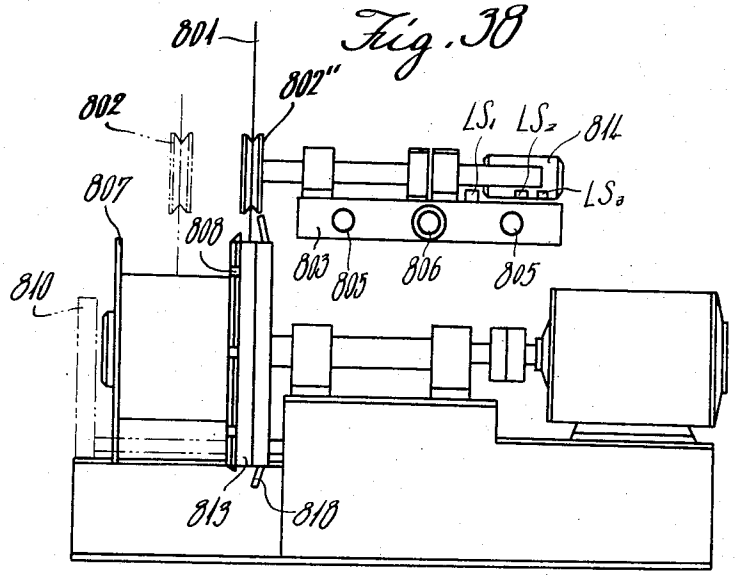
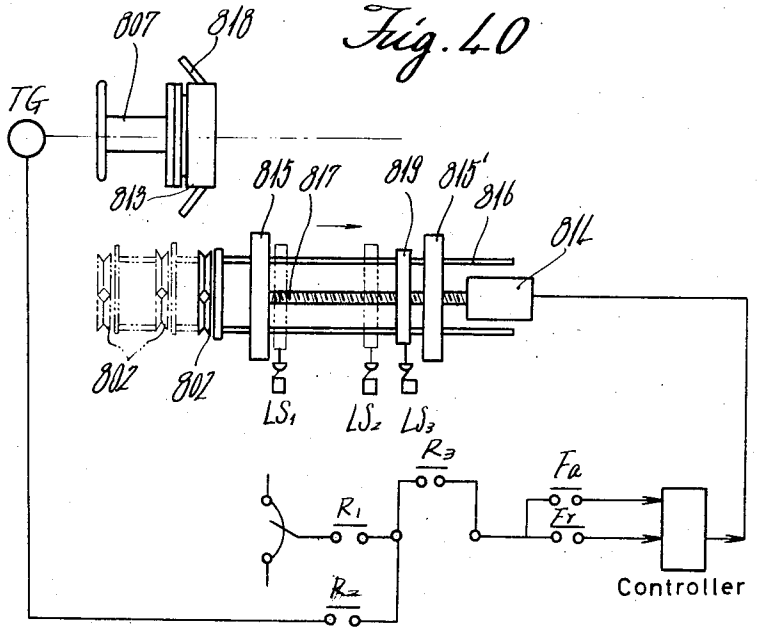


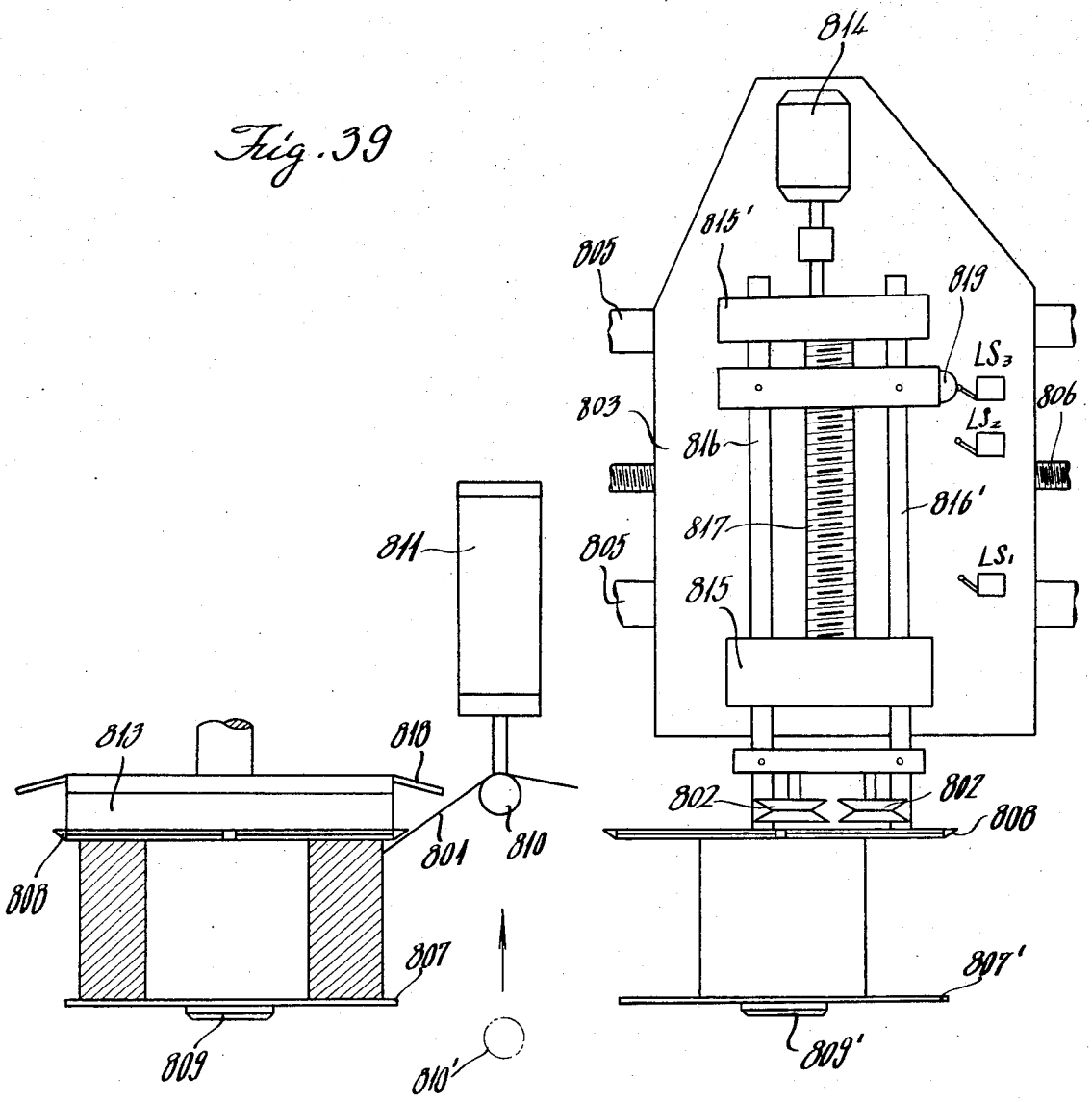
Fig. 40



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Fig. 39



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Fig. 41

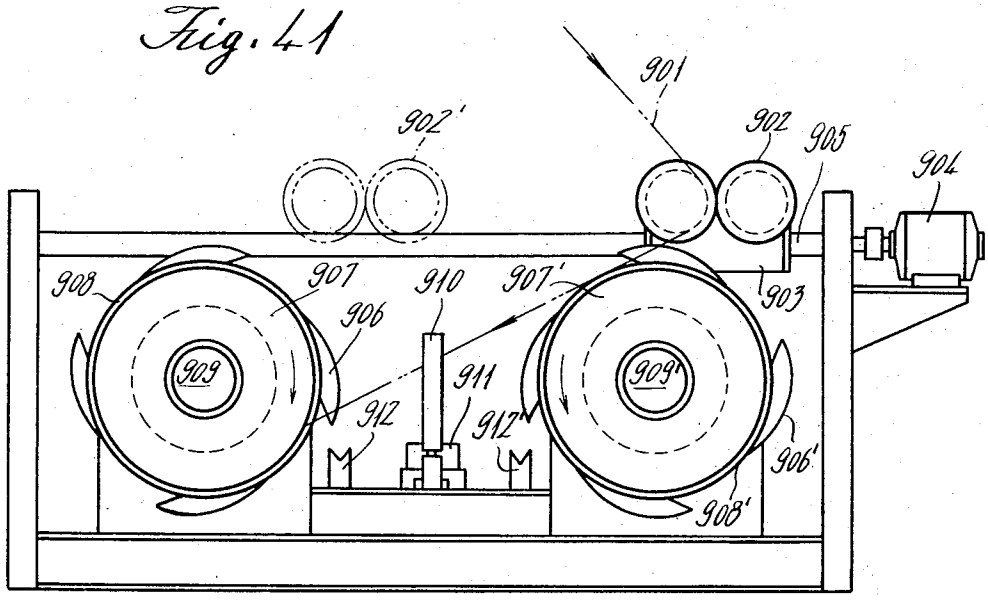
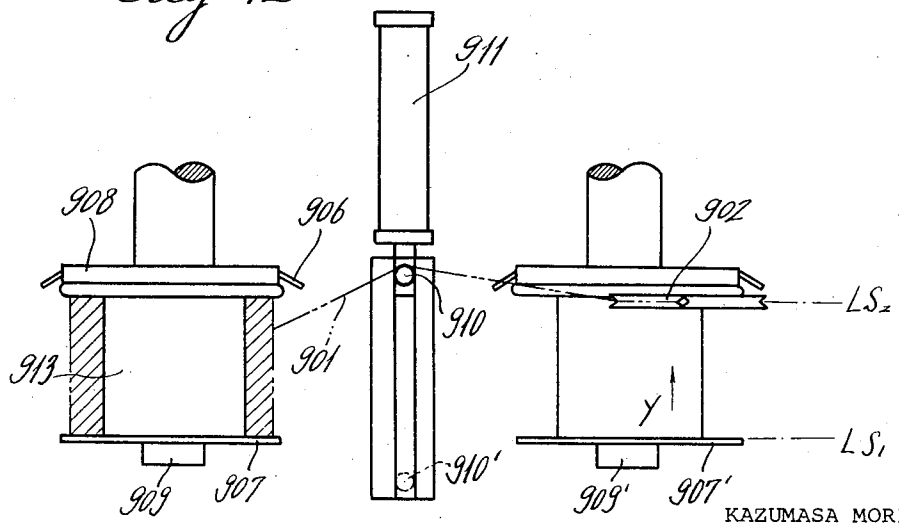


Fig. 42



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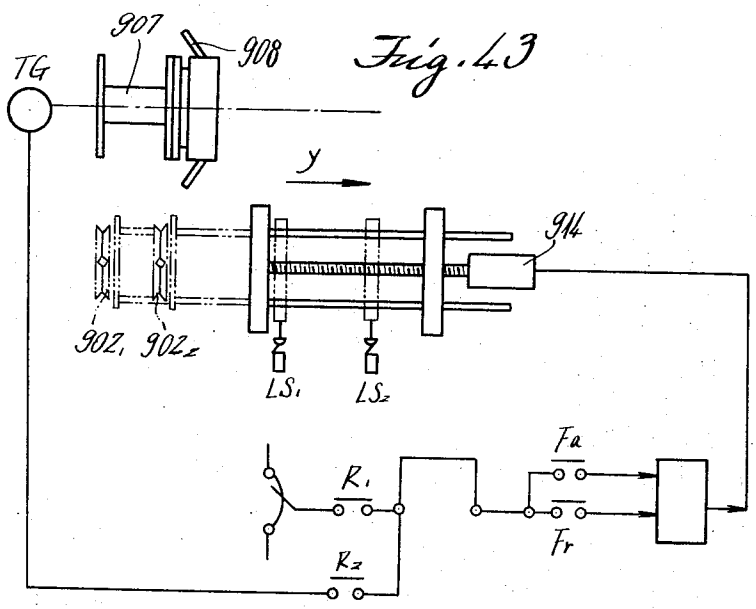


