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(71) **Applicant:** OHIO ELECTRONIC ENGRAVERS, INC. [US/US]; 4105 Executive Drive, Dayton, OH 45430 (US).

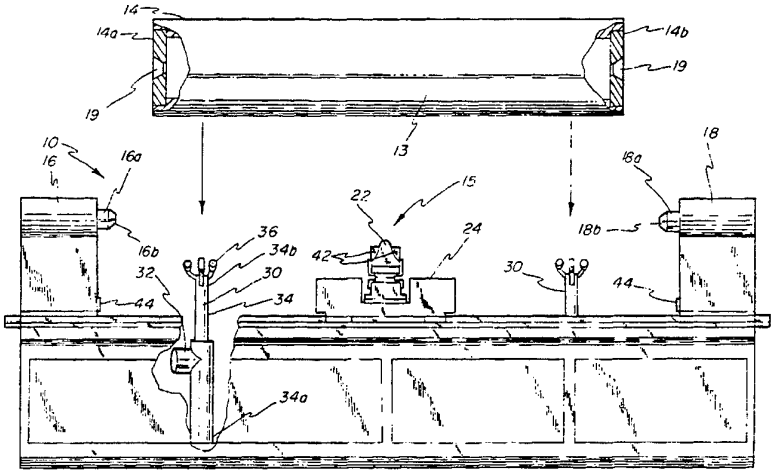
(72) **Inventors:** BORNHORST, Kenneth, F., Jr.; 1041 Ripple Creek Court, Centerville, OH 45458 (US). LIKINS, Robert, D.; 670 North Walnut Street, Wilmington, OH 45177 (US). EICHHORN, Thomas, J.; 2362 Brown Bark Drive, Dayton, OH 45431 (US). SEITZ, David, R.; 1115 Brichton Place, Vandalia, OH 45377 (US). WOODS, Curtis; 7024 Winter Hill Court, Centerville, OH 45459 (US).

(74) **Agents:** JENKINS, Matthew, R. et al.; Biebel & French, 2500 Kettering Tower, Dayton, OH 45423 (US).

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(54) **Title:** ENGRAVER CYLINDER SUPPORT APPARATUS AND METHOD



(57) **Abstract**

A method and apparatus for automated loading and unloading of a cylinder (14) in an engraver (10). The method and apparatus permit the engraver (10) to accommodate cylinders (14) of differing geometries, including a range of lengths, diameters and mounting configurations. The engraver (10) comprises a headstock (16) and a tailstock (18) which cooperate to rotatably support a cylinder (14) at an engraving station (15) in the engraver (10). The engraver (10) also comprises a cylinder handling system having at least one cylinder support (30) for supporting the cylinder (14) between the headstock (16) and tailstock (18) during loading and unloading of the cylinder (14). The cylinder handling system comprises a driver (32) for driving the cylinder support (30) towards and away from the engraving station until the headstock (16) and tailstock (18) engage and rotatably support the cylinder (14). Once the cylinder (14) is rotatably supported between the headstock (16) and tailstock (18), then the cylinder support (30) is retracted. Each cylinder support (30) comprises a telescoping support member (34) having a support nest (36) for engaging and supporting the cylinder (14) at the engraving station (15).

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Engraver Cylinder Support Apparatus and Method

Background of the Invention

1. Field of the Invention

This invention relates to an engraver, and more particularly, it relates to a cylinder support and method for supporting a cylinder to be engraved in an engraver of the general type disclosed, for example, in U.S. Patent Nos. 2,881,246; 2,874,479; 3,964,382; and 4,013,829.

2. Description of Related Art

The basic principle of electro-mechanical engraving of a gravure cylinder involves rotating a plated cylinder while actuating an electrically driven tool which cuts or engraves cells or lines into the surface of the plated cylinder. The engraved cylinder is normally used in a web-type gravure printing press for printing paper, plastic or metallic film material. In addition to printing newspapers and magazines, the engraved cylinders may also be used for direct or indirect printing of cloth, applying glue, printing of packaging materials for products, and printing of woodgrain patterns for making a wall panelling, floor coverings and other surface coverings.

In the gravure printing process, the engraved cylinder is flooded with ink, and a doctor blade wipes off excess ink from the surface so that only the engraved cells contain ink which is transferred to the material being printed. To obtain a high quality print, it is necessary that the cells be very accurately placed or located on the cylinder surface, usually within 1 or 2 microns within a desired predetermined location. The depth of the engraved cells must also be accurately controlled since the depth determines the amount of ink transferred which, in turn, determines the shade of gray in a black/white print, for example. In a color print,

the amount of ink transferred to the paper or materials is even more critical since multiple colors are typically mixed to produce various shades of all possible colors. A slight variation in the desired amount of ink affects not only the darkness of the color but, more importantly, the production of the desired color hues.

In engraving systems of the past, the cylinders were manually guided or hoisted to an engraving area of the engraver, whereupon it was secured between a stationary headstock and a slidable tailstock. The tailstock forcibly engaged one end of the cylinder and forced the other end of the cylinder into engagement with the headstock. For shafted cylinders, the ends of the cylinders would be gripped by chucks or other clamping devices located in the headstock and tailstock.

Another problem with engravers of the past is that the cylinders had to be manually loaded into the engraver. Because of the weight and size of the cylinders, it was very time-consuming to properly position and manually align the cylinders in the engraver. In addition, it was often necessary that the operator manually adjust the tailstock before the engraver could accommodate cylinders of varying lengths. Still another problem is that in the engravers of the past, the operator had to manually adjust the engraving head to accommodate cylinders of different diameters.

What is needed, therefore, is a method and apparatus for facilitating loading a cylinder in an engraver and for handling the cylinder so that it can be properly centered and aligned between the headstock and tailstock of the engraver.

Summary of the Invention

In one aspect, this invention comprises a cylinder handling system for use in an engraver having a headstock and a tailstock which cooperate to rotatably support a cylinder at an engraving station in said

engraver, comprising at least one support for supporting the cylinder between said headstock and tailstock; and a driver coupled to the at least one support for driving said at least one support towards and away from said engraving station.

In another aspect, the invention comprises a cylinder support for use in an engraver having headstock and tailstock which cooperate to rotatably support a cylinder at an engraving station in said engraver, comprising support means for supporting the cylinder between said headstock and tailstock; and drive means coupled to said support means for driving said support means towards and away from said engraving station.

In another aspect, the invention comprises the method for supporting a cylinder in an engraver comprising the steps of: (a) positioning the cylinder on a support at an engraving station in the engraver; (b) rotatably supporting said cylinder between a headstock and a tailstock; and (c) retracting said support away from said engraving station.

In another aspect, the invention comprises the method for supporting a cylinder in an engraver comprising the steps of: (a) positioning the cylinder on a support at an engraving station in the engraver; (b) rotatably supporting said cylinder between a headstock and a tailstock; (c) retracting said support away from said engraving station; and (d) driving the engraver which permits the head to be driven into operative relationship with the cylinder surface.

An object of this invention is to provide a method for automatically loading a cylinder in an engraver, thereby either reducing or eliminating the need for precision handling by an operator.

