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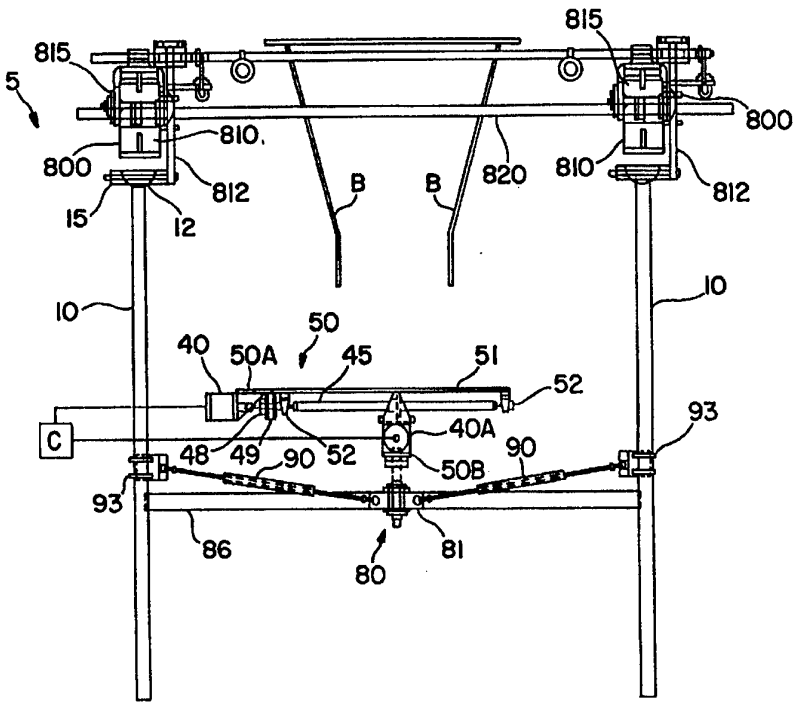

(57) Abstract

A yarn coiling apparatus (5) is disclosed that allows for easily changing the configuration of the yarn layout. This is achieved by using a programmable controller (C) to vary the amount by which first (50a) and second linear (50b) moving mechanisms move a pin (85) that is attached through a frame (80) to depending yarn tubes (10). By varying the program within the controller, the layout is changed. This device eliminates all the problems found in conventional gear and crank-based yarn coilers.

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"YARN COILING APPARATUS".

RELATED PROVISIONAL PATENT APPLICATION

This application is a continuation-in-part of and claims priority to US Provisional Patent Application Serial Number 60/002,612, filed August 21, 1995.

BACKGROUND OF THE INVENTION

U.S. Patent No. 4,158,253, to Gaghan et al. (hereinafter "the '253 patent") discloses a simplified yarn coiler. The '253 patent attempts to achieve the laudable goals of trying to make a modular yarn coiler that is easy to construct and repair.

The device of the '253 patent, however, has many drawbacks. One of these drawbacks concerns the '253 patent's use of a crank and gear transmission. Due to this transmission, the '253 device cannot be easily modified to change the pattern of the yarn coil which is made. Accordingly, it is not easy to go from making large diameter coils to smaller diameter coils. In the '253 device, this would require changing the various gears and cranks shown in the '253 patent to achieve a different final drive ratio, which controls coil size. This gear and crank system also makes it difficult and costly to run and synchronize multiple yarn coiling stations in a single factory because each station needs its own gear and crank transmission. Furthermore, the use of gears, themselves, carries inherent problems. For example, gears are subject to mechanical wear, which after time could cause the machine to function improperly, such as when gear teeth break off or there becomes substantial play between deformed teeth.

Thus, there is room for improvement within the art.

OBJECTS OF THE INVENTION

It is an object of the invention to provide a yarn coiler that is substantially simpler than prior art yarn coilers.

It is a further object of the invention to provide a yarn coiler that uses substantially less parts than prior art yarn coilers.

It is yet a further object of the invention to provide a yarn coiler that is not subject to the problems inherent with gear and crank-based mechanical drives.

It is still yet a further object of the invention to provide a yarn coiler that can be easily programmed to coil yarn in large or small diameter cans or any other configuration.

It is still yet a further object of the invention to provide a yarn coiler that can be easily coordinated and synchronized with other identical yarn coilers to produce a yarn coiling factory.

It is still yet a further object of the invention to provide an improved yarn coiler that can be retro-fitted out of a prior art yarn coiler.

These and other objects of the invention are achieved by a yarn coiler comprising at least one swivelly mounted depending yarn tube and an adjustable moving mechanism connected to the tube for moving the tube along a predetermined path. The depending tube can thereby be made to move along a variety of predetermined paths by adjusting the moving mechanism. The adjustable moving mechanism preferably comprises a programmable controller into which a program representing the predetermined path is placed, together with first and second linear moving mechanisms, each independently controlled by the programmable controller, for moving the tube in first and second linear directions, these directions being perpendicular to and coplanar with each other. Furthermore, a frame may connect a plurality of yarn tubes such that the depending yarn tubes move along the same path, the frame being connected to the adjustable moving mechanism for being moved along a predetermined path.

BRIEF DESCRIPTION OF THE DRAWINGS

Figures 1A and 1B are elevational views of a yarn coiler according to the invention.

Figure 2 is a plan view of a yarn coiler according to the invention.

Figure 3A is a side elevation view of a second linear moving mechanism for use with a yarn coiler according to the invention.

Figure 3B is a front view of a first linear moving mechanism for use with the yarn coiler according to the invention.

Figure 4 is an elevational view of a second embodiment of a two-dimensional moving mechanism for use with the yarn coiler according to the invention.

Figure 5 is a view along line 5-5 of Figure 4.

Figure 6 is a plan view of the first linear moving mechanism for use with the second embodiment of a two-dimensional moving mechanism for use with the yarn coiler according to the invention.

Figure 7 is an elevational view of a third embodiment of a two-dimensional moving mechanism for use with the yarn coiler according to the invention.

Figure 8 is a view along line 8-8 of Figure 7.

Figure 9 is a view along line 9-9 of Figure 8.

Figure 10 is an elevation view of a fourth embodiment of a two dimensional moving mechanism for use with the yarn coiler according to the invention.

Figure 11 is a plan view of the fourth embodiment of a two dimensional moving mechanism for use with the yarn coiler according to the invention.

Figure 12 is a view along line 12-12 of Figure 11.

Figure 13 is a schematic view of a single controller connected to a plurality of yarn coiling stations.

DETAILED DESCRIPTION OF THE DRAWINGS

Figures 1A and 1B show elevational views of a first embodiment of yarn coiler 5 according to the invention. Figure 2 shows yarn coiler 5 having the ability to simultaneously coil four cans of yarn 2. Although each yarn can must have the same diameter, that diameter may vary as shown by differing diameters 3, 3a of Figure 2.

Supported above the floor on which yarn cans 2 are placed are four depending hollow yarn tubes 10. There is one tube 10 per yarn can 2. Each yarn tube 10 has upper and lower ends. At the upper end of each yarn tube 10, pivot 12 is attached. Attached to the coiler support frame will be pivot mount 15.

In the preferred embodiment it is envisioned that pivot 12 will be a semispherical-shaped ball and pivot mount 15 will be a corresponding semispherical-shaped hole. The ball will have a hole therethrough for downwardly directed yarn to pass through. Other types of pivots and pivot mounts may be used. Furthermore, while four depending hollow yarn tubes 10 are shown in the preferred embodiment, it is possible for there to be as few as one, or more than four, depending hollow yarn tubes 10.

Yarn strands are fed to yarn tubes 10 by yarn feed mechanisms 800, 800'. The yarn feed mechanisms are mounted to either overhead supports or legs to suspend them, as well as depending yarn tubes 10, above yarn cans 2, which will be resting on the factory floor. Side plates 812, 812' support pivot mounts 15. For feeding yarn strands S, a motor (not shown) rotates shafts 820, 820'. Mounted on ends of shafts 820, 820' are feed rolls 810, 810'. Against yarn strand S and feed rolls 810, 810' are idler rolls 815, 815'.

For moving the four yarn tubes 10 in an arcuate path for coiling the yarn, two-dimensional moving mechanism 50 connected to frame structure 80 is provided. Frame structure 80, which will later be described in greater detail, is used to cause each tube 10 to simultaneously move along the same path, at the same speed, as the other tubes 10, thereby producing four identically coiled cans of yarn 2.

