Sept. 21, 1965 N. J. SMITH 3,207,060

WIRE TIER

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Fig. 7

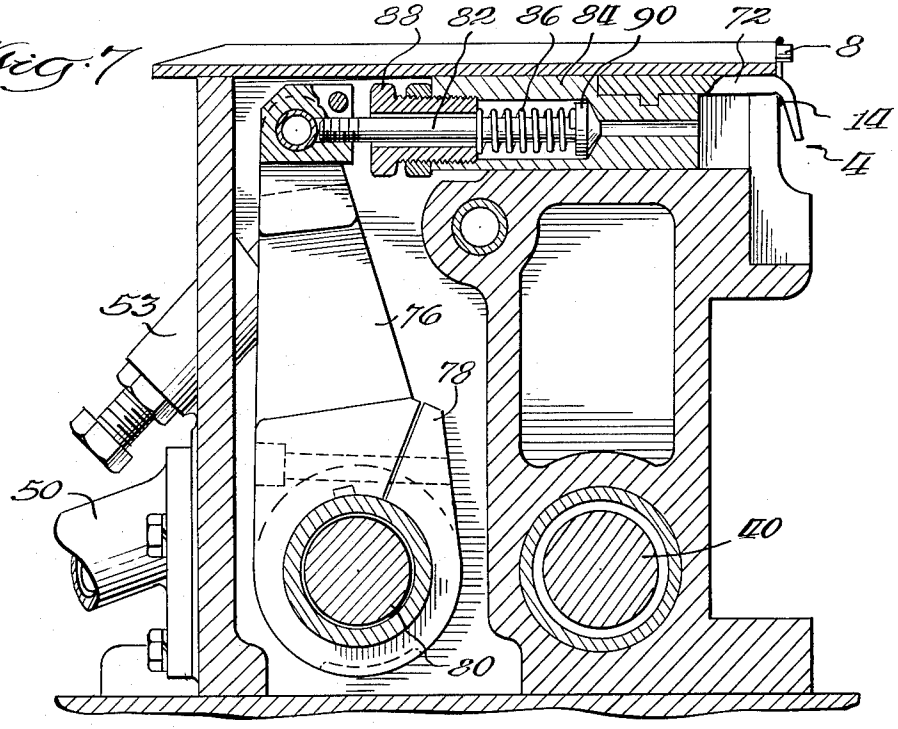


Fig. 1

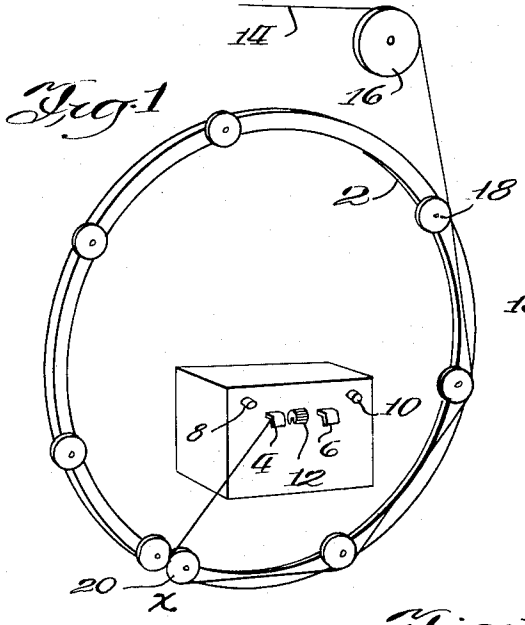


Fig. 2

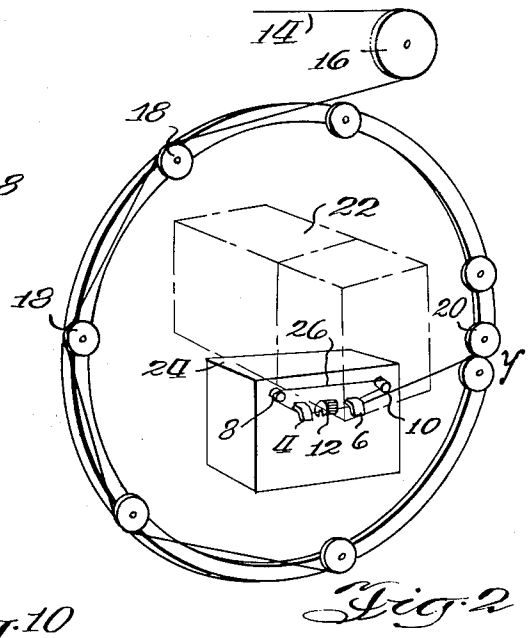
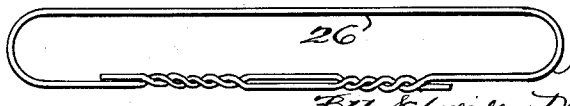