Another object of this invention is to provide a cylinder handling system which facilitates the

centering of a cylinder between a headstock and a tailstock of an engraver.

Still another object is to provide an engraver which can accept a variety of setup parameters, including cylinder length, diameter, test cut position and engrave head characteristics from a controller, thereby reducing or eliminating the need for manual adjustment by an operator.

Another object of this invention is to provide a cylinder handling system having an automatically controlled headstock, tailstock and head slide which provide for programmable adjustment in order to accommodate cylinders of varying lengths and diameters.

These objects, and others, may be more readily understood in connection with the following specification, claims and drawing.

Brief Description of the Drawing

Fig. 1 is perspective view of a programmable gravure engraver showing a headstock, a tailstock, an engraving head, and a plurality of cylinder supports;

Fig. 2 is a fragmentary front plan view of the engraver shown in Fig. 1, showing details of one of the telescoping cylinder supports;

Fig. 3 is another plan view of the engraver showing the cylinder supported by the cylinder supports;

Fig. 4 is another plan view of the engraver showing the cylinder rotatably supported by the headstock and tailstock after the cylinder supports have been retracted;

Fig. 5 is a fragmentary sectional view showing details of the cylinder support and a support nest; and

Fig. 6 is a top view of one of the cylinder supports, showing details of the support nest.

Detailed Description of the Preferred Embodiment

Fig. 1 is a general perspective view of a preferred embodiment of an engraver, designated generally

as engraver 10. In the embodiment being described, the engraver 10 is a gravure engraver, but the invention may be suitable for use in any engraver. The engraver 10 may have a surrounding slidable safety cabinet structure which is not shown for ease of illustration. Engraver 10 comprises a base 12 having a headstock 16 and tailstock 18 slidably mounted in tract 20 such that the headstock 16 and tailstock 18 can move towards and away from each other. In this regard, engraver 10 comprises a plurality of linear actuators or first drive motor means or first drive motor 46 and a second drive motor means or second drive motor 48 which are capable of driving the headstock 16 and tailstock 18, respectively, towards and away from each other. For example, the drive motors may cause the headstock 16 and tailstock 18 to be actuated to a fully retracted position, as shown in Fig. 2, or to a cylinder support position shown in Fig. 1. The drive motors may be selectively energized to cause the headstock 154 and tailstock 18 to be actuated either independently or simultaneously. Although not shown, a single drive motor may be used with a single lead screw (not shown) having reverse threads (not shown) on which either end causes the headstock 16 and tailstock 18 to move simultaneously towards and away from each other as the leadscrew is driven. Driving both the headstock 16 and tailstock 18 permits cylinders 14 of varying lengths to be loaded by an overhead crane, for example, whose path is perpendicular to the engravers axis of rotation. However, it should be appreciated that a stationary headstock 16 and tailstock 18 may be used with a driven tailstock 16 or headstock 18, respectively, if, for example, a cylinder loading mechanism (not shown) loads the cylinder 14 by moving it in a direction which is generally parallel to the axis of rotation of the engraver. As best illustrated in Figs. 2-4, the headstock 16 and tailstock 18 comprise a support shaft

16a and support shaft 18a, respectively. The support shafts 16a and 18a each comprise a conically shaped end 16b and 18b, respectively. The cylinder 14 comprises a first end 14a and second end 14b each having a receiving opening 19 (Fig. 2) for receiving ends 16b and 18b, respectively. As best illustrated in Figs. 2-4, the receiving opening 19 is also conically shaped in cross-section so as to matingly receive the ends 16b and 18b.

Although not shown, if a shafted cylinder (not shown) was to be engraved, then the headstock 16 and tailstock 18 would each include a gripping device or chuck (not shown) to rotatably support the cylinder at the engraving station 15.

The engraver 10 also comprises an engraving head 22 having a cutting tool or stylus (not shown) for engraving a surface 13 on the cylinder 14. In the embodiment being described, surface 13 preferably has a copper coating of the type used in gravure engraving. The engraving head 22 is slidably mounted on a carriage 24 such that a third drive means or third drive motor 21 can drive the engraving head 22 towards and away from the cylinder 14 in a direction which is generally radial with respect to the center axis of cylinder 14. The carriage 24 is also slidably mounted on base 12 such that it traverses the entire surface 13 of cylinder 14 in the direction of double arrow 26 in Fig. 1, which is generally parallel to the axis of the cylinder 14. The engraver 10 also comprises a lead screw (not shown) and drive motors (not shown) for causing the carriage 24 to move in the direction of double arrow 26. The engraving head 22, carriage 24 and transverse movement thereof is similar to that shown in Serial Nos. 08/038,679; 08/022,127; and 08/023,060 which is assigned to the same assignee as the present invention and which is incorporated herein by reference.

The engraver comprises a controller 17 which controls the operation of the engraver 10 and which also controls all the drive motors, such as drive motors 21, 46 and 48. The drive motors 21, 46 and 48 mentioned herein are controlled by a programmable controller 17 which controls the operation of the engraver 10.

The engraver 10 also comprises drive means or a drive motor 28 for rotatably driving the support member 16a, cylinder 14, and support member 18a. The drive motor 28 is operatively coupled to the programmable controller 17.

The engraver 10 further comprises support means or at least one cylinder support 30 for supporting the cylinder 14 between the headstock 16 and tailstock 18, for example, during loading and unloading. The cylinder support 30 comprises a support member 34 having a first end 34a conventionally secured to base 12, for example, by a weld. A second end 34b of support member 34 comprises a support nest 36 which receives and supports cylinder 14. In the embodiment being described, the support member 30 is a telescoping support, with the second end 34b being capable of telescoping towards and away from said first end 34a. In this regard, each cylinder support 30 also comprises drive means or a driver 32 which is coupled to controller 17 and which comprises a gear and screw assembly (not shown) for telescoping or driving the support nest 36 towards and away from the engraving station 15. As best illustrated in Fig. 2, the controller 17 can energize driver 32 to move the cylinder support 30 into the support position shown in Fig. 2, whereupon the support nest 36 is capable of supporting the cylinder 14 at engraving station 15, for example, when the cylinder 14 is being loaded for engraving. As described later herein, the controller 17 subsequently energizes driver 32 to retract the cylinder support 30 and support nest 36 to the retracted position

shown in Fig. 4, for example, after the support shafts 16a and 18a of headstock 16 and tailstock 18, respectively, have engaged and support the cylinder 14.

As best shown in Figs. 5 and 6, the support nest 36 comprises a plurality of support arms 40 which rotatably support a plurality of rollers 38 and 39. The plurality of rollers 38 are mounted in pairs on a roller assembly 45. Each roller assembly 45 is pivotally mounted on an axle 43 (Fig. 5) which is coupled to one of the support arms 40. As best illustrated in Fig. 5, each roller assembly 45 can pivot about the axis of its respective axle 43. The roller assemblies 45 are each self-aligning and pivot to permit the engraver to accommodate a range of cylinder diameters.