As shown in Figures 1-3, two-dimensional moving mechanism 50 comprises first and second linear moving mechanisms 50a, 50b. First linear moving mechanism 50a is for moving depending tubes 10 in a first linear direction while second linear moving mechanism 50b is for moving depending tubes 10 in a second linear direction, perpendicular to and coplanar with the first. Each linear moving mechanism is independently controlled by programmable controller C, typically a conventional microprocessor-based digital device. Thus, by varying the program in controller C, it is possible to cause the depending tubes to move along a variety of paths. While typically the variety of paths (yarn coil layouts) will be circles of varying

radii, the instant invention is not limited to such movements. For example, squares of decreasing area may be produced, if needed. The variation in coil shapes for the yarn are only limited by the length of the various threaded jackshafts to be described herein and by the amount of swivel allowed by pivot 12 and pivot mount 15. Tubes 10 are not limited to a fixed path such as in the '253 patent. These general premises apply to each embodiment disclosed herein of two-dimensional moving mechanism 50.

As shown in Figure 3B, first linear moving mechanism 50a is mounted above frame 80 (FIGS. 1A & 1B) to a fixed and rigid overhead surface by first horizontal support bracket 51. First support bracket 51, adapted to be affixed to the fixed and rigid overhead surface, is generally flat. Mounted to, and below, first support bracket 51 are two pairs of bearings 52, 52' for rotatable receipt of two threaded jackshafts 45, 45' therein. Each jackshaft 45, 45' has a pulley 48, 48' mounted thereon, the pulleys 48, 48' being connected by drive belt 49. Accordingly, jackshafts 45, 45' will rotate in the same direction and at the same speed. Motor 40 is connected to an end of one of jackshaft 45, 45' for rotating the same. Motor 40 is electronically connected to, and controlled by, controller C. Typically, all motors used in the yarn coiler according to the invention will be stepmotors because they are easy to synchronize and produce precise amounts of rotation. Furthermore, all motors described herein will also be mounted, either directly or by bracket, to the various supports so as to be fixed except for their respective drive shafts. Mounted on each threaded jackshaft 45, 45' are threaded bearings 46, attached to second linear moving mechanism 50b. It should be noted that as referred to herein, "bearing(s)" refer to ordinary bearings for rotatably supporting ends of a shaft, while "threaded bearing(s)" refer to those types of bearings which have threaded interiors such that when a threaded shaft inside the threaded bearing is turned, the threaded bearing will move in a linear direction along the shaft.

As shown in Figure 3A, second linear moving mechanism 50B is mounted on second support bracket 55. Second support bracket 55 is generally H-shaped, having horizontal portion 55', upper vertical portions 55'', and lower vertical portions 55'''. In this regard, "upper" and "lower" are measured with respect to horizontal portion 55'. Upper vertical portions 55'' of the H support threaded bearings 46 of first linear moving mechanism 50a (FIG. 3B). Thus, as controller C causes motor 40 to rotate jackshafts 45, 45', first linear moving mechanism 50A moves in the first linear direction.

Lower vertical portions 55''' of the H support bearings 54, 54' for receipt of another threaded jackshaft 43. At the end of jackshaft 43 is another motor 40a, also controlled by controller C, for rotating jackshaft 43. Carriage 57 has wheels 59 and is mounted to move along horizontal portion 55' of first support bracket 55, in a linear direction parallel to jackshaft 43 and perpendicular to jackshafts 45, 45'. To achieve this, middle portion of carriage 57 comprises a threaded bearing 58 that receives threaded jackshaft 43. Thus, as motor 40a causes jackshaft 43 to rotate, carriage 57 will be made to move in a linear direction parallel to jackshaft 43 and perpendicular to jackshafts 45, 45'. The lower portion of carriage 57 has a pin 85 downwardly depending therefrom. It is easily seen that as first linear moving mechanism 50a causes second linear moving mechanism 50B to move in a first linear direction, and that as second linear moving mechanism 50a causes carriage 57 to move in a second linear direction, perpendicular to and coplanar with the first, pin 85 will be caused to move along an arcuate path.

To move depending tubes 10 in an arcuate direction, they must be linked for movement to pin 85. Achieving this goal, frame 80 (FIGS. 1A & 1B) comprises two perpendicular beams 81, 86 (FIG. 2) that are attached together. One of beams 81, 86 has a mount for receiving pin 85. Thus, as pin 85 moves, so do beams 81 and 86. Each beam 81, 86 has first and second ends. Ends 81, 86 are connected to depending tubes 10 by connecting bars 90. In the preferred embodiment there are eight (8) such

connecting bars 90. Each depending tube 10 is connected to both beams 81 and 86 by two connecting bars 90 and one frame connector 93. Connecting bars 90 are made from adjustable length mechanical elements. With this structure, as pin 85 is moved in an arcuate path by first and second linear moving mechanisms 50a, 50b, beams 81, 86 move in that same arcuate path, causing connecting bars 90 to move depending tubes 10 along that same arcuate path.

It is highly probable that many factories currently use prior art yarn coilers such as that in the '253 patent. Accordingly, it will be advantageous to retro-fit these prior art coilers to take advantage of the teachings of the instant invention. In this regard, that is simple. As shown in Figures 1A and 1B, the prior art drive mechanism of the '253 patent has been removed from bracket B. Then, all one would need to do is mount the selected embodiment of the two-dimensional moving mechanism to the existing overhead support, connect controller C to the two motors, and enter the selected program in controller C. This retro-fitting is conceived to take a minimum amount of time.

Figures 4-6 show various views of a second embodiment of a two-dimensional moving mechanism 150 for use with the yarn coiler according to the invention. In this embodiment, both first and second linear moving mechanisms 150a, 150b have dual jackscrew structures. As shown in Figures 4-6, first linear moving mechanism 150A is mounted above frame 80 (FIGS. 1A & 1B) to a fixed and rigid overhead surface by inverted U-shaped bracket 160. Mounted to downwardly depending legs 161, 162 of U-shaped bracket 160 are two pairs of bearings 163, 163' for rotatable receipt of two threaded jackshafts 180, 180' therein. Each jackshaft 180, 180' has a pulley 170, 170' mounted thereon and the pulleys 170, 170' are connected by drive belt 175. Accordingly, jackshafts 180, 180' will rotate in the same direction and at the same speed. Motor 155 is connected to an end of one of jackshafts 180, 180' for turning the same in accordance with the program in controller C. Mounted on each threaded jackshaft 180, 180' are threaded bearings 205, 205'

attached to second linear moving mechanism 150b. Second linear moving mechanism 150b is mounted in a generally inverted box-like second support bracket 200. Second support bracket 200 has a horizontal portion, two downwardly depending sides 201, 201', and two downwardly depending ends 202, 202'. Mounted to downwardly depending ends 202, 202' are two pairs of threaded bearings 205, 205' through which jackshafts 180, 180' pass. Thus, as controller C causes motor 155 to rotate jackshafts 180, 180', second linear moving mechanism 150b moves in the first linear direction.

As shown in Figure 6, second support bracket 200 has two pairs of bearings 241, 241' mounted on its sides 201, 201', for receipt of another pair of threaded jackshafts 244, 244'. Each jackshaft 244, 244' has a pulley 260, 260' mounted thereon, pulleys 260, 260' being connected by drive belt 265. Accordingly, jackshafts 244, 244' will rotate in the same direction and at the same speed. Motor 255 is attached to an end of one of threaded jackshafts 244, 244' for rotating the same. Carriage 230 is mounted to move in a linear direction parallel to the direction of jackshafts 244, 244' and perpendicular to jackshafts 180, 180' (FIG. 5). To achieve this, carriage 230 has threaded bearings 245, 245' that receive threaded jackshafts 244, 244'. Thus, as motor 255 causes jackshafts 244, 244' to rotate, carriage 230 will be made to move in a linear direction parallel to jackshafts 244, 244' and perpendicular to jackshafts 180, 180'. A lower portion of carriage 230 has pin 85 downwardly depending therefrom. It is easily seen that as first linear moving mechanism 150A causes second linear moving mechanism 150B to move in a first linear direction, and as second linear moving mechanism 150B causes carriage 230 to move in a second linear direction, perpendicular to and coplanar with the first, pin 85 (FIG. 4) will be caused to moved along an arcuate path.

Figures 7-9 show yet a third embodiment, a two dimensional moving mechanism 300 which is very similar to the second embodiment inasmuch as the third embodiment uses: two pairs of threaded jackshafts 322, 322' and 360, 360'; two pairs of

threaded bearings 345, 345'and 385, 385'; two motors 330, 355; two pairs of pulleys 370, 370' and 340, 340'; two drive belts 325, 375, connecting the pulleys; and pin 85. In this embodiment, two dimensional moving mechanism 300 is attached to the fixed and rigid overhead support by first support bracket 310, in the form of a generally flat bracket. Second linear moving mechanism 300B is attached to first linear moving mechanism 300A by use of a second support 350, which is mounted to threaded bearings 345 of first linear moving mechanism 300A. This embodiment works in an identical fashion to that described with respect to the second embodiment and only differs in the construction of the various supports of the two linear moving mechanisms.