Fig. 10



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WIRE TIER

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Fig. 3

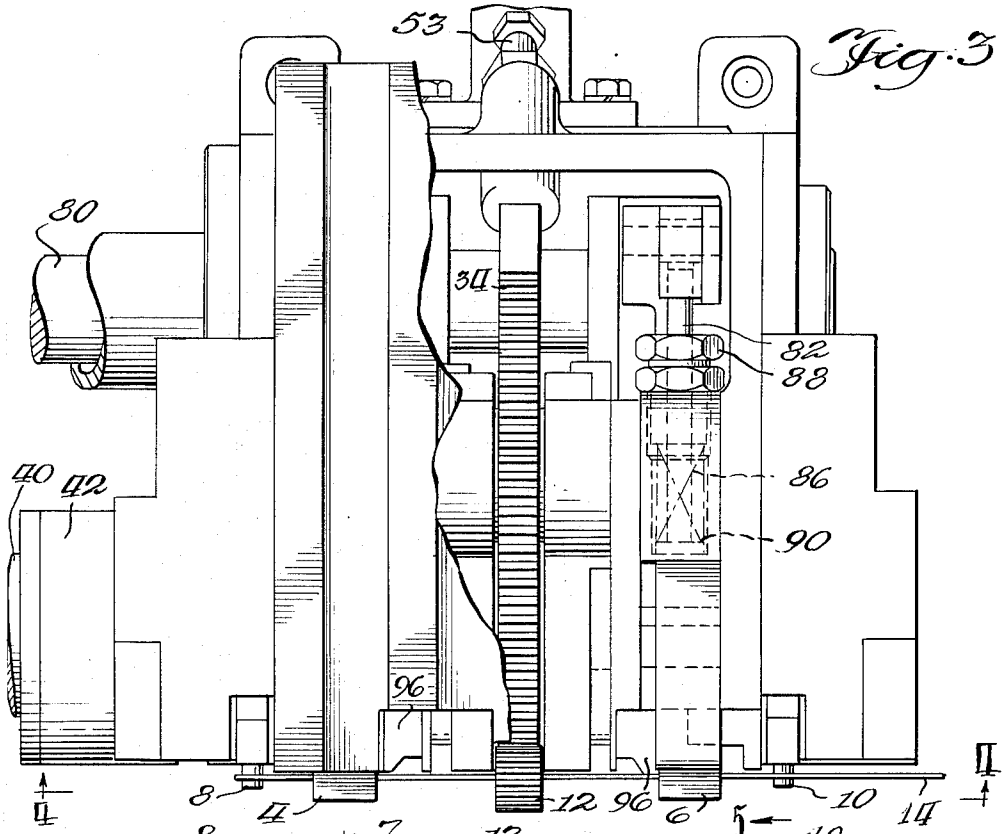
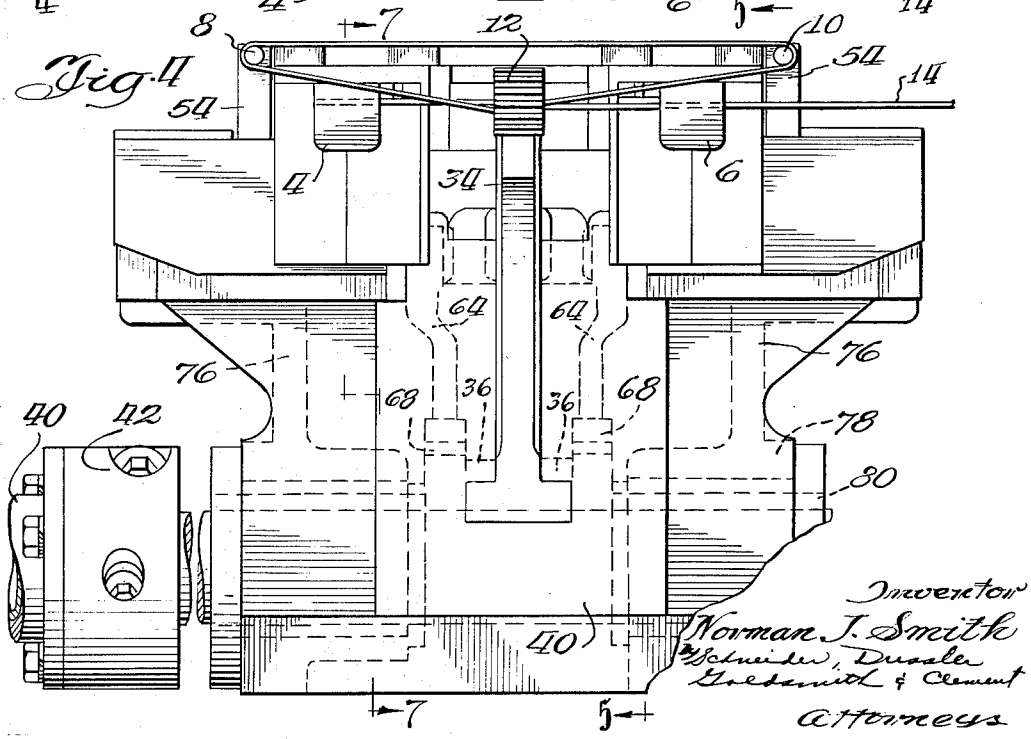