The axis of each roller 38 is generally perpendicular to the axis of cylinder 14. This facilitates permitting the cylinder 14 to move laterally in the engraver 10 when the headstock 16 and tailstock 18 grip and release the cylinder 14. The plurality of rollers 38 also facilitate supporting cylinder 14 such that its center axis is generally parallel with the center axis of each of the support shafts 16a and 18a of the headstock 16 and tailstock 18, respectively.

It is to be noted that rollers 39 facilitate guiding and centering cylinder 14 between the headstock 16 and tailstock 18, thereby accommodating lateral misalignment when the cylinder 14 is loaded onto the engraver 10 from above. In the embodiment being described, the plurality of rollers 38 and 39 are made of composite material. It is to be noted that the support nest 36 is capable of supporting cylinders 14 of various weights and having various lengths and diameters.

Although not shown, the engraver 10 may include a plurality of brushes (not shown) positioned in operative relationship with the rollers 38 and 39. The function of the brushes is to clean the rollers and keep

their surfaces free of foreign material, such as copper shavings. This facilitates preventing the engraver 10 from making unwanted indentations or scratches in the surface 13 of cylinder 14.

The engraver 10 also comprises sensing means or first sensors 42 which are coupled to controller 17 and which are located on the engraving head 22 (Fig. 1). The sensing means or sensors 42 are capable of sensing, for example, the surface 13 of cylinder 14. The sensors 42 are also capable of sensing the ends 14a and 14b of cylinder 14.

The engraver 10 also comprises second sensing means or sensors 44 coupled to controller 17 and associated with the headstock 16 and tailstock 18 for detecting the proximate location of the carriage 24 relative to the headstock 16 and tailstock 18. In the embodiment being described the first and second sensors 42 and 44 facilitate preventing the carriage 24 from engaging either the headstock 16 or the tailstock 18. A method for loading and unloading the cylinder 14 on the engraver 10 will now be described.

When it is desired to load a cylinder 14 on engraver 10, controller 17 energizes the first and second driver motors 46 and 48 to cause the headstock 16 and tailstock 18, respectively, to move to the loading position shown in Fig. 2. It is to be noted that controller 17 can be programmed with dimensions of the cylinder 14, such as length and diameter. The controller 17 also energizes driver 32 of cylinder support 30 to telescope the support member 34 such that the support nest 36 is operatively positioned at the engraving station 15, as shown in Fig. 2. It is to be noted that controller 17, having been programmed with the length and diameter of cylinder 14, energizes driver 32 to position the support nest 36 such that, when cylinder 14 is supported by the cylinder supports 30, the ends 16b and

18b are generally positioned in operative relationship or alignment with receiving openings 19 on the first end 14a and second end 14b, respectively. After the headstock 16 and tailstock 18 have been actuated to the open position shown in Fig. 2 and the cylinder supports 30 are in the support position, the cylinder 14 is lowered onto the support nest 36. As mentioned earlier herein, the plurality of rollers 39 assist locating and centering the cylinder 14 on the roller assemblies 45 and their respective rollers 38.

Once the cylinder 14 is supported by the support nests 36 of cylinder supports 30, the controller 17 can energize the first and second drivers 46 and 48 to drive the support members 16a and 18a towards ends 14a and 14b, respectively. The headstock 16 and tailstock 18 are driven towards cylinder ends 14a and 14b, respectively, until ends 16b and 18b matingly engage the mating receiving openings 19 in the ends 14a and 14b. Once cylinder 14 is supported between ends 16b and 18b of headstock 16 and tailstock 18, respectively, controller 17 energizes the driver 32 to retract the support nest 36 to the non-support position shown in Fig. 4. It is to be noted that the cylinder 14 is rotatably supported between the headstock 16 and tailstock 18 such that, when controller 17 energizes drive motor 28, the cylinder 14 rotates, for example, in a clockwise direction. The controller 17 subsequently energizes the third drive motor 19 to move the carriage 24 and engraving head 22, respectively, into operative relationship with the surface 13 of the cylinder 14. It is to be noted that the controller 17 may use sensors 42 and 44 to detect the relative position of the cylinder 14 with respect to the engraving head 22. The sensors 42 and 44 are also capable of sensing the ends 14a and 14b in order to facilitate preventing carriage 24 from engaging either the headstock 16 or tailstock 18. The sensors 42 and 44

also permit the controller 17 to position the engraving head 22 in the approximate center of cylinder 14 which, in turn, enables the engraver 10 to accommodate for longitudinal variations in cylinder 14 lengths after the cylinder 14 has been rotatably mounted in the engraver 10. This permits the image (not shown) to be engraved in the surface 13 to be centered on the cylinder 14. The sensors 42 and 44 also enable the engraver 10 to set travel limits to prevent the engraving head 22 from engaging either the headstock 16 or tailstock 18.

After the cylinder 14 is properly located at the engraving station 15, the cylinder ends 14a and 14b are detected by sensors 42 and 44. A test pattern (not shown) is engraved at a position typically defined by the controller 17 or a supervisory computer (not shown). The test pattern is a small pattern of full and partial cells (not shown) characteristic of the cells to be engraved on the cylinder surface 13. The test pattern is typical cut at a location on the surface 13 which will not be used by the image being engraved.

If the test pattern cut is unsatisfactory, then correction are made and another test pattern is cut. This process is repeated until a successful test pattern is cut. If the test pattern is acceptable, In the embodiment being described, controller 17 energizes drive motor 28 to rotatably drive cylinder 14. Controller 17 then causes the carriage 24 to cause the engraving head 22 to traverse the surface 13 of cylinder 14 and simultaneously energizes the cutting stylus (not shown) to oscillate into contact with the cylinder 14, thereby engraving the desired image which comprises a series of control depth cells (not shown) in the surface 13 of cylinder 14. The cylinder 14 rotates in synchronism with the oscillating movement of the stylus (not shown) while the lead screw (not shown) arrangement provides axial movement of the engraving head 22 and carriage 24 such

that a precisely controlled engraving path (not shown) is maintained on the surface 13 of print cylinder 14.

After engraving has been completed, controller 17 energizes third drive motor 21 to retract the engraving head 22. Controller 17 also energizes driver 32 to cause the cylinder support 30 to move into the support position shown in Figs. 1 and 2. Controller 17 then energizes the first and second drive motors 46 and 48 to retract the headstock 16 and tailstock 18, respectively, as shown in Fig. 3. The cylinder 14 may then be removed from the engraving station 15, and another cylinder may then be loaded and engraved in the manner described above.

Advantageously, this invention provides a method and apparatus for automatically loading an engraver 10 with a cylinder 14 to be engraved. The method and apparatus reduce or eliminate the need for an operator during loading and unloading of cylinder 14. The invention may be used to fully automate the engraving process or, alternatively, the invention could be semi-automated, thereby permitting the operator to manually control the operation of the engraver 10. The method and apparatus also provide means for automatically loading and centering cylinder 14 at engraving station 15 such that, for example, when the engraving head 22 is in the home position shown in Fig. 1, the engraving head 22 is positioned generally midway between ends 14a and 14b of cylinder 14.