Figures 10-12 show yet a fourth embodiment of a two dimensional moving mechanism 400. The fourth embodiment uses: two threaded jackshafts 422, 460; two threaded bearings 445, 485; two motors 430, 455 linked by controller C; and pin 85. This embodiment lacks the pulleys found in some of the other embodiments of the invention since first and second linear moving mechanisms 400A, 400B each comprises only a single threaded jackshaft. In this embodiment, it is foreseen that first and second linear moving mechanisms 400A, 400B each comprise a conventional, off-the-shelf linear movement generating device, such as an NSK MONOCARRIER. Such conventional linear movement generating devices comprise the combination of a fairly rigid and inflexible beam, bearings, threaded jackshaft, and motor. While such linear movement generating devices have seen use in many environments, prior to the instant invention, use of two such devices as a replacement for the mechanical gear drive of a yarn coiler such as shown in Gaghan has not been envisioned. In this embodiment, two dimensional moving mechanism 400 is attached to the fixed and rigid overhead support, preferably bracket B from which the prior art gear drive was hung (Figures 1A, 1B), by use of one or more angle-members 410. Each angle member 410 preferably has a plurality of holes 470 therein for mating with the holes in bracket B and the passing of fasteners (not-shown)

therethrough. Hanging from angle-members 410, by use of fasteners 415 or any other means such as welding or adhesive, is first support bracket 451. First support bracket 451 will typically take the form of a generally flat rectangular or square plate. First linear moving mechanism 400A is hung from first support bracket 451 by mounting its first rigid and inflexible beam 453, which supports bearings 452, which themselves support threaded jackshaft 422, to the ends or lower surface of first rigid and inflexible beam 453. Second linear moving mechanism 400B is attached to first linear moving mechanism 400A by having threaded bearing 445 of first linear moving mechanism 400A support second support plate 465 thereunder using any known connectors, including but not limited to threaded fasteners or welding. Second rigid and inflexible beam 463 of second linear moving mechanism 400B is hung from, or is unitary with second support bracket 465. Bearings 441, which support threaded jackshaft 460, are mounted to the ends or lower surface of second rigid and inflexible beam 463. Finally, threaded bearing 485 is positioned on threaded jackshaft 460 and pin 85 downwardly depends from threaded bearing 485. The conventional construction of second linear moving mechanism 400B as described above in combination with second support bracket 465 assures that the second linear moving mechanism 400B will not pivot about threaded bearing 485. Accordingly, threaded jackshaft 460 will not jam within threaded bearing 485.

The embodiment of Figures 10-12 operates as follows and can be retro-fitted to replace a prior art gear drive as generally described above. The user first removes the prior art gear drive used in the prior art yarn coiler. Two dimensional moving mechanism 400 is hung from now-empty bracket B using fasteners passed through holes 470 and the corresponding holes in bracket B (other hanging mechanisms may be used). As controller C causes motor 430 of first linear moving mechanism 400A to rotate jackshaft 422, second linear moving mechanism 400B moves in the first linear direction indicated by the arrows in Figure 11. Similarly, as controller

C causes motor 455 of second linear moving mechanism 400B to rotate jackshaft 460, threaded bearing 485 will be made to move in the second linear direction, parallel to jackshaft 460 and perpendicular to jackshaft 422, as indicated by the arrows in Figure 12. The lower portion of threaded bearing 485 has a pin 85 downwardly depending therefrom. It is easily seen that as first linear moving mechanism 400A causes second linear moving mechanism 400B to move in a first linear direction, and that as second linear moving mechanism 400B causes threaded bearing 485 to move in a second linear direction, perpendicular to and co-planar with the first, pin 85 will be caused to move along an arcuate path.

Described to this point has been a single yarn coiling station, or apparatus, 5, comprising four separate yarn coiling tubes 10. Typically, however, a factory will have a plurality of yarn coiling stations 5, producing many more than four cans of yarn at a time. With prior art yarn coilers such as the one shown in the '253 patent, it has been very difficult to synchronize these plurality of yarn coiling stations. Mechanical gear and crank movements make it very hard to interconnect multiple coiler stations. Furthermore, each coiler station will need its own gear and crank transmission, adding substantial cost to the factory. With the instant invention, the use of controller C and step motors eliminates this problem. A single controller C, programmed with the desired yarn layout, can control virtually any number of step motors. Thus, one controller C can be used to cause any number of yarn coiling stations to produce the desired yarn layout, as schematically seen in FIG. 13, where a controller C' is connected to yarn coiling stations 105, 205, 305, and 405, each of these stations being identical to the yarn coiler 5 described previously herein. This allows the layout of all the yarn coiling stations to be changed by merely making a single change to controller C, rather than changing the gear and crank transmission of each individual yarn coiling station.

Finally, while the invention is discussed with the use of a programmable controller which independently controls first

and second linear moving mechanisms to produce the arcuate movement of depending tubes 10 to produce the yarn coils, the concept behind the invention is not limited to such a use. It is entirely possible to use other methods, including the use of complex mechanical movements, to provide a yarn coiler having the ability to produce a variety of yarn layouts. While not preferred, all such methods are within the scope of the invention.

The above description is given in reference to an improved yarn coiler. However, it is understood that many variations are apparent to one of ordinary skill in the art from a reading of the above specification and such variations are within the spirit and scope of the instant invention as defined by the following appended claims.

THAT WHICH IS CLAIMED:

1. A yarn coiler comprising:

at least one swivelly mounted depending yarn tube;

an adjustable moving mechanism connected to said tube for moving said tube along a predetermined path;

whereby said depending tube can be made to move along a variety of predetermined paths by adjusting said moving mechanism.

2. The yarn coiler according to claim 1, wherein said adjustable moving mechanism comprises a programmable controller into which a program representing said predetermined path is placed.

3. The yarn coiler according to claim 2, wherein:

said adjustable moving mechanism further comprises first and second linear moving mechanisms for moving said at least one tube in first and second linear directions; and

said programmable controller independently controls each said first and second linear moving mechanisms.

4. The yarn coiler according to claim 3, wherein said first and second linear directions are perpendicular and coplanar.

5. The yarn coiler according to claim 1, wherein:

said at least one yarn tube comprise a plurality of yarn tubes;

and further comprising:

a frame, said frame connecting said depending yarn tubes such that said depending yarn tubes move along the same path; and

wherein said adjustable moving mechanism is connected to said frame for moving said frame along a predetermined path.

6. The yarn according to claim 2, further comprising a plurality of identical yarn coilers, all controlled by the same said programmable controller.

7. A yarn coiler comprising:

a plurality of depending tubes, each said depending tube having upper and lower ends, said upper ends having a pivot mounted thereto, said pivot attached to a pivot mount, said

pivot and pivot mount allowing for swivelling movement of said depending tubes such that the lower end of each tube may move along a pre-programmed path to dispense textile material therefrom;

a frame, said frame connecting said depending tubes such that said depending tubes move along the same path;

a two-dimensional moving mechanism connected to said frame for moving said frame in first and second linear directions;

a programmable controller interacting with said two-dimensional moving mechanism to allow for independently varying the degree by which said frame moves in either of said first or second linear directions;

whereby said two-dimensional moving mechanism can be used to cause said depending tubes to move along a variety of paths by varying the program within said controller.

8. The yarn coiler according to claim 7, wherein said two-dimensional moving mechanism comprises:

a first linear moving mechanism for moving said frame in a first linear direction; and

a second linear moving mechanism for moving said frame in a second linear direction, perpendicular to said first linear direction.

9. The yarn coiler according to claim 8, wherein said first and second linear moving mechanisms have first and second motors, respectively, for independently driving said first and second linear moving mechanisms in their respective first and second linear directions.

10. The yarn coiler according to claim 9, wherein:

said first linear moving mechanism comprises:

a first support bracket affixed to an overhead surface;

first and second pairs of bearings attached to, and below, said first support bracket;

first and second threaded jackscrews rotatably received in said first and second pairs of bearings, each said first and second jackscrews having a pulley mounted on an end thereof;

a first belt wrapped around said two pulleys;

said first motor affixed to one of said threaded jackscrews and said first support bracket for rotating both said jackscrews in the same direction and at the same speed via said belt and pulleys; and

said second linear moving mechanism comprises:

a second support bracket rigidly attached to said pair of threaded bearings of said first linear moving mechanism;

at least one pair of bearings attached to, and below, said second support bracket;

at least one threaded jackscrew rotatably received in said at least one pair of bearings;

said second motor affixed to said at least one threaded jackscrew and said second support bracket for rotating said at least one threaded jackscrew; and

at least one threaded bearing, said at least one threaded bearing receiving said at least one threaded jackscrew therethrough;

wherein said frame is attached to said second linear moving mechanism.

11. The yarn coiler according to claim 10, wherein said second linear moving mechanism further comprises:

a carriage attached to said at least one threaded bearing of said second linear moving mechanism;

a pin depending from said carriage; and

wherein said frame is attached to said second linear moving mechanism by use of said pin.