Fig. 43

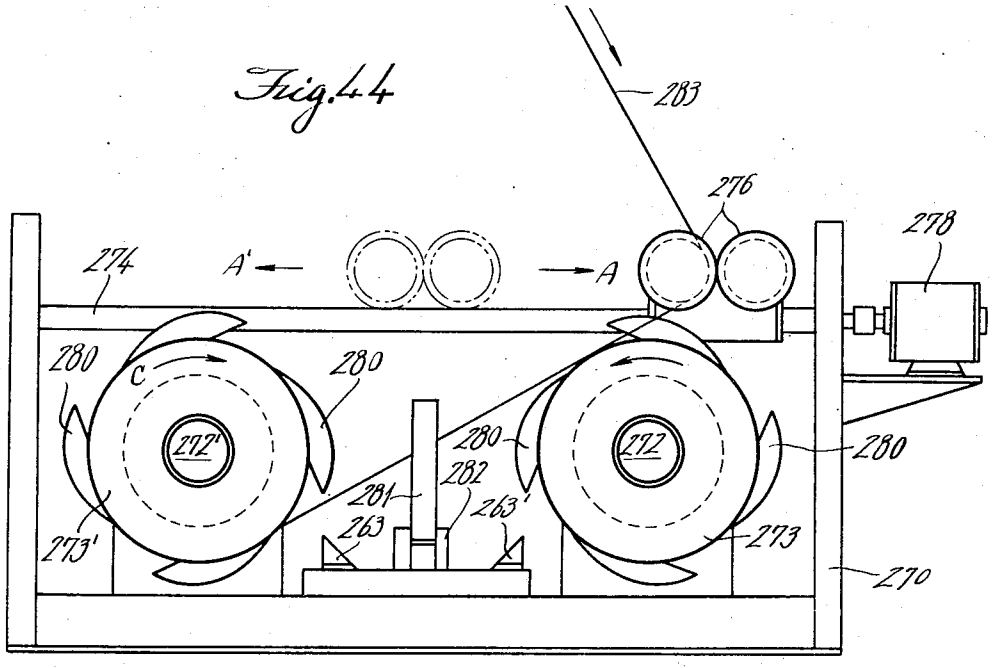


Fig. 44

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Fig. 45

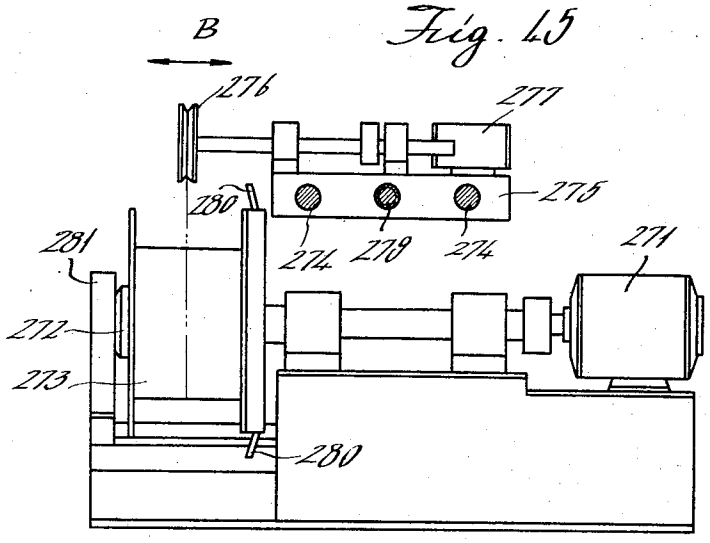


Fig. 46

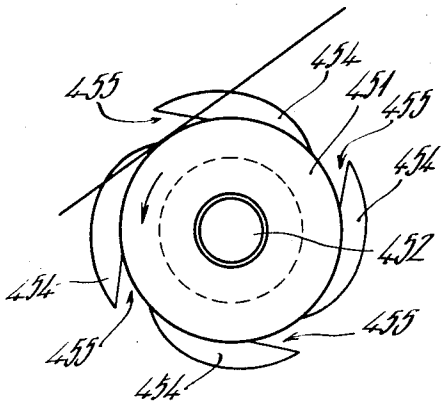
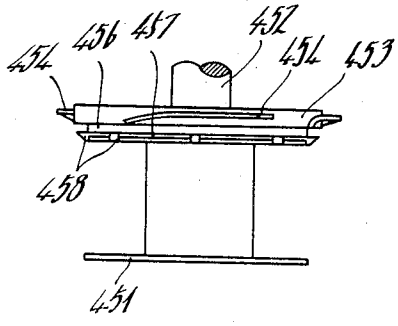


Fig. 47



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Fig. 48

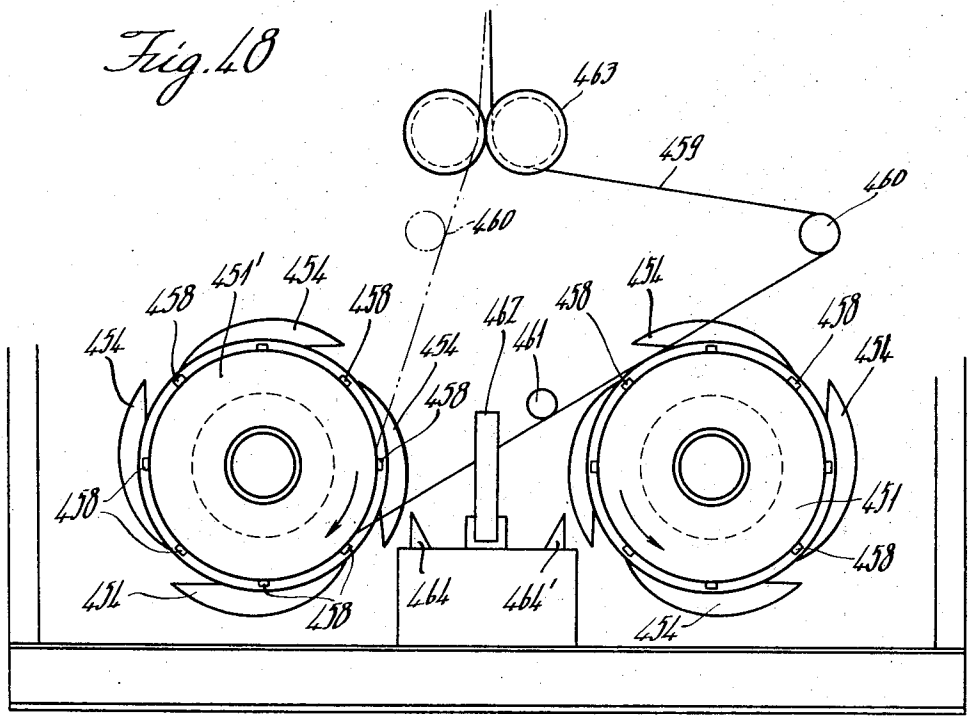
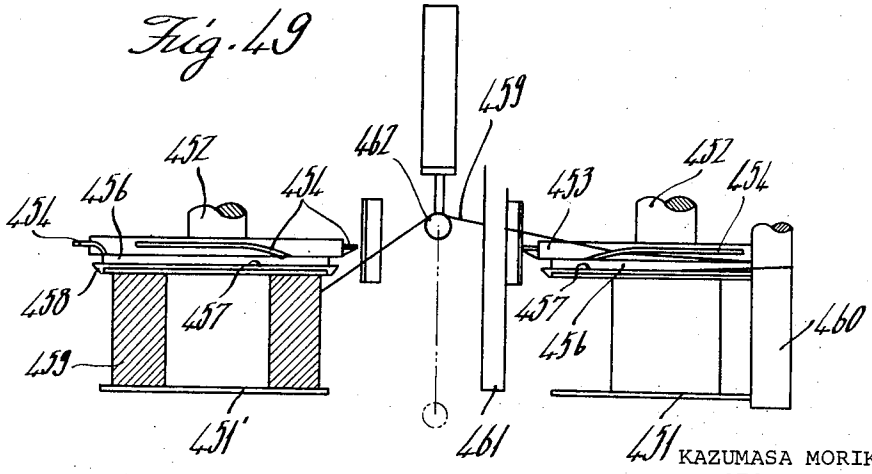


Fig. 49



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CONTINUOUS WINDING APPARATUS

The present invention relates to the method and apparatus for gripping the end portion of the wire wound-up in a predetermined amount on a spool at the moment when the winding is shifted from the said spool to an empty spool, in a wire winding apparatus which winds such wire as electric cable, etc. at a high speed and in a continuous manner, particularly in a continuous winding apparatus for the wire which has two spools with shafts being parallel to each other and with winding-up surfaces being positioned on the same plane, and in which the wire is consecutively wound onto the said two spools alternately, and further the present invention relates to the various related apparatus in the continuous winding apparatus for the wire.

In a conventional type of continuous winding apparatus for the wire, no such apparatus is provided which grips the end portion of wire wound up on a spool in a predetermined amount. Therefore the spool on which a predetermined amount of the wire has been wound up must be stopped every time the wire is shifted from the said spool to the empty spool. Especially when the wire is wound up on a spool at a high speed, it takes several seconds to bring the spool to a complete stop because of its mechanical and electrical characteristics. Therefore, since the spool will rotate several ten times during said several seconds, the end portion of the cut wire will make uncontrolled and irregular movement, thus damaging the outer layer of the wire already wound on the spool and rendering the same defective, sometimes with a danger of the end portion of the wound-up wire being cut off and flying around. And especially in case of the hard wire material, the wire already wound up onto the spool becomes loose due to the spring back action of the wire causing great difficulties when the spool is removed from its shaft. Thus the conventional type of a continuous winding apparatus had serious shortcomings.

While such means is employed as for holding down one spot or two of the wire wound on the spool from outside for preventing said loosening of the wound-up wire by cylinders, etc., it has been difficult to prevent uncontrolled movement of the end portion of the wire and flying of cut pieces of the wire ends by such means although the loosening of the wire may be prevented by the same.

The present invention is to eliminate said shortcomings, and lies in that a beak-like catchers for gripping the wire are provided in a protruding manner at a flange of the spool or at the circumference of an end plate fixed to a spool driving shaft, and a barrel for winding the end portion of the wound-up wire is provided for winding up the wound-up end portion of the wound-up wire in a fixed position in relation to the spool driving shaft, and at the same time a non-rotating cover which is fixed to a frame having a wire inlet opening and preventing the wire from jumping out of place is provided to cover the outer circumference of the barrel to wind the end portion of the wound-up wire, wherein the wound-up end portion is wound around the barrel positioned within the said cover near the spool to which a predetermined amount of wire has been spooled by relative action involved in the shifting of the winding up of the wire from the spool to which the wire has been wound up in a predetermined amount over to the empty spool.

Thus since the end portion of the wound-up wire is placed into the cover for preventing the wire from jumping out of place according to the present invention, the un-controlled and irregular movement of the end portion of the wire, the flying of cut off ends, the loosening of already wound-up wire, etc. can be effectively prevented.

In the continuous winding apparatus to which the present invention relates there are two types; that is (1) the type wherein the wire is wound up consecutively and alternately to two or more of the spools having rotating shafts, arranged in the same plane and rotating surfaces parallel to each other, and (2) the type wherein the wire is consecutively and alternately wound up by two spools having rotating shafts arranged parallel to each other and rotating surfaces on the same plane. And in both of the above types (1) and (2) the number of spools is generally two and the wire is wound alternately on the spools.

Further the present invention is to provide such a mechanism for handling the end portion of the wound-up wire as may be advantageously applied particularly to the continuous winding apparatus of the type (2) mentioned above, and at the same time to provide various mechanisms applicable in a continuous winding apparatus.

One of the main objects of the present invention lies in completely eliminating such various defficiencies and troubles caused by the end of already wound-up wire as have hitherto been met in a conventional type of the continuous winding apparatus, through, as mentioned before, winding up and gripping the end of already wound-up wire into a non-rotating cover which covers the barrel for winding the end portion of the wound-up wire and prevents the wire from jumping out of place, the said barrel being in a fixed position in relation to the rotating shaft of the spool on which a predetermined amount of the wire has been spooled, at the time when the spooling of the wire is shifted from the spool on which a predetermined amount of the wire has been spooled to the empty spool.

One of the objects of the present invention is to provide such a mechanism to grip or catch the finishing end portion of wound-up wire as being suitable to the continuous winding apparatus according to the type (2) mentioned above, by providing wire catchers on its circumferential surface of the flange of the spools or on the circumference of the end plates being fixed in position in relation to the rotating shafts of the spools and by providing barrels for winding the finishing end portion of the wound-up wire which are fixed in place in relation to the rotating shafts of the spools, and further a cover which covers the circumference of the said barrels for winding the finishing end portion of the wound-up wire for preventing the wire from jumping out of place, having wire intake openings, said cover being so positioned, in a non-rotating manner, as forming a space between the cover and the above-mentioned flange or the end plates to allow passing of the wire, so that the finishing end portion of the wound-up wire which is to be wound on said barrel is taken into said cover through the action of the mechanism at the time when the wire is shifted, or is to provide a continuous

winding apparatus having the wire end catching mechanism mentioned above, for winding such a wire as electric cable, etc. consecutively and alternately on two spools having their winding surfaces on a same plane.