Various changes or modification in the invention described may occur to those skilled in the art without departing from the true spirit or scope of the invention. For example, although the invention has been shown and described as being pertinent to the gravure engraving environment, it should be appreciated that it could be used in other type of engraving, such as laser engraving of flexo rollers or other processes such as

polishing of cylinders 14. Also, the engraver 10 could be provided with one cylinder support 30 or a plurality of cylinder supports 30, if desired. Furthermore, the driver 32 and first, second and third drive motor means 21, 46, and 48 have been described as comprising motors, but they could be any suitable driving apparatus which is capable of performing the same function. Likewise, the cylinder support or support means 30 has been shown and described as comprising the support member 34 and support nest 36, but it could comprise any suitable means which is capable of supporting the cylinder 14 at the engraving station 15 during loading and unloading. The above description of the invention is intended to be illustrative only and not limiting, and it is not intended that the invention be restricted thereto, but that it be limited only by the true spirit and scope of the appended claims.

What is claimed:

1. A cylinder handling system for use in an engraver having a headstock and a tailstock which cooperate to rotatably support a cylinder at an engraving station in said engraver, comprising:

at least one support for supporting the cylinder between said headstock and tailstock; and

a driver coupled to said at least one support for driving said at least one support towards and away from said engraving station.

2. The cylinder handling system of claim 1 wherein said cylinder handling system further comprises:

a first drive motor coupled to said headstock;

a second drive motor coupled to said tailstock;

said first and second drive motors being capable of being selectively energized by a controller, in order to cause said headstock and tailstock to move towards and away from the ends of said cylinder.

3. The cylinder handling system of claim 1 wherein said cylinder handling system comprises:

a drive motor coupled to both said headstock and said tailstock;

said drive motor being coupled to said headstock and tailstock such that said headstock and tailstock is capable of moving towards and away from each other when said drive motor is energized.

4. The cylinder handling system of claim 1 wherein said cylinder handling system comprises:

a drive motor coupled to either said headstock and said tailstock;

said drive motor being coupled to either said headstock or said tailstock such that said headstock or tailstock moves towards and away from said tailstock and said headstock, respectively, when said drive motor is energized.

5. The cylinder handling system of claim 1 wherein said cylinder comprises a first end and a second end, said headstock and tailstock each comprise a support member for supporting said first and second ends, respectively, of said cylinder.

6. The cylinder handling system of claim 5 wherein said first and second ends comprise a receiving opening which is generally conically shaped in cross-section;

said support member of said headstock and tailstock being generally conically shaped so as to be received in mating engagement in said receiving opening in said first and second ends, respectively.

7. The cylinder handling system of claim 5 wherein said first and second ends comprise a shaft located on the ends of said cylinder, said headstock and tailstock each comprising a chuck for clamping said shaft.

8. The cylinder handling system of claim 1 wherein said engraver is a gravure engraver.

9. The cylinder handling system of claim 1 wherein said engraver comprises a carriage having an engraving head slidably mounted thereon; said cylinder handling system further comprising:

at least one sensor associated with said carriage for sensing the position of said cylinder when said cylinder is located at said engraving station.

10. The cylinder handling system of claim 9 wherein said at least one sensor comprises an inductive sensor which is capable of sensing the relative position between said cylinder and said engraving head as well as the ends of said cylinder.

11. The cylinder handling system of claim 1 wherein said at least one support further comprises a support nest.

12. The cylinder handling system of claim 11 wherein said support nest comprises a plurality of rollers for supporting said cylinder between said headstock and tailstock.

13. The cylinder handling system of claim 11 wherein said driver comprises a motor and said support nest comprises a plurality of rollers for supporting said cylinder between said headstock and tailstock.

14. A cylinder support for use in an engraver having a headstock and a tailstock which cooperate to rotatably support a cylinder at an engraving station in said engraver, comprising:

support means for supporting the cylinder between said headstock and tailstock; and

drive means coupled to said support means for driving said support means towards and away from said engraving station.

15. The cylinder support of claim 14 wherein said cylinder support comprises:

first drive motor means coupled to said headstock;

second drive motor means coupled to said second tailstock;

said first and second drive motor means being capable of being selectively energized by a controller to move said headstock and tailstock towards and away from ends of said cylinder.

16. The cylinder support of claim 14 wherein said cylinder support comprises:

a drive motor coupled to both said headstock and said tailstock;

said drive motor being coupled to said headstock and tailstock such that said headstock and tailstock move towards and away from each other when said drive motor is energized.

17. The cylinder support of claim 14 wherein said cylinder support comprises:

a drive motor coupled to either said headstock and said tailstock;

said drive motor being coupled to either said headstock or said tailstock such that said headstock or tailstock moves towards and away from said tailstock and said headstock, respectively, when said drive motor is energized.

18. The cylinder support of claim 14 wherein said cylinder comprises a first end and a second end, said first and second ends comprising a receiving opening which is generally conically shaped in cross-section;

each of said headstock and tailstock having a generally conically shaped support member for being received in mating engagement in said receiving opening in said first and second ends, respectively.

19. The cylinder support of claim 14 wherein said cylinder comprises a first end and a second end, said first and second ends each comprising a support shaft;

each of said headstock and tailstock having a gripping device for receiving said support shafts and for rotatably supporting said cylinder.

20. The cylinder support of claim 14 wherein said engraver is a gravure engraver.

21. The cylinder support of claim 14 wherein said engraver comprises a carriage having an engraving head slidably mounted thereon; said cylinder support further comprising:

sensing means associated with said carriage for sensing the position of said cylinder when said cylinder is located at said engraving station.

22. The cylinder support of claim 18 wherein said sensing means comprises an inductive sensor which is capable of sensing the relative position between said cylinder and said engraving head as well as a first end and a second end of said cylinder.

23. The cylinder support of claim 15 wherein said cylinder support comprises third drive motor means coupled to said engraving head for causing said engraving head to move towards and away from the engraving station.

24. The cylinder support of claim 14 wherein said support means comprises a support member having a support nest at an end thereof.

25. The cylinder support of claim 24 wherein said support nest comprises a plurality of support rollers rotatably mounted thereon.

26. The cylinder support of claim 24 wherein said drive means comprises a motor, said support member comprising a telescoping member to enable said drive motor to telescope said support nest towards and away from said engraving station.

27. An engraver comprising:

a base;

a headstock and a tailstock, said headstock and tailstock being capable of rotatably supporting a cylinder therebetween;

a carriage slidably mounted on said base to move in a direction which is generally parallel to said axis of said cylinder;

an engraving head slidably mounted on said carriage for movement towards and away from said engraving station;

a drive motor for rotatably driving said cylinder when said cylinder is mounted between said headstock and tailstock;

at least one support for supporting the cylinder between said headstock and tailstock; and

a support driver coupled to said at least one support for driving said at least one support towards and away from said engraving station and in a direction which is generally radial with respect to the cylinder axis when the cylinder is mounted between the tail supports.