12. The yarn coiler according to claim 11, wherein:

said at least one pair of bearings attached to, and below, said second support bracket further comprises first and second pairs of bearings;

said at least one threaded jackscrew of said second linear moving mechanism comprises two threaded jackscrews rotatably received in said first and second pairs of bearings, each said first and second jackscrews having a pulley mounted on an end thereof;

a second belt wrapped around said pulleys of said jackshafts;

said second motor being affixed to one of said threaded jackscrews and said second support bracket for rotating both said jackscrews in the same direction and at the same speed via said belt and pulleys;

said at least one pair of threaded bearings of said second linear moving mechanism comprises two pairs of threaded bearings; and

said carriage is attached to said two pairs of threaded bearings of said second linear moving mechanism.

13. The yarn coiler according to claim 11, wherein:

said first support bracket is a flat plate;

said second support bracket is a generally H-shaped member having horizontal and vertical portions, said threaded bearings of said first linear moving mechanism being mounted to said vertical portions above said horizontal portion and said bearings of said second linear moving mechanism being mounted to said vertical porions below said horizontal portion; and

said carriage includes wheels for riding along said horizontal portion.

14. The yarn coiler according to claim 12, wherein:

said first support bracket having an inverted U-shape in which the horizontal portion of said U-shaped bracket is affixed to said overhead surface;

said first and second pairs of bearings of said first linear moving mechanism being mounted to the downwardly depending legs of said u-shaped bracket;

said second support bracket having a horizontal portion, two downwardly depending ends and two downwardly depending sides, said first and second pairs of threaded bearings of said first linear moving mechanism being mounted to said two downwardly depending ends, said first and second pairs of bearings of said second linear moving mechanism being mounted to said two downwardly depending sides; and

said carriage having a width such that it fits between said two ends of said second support bracket and is positioned

inside a space bounded by said horizontal portion, said two downwardly depending sides, and said two downwardly depending ends.

15. The yarn coiler according to claim 12, wherein:

said first support bracket is a first horizontal plate;

said first and second bearings of said first linear moving mechanism are mounted to the bottom of said first horizontal plate;

said second support bracket being a second horizontal plate, the top of said second horizontal plate being attached to said first and second pairs of threaded bearings of said first linear moving mechanism; and

said bearings of said second linear moving mechanism being mounted to the bottom of said second horizontal plate.

16. The yarn coiler according to claim 10, wherein said frame comprises:

first and second perpendicular and attached linear beams, each having first and second ends, said pin being mounted to one of said first and second beams; and

connectors connecting each said depending tube to both of said linear beams.

17. The yarn coiler according to claim 12, wherein each of said connectors is a variable length mechanical element.

18. The yarn coiler according to claim 7, wherein:

said pivot comprises a semispherical-shaped ball; and

said pivot mount comprises a corresponding semispherical-shaped hole.

19. The yarn coiler according to claim 9, wherein:

said first linear moving mechanism comprises a first off-the- shelf linear movement generating device, said first off-the-shelf linear movement generating device attached to an overhead surface by a first support bracket;

said second linear moving mechanism comprises a second off-the-shelf linear movement generating device attached to said first off-the-shelf linear movement generating device; and

wherein said frame is attached to said second off-the shelf linear moving mechanism.

20. The yarn coiler according to claim 19, wherein:

said first off-the-shelf linear movement generating device comprises:

a first beam;

a pair of bearings attached to, and below, said beam;

a first threaded jackscrew rotatably received in said first pair of bearings;

a first threaded bearing receiving said threaded jackscrew therethrough;

said first motor affixed to said threaded jackscrew and said first beam for rotating said jackscrew; and

said second off-the-shelf linear movement generating device comprises:

a second beam rigidly attached to said first threaded bearing of said first off-the-shelf linear movement generating device;

a pair of bearings attached to, and below, said second beam;

a threaded jackscrew rotatably received in said at least one pair of bearings;

said second motor affixed to said threaded jackscrew and said second beam for rotating said threaded jackscrew; and

a second threaded bearing, said second threaded bearing supporting a pin;

whereby said frame is attached to said second off-the shelf linear moving mechanism by said pin.

21. The coiler according to claim 19, wherein said overhead surface comprises at least one bracket associated with a gear drive.

22. The yarn coiler according to claim 19, wherein:

said controller is a programmable controller; and

whereby by varying the program within said controller said first and second linear moving mechanisms can be independently controlled to cause said depending tubes to move along a variety of paths.

23. The yarn coiler according to claim 19, further comprising:

a second yarn coiler identical to the first; and

wherein the same controller causes said depending tubes of both yarn coilers to move along the same predetermined path.

24. The yarn coiler according to claim 23, wherein the predetermined path of both yarn coilers can be simultaneously varied by varying the program within said controller.

25. The yarn coiler according to claim 19, wherein said first and second linear directions are perpendicular.

26. A process for modifying a yarn coiler, comprising the steps of:

providing a yarn coiler having:

a plurality of depending tubes, each said depending tube having upper and lower ends, said upper ends having a pivot mounted thereto, said pivot attached to a pivot mount, said pivot and pivot mount allowing for swivelling movement of said depending tubes such that the lower end of each tube may move along a pre-programmed path to dispense textile material therefrom;

a frame, said frame connecting said depending tubes such that said depending tubes move along the same path; and

a mechanical gear drive connected to said frame for moving said frame in first and second linear directions, said mechanical gear drive supported by at least one bracket;

disconnecting said mechanical gear drive from said frame;

removing said mechanical gear drive from said at least one bracket;

supporting a two-dimensional moving mechanism from said bracket;

connecting said two-dimensional moving mechanism to said frame for moving said frame in first and second linear directions; and

providing a programmable controller interacting with said two-dimensional moving mechanism to allow for independently varying the degree by which said frame moves in either of said first or second linear directions;

whereby said two-dimensional moving mechanism can be used to cause said depending tubes to move along a variety of paths by varying the program within said controller.

27. The process according to claim 26, wherein:

said step of supporting a two-dimensional moving mechanism from said bracket, further comprises:

attaching a first off-the-shelf linear movement generating device from said bracket; and

attaching a second off-the-shelf linear movement generating device from said first off-the-shelf linear movement generating device; and

said step of connecting said two-dimensional moving mechanism to said frame for moving said frame in first and second linear directions, further comprises:

connecting said frame to said second off-the-shelf linear movement generating device.

28. A yarn coiler comprising:

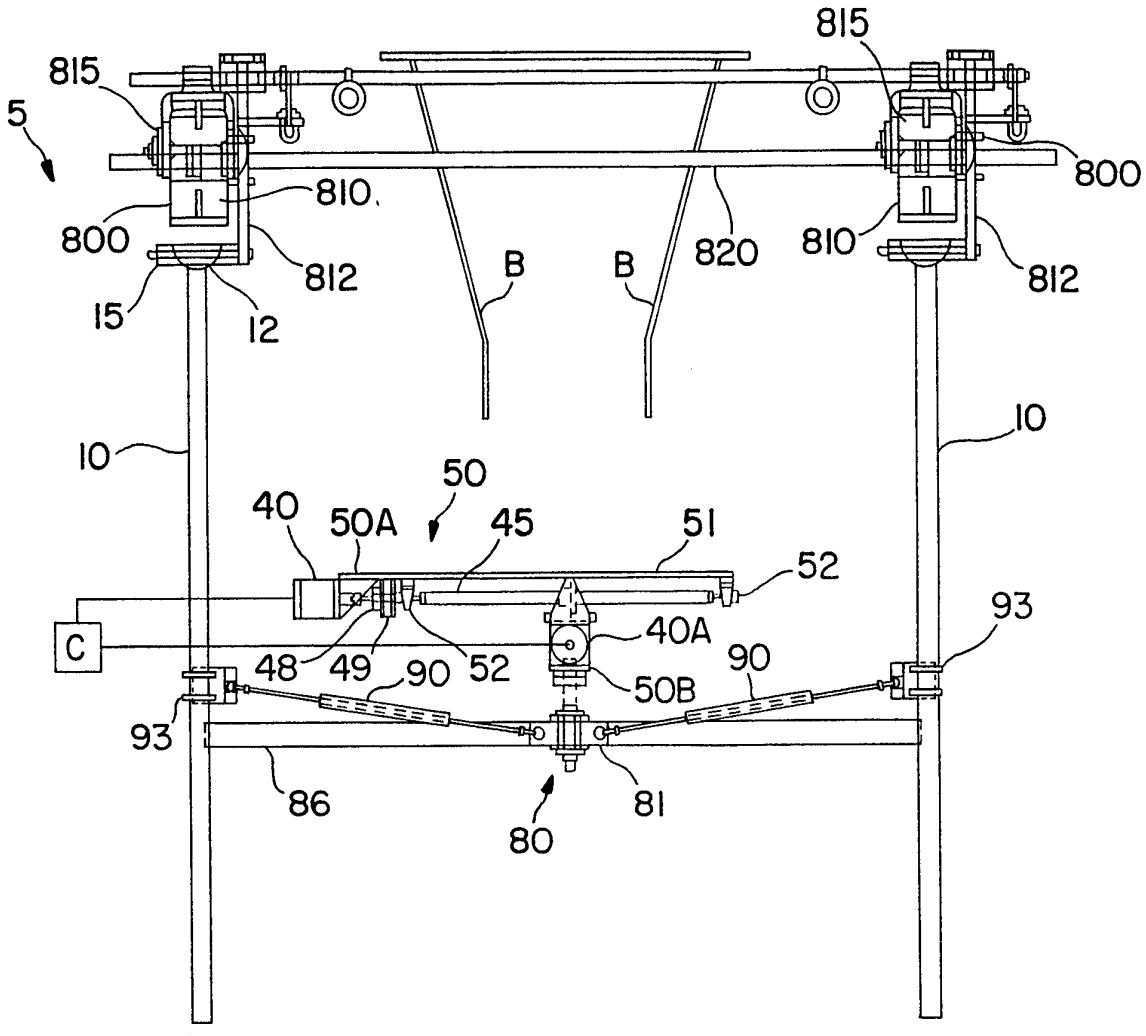
a plurality of depending tubes, each said depending tube having upper and lower ends, said upper ends having a pivot mounted thereto, said pivot attached to a pivot mount, said pivot and pivot mount allowing for swivelling movement of said depending tubes such that the lower end of each tube may move along a pre-programmed path to dispense textile material therefrom;