Fig. 4



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WIRE TIER

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Fig. 6

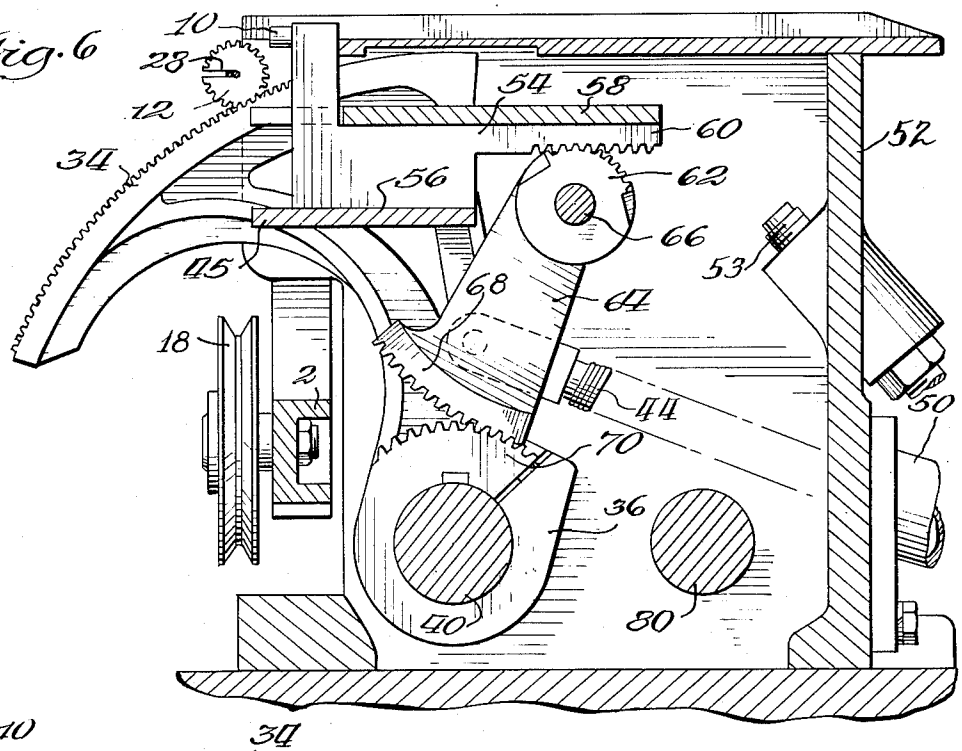
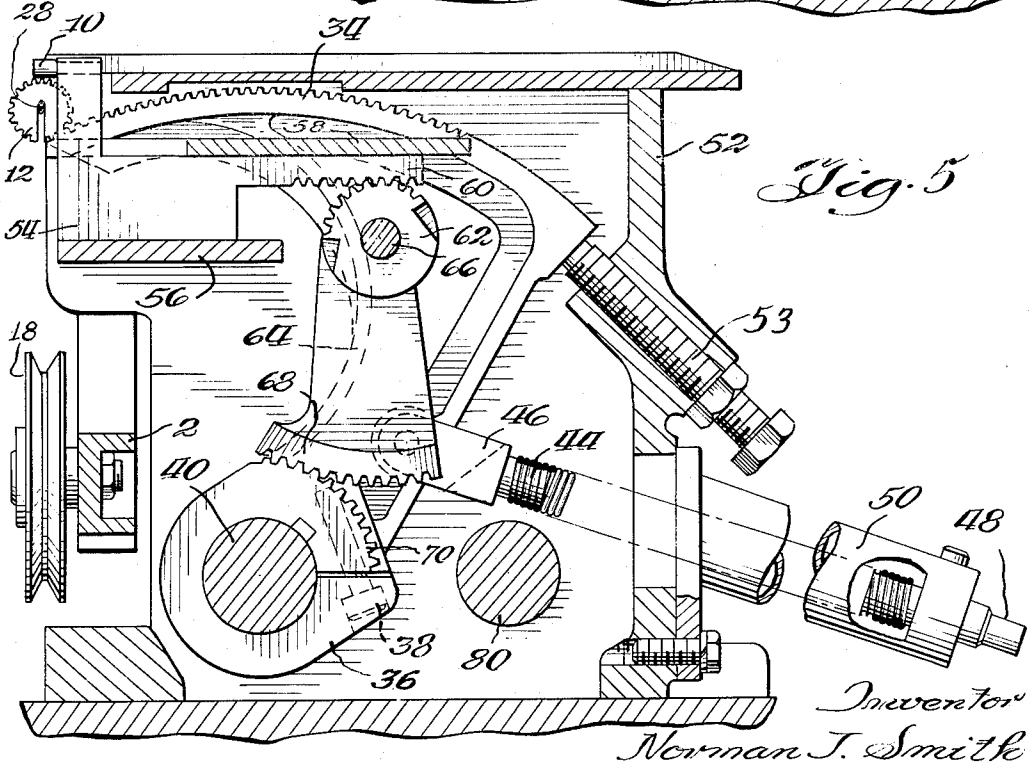


Fig. 5



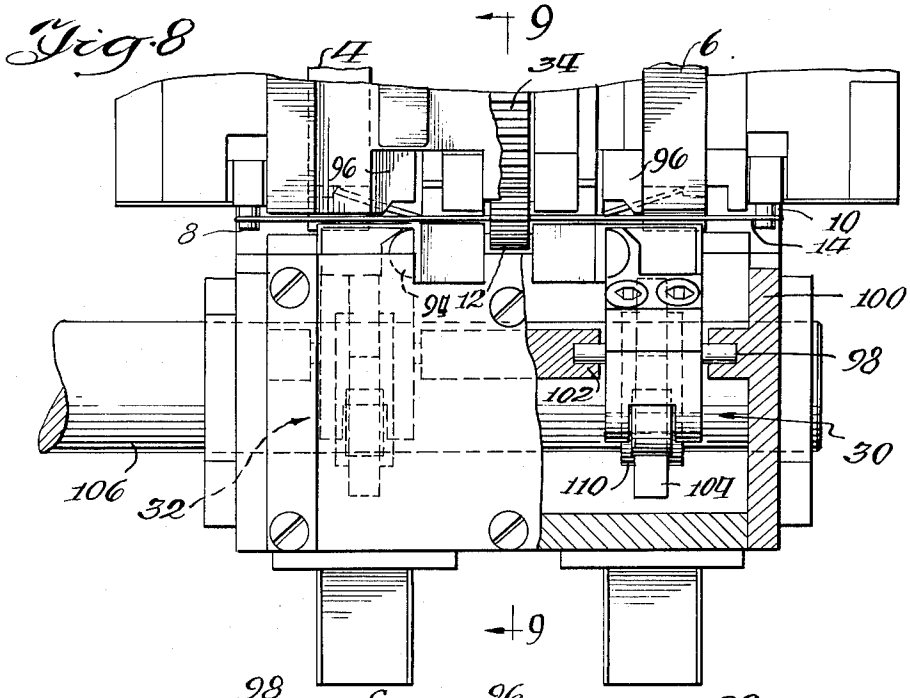
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WIRE TIER