28. The engraver of claim 27 wherein said cylinder comprises a first and a second end, said engraver further comprising:

a first drive motor coupled to said headstock;

a second drive motor coupled to said tailstock;

said first and second driver motors being capable of being selectively energized to cause said headstock and tailstock to move towards and away from each other such that they can grip the first and second ends of said cylinder.

29. The engraver of claim 27 wherein said engraver comprises:

a drive motor coupled to both said headstock and said tailstock;

said drive motor being coupled to said headstock and tailstock such that said headstock and tailstock move towards and away from each other when said drive motor is energized.

30. The engraver of claim 27 wherein said engraver comprises:

a drive motor coupled to either said headstock and said tailstock;

said drive motor being coupled to either said headstock or said tailstock such that said headstock or tailstock moves towards and away from said tailstock and said headstock, respectively, when said drive motor is energized.

31. The engraver of claim 27 wherein said headstock and tailstock each comprise a support member for engaging said first and second ends, respectively, of said cylinder and also for rotatably supporting said cylinder at said engraving station.

32. The engraver of claim 31 wherein said first and second ends of said cylinder each comprise a receiving opening which is generally conically shaped in cross-section;

each of said support members of said headstock and tailstock being generally conically shaped so as to be received in mating engagement in said receiving opening of said first and second ends, respectively.

33. The engraver of claim 27 wherein said first and second ends of said cylinder each comprise a support shaft;

each of said headstock and tailstock comprising a gripping device for gripping said support shafts and for rotatably supporting said cylinder.

34. The engraver of claim 27 wherein said engraver is a gravure engraver.

35. The engraver of claim 27 wherein said engraver comprises a carriage having an engraving head slidably mounted thereon; said engraver further comprising:

sensing means associated with said carriage for sensing the position of said cylinder when said cylinder is located at said engraving station.

36. The engraver of claim 35 wherein said sensing means comprises an inductive sensor which is capable of sensing the relative position between said cylinder and said engraving head as well as the first end and the second end of said cylinder.

37. The engraver of claim 28 wherein said engraver comprises a third drive motor coupled to said engraving head for causing said engraving head to move towards and away from said engraving station.

38. The engraver of claim 27 wherein said at least one support comprises a support nest.

39. The engraver of claim 38 wherein said support nest comprises a plurality of rollers for supporting said cylinder between said headstock and tailstock.

40. The engraver of claim 39 wherein said plurality of rollers are positioned in a general U-shape for receiving said cylinder to facilitate minimizing damage to the surface of the cylinder after the cylinder is supported by said plurality of rollers and when said cylinder moves in a direction which is generally parallel to the axis of the cylinder.

41. A method for supporting a cylinder in an engraver comprising the steps of:

(a) positioning the cylinder on a support nest at an engraving station in the engraver;

(b) rotatably supporting said cylinder between a headstock and a tailstock; and

(c) retracting said support nest away from said engraving station.

42. The method as recited in claim 41 wherein said cylinder comprises a first end and a second end, said step (b) further comprising the step of:

(b)(1) driving said headstock and tailstock towards said first and second ends, respectively, in order to rotatably support said cylinder therebetween.

43. The method as recited in claim 42 wherein said step (a) further comprises the step of:

(a)(1) energizing a first drive motor and a second drive motor to move said headstock and tailstock, respectively, to a loading position.

44. The method as recited in claim 41 wherein said step (a) further comprises the step of:

(a)(1) energizing a drive motor to cause said headstock and tailstock to move simultaneously to a loading position.

45. The method as recited in claim 41 wherein said step (a) further comprises the step of:

(a)(2) driving said support into said engraving station.

46. The method as recited in claim 41 wherein said support comprises a support nest secured to an end thereof.

47. The method as recited in claim 41 wherein said method further comprises the steps of:

(d) engraving a surface of the cylinder with an image;

(e) raising said support;

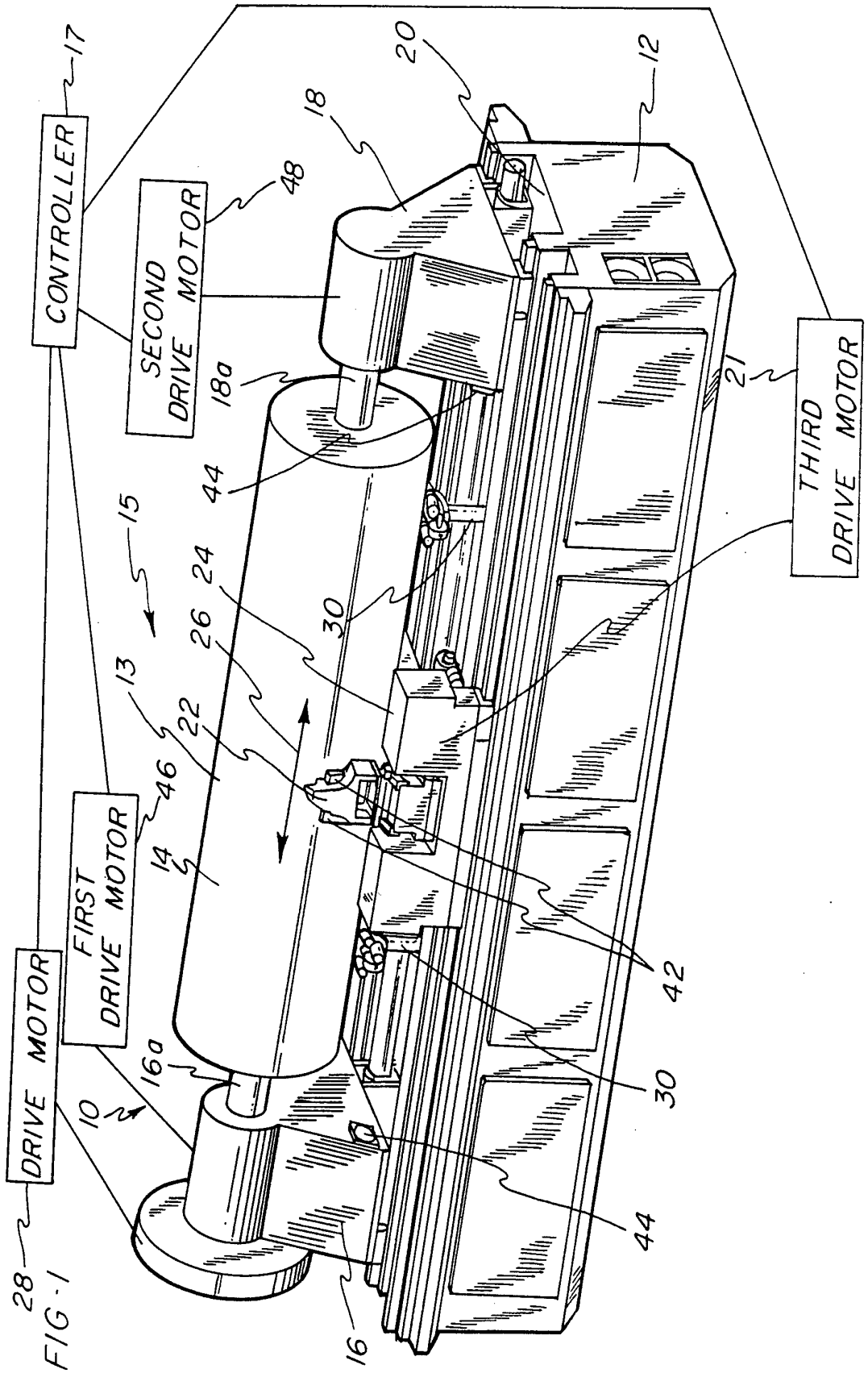
(f) retracting said headstock and tailstock such that said support supports the cylinder.