a frame, said frame connecting said depending tubes such that said depending tubes move along the same path;

first and second linear moving mechanisms connected to said frame for moving said frame in first and second linear directions;

a controller, said controller interacting with said first and second linear moving mechanisms to independently operate said first and second linear moving mechanisms;

whereby said controller causes said depending tubes to move along a predetermined path.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810
800
812
B
B
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810
812
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10
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50A
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52
C
48
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90
52
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50B
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93
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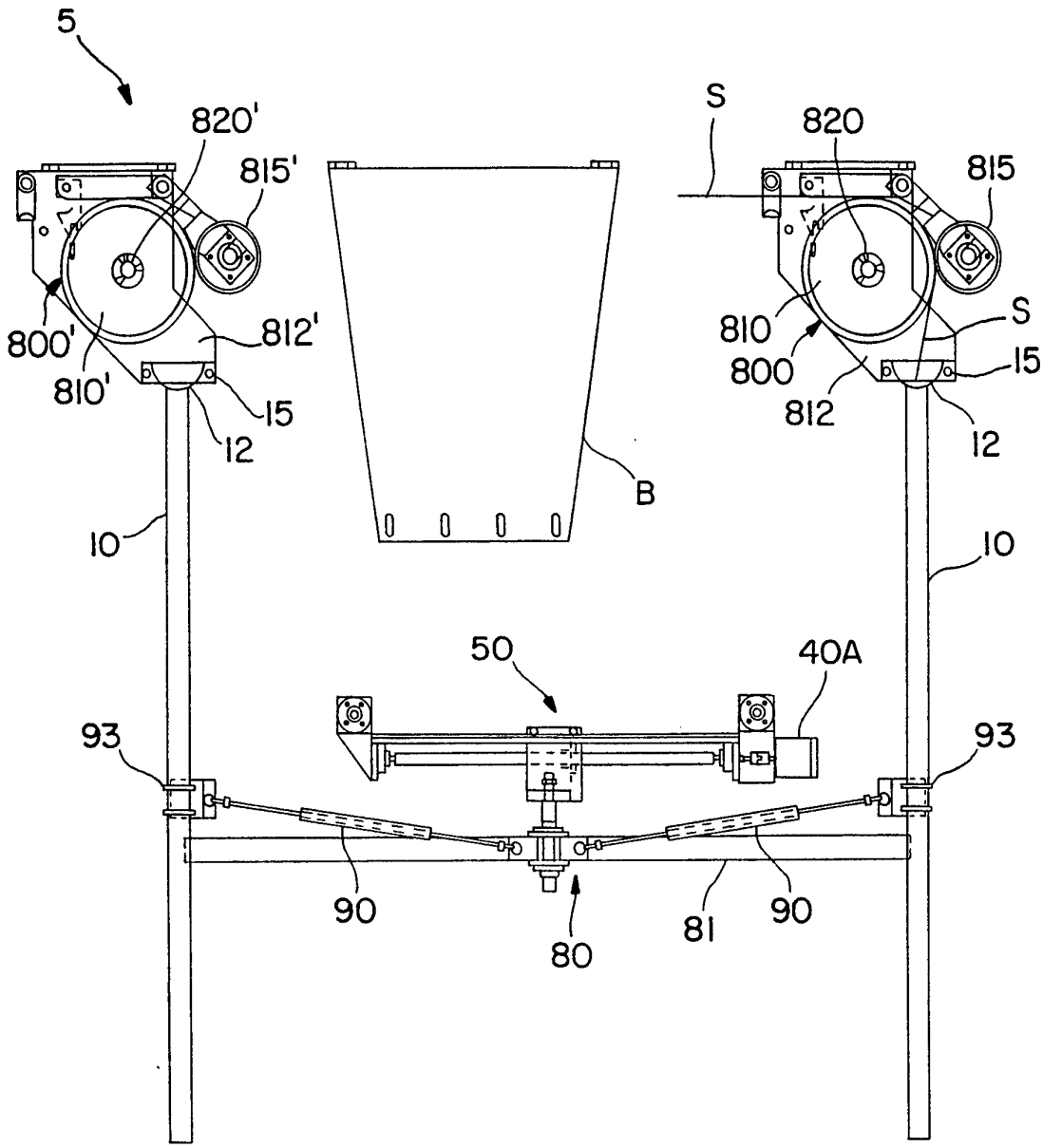
86
80
81

FIG. 1A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820'
815'
800'
810'
812'
15
12
10
B
S
820
815
810
800
812
S
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12
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50
40A
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93
90
80
81
90

FIG. 1B

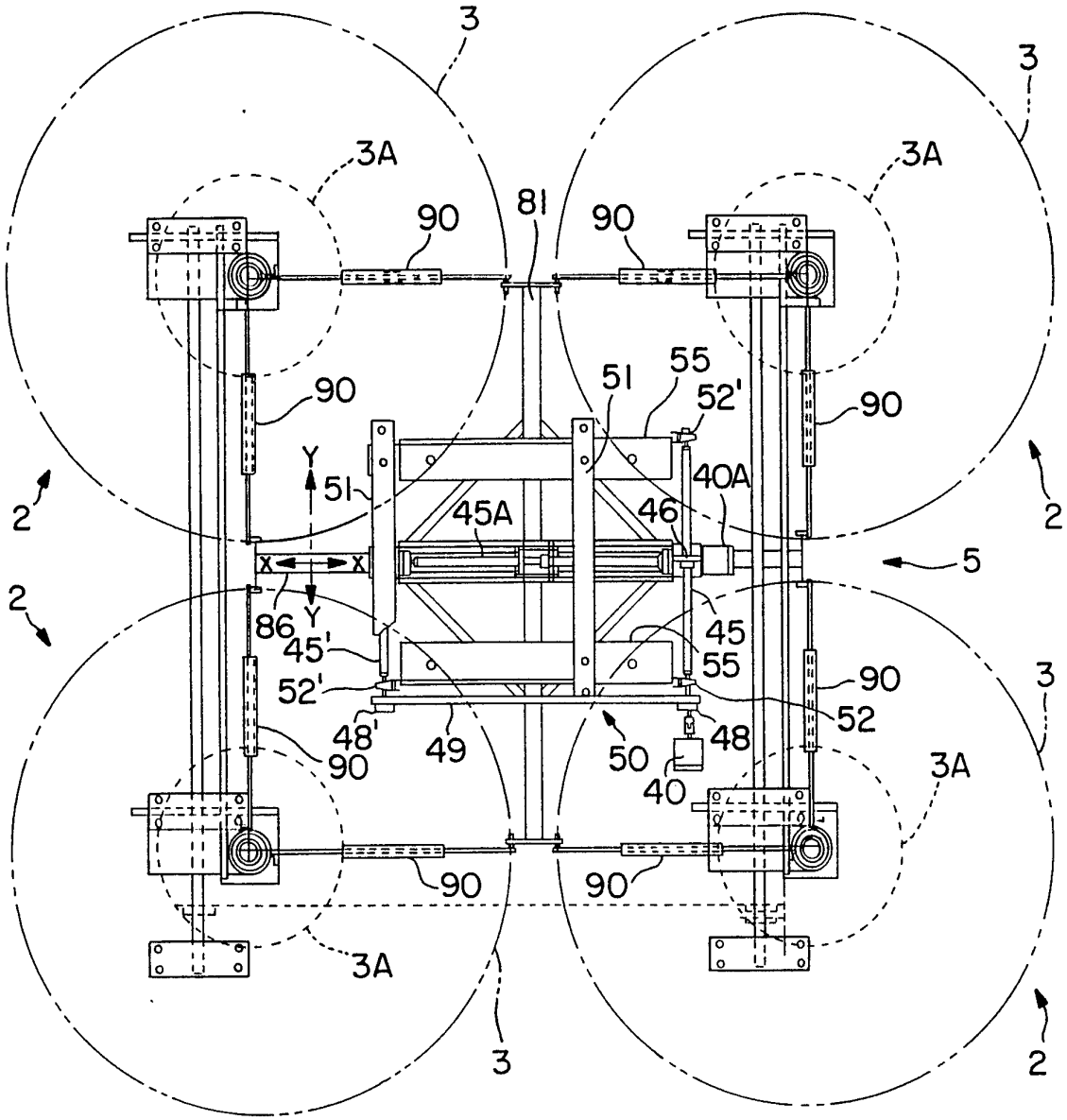
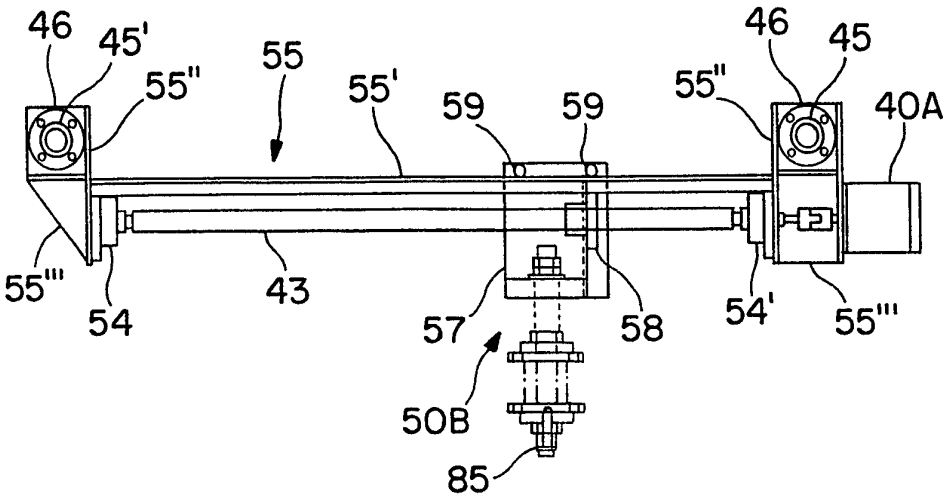