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Fig. 8



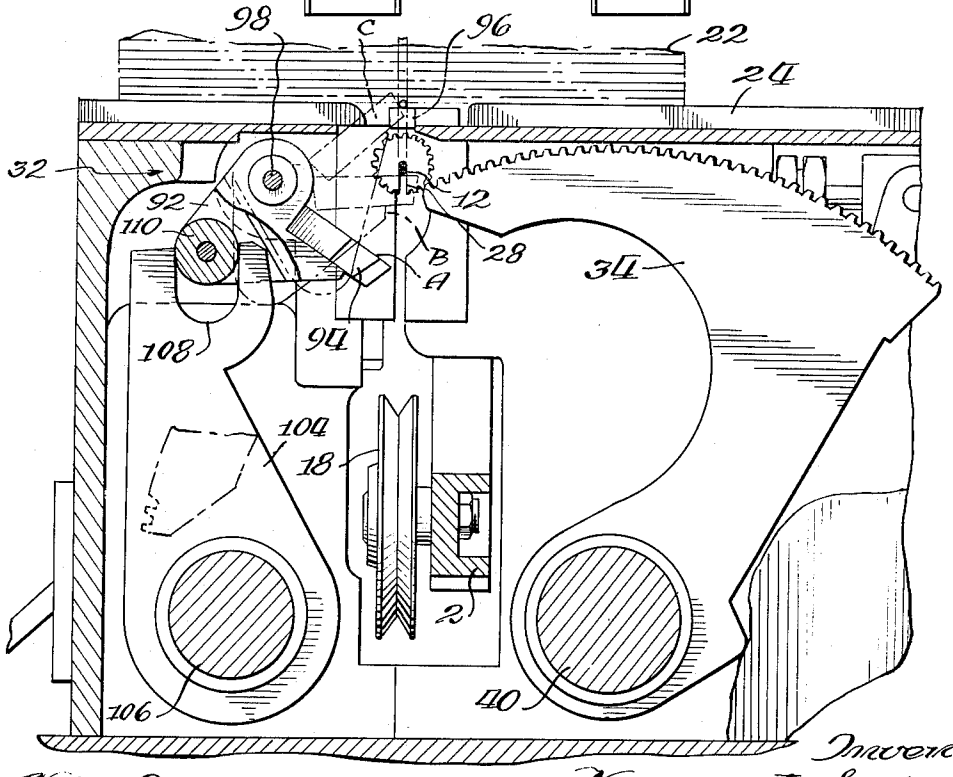


Fig. 9

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United States Patent Office

3,207,060

Patented Sept. 21, 1965

3,207,060

WIRE TIER

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Filed Aug. 30, 1963, Ser. No. 305,670
3 Claims. (Cl. 100—27)

This invention relates to a wire tying machine capable of tying bundles of varying thicknesses at a high rate, which machine will not jam in the event it is operated without a bundle being located therein.

Machines for tying bundles by wires that are wrapped therearound and then twisted together to secure the wire in position have been on the market for some time. These machines require that the bundle be manually located within the mechanism for circumscribing the wire about the bundle, after which the machine is cycled to effect the wire tying action. These machines have been particularly satisfactory where the bundles are relatively thick, in which situation the wire, which is under tension, does not curl up the sides of the bundle. As can be appreciated, these machines are only capable of handling a limited number of bundles per hour due to the time required to insert and remove bundles therefrom.

Generally speaking, a wire tying machine representative of the type above referred to and to which the present invention is applicable is constructed to pass wire drawn from a coil around a bundle about one and one quarter revolutions and thereafter fix the overlapped wire sections securely in place. The wire is placed in tension and the overlapped portions thereof are directed through a wire twisting device which twists the overlapped wire portions a predetermined amount to prevent them from separating. During the twisting operation, the wire is gripped on both sides of the twisting device. The knotter pinion portion of the twisting mechanism is arranged to receive and retain the wire as it is directed around the bundle, and, at the end of the twisting operation, the pinion is positioned so that the wire may be ejected therefrom.

After the wire has been twisted, a pair of cutters located between the transversely spaced grippers and the twisting mechanism are actuated to free the tied wire from the grippers. The end of the wire leading from the coil is retained in place by one of the grippers to facilitate tying of a subsequent bundle. The cutting mechanism performs the additional function of ejecting the twisted wire portion from the twisting mechanism.