48. The method as recited in claim 47 wherein said method further comprises the steps of:

(g) driving the engraving head to an operative relationship with the surface of the cylinder;

(h) detecting ends of the cylinder;

(i) performing a test cut of a test pattern on the cylinder.


CONTROLLER
17
SECOND DRIVE MOTOR
48
18
20
12
18a
44
15
24
26
30
13
22
46
14
FIRST DRIVE MOTOR
DRIVE MOTOR
10
16a
28
16
42
30
44
21
THIRD DRIVE MOTOR

FIG·1

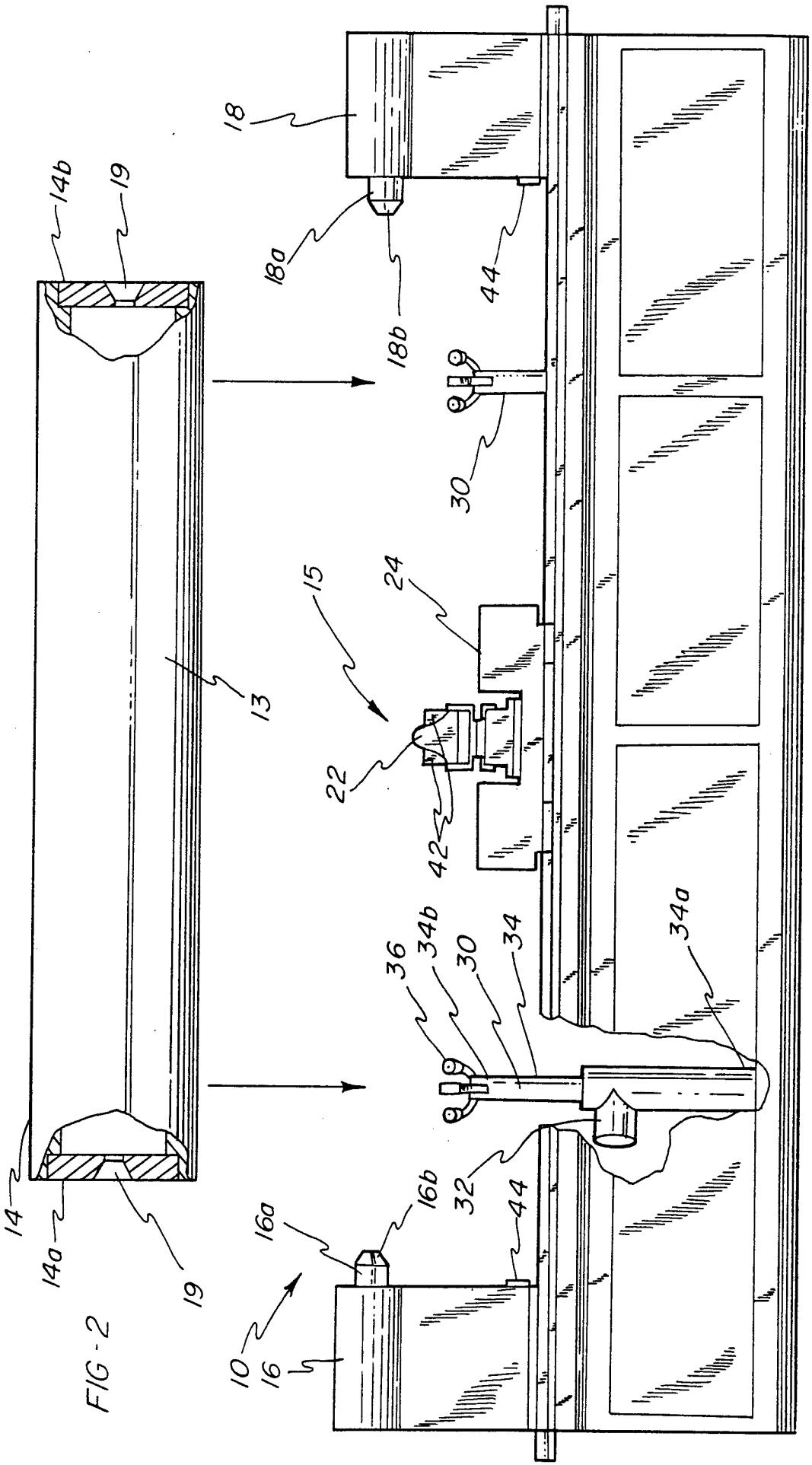

18
14b
19
18a
18b
44
30
15
24
13
22
42
34a
36
34b
30
34
32
44
14
14a
19
16b
16a
10
16