FIG. 2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45'
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55
55'
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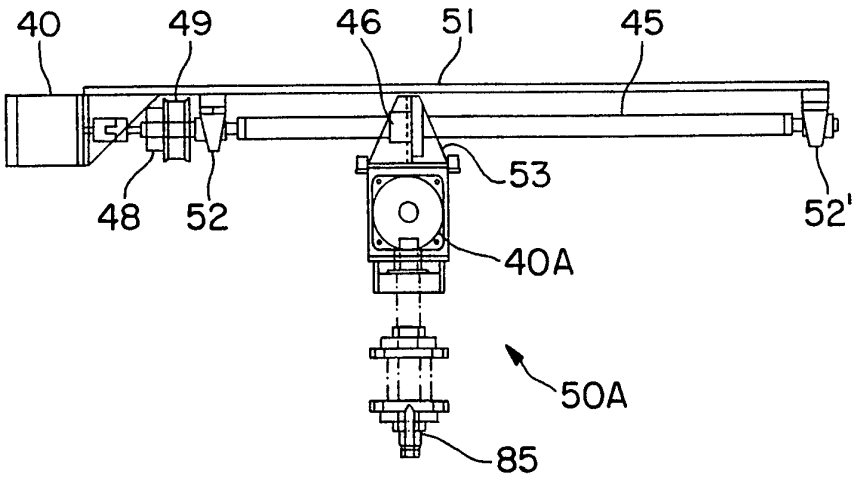
45
55"
40A
55'''
54
43
57
58
54'
55'''
50B
85

FIG. 3A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52'
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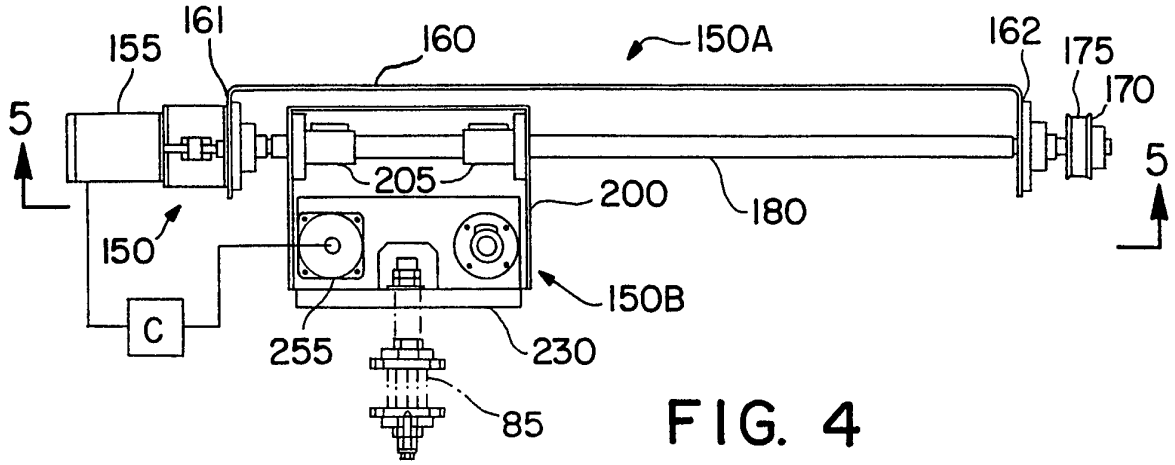
FIG. 3B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C
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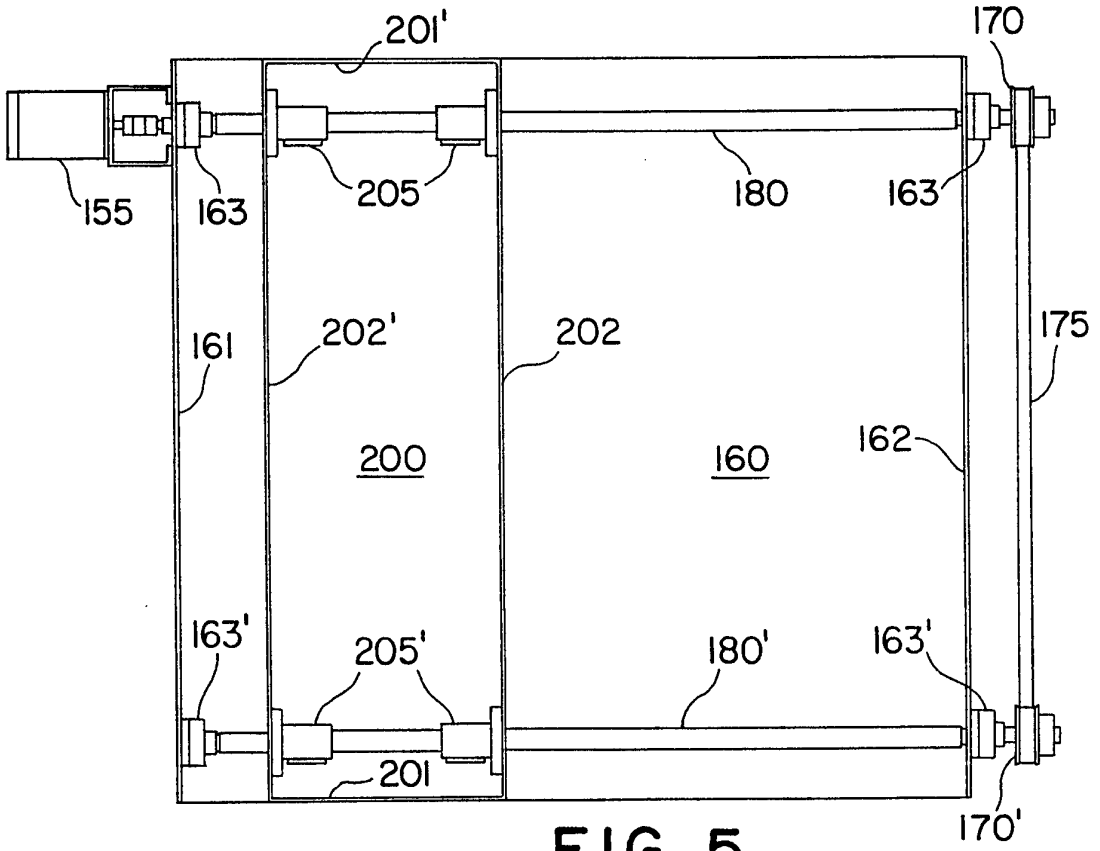
FIG. 4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202'
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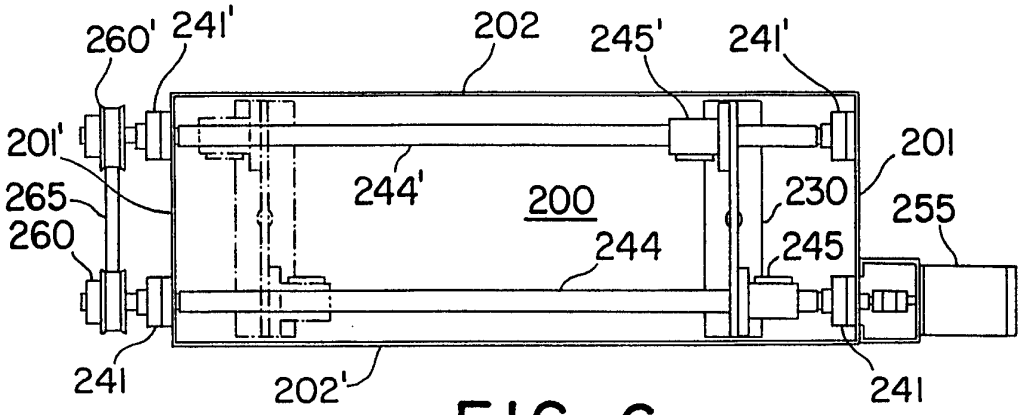
201
170'