The actual placing of the wire about the bundle is accomplished by a ring gear within which the bundle to be tied is located and to which a plurality of sheaves are connected. The sheaves guide the wire around the bundle and the wire is then extended through a double sheave that directs the wire inwardly to a suitable gripper mechanism that holds the end of the wire in place during the movement of the ring gear. The wire is moved more than 360° during each tying operation in order to effect overlapping of the wires and suitable mechanisms are provided to reverse the operation of the ring gear at the prescribed time to tie a number of bundles in sequence. That is to say, one bundle will be tied by passing the wire around the bundle in a clockwise direction and a subsequent bundle will be tied by rotating the ring gear and directing the wire about the subsequent bundle in a counterclockwise direction. Included in the machine are suitable mechanisms for timing the operation of the wire feed reversing means, twisting means, and cutting and gripper mechanisms so that they operate in the desired sequence. There are also provided devices for maintaining the wire taut so that there will not be any slack in the wire when the direction of operation of the ring gear is reversed.

Wire tying machines of the type referred to above are

illustrated in Parker Patents Nos. 1,875,259 and 1,875,260. These patents disclose, in detail, wire tiers to which the present invention may be applied, and the specifics of such machines, other than those necessary to assist in the understanding of the present invention, will not be dealt with in this application.

The aforementioned machines as typified by the Parker patents have proven to be satisfactory when they are used with relatively thick bundles and the machines are not operated until a bundle is placed therein. However, such machines are not capable of handling bundles at a very rapid rate, nor are they adaptable to handle a full range of bundle sizes. Similarly, the machines cannot be started prior to the placing of a bundle therein since such operation would prevent accurate positioning of the bundle in the machine. Such deficiencies are factors seriously limiting their effectiveness in places such as newspaper plants wherein it is desired to tie bundles containing varying quantities of newspapers in the shortest possible time. In such a situation, as in other similar operations, there is a need for insuring that the bundles are not crushed or "rolled up" during the tying operation. Also, the time interval during which a bundle need be present in the tying machine must be kept at a minimum.

To reduce the time interval above referred to, it would be desirable to be able to start the machine during the period that the bundle is being positioned in the wire tying machine. Another desirable feature would be to guide the wire so that preforming thereof could be accomplished to prevent the crushing and rolling problems attendant with relatively thin bundles. A tier having these features is particularly adaptable for use with a machine for aligning and positioning the bundles in the wire tier. A machine of this type is described in detail in copending application Serial No. 393,887, filed September 2, 1964, in the name of the instant inventor and assigned to the assignee of this application.

During high speed operation of wire tiers, it is necessary that jamming or clogging of the machine by wire snarled between the various gears be prevented. This is particularly important in the event it is started without a bundle being actually located in place since unless this contingency is provided for, the wire, during the tying cycle, will be jammed between the knotter pinion and gear sector for rotating said knotter pinion. The advantage in preventing this situation is obvious, since the jamming of the wire within the confines of the apparatus would require that the machine be partially disassembled to remove the clogging wire before operation of the machine can continue. The time during which the machine is rendered inoperative would seriously limit the output of the machine. A device for preventing this from occurring is particularly desirable where operation of the wire tying apparatus is begun before the bundle is actually located in place, since the likelihood that the bundle may not be accurately positioned has been increased.

In accordance with the present invention, there is provided a retractable pin means located adjacent the wire twisting and gripping mechanisms which serves to preform and support the wire being disposed about the bottom of the bundle to prevent rolling and crushing of relatively thin bundles. The pins also define a "frame" about which the wire can be wrapped in the event the machine is operated without a bundle being located therein. In the latter situation, the wire is formed into a closed loop that is ejected from the machine after the overlapping ends thereof are twisted together. This prevents the wire from being jammed between the knotter pinion and sector gear.

The movement of the pins is regulated by the gear mechanism effecting movement of the twisting device or knotter pinion, whereby the pins are located in the path

of the movement of the wire during the tying and twisting operations and are retracted out of engagement with the wire when the twisting is completed to permit ejection of the twisted wire from the knotter pinion. In the extended position, the pins guide the wire relative to the bottom of the bundle, which action can be begun before the bundle is finally positioned in place within the ring gear.

The structure by which the above and other advantages of the invention are attained will be described in the following specification, taken in conjunction with the accompanying drawings illustrating a preferred structural embodiment of the invention in which:

FIGURE 1 is a schematic view showing one end of the wire gripped in position prior to cycling the wire tier;

FIGURE 2 is a schematic view showing the disposition of the wire when the machine is actuated both with and without a bundle in position to be tied;

FIGURE 3 is a plan view, partially broken away, of the twisting and gripping portion of the wire tier;

FIGURE 4 is a view taken along lines 4—4 of FIGURE 3;

FIGURE 5 is a view, partially in section, taken along lines 5—5 of FIGURE 4 showing the position of the twisting mechanism and retractable pin assembly prior to the twisting of the overlapped wire portions;

FIGURE 6 is a view similar to FIGURE 5 showing the position of the various mechanisms just prior to the completion of the twisting action;

FIGURE 7 is a view taken along lines 7—7 of FIGURE 4 illustrating the means for operating one of the grippers;

FIGURE 8 is a plan view, partially broken away, illustrating a portion of the twisting and gripping mechanism, along with the cutter box assembly;

FIGURE 9 is a sectional view taken along lines 9—9 of FIGURE 8; and

FIGURE 10 is a view showing a knotted closed loop of wire.