FIG-2

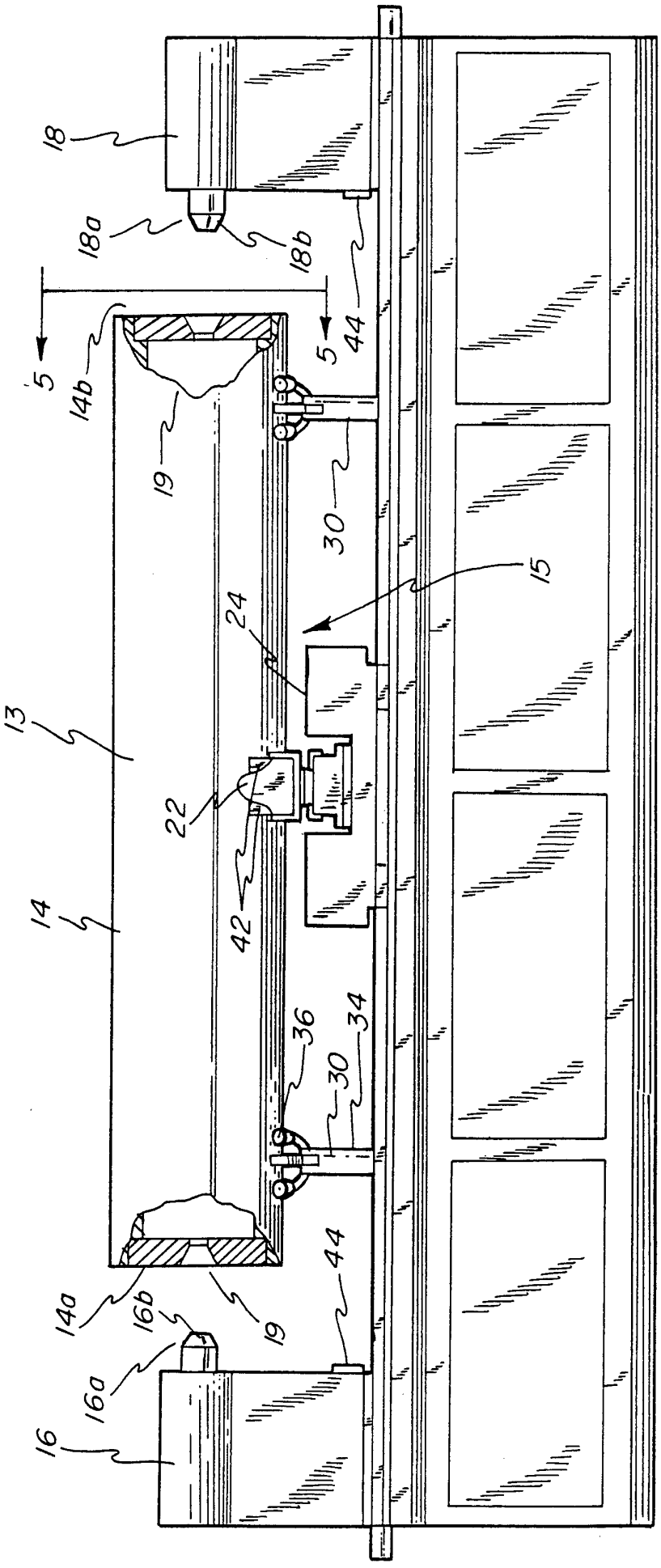

18
18a
18b
5
5
44
14b
19
30
15
24
13
22
42
14
36
34
30
44
14a
16b
19
16a
16

FIG-3

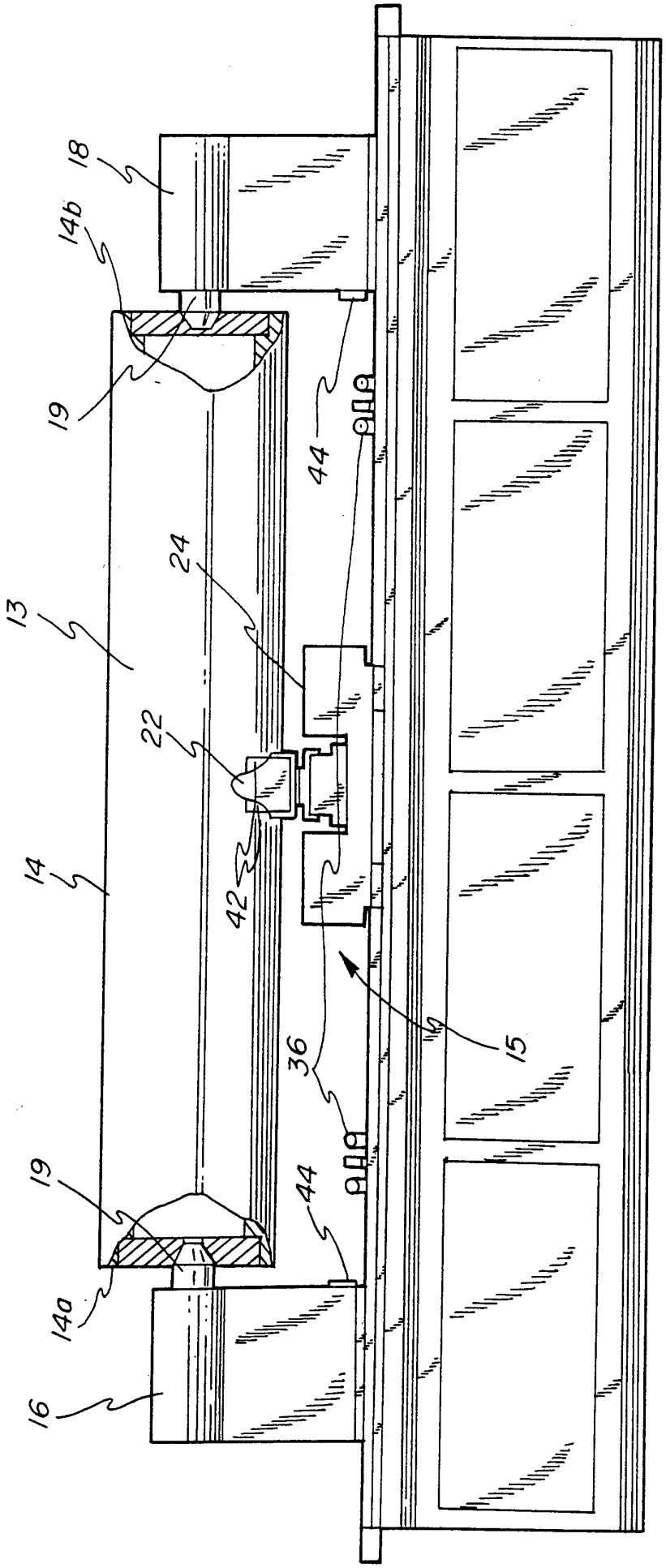


FIG - 4

FIG - 5

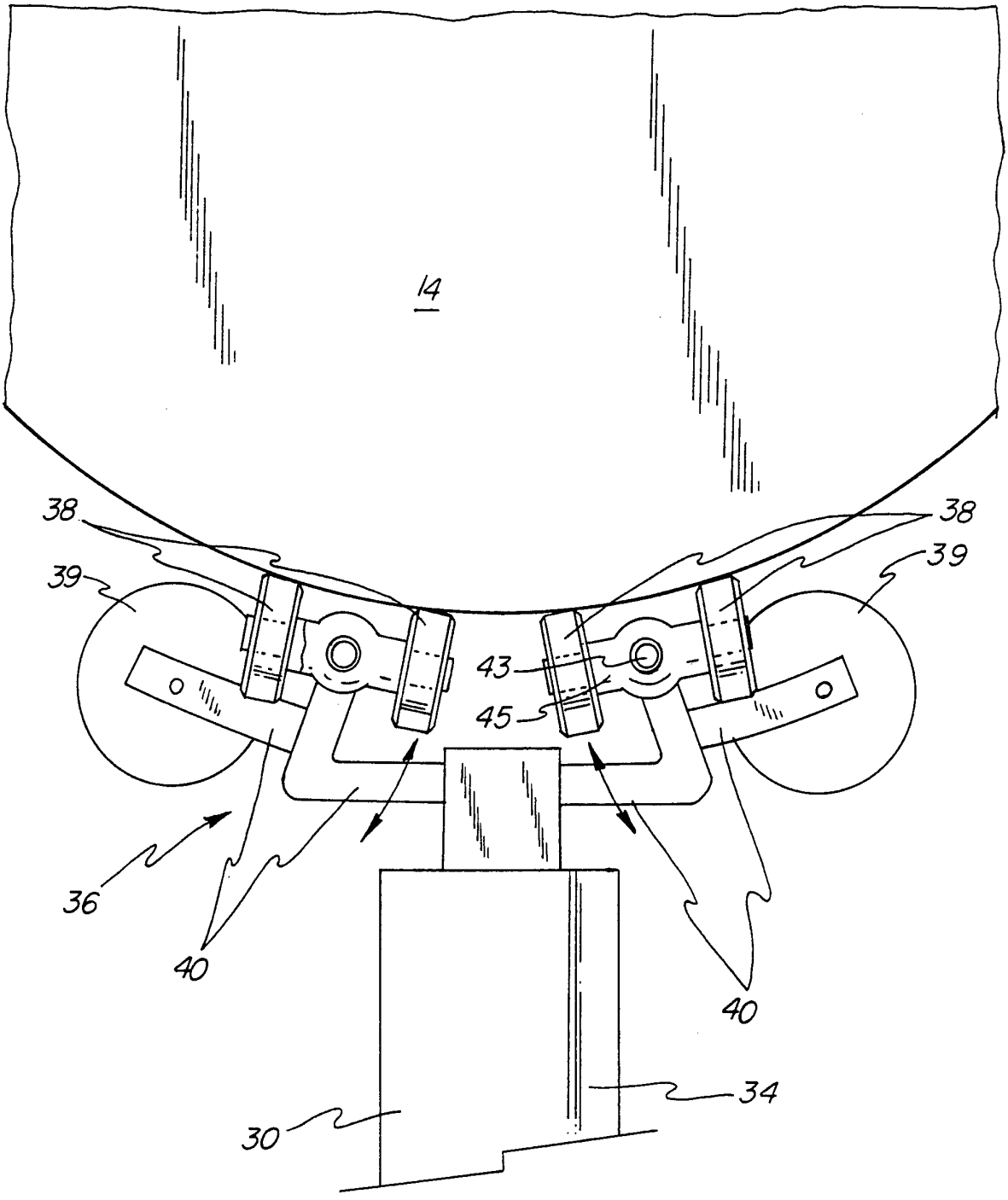
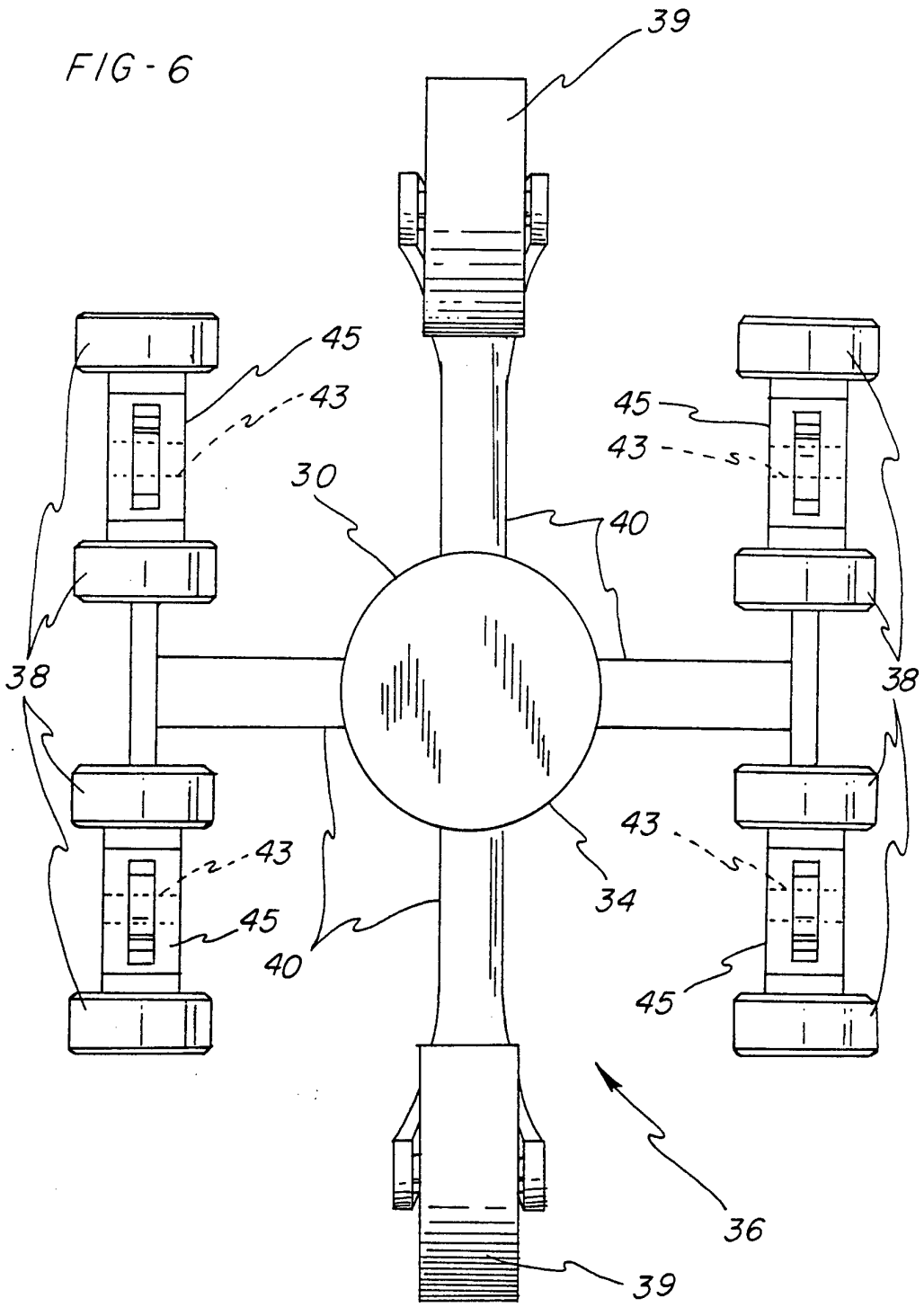


FIG - 6



INTERNATIONAL SEARCH REPORT

International application No.
PCT/US94/05133

A. CLASSIFICATION OF SUBJECT MATTER

IPC(5) :H04N 1/23; B23B 15/00; B23C 9/00; B23D 7/08
US CL :358/299; 408/67; 409/132,219
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. : 358/299; 408/33,67; 409/64,76,87,94,131,132,133,145,152,219,227

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)

APS
search terms: cylinder, support, gravure, engrav###, headstock, tailstock, loading, automatic, automatically

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US, A, 3,770,888 (de Vos et al) 06 November 1973, see entire document	1-48
A	US, A, 3,964,382 (Baar et al) 22 June 1976, see entire document	1-48
X	US, A, 3,990,133 (Schalles et al) 09 November 1976, fig.s 1-3 and 5, columns 5-6	1-7,11, 14-19,23, 24,27-33, 37,38, 41-47
A	US, A, 4,054,081 (Brown) 18 October 1977, see entire document	1-48
A	US, A, 4,451,856 (Buechler) 29 May 1984, see entire document	1-48

[X] 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
21 June 1994

Date of mailing of the international search report
JUL 15 1994

Name and mailing address of the ISA/US
Commissioner of Patents and Trademarks
Box PCT
Washington, D.C. 20231
Facsimile No. NOT APPLICABLE

Authorized officer
ERIC FRAHM
Telephone No. (703) 308-1317

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US94/05133

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US, A, 5,029,011 (Fraser) 02 July 1991, see entire document	1-48