FIG. 5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202
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241'
201'
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244
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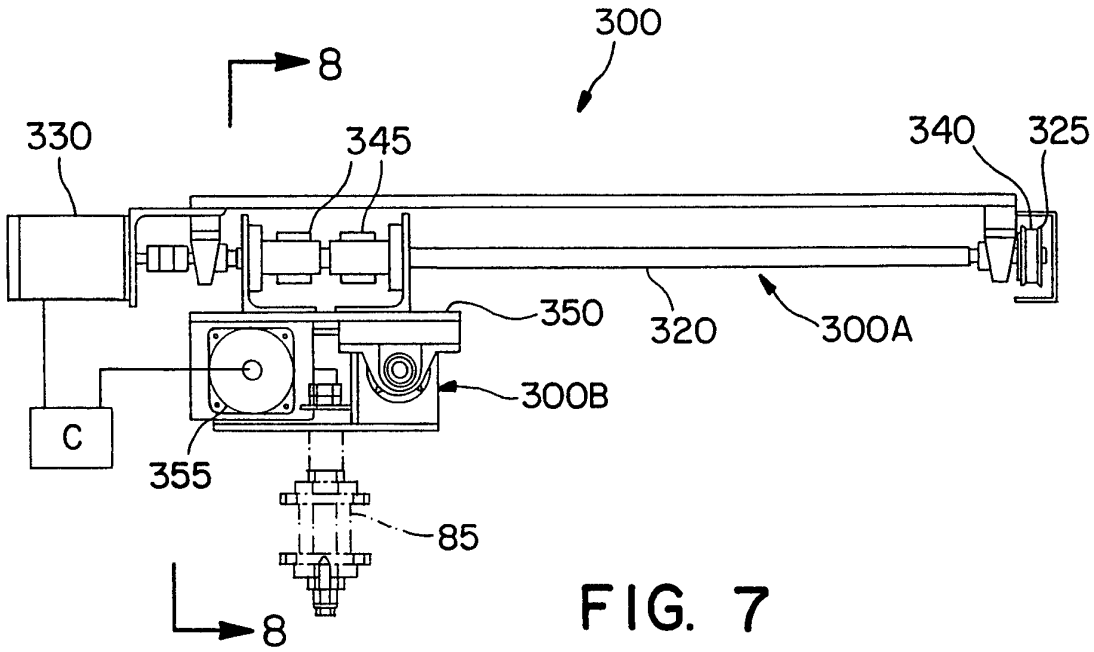
241
202'
241

FIG. 6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C
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85
8

FIG. 7

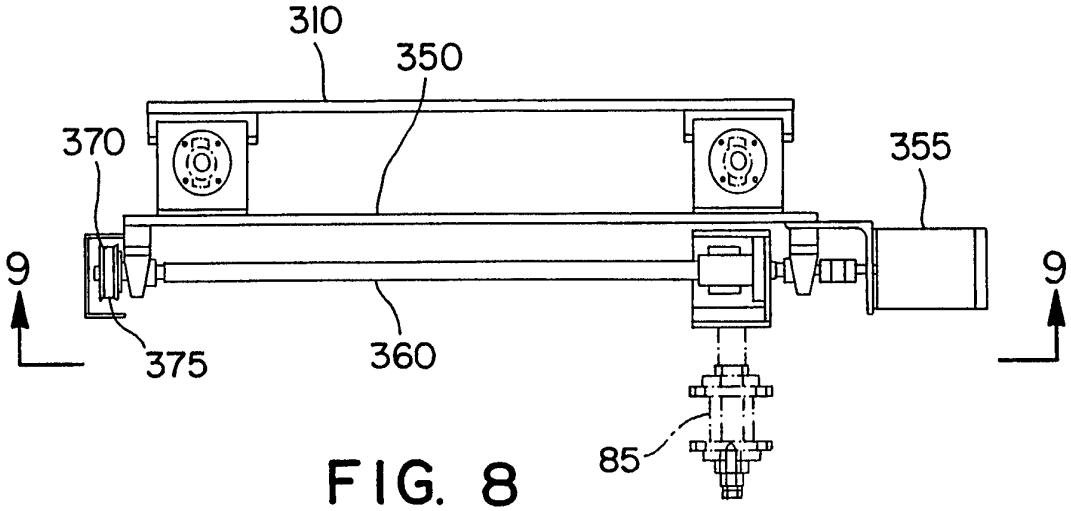
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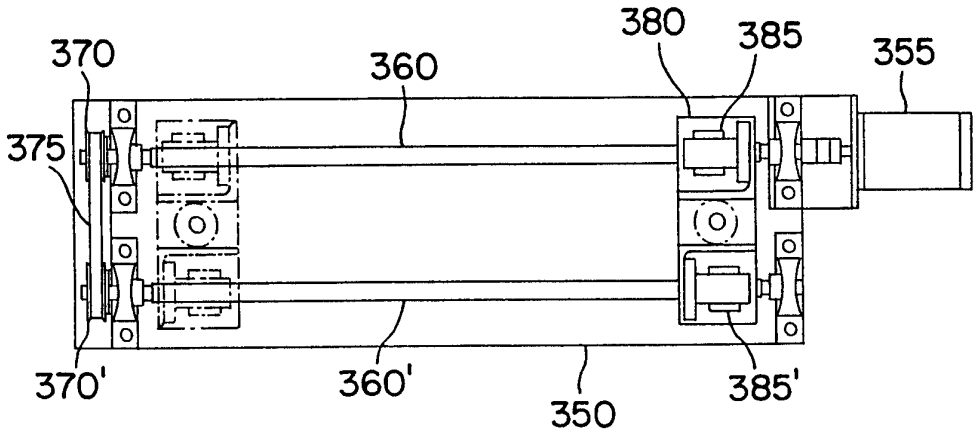
FIG. 8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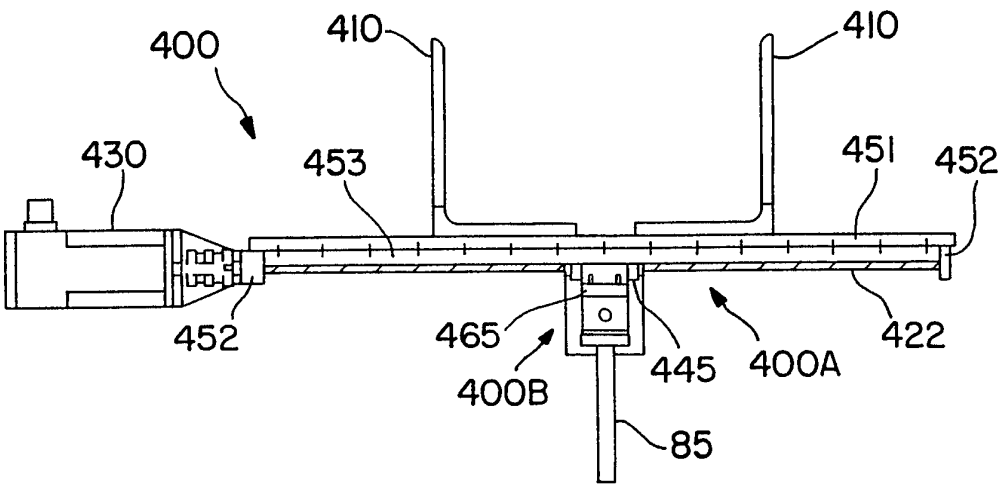
350
385'