Referring first to FIGURE 1, there is schematically illustrated a wire tier including a ring gear **2**, gripper assemblies **4**, **6**, guide pins **8**, **10**, and knotter pinion **12** as they are positioned prior to the start of the wire wrapping and tying action. The wire **14**, connected at one end to a wire supply (not shown), extends over a pulley **16**, sheaves **18** secured to ring gear **2**, and between a double sheave **20** inwardly to gripper **4** which retains the wire in the position shown. The double sheave **20** forms a guide member enabling the wire to lead off from either of the sheaves, or both, during winding of the wire. It is, of course, understood that during the start-up of the wire tier, or when the wire supply is exhaused, the wire will be threaded into the position shown in FIGURE 1.

During the wire tying operation, the wire **14** is circumscribed about a bundle **22** located on a conveyor platform **24** or, in the absence of a bundle, the wire is wrapped around pins **8**, **10** to form a closed loop of wire **26**, the over-lapping ends of which are knotted in the same manner as if a bundle were located on the platform to be tied. The two possible arrangements are shown in FIGURE 2.

In order to obtain a better understanding of the device, a brief description of the operation of the various mechanisms shown in FIGURES 1 and 2 is provided immediately below.

Starting from the position shown in FIGURE 1, in which the end of the wire **14** extends between the sheaves **20** inwardly of the ring gear **2** and is held by means of gripper **4**, the motor (not shown) for operating the ring gear is started to effect tying of the bundle by moving the ring gear **2** in a counterlockwise direction. The wire is fed into and through slot **28** in knotter pinion **12**, in front of the retracted right-hand gripper **6** under the pin **10**, and around the bundle in a counterclockwise direction. The wire directed around the bundle **22** is passed under the pin **8**, in front of the retracted left-hand gripper **4**, through the slot **28** in the knotter pinion **12**, and under the gripper **6**, which at this time in the cycle has been extended to receive wire **14**, in the position shown in FIGURE 2. During this period, the ring gear has been moved approximately 430° and in its final position retains the wire in tension about the bundle being tied. Such movement has resulted in the formation of vertically disposed overlapping wire portions in the slot **28** of knotter pinion **12** and between the grippers **4**, **6**.

The twisting mechanism including the knotter pinion **12** is then rotated to form the knot to tightly secure the overlapped portions of the wire together.

When the twisting has been completed, the cutter assemblies **30**, **32** (see FIGURES 8 and 9) are operated to sever the wire from the grippers **4**, **6** and the pins **8**, **10** are retracted to permit the wire to be ejected from the twisting mechanism to allow the tied bundle to be removed from the wire tier.

If the tier is operated without a bundle being disposed within the ring gear, a tied closed loop of wire **26** is formed about the pins **8**, **10** and subsequently ejected from the machine.

In either event, the gripper assembly **6** will retain the wire **14** disposed about the sheaves **18**, **20** in the same relative position as shown in FIGURE 1, but on the opposite side of the knotter pinion **12**. The wire retained by the gripper **6** will facilitate tying of a subsequent bundle when the ring gear is rotated in a clockwise direction.

It remains to note that after the cutting action has taken place, the gripper **4** is opened to release the small piece of wire retained therein. Also, after a bundle has been tied, or a loop ejected, the twisting mechanism and retractable pins are returned to their starting position to handle a subsequent bundle.

The relative locations of the retractable pins for guiding the wire being directed around the bundle and the gripping and twisting mechanisms are shown in plan and elevation views in FIGURES 3 and 4. The details, however, of the individual components are best seen in FIGURES 5 and 6.

The knotter pinion **12**, which is slotted at **28** to receive overlapped wire portions in a vertical relationship, is rotated by a twisting sector gear **34** that extends outwardly, intermediate the ends thereof, from a split hub **36** that is suitably secured, such as by screw **38**, to a shaft **40**. The movement of the shaft **40** is controlled by a cam (not shown) which is in turn positioned by the wire tier motor through various gears and cams, the details of which are not important to an understanding of the present invention. It is sufficient to note that the cam is designed to move the sector gear in a counterclockwise direction (FIGURE 6) to twist the wire at the desired time and to permit the sector gear to be returned to the position shown in FIGURE 5. The gear sector **34** is designed so that movement thereof rotates knotter pinion **12** a full two and one half turns plus a sufficient amount of overtwist to insure that the two straight wires remain vertically stacked in the pinion slot **28** to eliminate side drag or friction between the two wires and the slot side walls. Because of the spring characteristics of the wire, it has a tendency to unwind. If the knotter pinion did not overtwist sufficiently to allow the double wires to unwind to a point where both wires remain stacked one on top of the other, jamming would occur in the knotter pinion during ejection. The twisting of the overlapping wire portions located adjacent each side of the knotter pinion forms a double knot of the type shown in FIGURE 10.

As previously noted, the sector gear **34** is moved in a counterclockwise direction during the tying cycle by means of a cam (not shown). The return of the sector gear in a clockwise direction after completion of the tying cycle is accomplished by means of gear return spring **4**, which is affixed to a threaded stud **46** that is pinned

to sector gear **34**. The other end of the spring **44** is secured to a stud **48** located within a housing **50** secured to enclosure **52**. The clockwise movement of sector gear **34** is limited by stop **53**.

As briefly mentioned hereinbefore, the pins **8**, **10** are disposed to guide the wire as it is wrapped about the bundle prior to and during the rotation of the knotter pinion to twist the overlapped wire portions. The pins are moved in conjunction with the rotation of the knotter pinion so that they will be out of engagement with the wire after the tie has been formed. To effectuate this mode of operation, the movement of the pins **8**, **10** is controlled by the rotation of shaft **40** and corresponding movement of hub **36** through interengaging gear mechanisms as shown in FIGURE 5. Pin **8** is reciprocated by similar gearing located on the opposite side of gear sector **34** and thus it will only be necessary to describe the mechanism controlling the movement of pin **10**.