Another object of the present invention is to provide a continuous winding apparatus for winding wire alternatively and consecutively on two spools having the above-mentioned mechanism to catch the finishing end of the wound-up wire and having a traverser and catching guides, wherein the finishing end of the wound-up wire to be wound on the barrel for winding the finishing end portion, is caught into the cover of the above-mentioned mechanism by the action of the catching guides.

Further another object of the present invention is to provide a continuous winding apparatus for winding wire alternatively and consecutively on the above-mentioned two spools, having such an apparatus for assuring proper functions of the wire-shifting which hooks the wire with the wire catcher on the empty spool side at the time when the wire is shifted from the spool to which a predetermined amount of wire is wound to the empty spool.

Such a continuous winding apparatus as mentioned above has shortcomings that while the wire needs to be pulled, at the time when the wire is shifted from the spool on which a predetermined amount of wire has been wound to an empty spool and is wound thereon, to the side of the empty spool by a traverser and a portion of the wire thus pulled needs to be hooked to the wire catcher on the empty spool side, the locus of the above-mentioned wire to be pulled will greatly vary depending on the amount of wire already wound on the loaded spool, and the length of wire between the traverser and the spool is long and the wire will vibrate up and down, thus the hooking of the wire to the wire catcher on the empty spool side can not be done with sureness.

Thus is order to overcome the above defficulties, it will be necessary to use such a wire catcher as being larger than the outer diameter of the spool flange, but as the size of this apparatus itself should desirously be made as small as possible, the size of the wire catcher will be naturally limited. Therefore, with only a small wire catcher it has been difficult to surely hook the wire and complete and satisfactory catching or gripping of the wire has been difficult.

The present invention is intended to eliminate said difficulties and to provide a guide for adjusting wire position, which is positioned between the traverser and the spool and moves forward and backward, in a continuous winding apparatus for winding wire alternately and consecutively on two spools, for adjusting the locus of wire up to the traverser which has been shifted from the spool, on which a predetermined amount of wire has been wound, to the direction of an empty spool, thus wire is surely hooked to the wire catcher on the empty spool side. Therefore, the catching of wire to the empty spool can be done in surer manner according to the present invention, without being influenced by the amount of wire wound on the spool on which a predetermined amount of wire has been wound, and by the vibration of the wire.

Further in the above, the intended results can be secured with a simple and compact structure if a guide for adjusting wire position (a level guide) for assuring a proper shifting operation as mentioned above is provided to the catching guide in order to facilitate the hooking of wire with the wire catcher on the empty spool side. That is, by integrally attaching the level guide to the catching guide, the use of a cylinder for operating said level guides will not be necessary, and further as the space between the spools can be made small, the entire apparatus can be made compact and the number of parts may be made small, thus simplifying the control and operation of the apparatus.

Still further object of the present invention lies in providing a spooler which comprises a rotating shaft on which a spool and a barrel for winding the finishing end portion of wire are mounted removably, said shaft being supported movably in axial direction, a stationary cover for covering the above barrel at the winding position, and a cylinder for moving the above shaft in axial direction, thus placing and displacing the spool in and out of the winding position.

Generally speaking in this type of continuous winding apparatus, two spools are placed in a housings on the wire winding line and the wire is wound on the spools consecutively and alternately by shipping the wire from one spool to the other, replacing the full spool with an empty spool, thus effecting continuous winding of wire.

Then, this requires that the removing of the spool fully wound and placing of an empty spool are to be done on the wire winding line, thus causing danger and lowering the operating efficiency.

Therefore, the present invention is to secure safety in operation at the time of replacing spools and enhance operating efficiency by allowing the shaft of the spool and the spool itself to be removed out of and placed into the wire winding line.

On the other hand, the above-mentioned spool removing and placing apparatus may be so made that spools are so mounted as being freely assembled and disassembled; and the barrel for winding the finishing end portion of wire is fixed to the rotating shaft which is supported on a movable bed, and the cover for covering the finishing end portion of wire wound on the barrel is composed of an upper portion fixed to a housing and a lower portion fixed to the movable bed, and that at the same time a cylinder is assembled to the movable bed for moving the movable bed to the axial direction of the rotating shaft, thus allowing said spool to be removed out of and placed into the wire winding line.

As the cover in the above-mentioned continuous winding apparatus, it will be more convenient to provide an opening for removal of scrapped wire at the lower portion of the cover and a lid which can be freely opened and closed at its upper portion.

That is, for taking out the finishing end portion of wound wire out of the wound-up portion of said spool, it is necessary to provide an opening through the cover for removing the finishing end portion of wire, or to make the entire cover in such structure as being freely removed and assembled.

And in providing an opening through said cover, according to the experiments made by the inventors, the finishing end portion of wound wire is liable to be

jumping out of this opening unless the radial angle of the opening at the outer of the rotating shaft is made smaller than 15°.

However, in a winding apparatus with small size spools if said radial angle of the opening is not larger than 15°, removal of the wire will be difficult and operating efficiency will become poor.

Therefore, it is desirous to provide an opening at the upper portion of said cover with a radial angle layer than 15° and providing thereto a lid which can be freely opened and closed, and if a scrapped wire removal opening is provided at the lower end portion of said cover, it will be advantageous as scrapped wire may be conveniently removed and as there will be no fear that scrapped wire will remain within the cover until a subsequent operation.

Further, another object of the present invention is to provide a spool removal and assembly apparatus which allows the spools in a continuous winding apparatus to be simply and swiftly removed when the wire is cut at the completion of winding or during the winding of wire.

In a conventional winding apparatus, as the removal and assembling of the spools are done on the wire winding line, there has been such fear that cut pieces of the wire being wound in the other spool may constitute hazards to the workers engaged in removal or assembling of the spool, and the removal or assembling operations themselve are complicated.

The present invention is to solve the problems just mentioned and is to provide an apparatus for removing and assembling of a spool, especially usefull for a spool which is used in combination with a barrel for winding the finishing end portion of wound wire.

Now, still another object of the present invention lies in providing improvement in a wire cutting apparatus used at the time when wire is shifted from the spool on which a predetermined amount of wire has been wound to the empty spool in the above-mentioned continuous winding apparatus.

Hitherto, the wire cutting apparatus in this kind of continuous winding apparatus has such shortcomings that while the wire is moved, when a predetermined amount of wire material is wound to one spool, to the direction of the other empty spool, thus ready to be wound on said empty spool, and at this time there is a fear that the finishing end portion of the wire wound to the first spool might be cut off by either one or by both of the cutting apparatus closed to the spool on which a predetermined amount of wire has been wound and close to the empty spool. If the wire is cut either by both or either of the above cutting apparatus, the wire between the both cutting apparatus would be cut, cut pieces jump around, thus causing hazards.

The present invention is further intended to eliminate said shortcomings and is to provide such a wire cutting apparatus in a continuous winding apparatus for winding wire alternately and consecutively on two spools. According to the present invention, the wire cutting apparatus is provided to each of two spools respectively and the cutting apparatus on the empty spool side is pushed forward and at that moment the cutting apparatus close to the other spool, on which the wire has been wound is pushed back, thus the cutting apparatus is alternately pushed forward or pushed back.

Therefore, according to the present invention, both of the cutting apparatus can operate alternately to surely cut the wire wound up in a predetermined amount, and such a problem of cut pieces of scrapped wire as in the conventional apparatus can be eliminated.

And, as the cutting apparatus mentioned above, there are such an apparatus as having a pair of round cutters (or shears) adjacent to each other, which are positioned close to each spool and are rotatable or are driven to rotate, and such a wire cutting apparatus as having cutting blade close to a wire catcher.

Further, another object of the present invention lies in providing such a safety screen, as being able to be placed in and out and being also useful as stopper mechanism, between spools for insuring safety in winding operation and protecting the machine, etc. and more specifically providing a central safety screen for preventing jumping up of wire when it is cut.

The central safety screen of the present invention will be located between two spools when wire is being wound to one of the spools, thus isolating the spools from each other, and when the wire is shifted from a full spool to an empty spool the screen will retreat so that it will not be on a way of the wire shifting, and after the wire has been shifted to the empty spool, the screen will proceed to come to a position between two spools.

In addition, the central safety screen of the present invention also serves as a stopper (wire guide) for preventing the wire from being caught by the wire catcher on the side of the empty spool to which the wire is shifted during the time before the guide roller comes to a predetermined position while the central screen is retreating at the time of wire shifting.

Moreover, in the present invention, if necessary, screens may be placed on both sides of the traverser so that either one of these screens comes to such a position as being in the same plane with the above-mentioned central safety screen, thus further insuring the safety and proper operation at the time when the wire is wound.

Still another object of the present invention is to provide such improvement of the spool in a continuous winding apparatus as having, in addition to the barrel for winding the finishing end portion of wire mentioned above, a barrel for winding a starting end portion of the wire to be wound.

Generally speaking, in a conventional continuous winding apparatus, the wire is wound on two spools alternately and continuously through a traverser, and in this case the starting end portion of wire to be wound consists of a length equal to the distance between the wire catcher and the flange of the spool, but since the distance between the wire catcher and the flange of the spool is short, the length obtainable as the starting end portion to be wound is at maximum about 15cm.

However, in supplying the wire thus wound on each spool to a subsequent step, it will be necessary to joint, by welding the starting end portion of wire at one of the spools and the finishing end portion of the wire already wound on the other spooler, and as the starting end portion is only such length as 15cm, it is too short to satisfactorily conduct jointing operations such as welding, etc., and sometimes said welding operations can not be effected.

Therefore, the inventors of the present invention have, in an effort to eliminate the shortcomings men-

tioned above, developed such a winding apparatus that a barrel, for winding the starting end portion of wire to be wound, is attached to a rotating shaft which supports the spool, and projections for preventing slipping of the wire are provided on the circumference of the barrel just mentioned above at its side facing the spool, wherein the function of the traverser and that of the catching guide are synchronized for causing said barrel to wind a required length of starting end portion of wire to be wound.

And as the barrel for winding the starting end portion of wire to be wound according to the present invention, it is advantageous to employ such a barrel having a diameter larger than the barrel diameter of the spool and at the same time smaller than the mean value of the barrel diameter of the spool and the outer diameter of the spool flange, thereby various difficulties which may arise at the time when the wire is shifted from the barrel for winding the starting end portion of wire to be wound over to the barrel of the spool may be eliminated. Such structure as just mentioned have great effects especially for the spool having a great ratio between the diameter of flange of the spool and the barrel diameter of the spool.

Further, another object of the present invention is to provide, in the above-mentioned continuous winding apparatus, such an apparatus for winding the starting end portion of wire to be wound by using the traverser for taking out the required length of the starting end portion of wire to be wound into the spool. That is, in the present invention the above-mentioned object is achieved by temporarily stopping the operation of the traverser for a predetermined length of time, at the time when the traverser comes above the barrel for winding the starting end portion of wire to be wound, for example by actuating a limit switch, until the catching guides bring the wire to be engaged with the wire catcher provided on the circumference of the spool.

According to the present invention, the synchronizing action for the traverser and the catching guide becomes unnecessary, and simplification of this kind of control mechanism may be achieved, and at the same time it will be possible to freely and precisely adjust the length of the starting end portion of wire to be wound where necessary.

Further, another object of the present invention is to provide a continuous winding apparatus of the type mentioned above, wherein at the time the wire is shifted from a full spool to an empty spool by synchronizing the action of the traverser and that of the catching guide and feeding the traverser and the catching guide, the accuracy of the length of wire is enhanced through counteracting the variations in the wire diameter with the speed of wire feeding without employing other adjusting means.

In a conventional continuous winding apparatus having two spools arranged in parallel to each other, on which the wire is wound alternatively and continuously, the accuracy in length of wound wire has not been regarded as vital matter since the wire is rewound and measured in the subsequent step. However from viewpoints of operation rationalization and enhancement of productivity and work yield, the rewinding of wire for measuring is undesirable, and it is most desired to directly measure the wire in the winding operation in the continuous winding apparatus.