FIG. 9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400B
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FIG. 10

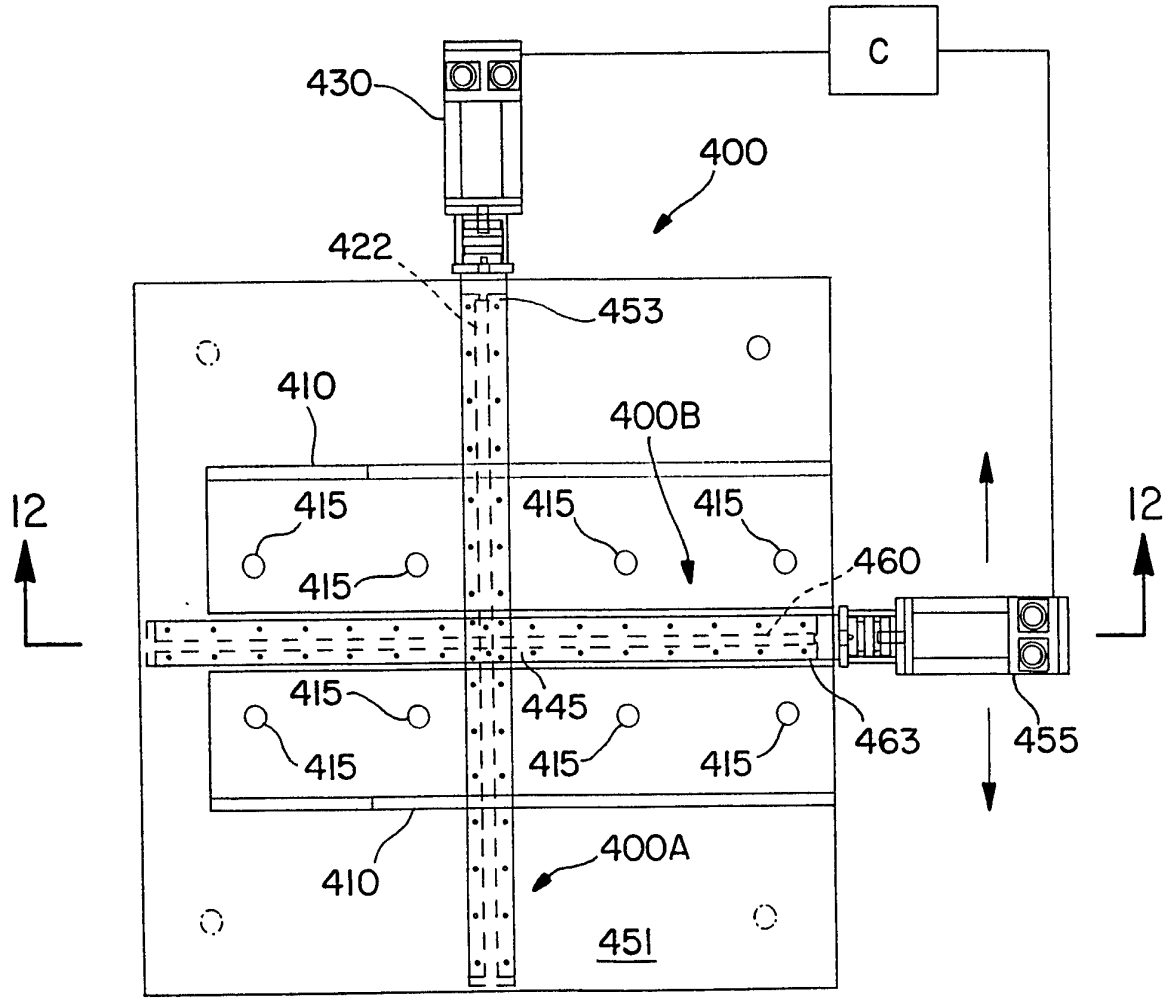
C
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FIG. 11

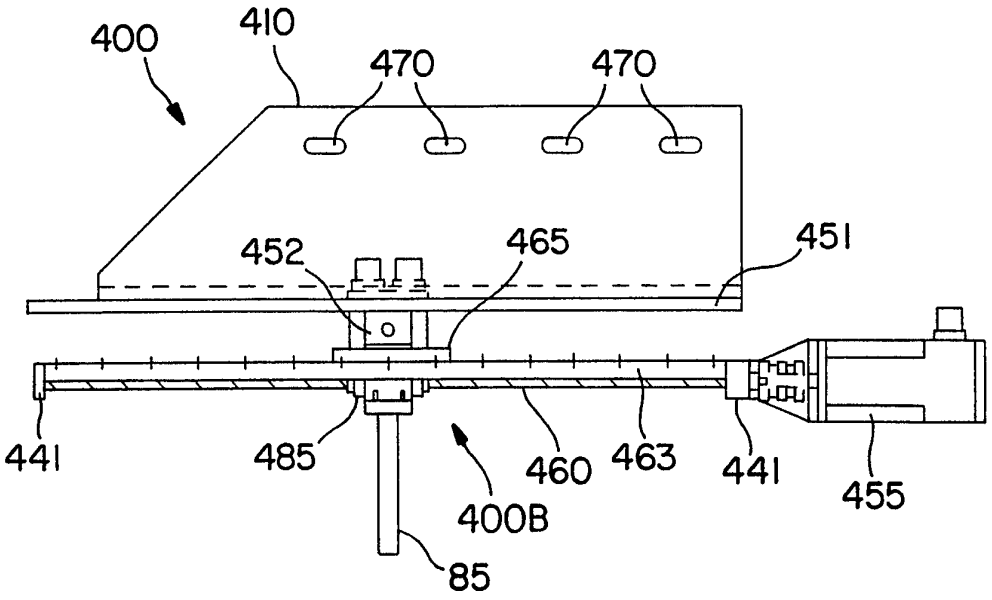
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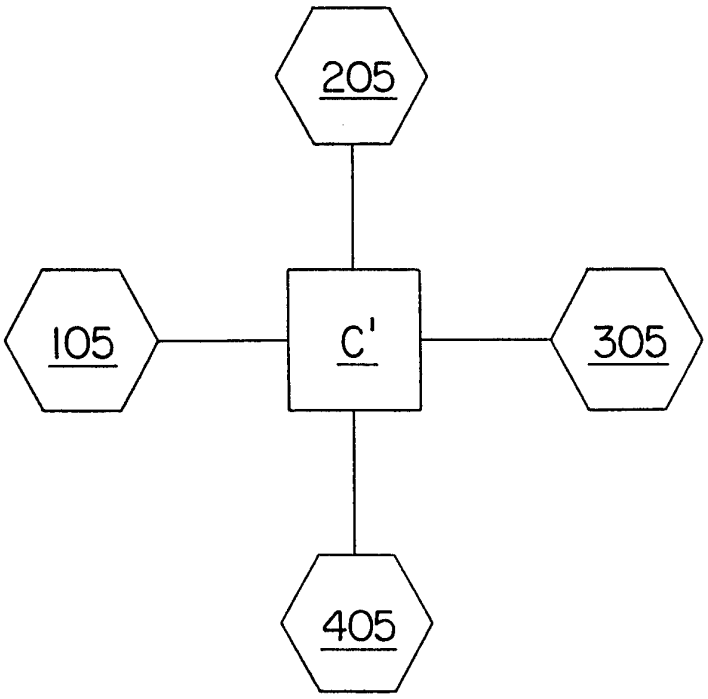
FIG. 12


205
105
C'
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405

FIG. 13

INTERNATIONAL SEARCH REPORT

Inter ɔnal application No.
PCT/US96/13519

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) :B21C 47/10
US CL :242/361
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 242/361, 361.1, 361.4, 47; 19/159 R, 159 A; 28/289

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X --- Y	US 4,158,253 A (Gaghan et al.) 19 June 1979, Whole Document	1, 5 --- 2-4,6-28
Y --- A	US 5,506,381 A (Matsushima et al.) 9 April 1996, Whole Document	2-4,6-28 --- 1,5
X ---- A	US 349,148 A (Eccles) 14 September 1886, Whole Document	1,5 ------ 2-4,6-28
X --- A	US 4,408,378 A (Ketteringham et al.) 11 October 1983, Whole Document	1,28 --- 2-27
A	US 1,121,480 A (Connelly) 15 December 1914, Whole	1-28

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E"	earlier document published on or after the international filing date	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&"	document member of the same patent family
"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search 28 OCTOBER 1996	Date of mailing of the international search report 31 DEC 1996
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230	Authorized officer MICHAEL R. MANSEN Telephone No. (703) 308-2168

Form PCT/ISA/210 (second sheet)(July 1992)★