The pin **10** is press-fitted into the upper arm of a support **54** that is slidably disposed between a pair of horizontally extending plates **56**, **58**. The opposite end of support **54** defines a rack **60** that is engaged by gear teeth **62** formed in the upper end of a mutilated gear **64** that is pivotally mounted about a transversely extending pin **66**. The lower end of gear **64** defines gear teeth **68** that engage teeth **70** formed on hub **36**. Thus, it can be seen that counterclockwise rotation of shaft **40** (FIGURE 6) will rotate sector gear **34** to effect twisting movement of knotter pinion **12** and at the same time will, by clockwise movement of gear **64** through teeth **62**, move pin **10** and corresponding pin **8** out of engagement with the wire wrapped therearound during the wire tying operation.

The retraction of the pins **8**, **10** will prevent them from in any way interfering with the ejection of the wire from the knotter pinion when the bundle is to be removed from the wire tier.

In FIGURE 7, there is disclosed, in section, a mechanism for effecting operation of one of the grippers that holds the wire in position during the wire twisting and cutting operations. Briefly, each of the gripper assemblies **4**, **6**, which lie on opposite sides of the knotter pinion **12** includes a dog portion **72**, having an overhanging head that is bevelled or tapered at its outer end to facilitate movement of the wire under the dog when the gripper is extended to receive the wire being wrapped around the bundle. The grippers are operated at different times, as determined by the operation of the machine. The details of the controls for the grippers are not essential to the present invention. However, in order to facilitate an understanding of their operation, a cross-sectional view of the mechanisms for operating one of the gripper assemblies is illustrated in FIGURE 7. Due to their similarity only one will be described.

As illustrated, the means for extending and retracting the gripper heads into and out of position to receive the wire includes an arm **76** that extends outwardly from a split hub **78** that is rotatably mounted on a shaft **80**. The upper end of arm **76** is secured to a rod **82**. The rod **82** is biased into resilient engagement with sleeve **84** to which the dog **72** of the gripper assembly **4** is connected. Accordingly, clockwise movement of arm **76** will move rod **82**, sleeve **84** and dog **72** to move gripper **4** outwardly, wherein the head of dog **72** is in position to receive a wire being directed around the bundle and into the knotter pinion **12**. The movement of arm **76** is controlled by suitable springs and cam mechanisms, the details of which are not important to an understanding of the present invention. The spring **86** located between an adjusting nut **88** and the knob end **90** of rod **82** is included to provide for sufficient tension to hold the wire throughout the winding and twisting cycle and to compensate for different thicknesses of wire.

The mechanism above described is duplicated on the other side of knotter pinion **12** for effecting similar movement of gripper **6**. The two gripper assemblies operate at different times in the cycle, since as mentioned previously, the gripper **6** is (a) first retracted out of the way of the wire during the initial counterclockwise movement of ring gear **2**, (b) extended to receive the wire after it has circumscribed bundle **22**, and (c) retracted to grip and hold wire in place during the subsequent twisting and cutting operations and to retain the end of the wire leading from the main wire coil in position to facilitate tying a subsequent bundle. Gripper assembly **4** stays in the position shown in FIGURE 1 throughout the operating cycle, after which it opens to release the short strip of wire contained therein. In a succeeding cycle, the operation of the gripper assemblies is reversed.

With the grippers in the engaged position shown in FIGURE 2, the cutting mechanisms illustrated in FIGURES 8 and 9 are then operated to sever the wire from the coil of wire inwardly of gripper **6** and to cut the wire free of gripper **4**. As shown in FIGURES 8 and 9, the cutter mechanism consists of cutter assemblies **30**, **32** located on opposite sides of knotter pinion **12** between pinion **12** and the adjacent gripper assembly. Each cutter assembly consists of a cutter holder **92** to which is secured a cutter tip **94** that is adapted to engage a wire portion to be cut and move it between the cutter tip **94** and a stationary cutter bevel **96** fixed in place adjacent the knotter pinion to effect the cutting action. The cutter holder **92** is pivotally mounted about a pin **98**, the ends of which are rotatably supported in recesses formed in transversely spaced support members **100**, **102**.

The pivotal movement of the cutter holder **92** is controlled by an arm **104** that is connected to a shaft **106**. The arm **104** defines a U-shaped slot **108** in its upper end which is designed to receive a roller **110** affixed to the outer end of the cutter holder **92**. Clockwise movement of arm **104** by shaft **106** rotates cutter holder **92** counterclockwise to move the cutter tip **94**, in sequence, through positions A, B and C. Position A is the stationary or at rest position before the arm **104** is pivoted; position B is the position of cutter tip **94** when it engages the overlapped wire portions to tuck the ends of wire and retain the vertically disposed overlapped portions in position in the slot **28**; and position C is that position taken by the cutter tip **94** after the wire has been severed from the gripper holding an end thereof. This last-mentioned step occurs after the knotter pinion has completed its twisting action and the wires are free to be moved upwardly out of the slot **28** into cutting engagement with the stationary bevels **96**. The operation of shaft **106** is controlled by suitable cam and spring mechanisms and the movement thereof is correlated with the movement of the sector gear **34** so that the aforementioned sequential positioning of cutter assemblies **30**, **32** takes place at the prescribed time.