The present invention is to meet to such demand as just mentioned by effecting the cutting of wire at earlier time and enhancing the accuracy in wire length through incorporating such mechanism as able to first feed the traverser at the time the wire is shifted from one spool to the other, and as able to fast feed the catcher guide, movement of which being synchronized by that of the traverser.

Still another object of the present invention lies in providing a continuous winding apparatus in which a traverser and a shifting guide are integrally built.

In a conventional continuous winding apparatus, the wire is wound on two spools, and at this time the wire is guided by a traverser and a shifting guide onto the spool and when a predetermined amount of wire is wound, a screw bar directly connected to an electric motor for shifting will rotate according to a shifting signal, then thereby the shifting guide will move along a guide bar up to a predetermined location and then it will stop.

And as the catching guide pushes the wire toward the wire catcher through the action of a cylinder, the wire is caught by the wire catcher and is cut by the cutting apparatus, thus winding is completed. And in a conventional winding apparatus, as the traverser is fixed and the shifting guide roller moves horizontally below the traverser, the traverser must be positioned much higher than the level of the spool by a height required for the shifting guide roller.

Therefore when the wire is wound under normal conditions, the difference between the positions of the traverser and of the wire on the spool becomes large and at the same time the difference in their positions will vary depending on the level of the wire already wound on the spool, thus it becomes difficult to wind the wire flatly on the barrel of the spool, moreover, when the wire is shifted from the full spool to the empty spool it is wound through the shifting guide roller, therefore the degree of shipping of the wire on the shifting guide roller varies depending on the diameter and tension, etc. of the wire, thus shifting of the wire becomes irregular.

At the same time there has been such shortcomings that the wire is bent by the shifting guide roller, deteriorating the mechanical properties of the wire.

The present invention is intended to eliminate such difficulties as mentioned above, and is to integrally build the shifting guide roller of conventional type and the traverser together, so that the traverser moves horizontally toward the spool at the time of shifting of the wire to the empty spool.

Still another object of the present invention is to provide a continuous winding apparatus having a wire catcher which is advantageous for catching the starting end portion of wire to be wound.

The present invention is characterized by providing a wire catcher on the circumferencial surface of the end plate integrally built with the rotating shaft of the spool in such manner that the wire catcher is projecting in the radial direction, and is forming a space for catching the wire between the wire catcher and the circumferential surface.

Therefore by using the wire catcher according to the present invention, the difficulties in catching the wire at the time of taking out the starting end portion of wire to be wound, are eliminated, and an efficient continuous winding of the wire is thus achieved.

Examples of embodiment of the present invention will be explained as follows, in order to illustrate the present invention. These explanations will not set limits to the present invention and any modification not deviating from the essence of the invention may be, of course, included in the scope of the present invention.

FIG. 1 shows a plan view of a continuous winding apparatus, provided with spools, which have barrels for winding the finishing end portion of the wound-up wire;

FIG. 2 is a front view of FIG. 1;

FIG. 3 is a side view of a spool and the said barrel of FIG. 1; and

FIG. 4 is a partly sectioned view of FIG. 3.

FIG. 5 is a front view of a continuous winding apparatus, provided with guides for adjusting wire position; and FIG. 6 is a side view of FIG. 5.

FIG. 7 is a front view, showing another example of a continuous winding apparatus, provided with guides for adjusting wire position;

FIG. 8 is a side view of FIG. 7;

FIGS. 9 (a) and (b) illustrate the operations in FIG. 7 and FIG. 8.

FIG. 10 is a side view of a guide for gripping the wire in beak-like catchers provided with a guide for adjusting the wire position.

FIG. 11 is a front view of part of FIG. 10.

FIG. 12 is a vertically sectioned side view of an apparatus for loading and unloading a spool in a continuous winding apparatus;

FIGS. 13 (a) and (b) are respectively a vertically sectioned side view and a front view of another example of an apparatus for loading and unloading spools in a continuous winding apparatus;

FIG. 14 is a section, along A—A in FIG. 13 (a);

FIG. 15 is a side view of a cover for gripping the finishing end portion of the wound-up wire;

FIG. 16 is a section of the main part of the cover and

FIGS. 17 (a) and (b) are respectively a front view and a section, along B—B, showing the mechanism of the cover of FIG. 15.

FIG. 18 is a section of an apparatus for loading and unloading of a spool;

FIGS. 19 (a) and (b) are respectively a section, along C—C and a section, along D—D, in FIG. 18; and

FIGS. 20 (a), (b) and (c) illustrate the respective states of loading and unloading a spool in FIG. 18.

FIG. 21 is a front view of a wire cutting apparatus for putting in and out the wire cutters or shears in a continuous winding apparatus.

FIG. 22 is a plan view of the above, and

FIG. 23 is a front view of a wire cutting or shearing apparatus;

FIG. 24 is a plan view of the same;

FIGS. 25 (a) and (b) are respectively a front view and a side view of a unit of a cutting or shearing apparatus;

FIGS. 26 (a) and (b) and FIGS. 27 (a) and (b) are respectively plan views and front views, illustrating the motions of another example of the wire cutting or shearing apparatus;

FIGS. 28 (a), (b) and (c) are respectively a plan view, a front view and a side view of a cutting or shearing apparatus, serving also as a wire catcher.

FIG. 29 is a front view of a continuous winding apparatus, provided with a safety screen;

FIG. 30 is a section view along E—E in FIG. 29; and

FIG. 31 is a section view along F—F in FIG. 29.

FIG. 32 is a front view of a continuous winding apparatus, provided with spools, which have a mechanism to start winding;

FIG. 33 is a side view of the same;

FIG. 34 is a plan view of a part of the same;

FIG. 35 is a partly sectioned view; and

FIG. 36 is a vertically sectioned side view of a spool, having a barrel for winding the starting portion of the wire to be wound.

FIG. 37 is a front view of a continuous winding apparatus, having a mechanism to take out the starting portion of the wire to be wound;

FIG. 38 is a side view of the apparatus in FIG. 37;

FIG. 39 is a plan view of the same; and

FIG. 40 is a circuit diagram, showing a controlling system in FIG. 37 to FIG. 39.

FIG. 41 is a front view of a continuous winding apparatus, having a mechanism to regulate a wire length;

FIG. 42 is a plan view of the same;

FIG. 43 is a circuit diagram showing a controlling system in FIG. 41 to FIG. 42.

FIG. 44 is a front view of a continuous winding apparatus, provided with the traverser of the present invention;

FIG. 45 is a side view of the same.

FIG. 46 and FIG. 47 are respectively a front view and a plan view of a spool, provided with a wire catchers of the present invention; and

FIG. 48 and FIG. 49 are respectively a front view and a plan view of a continuous winding apparatus, using the said spool.

EXAMPLE 1: (FIG.1 to FIG.4)

1 shows a wire and the said wire 1 is to be wound through a conventional traverser 2, serving also as a travelling guide, on spools 8 and 8', which are fixed on rotating shafts 9 and 9'. 3 is a shifting guide, having the said traverser 2 installed on the shifting guide, and the said shifting guide 3 is engaged with a threaded rod 4, installed on a frame. As the threaded rod is rotated in a clockwise or an anticlockwise direction by the normal or reverse rotation of a motor 6 for shifting, shifting guide 3 will be horizontally moved by the rotation of the threaded rod 4.

5 and 5' are end plates, joined with the outward surface of flanges of the spools 8 and 8' respectively, and fixed to the rotating shafts 9 and 9' of the spools. Around the circumference of the end plates 5 and 5', a plurality of wire catchers 7 and 7' are attached at regular intervals, projecting outside the circumference of the flanges of the spools 8 and 8'. Barrels 17 and 17' for winding the finishing end portion of the wound-up wire, are, also, installed on the side of end plates 5 and 5', opposite to the side to which are joined the flanges of the spools. Around the periphery of the barrels 17 and 17', covers 14 and 14' with an inlet 16 for the wire, are positioned to prevent the wire from getting off and the covers are fixed to the frames 15 and 15'. 10 and 10'

are guides for guiding the wire to beak-like catchers, and the said guides **10** and **10'** can be moved in the forward and backward directions by the action of cylinders **12** and **12'**. **11** is a stop, positioned between the said guides **10** and **10'**, and **13** and **13'** are the wire cutting or shearing apparatus.

The space *d* between the end plate **5** and the cover **14**, as shown in FIG. **3**, should be equal to, or 1½ times as large as the diameter of the wire, in order to pass the wire **1**.

Next, we shall explain how to operate the apparatus. The wire **1** is wound through the traverser **2** which operates automatically as described hereinafter in connection with FIGS. **40** and **43**, serving also as a shifting guide, on the spool **8**, which is fixed on the rotating shaft **9**, the traverser **2** moving back and forth parallel to shafts **9** and **9'**. The prescribed quantity of the wire having been wound, a shifting signal is provided by a switch means (not shown) controlled, for example, from a conventional counter to energize the motor **6** to rotate the threaded rod **4** for shifting, and the shifting guide **3** moves to and stops at the position shown in solid lines where it actuates a limit switch (not shown). The limit switch signal for stopping actuates a solenoid valve for supplying pressure fluid to the cylinder **12**, and also, after a delay provided by a timer or the like, actuates a solenoid valve for supplying pressure fluid to the cylinder **12'**. The limit switch, solenoid valve and timer circuit is conventional and is not shown. The catching guide **10** starts being moved by the cylinder **12** and after the delay, the catching guide **10'** starts being moved by the cylinder **12'**. The positions of the catching guides **10** and **10'** lag behind each other. Though the traverser **2** may be in any place, when the catching guide is in the position **10'**, the wire **1** can not be gripped in the wire catcher **7'** on the side of the spool **8'** because of the stop **11**. Therefore, the wire **1** is, first, gripped, through the guide **10**, in the wire catcher **7** on the side of the spool **8**, which has wound up the prescribed quantity of the wire. Then, the wire is passed through the space *d* and after a few windings of the wire **1** on the barrel **17**, the wire **1** is gripped, through the catching guide **10'**, in the wire catcher **7'** on the side of the empty spool **8'**, and cut by the cutting or shearing apparatus **13'**. The cut end portion of the wound-up wire to be wound is passed through the inlet **16** of the cover **14** of the barrel on the side of the spool **8**, on which the prescribed quantity of wire has been wound. Then, the wire is wound on the barrel for winding the finishing end portion of the wound-up wire, and the finishing end portion of the wound-up wire can be caught in a perfect condition.

According to the present invention, the finishing end portion of the wound-up wire, is wound on the barrel for winding the finishing end portion of the wound-up wire, and, besides, is contained in the cover for preventing the free end of the wire from whipping, so that the said finishing end portion can not get off. Moreover, the wire, which has been wound already in the spool, will not be damaged by beating of the end portion of the said wire. The present invention is characterized by such an efficient winding of the wire.

EXAMPLE 2: (FIG. **5** and FIG.**6**)

21 is a wire and the said wire **21** is to be wound through a guide pulley **22** and the traverser **23**, serving also as a shifting guide, on spools **25** and **25'**, which are fixed to rotating shafts **30** and **30'**. **33** is an end plate, joined with the outward surface of a flange of the spools **25** and **25'**, and fixed to a driving shaft **31**, which is installed in one body with the rotating shaft **30** of the spool. Around the circumference of the end plate **33**, a plurality of wire catchers **24** and **24'** are attached at regular intervals, projecting outside the circumference of the flanges of the spools **25** and **25'**. **26** and **26'** show guides for adjusting wire position, which are moved forward or backward by the action of a cylinder **27**. The said guides **26** and **26'** are placed in the position **26''**, shown with a chain line in FIG. **6**, namely, above the spool, when they are moved forward; and drawn back outside the spool as shown with a solid line, when they are moved back-ward. **28** shows a guide for gripping the wire to beak-like catchers, which is placed in the middle of the spools **25** and **25'**. The said guide **28** can be moved forward and backward by the action of a cylinder **29**. **32** and **32'** show wire cutting or shearing apparatus.

Next, we shall explain how to operate the apparatus. The wire **21** is to be wound through the guide pulley **22** and the traverser **23**, serving also as a shifting guide, to the spool **25**, which is fixed to the rotating shaft **30**. A prescribed quantity of the wire being wound, the shifting guide **23** moves to and stops at the position **23'**, according to a shifting signal. On this signal for stop, the guide **26'** for adjusting wire position moves forward to the position **26''** by the action of the cylinder **27**, and is jointed with the wire **21'** or **21''**, which is stretched between the traverser **23'** and the spool **25**. The said wire **21'** or **21''** is, thus, adjusted into a certain position (most suitable to be gripped by the wire catchers **24**). **21''** shows the position of the wire, when the wire (**21**) has been wound fully to the periphery of the spool (**25**).

When the catching guide **28** is drawn back to the position **28'** by the action of the cylinder **29**, the wire **21'** or **21''** is, instantly, pressed to be engaged by the wire catchers **24'** on the side of the spool **25'**. As the spool **25'** rotates, the wire **21** is gripped in the wire catcher **24'**, and then, cut by the cutting or shearing apparatus **32'**, and later on, wound on the empty spool **25'** in sequence.

At the same time, the spool on which the prescribed amount of the wire has been wound stops. The traverser **23'**, serving also as a shifting guide, the guide **26'** for adjusting the wire position and the catching guide **28'** are respectively reset in the prescribed positions.

As above-mentioned, the present invention is characterized by an automatic and perfect continuous wire winding, in which both spools **25** and **25'** are respectively provided with the guides **26** and **26'** for adjusting the wire position, and the wire, stretched between the traverser and the spools, is adjusted into a certain position by the forward movement of the adjusting guide so as to be exactly caught in the wire catcher on the empty spool side.

EXAMPLE 3: (FIG.7 to FIG.11)

21 shows a wire and the said wire 21 is to be wound through a guide pulley 22 and a traverser 23, serving also as a shifting guide by being mounted on a threaded rod (not shown) as in FIG. 2, on alternately spools 25 and 25', which are fixed to rotating shafts 30 and 30'.

33 shows an end plate, jointed with the outward surface of a flange of the spools 25 and 25' and fixed to a driving shaft 31, which is fixed to the rotating shaft 30 of the spool. Around the circumference of the end plate 33, a plurality of wire catchers 24 and 24' are attached at regular intervals in the peripheral direction, projecting outside the periphery of the flanges of the spools 24 and 24'.

28 shows a guide for gripping the wire to beak-like catchers, placed in the middle of the spools 25 and 25', and the said guide roller 28 can be moved forward and backward by means of a cylinder 29.

26 shows a guide for adjusting wire position, which is fastened by means of a spring washer 34 and a nut 35 at a suitable position in an upper longitudinal hole 27 of the guide 28. 32 and 32' show wire cutting or shearing apparatus.

Next, we shall explain how to operate the apparatus. The wire 21 is to be wound through the guide pulley 22 and the traverser 23, serving also as a shifting guide, to the spool 25, which is fixed to the rotating shaft 30. A prescribed quantity of wire being wound, the shifting guides 23,23 move to and stop at the position 23',23' according to a shifting signal.

On this signal for stop, the cylinder 29 starts to operate and the guide 26 for adjusting wire position has the catching guide 28 moved to the position to be able to joint with the wire 21' or 21'', which is stretched between the traverser 23' and the spool 25. The wire 21' or 21'' is, thus, moved to a certain position (most suitable to be gripped by the wire catcher 24'). 21'' shows the position of the wire, when the wire 21 has been wound fully to the periphery of the spool 25.

When the catching guide 28 is drawn back to the position 28' by the action of the cylinder 29, the wire 21' or 21'' is pressed against the said guide and contacted with the wire catchers 24' on the side of the spool 25'. As the spool 25' rotates the wire 21 is gripped in the wire catcher 21', and then cut by the cutting or shearing apparatus 22', and later on, the winding is performed on the empty spool 25' in sequence.

At the same time, the spool 25 on which the prescribed quantity of wire has been wound stops. The traverser, serving also as a shifting guide, and the catching guide are reset to the prescribed position.

The above-mentioned is an example of the continuous winding apparatus having one catching guide 28 with a driving cylinder 29. When the end plate 33, attached coaxially on the rotating shaft 31 of the spool 25, is used as a barrel for winding the finishing end portion of a prescribed length of the wound-up wire, it is necessary to install two catching guides 28'', 28'' (FIG. 9) in order to perform the above winding. In this case, guides 26 for adjusting the wire position may respectively be mounted on each of the catching guides 28'', 28''

The guides 26 for adjusting the wire position on the catching guides 28 have upwardly curved portions so that they are able to be controlled in up and down movement. It is necessary that the length *l* of the curved portion correspond to the thickness of the roll of wire on the spool.

EXAMPLE 4: (FIG.12)

41 is a spool and 42 is a spool for winding the finishing end portion of the wound-up wire, having a portion 42–1 for winding the starting end portion of the wire to be wound and a portion 42–2 for winding the finishing end portion of the wound wire. These portions 42–2 are engaged with the end of a sliding shaft 43. 44 shows a wire catcher, attached to the projecting part between the starting portion 42–1 and the finishing portion 42–2, and 45 shows a key, fixing the spool 42 to the shaft 43.

The shaft 43 has splines cut axially on the peripheral surface and is engaged with a hollow shaft 46, which has splines cut axially on the inner surface of the circumference. The shafts 43 and 46 rotate fixedly but slidable on each other in the direction of the hollow shaft. The shaft 46 is sustained to be freely rotatable by the bearings 47, 47', and a rotary pulley 55 is fixed on the shaft 46.

Covers 48 for the finishing end portion of wire are projected from the metal fittings 56 supporting the bearing 47, in order to cover the finishing portion 42–2.

Another end of the above-mentioned sliding spline shaft 43 is rotatably connected with an intermediate rod 50 through a bearing 49. The said rod 50 is connected with a piston shaft 52 of a cylinder 51 for pulling the shaft in and out, the cylinder being installed under the shaft 43 in parallel to it.

53 shows a stepped part to prevent the spool 41, and the barrel 42 to move excessively toward the motor (not shown) on the shaft 43. 54 shows a housing.

Now, we shall explain about the operation of the above apparatus. When the wire is wound on the spool 41, the spool 41 is placed in the position, shown with a solid line in FIG. 12, and revolved through the hollow shaft 46 and the shaft 43 by means of a driving moter and the pulley 55 through a belt (not shown in the drawing). When the spool 41 becomes full and is replaced with an empty spool, the shaft 43 is stopped, and the shaft 52 is moved by the action of the cylinder 51 in the direction of an arrow *d*. The shaft 43 moves, thus, in the direction *d* through the inside of the shaft 46, and the spool 41 gets out of the housing 54 to the position 41', shown with an imaginary line.

Consequently, the relacement of the spool can be done outside the housing 54, namely, outside the wire winding line.

At that time, the spool 42 steps forward, leaving behind the cover 48, which is fixed to the metal fittings 56 supporting the bearing 47, thus convenient for handling the starting and finishing end portions of the wire. When the empty spool is put on and set back at the former position 41 for winding, the finishing portion 42–2 is covered by the cover 48, thus very advantageous for operation efficiency.

EXAMPLE 5: (FIG.13 and FIG.14)

A wire **61** is to be wound through a traverser **62**, alternately on the spools **63,63**. The spool **63** is attached detachably to a shaft **65**. A barrel **64** for winding the finishing end portion of wire is fixed to the shaft **65**.

The barrel **64** consists of a starting portion **64–1** for winding the starting end portion of wire and a finishing portion **64–2** for winding the finishing end portion of wire, and has wire catchers between these portions **64–1** and **64–2**.

The above-mentioned shaft **65** is sustained rotatably by the bearings **67,67'**, which are installed on a movable bed **66**. The other end of the shaft **65** is connected through a coupling **68** with a motor **69** which is installed on the movable bed **66**. **70** shows a brake.

The above movable bed **66** is maintained by means of a dovetail joint on a fixed bed **71** movably in the axial direction of the shaft **65**. The movable bed **66** can be moved by means of a cylinder **72**, installed in the fixed bed **71**.

The finishing portion **64–2** is covered at the wire winding position, with a cover **74**. The cover **74** is divided into an upper part **74–1** fixed to a housing **73**, and a lower part **74–2** fixed to the movable bed **66**.

75 shows a stepped part, provided on the shaft **65** for preventing the spool **63** and the barrel **64** from moving excessively to the motor on the shaft **65**.

Now, we shall explain the operation of the above apparatus. When the wire is wound on the spool **63**, the spool **63** is driven to rotate at the position, shown in the drawing, with the shaft **65** through the coupling **68** by the motor **69**. When the spool **63** becomes full and the winding has been transfered to the other spool **63**, the shaft **65** is stopped and the movable bed **66** is moved in the direction of an arrow *d*, by the action of a cylinder **72**, through a piston rod **76** and an intermediate rod **77** and the full spool is replace with an empty spool. Then the shaft **65** attached with the spool **63** at its end goes forward with the bed **66** and the spool **63** goes outside the housing **73**. Thus it enables the workers to replace the spool efficiently, exactly and in safety, outside the wire winding line. At that time, the spool **63** goes forward with the lower part of the finishing portion **64–2**, being covered with the lower part of the cover **74–2**, while the upper part of the cover **74–1**, fixed on the housing **73**, is left behind so that the upper part of the finishing portion **64–2** is uncovered, thus advantageous for handling the starting and finishing end portions of wire.

EXAMPLE 6: (FIG.15 to FIG.17)

81 shows the barrel of a spool. The barrel **81** of the spool is fixed coaxially with an end plate **84**, which has many wire catchers projected at similar intervals along a peripheral direction. The said end plate may be used as a starting barrel for winding the starting end portion of wire to be wound.

The finishing barrel **85** for winding the finishing end portion of wire is similarly fixed coaxially to the outward surface of the said end plate **84**.

81 is detachably attached to the rotating shaft **86**, and the end plate **84** and the barrel **85** are unmovably attached to the rotating shaft **86**. A cover **87** is fixed to the base or housing at such a position as to be able to cover the barrel **85**. The cover **87** is not rotated in spite of rotation of the spool **81** the end plate **84** and the barrel **85**.

The cover **87** is provided, near its lower end, with a wire inlet **88**, opening to the side of the end plate **84**, so as to pull in the finishing end portion of wire.

The cover **87** has, also, on the surface of the lower end, an outlet **89** with a radial angle less than 15°, for taking out scrapped wire. The scrapped wire can, thus, be taken out easily.

Further, the upper part of the cover **87** is provided with a window **90**, which may have a radial angle less than 20° for satisfactory operating, depending on the size of the spool. The said window **90** has a lid **91** closing of the window **90**, which is mounted so it can open and close in the peripheral direction, on a hinge **92**. The lid **91** has a handle **93**, which is held in a clasp **94**, attached to the cover **87** in order to keep the lid closed.

The finishing end portion of wire is, in this manner, wound on the barrel for winding the finishing end portion of wire, while it is kept in the cover for preventing a wire from going out. So, the said finishing end portion does not get out and, moreover, the wire, which has been wound on the spool, is not damaged by the stroke of the finishing end portion of wire. An effective wire winding can, thus, be performed. Still more, when the spool becomes full, it is able to pull out the end portion of wire on the full spool through the opening and closing lid, so that it is convenient for performing the work easily and quickly. The outlet in the lower end of the cover is quite useful as it can take out completely scrapped wire.

EXAMPLE 7: (FIG.18 to FIG.20)

101 shows a rotating shaft having splines (axial grooves) cut on the outward surface, and being placed inside a pulley shaft **102** having similarly splines cut on the inner circumference; the said shafts being engaged so as not to be rotatable in respect to each other.

The pulley shaft **102** has a pulley **103** on the outward surface for receiving a drive from a motor (not shown in the drawing), and is sustained rotatably on a fixed base **105** by the bearings **104,104'**.

106 shows a clamping rod, passing through the inside of the rotating shaft **101**. One end (on the right side of the drawing) of the rod is connected by means of a coupling device **107** with a piston rod of a cylinder **108**. The said cylinder **108** has a double acting mechanism, and is fixed to a movable base **110**, which is fixed to the rotating shaft **101** in its axial direction, while the end of the base keeps the shaft rotatable by a bearing **109**. The said movable base **110** is connected with a piston rod of a cylinder **111** which is installed on the unmovable base (**105**).

The other end (on the left side of the drawing) of the rotating shaft **101** is projecting beyond the pulley shaft **102**, and is fixed by a key **114** with a barrel **113** for winding the starting end portion of wire to be wound, and with a barrel **112** for winding the finishing end portion of wire, and further is engaged with a spool **115**.

The rotating shaft **101** has a hollow in the part which is engaged with the spool **115** and the barrel **113**, and has a cap **116** screwed on its end surface.