The method of operation of the wire tier is as follows:

The operation of the machine will be described starting from the position shown in FIGURE 1 in which a wire **14** is in place around pulley **16** and sheaves **18** secured to ring gear **2** and is extended in between double sheaves **20** into gripping engagement with gripper assembly **4**.

When the machine is started, the ring gear **2** is rotated in a counterclockwise direction through approximately 430°, during which period sheaves **20** move from point X, through a complete revolution, and then to position Y. During this movement of the ring gear, the wire is first directed into the slot **28** of knotter pinion **12**, over the gripper **6**, which is retracted during the starting movement, under pin **10** and around the bundle **22** located on platform **24**. The wire is then directed under pin **8** over retracted gripper **4**, which is holding the wire end, through the slot **28** in the knotter pinion **12** and underneath gripper **6**, which has at this time opened to receive the wire as the double sheave **20** reaches point Y. At point Y, due to the characteristics of the crank motion

of the ring gear, the ring gear reaches a dwell position prior to its being rotated in the clockwise direction to tie a subsequent bundle. At this point in the cycle, the cutters **30**, **32** are moved to carry out their function. Just before the ring gear reaches the dwell position, and immediately thereafter, the gripper assembly **6** retracts and holds the wire in the position shown in FIGURE 2. At this time, the cutters move from position A shown in FIGURE 9, where they are out of engagement with the wire, into position B, where they act to insure that the overlapping wire portions are properly located in slot **28** of cutter pinion **12**. When the cutters reach position B, the sector gear **34** moves in a counterclockwise direction (see FIGURE 5) to rotate the knotter pinion **12** a full two and one half turns plus a sufficient amount of overtwist, so that the wires will be vertically stacked in the slot **28**. After overtwisting, the knotter pinion returns to the eject position with the slot **28** opening upward. During the twisting movement of the sector gear, the pins **8**, **10** are retracted out of engagement with the wire through the action of gear sector **64**. Thus, the pins will not present an obstacle to the ejection of the knotted wire from the knotter pinion. The pinion **12** remains in the ejection position while the cutter assemblies **30**, **32** move from position B to position C. During the first portion of this movement of the cutter assemblies, the cutters contact the wire and lift it above the stationary cutter bevels **96**. This action completes the cutting of the wire. At the end of its travel from position B to position C, the cutter assemblies carry or eject the knot from the pinion **12**.

The gripper assembly **4** is subsequently operated to allow the piece of wire held therein to drop out so that the gripper assembly is in position to receive wire during the next tying cycle.

It remains to note that at the completion of the tying and cutting operation, the cutter assemblies and sector gear **34** are returned to their starting position, as shown in FIGURES 5 and 9, respectively, to tie another bundle. As illustrated in FIGURE 5, the knotter pinion is moved to receive overlapping wire portions therein and the pins **8**, **10** are extended outwardly to receive and guide the wire being disposed about the bundle during a subsequent wire tying operation by the action of spring **44** which moves the gear sector clockwise against stop **53**, and gear **64** counterclockwise about pin **66**.

The aforementioned method of operation is that which takes places when a bundle is properly located within the ring gear. If a bundle is not so positioned, the pins **8**, **10** form a frame about which the wire will be disposed by the ring gear during the tying cycle. When this occurs, a loop **26**, as shown in FIGURE 10, will be formed and will be subsequently ejected from the machine, which will prevent jamming of the machine.

After the wire tying operation is completed, a subsequent bundle may be placed on the conveyor platform **24** and the ring gear rotated in the clockwise direction to tie another bundle.

Although there is described an illustrative embodiment of the invention in considerable detail, it will be understood that the description is intended to be merely exemplary, rather than restrictive, as many details may be modified or changed without departing from the spirit and scope of the invention.

I claim:

1. In a wire tier for bundles including a knotter pinion, means for wrapping a wire about a bundle and directing overlapped portions of said wire through the knotter pinion, means for rotating said knotter pinion to secure the overlapped portions together, means for gripping the wire during twisting, retractable pin means located on opposite sides of the knotter pinion and below the bundle for guiding the wire being disposed about the bundle, means for moving said retractable pins into and out of position to be engaged by said wire, a sector gear interconnecting and driving said knotter pinion rotating means and said pin moving means for positioning said pins out of engagement with the wire after the wire has been twisted to permit ejection of the wire from the wire tier.

2. A wire tier for wrapping a wire about a bundle and securing same thereto comprising a knotter pinion for twisting overlapped portions of the wire, pin means disposed on opposite sides of the knotter pinion and below the level of the bundle for guiding the wire about the bottom of the bundle, means for controlling the movement of said retractable pins and knotter pinion to provide for retraction of said pins out of engagement with the wire when the wire has been twisted, cutter means disposed between said knotter pinion and its adjacent retractable pin for cutting said wire after the knot has been formed, and for ejecting the wire from the knotter pinion.

3. In a wire tier for bundles including a knotter pinion, means for wrapping the wire about the bundle, overlapping portions thereof and directing the overlapped portions through the knotter pinion, means for rotating said knotter pinion to twist and secure the overlapped portions together, gripper means disposed adjacent to both sides of the pinion for securing the wire in place during the twisting action, means for moving said gripper means, retractable pins for preforming the wire being disposed about the bundle, said retractable pins being located adjacent to the sides of said gripper means, opposite from said knotter pinion, means for longitudinally moving said retractable pins into and out of engaging position with said wire, and means interconnecting the means controlling the movement of the knotter pinion, and retractable pins for preforming and retaining the wire in place during the twisting operation.

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