Next, we shall explain how to attach and detach the spool **115** to the rotating shaft **101**. The part of the

rotating shaft **101**, engaging with the spool **115**, has axial split grooves **122** cut at suitable intervals along the circumferential direction. The grooves **122** are in a radius inserted with metal fittings **117** movable in a radius direction for pressing the spool. The metal fittings **117** are always pressed towards the center by springs **118**.

The spring **118** is installed with a bolt **120** between its head and the wall of the press fitting **117**. The bolt **120** is inserted in a slider **119**, which is attached to the rod **106** rotatably and slidably.

A metal fitting **121** for pushing out the spool is inserted just inside the part of the rotating shaft **101**, attached with the spool. The metal fittings **121** for pushing out the spool can slide freely by means of the rod **106**. A radialty extending arm **121'** of the metal fittings **121** for pushing out the spool is engaged slidably with an axial split groove **123**, which is cut on the rotating shaft **101** at suitable intervals in the circumferential direction. The arm **121'** confronts the inside of the spool **115**.

The end of the rod **106** has tapered nuts **124,124'** which are contacted with the inner surface of the sloping part of the fittings **117** for pressing the spool. **125** shows a stopper, which is fixed to the rod **106** in order to control the metal fittings **121** for pushing out.

126 shows a slip-prevention member, attached to a partition plate **127** of the barrel **113**, and **128** shows a cover, fixed to a supporting frame of the bearing **104** to cover the barrel **112**.

The operation of the above apparatus will be explained as follows. When the spool **115** becomes full of wire, the spool is pushed out beyond the winding place, as shown in FIG. **18**, and is replaced with an empty spool. The cylinder **111** is started to move the movable base **110** and the rotating shaft **101** in the direction of an arrow A and to push out the spool **115**, attached to the end of the said shaft, beyond the winding place.

Then, in the state of FIG. **20** (a), the other cylinder **108** is set in motion to move the rod **106** in the direction *a* and to knock the stopper **125**, fixed to the rod **106**, against the metal fittings **121** for pushing out the spool, and also, to slide the tapered nuts **124,124'** forward along the surface of the sloping part of the fittings **117** for pressing the spool. The fittings **117** for pressing the spool can be moved toward the center by the spring **118** to loosen the spool **115**.

If the rod **106** continues to move in the direction *a*, the stopper **125** is pushing the spool **115** forward by means of the metal fittings for pushing out the spool. At that time, the spool **115** has already been freed from the fittings **117** for pressing the spool (FIG.**20** (b)),so that the spool is sliding on the rotating shaft **101** and is pushed forward (FIG.**20** (c)).

Thus, the spool **115** can be safely and easily taken out in the state of FIG.**20** (c).

As the spool **115** moves forward, the slip-prevention member **126** is detached from the side portion of the spool **115**. The spool **115** can be mounted on a taking-off stand and taken off from the shaft **101**, without any damage to the said member **126**.

In order to attach the empty spool **115** to the rotating shaft **101**, the rod **106** is placed in the intermediate state of FIG. **20** (b), between the state of FIG. **20** (a) when the winding is performed, and the state of FIG. **20** (c) when the spool is taken out. In other words, the spool is not strained by the fittings **117** for pressing the spool, while the metal fittings **121** for pushing out the spool, namely the stopper **125** is restored to the former state, so as to insert the spool to the prescribed position of the rotating shaft **101**.

As is stated above, according to the present invention, three steps of operation can be adopted by means of the cylinder **108** having a double cylinder mechanism — the step of operation (the spool is firmly fixed on the rotating shaft at the fixed position), the step of attaching the spool (the spool is at the fixed position, while it is not firmly fixed) and the step of taking out the spool (the spool is pushed out to a position on the rotating shaft to be easily taken out and not firmly fixed on the rotating shaft). Therefore, it is possible to replace the full spool with the empty spool easily and quickly in such a type of continuous winding apparatus that the wire is wound alternately on two spools in the same winding place, thus contributing much to increase the efficiency of operation.

EXAMPLE 8: (FIG.21 and FIG.22)

201 shows a wire and the said wire **201** is wound through a traverser **202** and a shifting guide **203** on a spool **205**. When a prescribed quantity of wire has been wound on the spool **205**, a detector (not shown in the drawing) for detecting it, is set in motion to dispatch a detecting signal and an empty spool **205'** starts to rotate at a prescribed speed of rotation. At the same time, by rotation of an electric motor **204** for shifting, the apparatus **212** with the shifting guide moves horizontally and the shifting guide **203** comes to rest at the position **203'**. And also, a cutting or shearing apparatus **210'** moves to the position **210''** by means of a cylinder **211'**. Receiving a signal for stop from the apparatus **212** with the shifting guide, a cylinder **209** is set in motion to move a guide roller **228** from the position **208** to the position **208'**. The wire **201** is caught on one wire catcher **207'**, which is attached on an end plate **206'** adjointed to the spool **205'**. And then, the wire is cut by the cutting or shearing apparatus **210''**.

The end portion of the cut wire remains to be hung on the wire catcher **207'** and continues to be wound on the said spool **205'** as the spool **205'** rotates. But having already wound the prescribed quantity of wire, the spool **205** comes to rest and to make it possible to replace the said spool **205** with another empty spool. The apparatus with the shifting guide **212**, the wire catching guide **208'** and the cutting or shearing apparatus **210''** are restored to the prescribed positions. And when the prescribed quantity of wire has been wound on the spool **205'**, the wire begins to be wound newly on the empty spool **205** by means of a similar operation as above-mentioned.

As above described, according to the present invention, the wire cutting or shearing apparatus are respectively installed close to the dual spools **205,205'**, which can wind the wire alternately and continuously. The said apparatus are made so as to be able to put in and out alternately. Only the cutting or shearing apparatus close to the empty spool can cut the wire which has been wound in the prescribed quantity. In a conventional winding apparatus during the operation of the cutting or shearing apparatus close to the dual spools or

the spool, which has wound the prescribed quantity of wire, scrapped wires are produced and flown off to cause damages to the wire wound on the spool and others. Whereas in the present invention, the wire can be effectively cut without such damages.

EXAMPLE 9: (FIG.23 to FIG.25)

301 shows a wire and the said wire **301** is wound on the spools **304,304'** through a traverser **302** and a shifting guide **303'**.

Now, for example, we shall explain the operation in case of shifting of the wire from the spool **304'** on the left side of the drawing to the spool **304** on the right side. When a prescribed quantity of wire has been wound on the spool **304'**, rotating in the direction of an arrow, a detector (not shown in the drawing) for detecting it, is set in motion to dispatch a detecting signal and the empty spool **304** starts to rotate with the prescribed speed in the direction of an arrow. At the same time, by the rotation of an electric motor (not shown in the drawing) for shifting, the shifting guide **303** moves horizontally from the position **303'** and stops at the position **303**.

The cutting or shearing apparatus **305,305'** can be moved forward and backward in the direction of an arrow by means of the cylinders **306,306'**. But now, the cutting apparatus **305** is moved forward by means of the cylinder **306** to the position for cutting wire, while, the other cutting apparatus **305'** is behind the position as shown in the drawing.

By the signal for stop of the apparatus **303** with the shifting guide, the cylinder **307** is set in motion and the catching guide **308** moves from the position **308'** to the position **308**. The wire **301** is caught on one of wire catchers, attached to the flange **309** of the spool **204**, and cut by the cutting or shearing apparatus **305**.

The end portion of the cut wire remains to be hung on the wire catcher **310** and continues to be wound on the said spool **304**, as the spool **304** rotates. But having already wound the prescribed quantity of wire, the spool **304'** comes to rest and to make it possible to replace the said spool **304'** with another empty spool. The travelling guide **303**, the catching guide **308** and the cutting or shearing apparatus **305** are restored to the prescribed positions. And, again, when the prescribed quantity of wire has been wound on the spool **304**, the wire begins to be wound newly on the empty spool **304'**, by means of a similar operation as above-mentioned.

311,311' show rotating shafts of the spools **304,304'**.

The cutting or shearing apparatus **305** or **305'** consists of a pair of cutters *c,c'*, which are able to rotate and, as shown in FIG. **25**, supported by means of the bearing (not shown in the drawing) on the portions *b* and *b'* of a bracket **312** having a notch portion *a*. The apparatus is attached to the stand **313,313'** which is able to slide and is on the side of the rod of a cylinder **306 306'** shown in FIG. **24**.

One (*c'*) of the pair of cutters is attached to the oblong hole so as to be able to regulate the position to approach to the other cutter *c*. It is desirable to rotate forcibly the circular cutters *c,c'* in the direction of an arrow.

In generally speaking, when the wire is cut, if the cutting is done thoroughly by one stroke, the bit by the wire catcher **310** or **310'** is weak and the wire tends to get off. On the other hand if the wire is cut not deeply, there is a problem that the shock is too large at the time of cutting. The present invention has solved this problem.

Namely, according to the present invention, the gap between the circular cutters can be regulated so as to control freely the depth of cut in the wire. The cutting of the wire can, thus, be performed quite smoothly.

EXAMPLE 10: (FIG.26 to FIG.28)

401 shows a spool, which is supported on a rotating shaft **402** and rotates as the shaft **402** rotates. The said rotating shaft **402** is fixed with an end plate **403** adjointed to a flange of the spool. Farther, around the circumference of the said end plate **403**, wire catchers **404** are attached at similar intervals in the peripheral direction, projecting outwards.

The end portions of the catchers **404** are bent toward the spool **401** and have the space **405** for catching the wire between the inner surface of the curved part and the circumference of the end plate **403** and the wire is to be caught in the said space **405**.

406 shows cutting blades, arranged on the outside (the side opposite to the spool) of each catcher **404**. The cutting blades are, as shown in FIG. **28**, projecting in a hooked and pointed shape from the outward surface of the catcher **404** and bending toward the circumference of the end plate **403**.

Now, we shall explain the operation of the above apparatus. When a prescribed quantity of wire **407** has been wound on one of the spools **401'**, by the signal for shifting, the shifting guide **408** and the guide for adjusting wire position (not shown in the drawing) are set in motion to correct the position so as to catch the wire on the catcher **404**, as shown in FIG. **26**. Then, the catching guide **409** is moved to the position **409'** to have the wire **407** bitten by the catcher **404** of the empty spool **401**. At that time, the spools **401,401'** rotates in the opposite direction as shown with arrows, so that the wire is, as the spools rotate, strained between the full spool **401'** and the catcher **404** of the empty spool **401** (refer to FIG.27). Then, the wire is bitten and cut by the cutting blades **406** arranged on the catcher **404**.

Then, the wire continues to be wound on the empty spool **401**, while the catching guide is restored to the position **409**.

As above-mentioned, according to the present invention, the wire catchers are respectively attached with cutting blades, and it is unnecessary to install a cutting or shearing apparatus independently as in the conventional apparatus and it is possible to simplify the structure of the apparatus considerably.

As a cutting or shearing apparatus needs not to be installed between the spools, the space may be smaller between the spools.

As the cutting blade is attached to each catcher, there is not necessary to set and correct the position of the cutting blade, thus very advantageous.

EXAMPLE 11: (FIG.29 to FIG.31)

501 and **501'** denote spools for winding the wire **502**, supported by the rotating shafts **503** and **503'**. **504** and **504'** are barrels for winding the starting end portion of

wire to be wound. **505** and **505'** are end plates having around their circumferences a number of wire catchers **506,506'** equally spaced in circumferential direction. **507** and **507'** are barrels for winding the finishing end portion of wound wire, and the barrels for winding the starting end portion of wire, the end plates and the barrels for winding the finishing end portion of wire are respectively fixed to the rotating shafts **503,503'**. **508** and **508'** are covers for the barrels **507** and **507'** for winding the finishing end portion of wire and these covers **508** and **508'** are fixed to the bases **509** and **509'** and spaces for inserting the wire therein are provided between these covers and the end plate **505**.

Around the circumferences of the barrels **504** and **504'** on their respective spool side, there are provided a number of slip-prevention clicks **510** and **510'** equally spaced from each other in the circumferential direction. By these clicks **510** and **510'** the wires wound on the barrels **504** and **504'** are prevented from slipping down in the spool direction. **511** and **511'** are catching guides which are moved forward and backward by their respective cylinders **512** and **512'**. **513** and **513'** are guides for adjusting wire position which are moved forward and backward by their respective cylinders **514** and **514'**, and **516** is a traverser mounted on a shifting base **517**. This traverser moves forward and backward corresponding to the normal and reverse rotation of the electric motor **518**, and the shifting base **517** on which the traverser is mounted engages with a screwed lever **520**, and the shifting base **517** can move horizontally in right and left directions by the rotation of said lever **520**. Further the shifting base **517** is supported by the supporting levers **521** on both sides of the lever **520** and slides along the lever **521**.

515 is a stopper (wire guide), and **522** is a central safety screen which is partially embedded and fixed on the slider **524** and slidably engaged in the bed **523**, and the stopper **515** and the screen **522** slide together on the bed.

526 and **526'** are screens for protecting the traverser **516** and assuring complete interception between the both spools, and are attached on the shifting base **517**.

When the wire is wound on either of the right and left spools **501** and **501'**, the stopper and screens are at the position of **515'** and **522'** in FIG. 31, thus intercepting the both spools **501** and **501'**. At this time, if the wire is wound on the spool **501**, the traverser is positioned at **516** and the screen **526'** comes align with the screen **522**.

Then when the spool becomes full, and the wire is to be shifted to the other spool, the lever **520** is rotated by the electric motor **519** according to an appropriate detection signal and the shifting base **517** is guided by the supporting lever **521** and traverser **516** moves from the position **516** to the position **516'**.

Then the cylinder **514** is activated to push forward the guide **513'** for adjusting the wire position to adjust the height of the wire between the spool **501** and the traverser **516'** so that the wire **502** is caught by the wire catcher **506'** on the side of the empty spool **501'**.

The catching guide is shifted to the position **511''** from the position **511** by the operation of the cylinder to guide the wire toward the wire catcher **506** on the side of the spool **501** on which a predetermined amount of wire has been wound. At this time the wire **502** is caught by the wire catcher **506** and wound on the barrel **507** and after a certain time, the catching guide on the side of the empty spool **501'** reaches to the position **511''''** by the operation of its cylinder, and when the wire **502** is engaged with the wire catcher **506'**, the wire **502** is cut by the wire cutting or shearing apparatus **527'**, and the end portion of the wire thus cut passes through the opening of the cover of the barrel on the side of the spool **501** on which a predetermined amount of wire has been already wound and guided into the cover and wound on the barrel **507**; thus the end portion of the wire is completely caught.

The starting end portion of the wire obtained by cutting the wire on the above cutting or shearing apparatus **527'** is left as caught by the wire catcher **506'**, and this starting end portion of the wire **502** is wound several times on the barrel **504'**, and then is consecutively wound on the empty spool **501'** through the slip-prevention click **510'**.

Thus, when the above shifting is completed, the winding apparatus on the side of the spool on which a predetermined amount of wire has been wound stops, and the catching guide and the traverser which acts also as a guide for adjusting wire position and the shifting guide move back to the preset position, and an ordinary wire winding onto the empty spool **501'** is effected.

Meanwhile, the stopper and the screen are back at the positions **515** and **522** respectively by the action of the cylinder **525** when the wire is shifted as above. At this time, the position of the stopper **515** is as such that the wire **502** is caught by the wire catcher **506** on the side of the spool on which a predetermined amount of the wire has been wound when the catching guide **511** reaches the position **511**, but is not engaged with the wire catcher **506'** on the side of the empty spool **501'**. Therefore, it is possible to wind the wire **502** on the barrel **507** on the side of winding for a certain time until the catching guide on the side of the empty spool reaches the position **511'** from the position **511'''**. Then the wire is engaged with the wire catcher **506'** on the side of the empty spool to complete the shifting operation.

EXAMPLE 12: (FIG.32 to FIG.35)

The wire **601** is wound on the spools **607** and **607'** fixed to the shaft **609** and **609'** through the traverser **602'** which acts also as shifting guide. The shifting base **603** on which the above traverser is mounted is supported by a guiding bar **605** suspended by the frame and also is engaged with the screwed lever **606**, which is rotated in clockwise or anticlockwise direction according to the normal or reverse rotation of the shifting motor **604** so that the shifting base **603** is moved horizontally. And the above traverser **602** is connected directly to the motor **614** which is rotated normally or reversely by the limit switches **615** or **616** so that the traverser **602** is moved horizontally forthward and backward.

The catching guide **610** is movable forthward and backward by the activation of the cylinder **611**. The barrel **613** is jointed to the outer surface of the flange of the spool **607**; on the circumference of the barrel **613** on the spool side, there are provided slip-preven-

tion clicks **608** at regular intervals, which project somewhat beyond the flange circumference of the spool **607** and the outside diameter of the barrel, and on the circumference of the barrel of the opposite side, there are provided wire catchers **618** appropriately spaced from each other. **612** and **612'** are a cutting or shearing apparatus, and **617** is a limit switch for winding the starting end portion of the wire on the barrel.

The functions of the above apparatus will be described under. When the wire **601** is guided by the traverser **602'** and wound on the spool **607** and thus a predetermined amount of the wire is wound, the shifting guide **603** is shifted to the position of the traverser **602** and stopped there according to the shifting signal by the rotation of the screwed lever **606** connected directly to the motor **604** for shifting. At this time, the supporting shaft of the traverser **602** is moved according to the limit switch **615** and a stop signal of the shifting guide **603** until it comes into contact with the limit switch **617** at a speed pre-adjusted to the guiding speed of the catching guide **610**.

Thus, the traverser **602** continues to shift until it reaches the upper portion of the barrel **613**. Simultaneously the catching guide **610** is attracted toward the cylinder **611** by the activation of the cylinder **611** according to the stop signal for the shifting guide **603** and the limit switch **615**. It should be noted that the guiding action of this guide **610** is effected synchronously to the arrival of the traverser **602** at the position **602''**.

Now, as the wire **601** is attracted by the guide **610** toward the cylinder as shown in FIG. **34**, the wire **601** is caught by the wire catcher **618'** on the side of the empty spool **607'** and cut by the cutting or shearing apparatus **612'**. Then, when a required number of windings are wound on the barrel **613** the traverser **602** advances so that the wire **601** passes through the slip-prevention clicks **608** and is wound on the empty spool **607'**. And at the same time, various mechanisms such as the catching guide **610** and so on are reset to the normal condition and the traverser **602** is moved back to the position **602'** and thus the winding of wire on the spool **607'** is continued.

As above described, as the wire **601** is wound on the spool after the starting end portion of the wire has been wound several times on the barrel **613**, it is possible to provide a required length of the starting end portion of the wire **601** outside the spool, thus faciliating the jointing of the wire in the subsequent step.

Further, as the slip-prevention clicks **608** are provided at appropriate space along the circumference of the barrel **613** on the spool side in such manner as they project beyond the flange of the spool and the outside diameter of the barrel, slipping down from the barrel of the wire which being wound on the barrel is prevented and an effective winding is assured.

EXAMPLE 13: (FIG.36)

The spool **701** is provided with a barrel **701–1** and a barrel **702** for taking out the starting end portion of the wire, and these barrels are mounted in adjointed relation on a common rotating shaft **705**. The spool **701** has a barrel **701-1** of a diameter D*i* and flanges **701–2** of a diameter D*o* on both sides, and the barrel **702** has a drum portion **702–1** of a diameter D and flanges **702–2** of a diameter almost equal to the diameter D. Around the circumference of the outside flange **702–2** of the barrel **702** there are provided wire catchers **703**, and if necessary, slip-prevention clicks **704** are provided outwardly on the circumference of the inside flange **702–2** adjacent to the spool.

Now if the ratio of the flange diameter D*o* to the drum diameter D*i* is larger than a certain value. The wire must overrun the flange of a diameter D*o* when the wire is shifted from the drum portion **702–1** to the barrel **701–1** of the spool.

Therefore, the running speed of the wire can not follow this so that the wire is elongated or loosened.

The present invention has overcome these difficulties by satisfying the following relation:

$$Di \leqq D < (Do + Di/2)$$

Namely, if the diameter *D* on the barrel **702–1** is not larger than the diameter *Di* of the barrel **701–1** of the spool, the wire can not have enough flexure and thus difficulties such as elongation and break of the wire are caused which result in poor winding when the wire shifts from the barrel **702–1** to the barrel **701–1** of the spool. As a result the starting end portion of the wire can not be used, thus the taking-out of the starting end portion will be meaningless.

On the other hand, if the difference between the diameter *D* of the barrel **702–1** and the diameter *Di* of the barrel **701–1** of the spool is too large and thus the diameter *D* exceeds the average of the diameter *Di* and the diameter *Do*, namely $(Do + Di)/2$, the flexure of the wire becomes so large that the wire stribes against the surrounding cover, thus causing wire break and poor winding.

EXAMPLE 14: (FIG.37 to FIG.40)

The wire **801** is wound on the spools **807** and **807'** fixed to the rotating shafts **809** and **809'** through the traverser **802** which acts also as a shifting guide and is positioned at **802'**. **803** is a shifting guide on which the above traverser **802** is mounted and which is supported by a guide bar **805** suspended by a frame and also is engageable with s screwed lever **806**. The screwed lever rotates clockwise or anticlockwise according to the normal or reverse rotation of the motor **804** so that the shift guide **803** moves horizontally. Further, as the above traverser **802** is directly connected to the motor **814** which rotates normally or reversely according to the limit switches LS_1 and LS_2, the traverser **802** moves horizontally forthward and backward. The traverser **802** is fixed to the top of the rods **816** and **816'** slidably supported by the bearings **815** and **815'**, and is shifted along the lengthwise direction of the shafts **809** and **809'** by the screw **817** driven by the motor **814**.

The catching guide **810** is movable forthward and backward through the activation of the cylinder **811**. The barrel **813** is adjoined to the outside surface of the flange of the spool **807** and slip-prevention clicks **808** are provided at regular intervals around the circumference of the barrel **813** on the spool side in such a manner that they project outward beyond the flange circumference and the outside diameter of the barrel. And on the opposite side of the barrel there are provided wire catchers **818** spaced from each other around the circumference of the barrel.

812 and 812' are respectively a wire cutting apparatus, and 819 is an activator for the switch fixed to the rods 816 and 816'. The limit switches LS_1 and LS_2 are activated by the activator.

Thus as shown in FIG. 40, the traverser is shifted between the limit switch LS_1 and the limit switch LS_2 according to the normal and reverse rotation (FIG.29 motor FIG.31) the normal winding condition, and the winding is done at a constant pitch of the traverser determined on the bases of the rotation rate of the rotating shaft 809. The activation of the traverser during the shifting is controlled in such a way that the traverser advances in a direction marked by an arrow beyond the switch LS_2 and reaches the switch LS_3 and stops there for a certain preset time according to a quick-deliver setting signal of a preset counter, wherever the traverser 802 may be. The motor rotes reversely with the quick-deliver signal and the traverser goes back to the switch LS_1.

The sequence circuit necessary to effect the above operation of the traverser is provided by a relay R_1 which is "on" only at the time of quick-deliver (shifting operation), a relay R_2 which is "on" only at the time of normal traverser, a relay R_3 which is "off" for a certain time at the position of the limit switch LS_2 and stops there for such "off" time during the shifting operation, and relays *Fa* and *Fr* which are alternately "on" to cause normal and reverse rotation of the traverse motor 814.

The functions of the above embodiment shall be described under.

The shift guide 803 is moved to the position of the traverser 802 by the rotation of the screwed lever 806 directly connected to the shift motor 804 and stops there according to the first-step signal immediately before the wire 801 is guided to the traverser positioned at 802' and wound on the spool 807 in a prefixed amount. Then the prefixed amount of the wire 801 is wound on the spool 807. After the completion of above winding, a second signal is emitted and the traverser 802 is quickly delivered to the switch LS_3 wherever the traverser may be. Namely, the traverser continues to shift until it reaches the upper portion of the barrel 813 and at the same time the catching guide 810 is attracted toward the cylinder 811 by the action of the cylinder upon the above second-step shift signal. In this case, when the traverser 802 comes just above the barrel 813, namely when the traverser pushes the limit switch LS_2, the traverser 802 stops for a while until the wire is engaged with the wire catcher 218' by the action of the guide 810, and thus a required length of the finishing end portion of the wire is wound on the barrel 813. The control of the stop time of the traverser 802 may be done by a timer or the stoppage of the traverser may be released after detecting the guide 810 has pushed the wire into the catcher 818.

Now, since the wire 801 is attracted toward the cylinder 811 by the catching guide roller 810 the wire is caught by the wire catcher 818' on the empty spool side and cut by the cutting or shearing apparatus 812'. And when a required number of windings are taken on the barrel as the spool 807' rotates, the traverser 802 advances so that the wire 801 passes through the slip-prevention clicks 808 and is wound on the empty spool 807'. At the same time various mechanisms such as the catching guide 810 and so on are reset to the normal state and the traverser 802 is moved back to the position 802', and thus the winding of wire on the spool 807' continues.

As above described, as the wire 801 is wound on the spool after the starting end portion of the wire has been wound on the barrel 813 in several times of windings, it is possible that a predetermined length of the starting end portion of the wire projects outside the spool, thus facilitating the joint of the wire in the subsequent step.

EXAMPLE 15: (FIG.41 to FIG.43)

The wire 901 is wound on the spools 907 and 907' which are fixed to the rotating shafts 909 and 909' through the traverser 902 which acts also as a shifting guide. 903 is a shifting base on which the above traverser 902 is mounted, and the said shifting base 903 is supported by a guide bar 905 suspended on a frame and is also engaged with a screwed lever (not shown) and is moved horizontally right and left by the normal or reverse rotation of a motor (904).

Further the traverser 902 is connected directly to another motor 914 and is moved horizontally also forthward and backward by the normal and reverse rotation of the motor 914 activated by the limit switches LS_1 and LS_2. 910 is a catching guide which is moved forthward and backward by the activation of a cylinder 911. 908 is a attaching frame which is adjoined to the outside surface of the spool flange and has a diameter almost equal to that of the said flange. Around the outside circumference of the frame there are provided wire catchers 906 appropriately spaced from each other in the circumferential direction.

912 and 912' are respectively a wire cutting or shearing apparatus.

The functions of the above embodiment shall be described under.

The length of wire to be wound on the spool 907 or 907' is preset by a preset counter and the like. The preset counter is so designed as to give a first presetting signal and a second presetting signal in order to shift the wire from the spool 907 or 907' on one side to the spool 907' or 907 on the other side.

An explanation will be made on the shifting operation of the wire 901 being wound on the spool to the empty spool 907'.

The traverser is activated by the motor 904 and shifts from the position 902' to the position 902 according to the first preset signal and reciprocates between the limit switches LS_1 and LS_2 while the wire is wound on the spool 907. When the preset length of the wire is wound, the second preset signal is emitted and the traverser 902 is set to quick-delivery. With this second preset signal, the guide, too, shifts quickly from the position 901' to the position 910. In the meantime the wire is caught by the wire catcher 906' or 906 and cut by the cutting apparatus 912' or 912.

As described above, the present invention is advantageous in that the accuracy of the wire length to be wound is improved by the mechanism that the traverser and the catching guide are set to quick-delivery wherever they may be by a signal of preset length.

The mechanism of quick-delivery according to the present invention shall be described referring to FIG. 43.

Under the normal winding condition, the traverser **902** is shifted a distance from 902_1 to 902_2 which corresponds to the distance between the limit switches LS_1 and LS_2 by the normal and reverse rotation of the motor **914**. When the wire shifts from the full spool to the empty spool, R_1 and F*a* are "on" and "off" by the signal from the preset counter wherever the traverser may be and the traverser is quickly shifted in the direction marked by an arrow Y according to the quick-delivery setting signal and reaches the limit switch LS_2. Then the circuit is set back to the normal state to reverse the motor **914** and thus the traverser reciprocates at a normal speed between the limit switches LS_1 and LS_2.

The sequence circuit required to effect the above operation of the traverser shall be explained under.

R_1 is "on" only at the time of quick-delivery namely at the time of shifting, and R_2 is a relay which is "on" at the time of traversing. F*a* and F*r* are keep-relays for activating the traverse motor **914** with the signal from the limit switches LS_1 and LS_2.

Thus according to the present invention the accuracy of length of the wire to be wound on the spool is improved, thus permitting elimination of the rewinding operation for measuring a length of the wire as conventionally practiced, enhancing the working efficiency and contributing to improve the yield and productivity.

EXAMPLE 16: (FIG. 44 and FIG. 45)

Spools **273** and **273'** supported by the shafts **272** and **272'** driven by a motor **271** are arranged within a frame **270**, and two guide levers **274** parallel to each other are suspended on the frame above the spools **273** and **273'**. **275** is a shifting base on which a motor for shifting the traverser **276** is mounted and this shifting base **275** is supported by the guide lever **274** and movable in parallel and also movable horizontally in the direction marked A,A' by the rotation of a screwed lever **229** inserted in the shifting base **275** and rotatable by the motor **278**. Also the traverser **276** is driven by the motor **277** and can reciprocate in the direction marked by an arrow B. **280** is a wire catcher provided around the circumferences of the spool **273** and **273'**, **281** is a guide for pushing the wire **283** toward the catcher and activated by the cylinder.

The functions of the above embodiment shall be described under.

When the wire **283** is caught by the traverser **276** and the end of the wire is attached to the spool **273'** and then the spool is rotated to the direction marked by an arrow C. The wire is wound consecutively on the spool **273** as the latter rotates. At this time the traverser **276** shifts to the direction of B as the motor **277** rotates, and the wire which is being wound on the spool **273'** is shifted from the right side of the spool **273'** to the left side or from the left side to the right side and such alternate shifting is repeated to wind the wire on the spool in good order.

In this way, when the preset amount of the wire **283** is wound and gets ready to be wound on an empty spool, the motor **278** for the shifting operation starts to rotate the screwed lever **279** and the shifting base on which the traverser is mounted shifts to the prefixed position and stops there. Then the wire **283** is wound on the spool **273** in a similar way as above.

As described above, the present invention can overcome the conventional defect that the wire delays between the traverser and the spool, and thus the wire can be wound properly without being affected by the variation in rotation rate of the spool.

EXAMPLE 17: (FIG.46 to FIG.49)

A spool **451** is supported by a rotating shaft **452** and the spool **451** is driven and rotated by the shaft **452**. The outside surface of the spool flange is adjoined to an end plate **453** fixed to the rotating shaft **452**, and wire catchers **454** are provided projectively and spaced relation to each other around the circumference of the end plate. The top end of each of these wire catchers is bent inwardly, and a space **455** is provided between the lower brim of the bent portion and the circumferential surface of the end plate **453** to catch the wire therein.

456 is a barrel for winding thereon the starting end portion of the wire positioned on the spool side, and **457** is a slip-prevention plate provided on the spool side of the barrel **456**. On the circumferential surface of the plate **457** there are provided slip-prevention projections in appropriately spaced relation to each other.

One of the features of the present invention is that a wire catcher as described above is provided and when this wire catcher is incorporated in the continuous wire winding apparatus, the following functions are eminent. Supporting the predetermined amount of wire **459** is wound one of the spools **451'**, the shift roller **460** and the level guide **461** are activated to adjust the position of the wire **459** so as to catch the wire easily as shown in FIG. **48**.

Then the action of the catching guide **462** is synchronized to the motion of the traverser **463** to engage the wire with the wire catcher **454**. As the top end of this wire catcher is bent inwardly, and there is provided a space **455** between the lower brim of the bent portion and the circumferential surface of the end plate **453**, as mentioned above, it is possible to push the wire automatically and firmly into the space **455** formed by the wire catcher **454** and catch the wire at the base of the space. **464** and **464'** are wirecutting or shearing apparatus.

According to the present invention, the wire catcher is so designed as to assure the wire catching at the time of taking out the starting and portion of the wire, and thus more effective and firmer catching of the wire is attained as compared with the conventional wire catcher.

What is claimed is:

1. A continuous wire winding apparatus in which wire such as cable wire is wound continuously at high speed, comprising rotatably driven spool means having flanges thereon, an end plate mounted coaxially with said spool means at one flange of the spool means, a wire catcher projecting from the circumference of said end plate, a barrel mounted coaxially with the spool means for having wound thereon the finishing end portion of the wire to be wound, and a cover non-rotatably mounted around the outside circumferential surface of said barrel for preventing whipping of the free end of the wire, whereby after a predetermined amount of wire has been wound on the spool means the end portion of the wire is caught within the cover on the barrel at the time of the shift of the wire away from the spool means.

2. A continuous wire winding apparatus in which wire such as cable wire is wound continuously at high speed onto alternate spool means, said apparatus comprising two parallel spool driving shafts spaced from each other in a plane, means for driving said driving shafts, wire traversing means positioned adjacent said plane and movable back and forth in a direction parallel to said driving shafts and said plane for traversing wire to be wound, shifting means adjacent said plane and movable back and forth in a direction parallel to said plane and between said shafts for shifting wire to be wound between said shafts, and spool means removably mounted on said shafts, each spool means having flanges thereon, an end plate mounted coaxially with said spool means at one flange of the spool means, a wire catcher projecting from the circumference of said end plate, a barrel mounted coaxially with said spool means for having wound thereon the finishing end portion of the wire to be wound, a cover non-rotatably mounted around the outside circumferential surface of said barrel for preventing whipping of the free end of the wire, wire guide means mounted between said shafts and having at least portions thereof movable parallel to the shafts, said wire guide means engaging the wire being wound on one spool means and guiding it to the wire catchers on said spool means during transfer to the other spool means, means connected to the movable portions of said wire guide means for moving said portions of said wire guide means, and wire cutting means adjacent said wire guide means to which the wire being shifted from one spool means to the other is guided for being cut by said guide means and said wire catcher on said one spool means, whereby wire extending through said traversing means and said shifting means is wound on one spool means while being traversed back and forth along said spool means as said spool means is rotated on one of said shafts, and when a predetermined amount of wire has been wound, said shifting means is moved to transfer said wire to the other spool means and said wire is engaged by said wire guide means and guided to said cutting means and cut, and the end portion of the cut wire on the one spool is engaged by said wire catcher and caught within the cover on the barrel.

3. A continuous wire winding apparatus as claimed in claim 2 in which said wire guide means comprises at least one guide elongated in a direction transverse to said spool driving shafts and to said plane, whereby the wire is guided by said guide means regardless of the amount of wire wound on said one spool means and the distance the wire coming off the one spool means is from the one spool driving shaft.

4. A continuous wire winding apparatus as claimed in claim 2 in which said wire guide means comprises three wire guides each elongated in a direction transverse to said spool driving shafts and to said plane, the middle guide being fixed, said other two wire guides constituting said movable portions, and the other two wire guides being mounted on said wire guide moving means and being movable parallel to said driving shafts, whereby said wire is guided by said guide means regardless of the amount of wire wound on said one spool means and the distance the wire coming off the one spool means is from the one spool driving shaft.

5. A continuous wire winding apparatus as claimed in claim 2 in which said wire guide means comprises a wire guide elongated in a direction transverse to said spool driving shafts and to said plane, said wire guide being mounted on said wire guide moving means for movement parallel to said shafts, and two curved wire guides, one on either side of said wire guide, and curved wire guide moving means on which said curved wire guides are mounted for movement parallel to said shafts, the ends of said curved wire guides being curved transversely of said plane toward the side of the plane on which said traversing and shafting means is located.

6. A continuous wire winding apparatus as claimed in claim 2 in which said wire guide means comprises three wire guides elongated in a direction transverse to said spool driving shafts and to said plane, said wire guide moving means comprising moving means for each wire guide on which said wire guides are respectively mounted, and each wire guide having a curved member mounted thereon having a portion generally parallel to the shafts and having the free end curved transversely of said plane a distance equal to the thickness of the wire wound on the spool means.

7. A continuous wire winding apparatus as claimed in claim 2 in which said wire guide means comprises three wire guides each elongated in a direction transverse to said spool driving shafts and to said plane, said wire guide moving means comprising moving means for each of the wire guides and on which said wire guides are respectively mounted and being movable parallel to said driving shafts, whereby said wire is guided by said guide means regardless of the amount of wire wound on said spool means and the distance the wire coming off the one spool means is from the one spool driving shaft.

8. A continuous wire winding apparatus as claimed in claim 2 further comprising a screen positioned between said shafts, and screen moving means movable parallel to said shafts on which said screen is mounted for moving said screen back and forth to and from a position between said spools.

9. A continuous wire winding apparatus as claimed in claim 2 further comprising a starting end winding barrel is mounted coaxially with said spool means, whereby the traversing means can be stopped at the time of transferring the wire to the empty spool means for starting a length of wire on said starting end winding barrel prior to winding the wire on the empty spool.

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