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<b>(21) International Application Number:</b> PCT/US94/01521 <b>(22) International Filing Date:</b> 14 February 1994 (14.02.94)  <b>(30) Priority Data:</b> 016,255                      11 February 1993 (11.02.93)                      US  <b>(71) Applicant:</b> SPARRO MACHINE PRODUCTS, INC. [US/US]; 382 Post Road, Westerly, RI 02891 (US).  <b>(72) Inventor:</b> SPEICE, Donald, G.; 14 Barberry Lane, Westerly, RI 02891 (US).  <b>(74) Agents:</b> HOLMES, Stephen, J. et al.; Salter, Michaelson & Benson, 321 South Main Street, Providence, RI 02903 (US).		<b>(81) Designated States:</b> BR, CA, DE, GB, JP, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).  <b>Published</b> <i>With international search report.</i>
<b>(54) Title:</b> PROGRAMMABLE SPEED SELECTOR FOR A REEVES DRIVE  <div> </div> <b>(57) Abstract</b>  <p>A programmable speed selector (10) is provided for automatically adjusting the speed of a Reeves drive (11). The speed selector (10) includes an output shaft (28) which attaches to the adjustment crank shaft (18) of the Reeves drive (11) and a reversible motor (30) having a drive shaft (32) for driving the output shaft (28). Push button switches (82) are provided to selectively energize the motor (30) so that the drive shaft (32) can be manually rotated to a plurality of different rotational positions. A sensing device (34) is provided for sensing the direction and number of revolutions of the drive shaft (32) during positioning thereof and a micro-controller (36) is provided for learning the rotational positions and storing them into selected memory locations (64). Once programmed, the user may select one of the preset speeds on a key pad (66) and the device will automatically control the motor (30) to position the drive shaft (32) in the desired position thereby automatically adjusting the Reeves drive (11) to a desired speed.</p>		

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1                   **PROGRAMMABLE SPEED SELECTOR FOR A REEVES DRIVE**

2

3           **Background of the Invention:**

4           The instant invention is related to Reeves type  
5 variable speed transmission devices and more particularly  
6 to a programmable speed selector therefor.

7           A Reeves type variable speed transmission unit  
8 comprises a pair of split pulleys with a drive belt  
9 extending around both pulleys. Speed adjustment of the  
10 pulley arrangement is accomplished by means of a worm  
11 screw arrangement which is operative for adjusting the  
12 distance between the two halves of one of the split  
13 pulleys. The worm screw includes a crank shaft which is  
14 manually rotatable for adjustment of the spacing of the  
15 pulley halves, and the Reeves drive includes a speed  
16 indicator for indicating the speed at which the Reeves  
17 drive is set. Adjustment of the speed of the Reeves  
18 drive is accomplished through manual rotation of the  
19 crank shaft and visual inspection of the speed indicator  
20 to determine when the desired speed is reached. Rotation  
21 of the hand crank in a clockwise direction decreases the  
22 speed of the drive, and rotation in a counterclockwise  
23 direction increases the speed of the drive.

24           Reeves type transmission units have heretofore been  
25 known in the art for providing variable speeds in milling

1 machines and other mechanical machinery. The milling of  
2 machine parts often requires the use of several different  
3 milling tools each of which requires a different  
4 rotational speed of the milling machine, and the Reeves  
5 drive enables the milling machine to be readily adjusted  
6 to the required speeds. However, it has been found that  
7 repeated manual adjustment of the speed of a milling  
8 machine is inefficient and inconsistent, thereby causing  
9 inconsistent milling results.

10 Heretofore, motorized speed changing devices for  
11 Reeves drives have been known in the art. In particular,  
12 Warnke Tool Industries of Oxford, Michigan, manufactures  
13 such a device which comprises an electric motor that  
14 attaches to the crank shaft portion of the worm screw,  
15 and a rheostat switch which is operative for controlling  
16 rotation of the worm screw in clockwise and counter-  
17 clockwise directions. Although this device facilitates  
18 rotation of the worm screw, it does not provide any means  
19 for automatically selecting a desired speed.

20 The U.S. patent to Moser et al No. 3,216,268 also  
21 discloses a motorized apparatus for adjusting the speed  
22 output of a Reeves type transmission unit. More  
23 specifically, the Moser patent discloses a vernier  
24 adjustment mechanism for making very fine adjustments of  
25 the Reeves drive. The apparatus includes an electric

1 motor which is coupled to the worm screw of the drive  
2 through a gear mechanism, and a control unit which is  
3 operative for controlling operation of the motor.

4 Still further, computer numerical control (CNC)  
5 systems have been known for programming milling  
6 operations and automatically controlling a milling  
7 machine according to a set program.

8

9 **Summary of the Invention:**

10 The instant invention provides a programmable speed  
11 selector for a Reeves Drive.

12 Briefly, the programmable speed selector comprises  
13 an output shaft which is attached to the crank shaft  
14 portion of the worm screw of the Reeves drive, a  
15 reversible motor having a drive shaft for rotating the  
16 output shaft, an optical encoder mechanism for measuring  
17 the direction of rotation and the number of full and  
18 partial revolutions of the drive shaft, and a micro-  
19 controller for learning and storing a plurality of  
20 rotational positions of the drive shaft. Rotation of the  
21 drive shaft causes a corresponding rotation of the crank  
22 shaft and a resulting speed adjustment of the Reeves  
23 drive. In this regard, each rotational position of the  
24 drive shaft corresponds to a speed of the Reeves drive.  
25 The programmable speed selector includes push-button

1 switches for selectively energizing the motor and  
2 rotating or jogging the drive shaft to adjust the speed  
3 of the Reeves drive to a desired speed. The optical  
4 encoder mechanism measures the direction of rotation and  
5 the number of full or partial revolutions of the drive  
6 shaft as the desired speed is adjusted, and then stores  
7 the information into a memory location. When a preset  
8 speed is selected from the memory, the micro-controller  
9 automatically operates the motor to re-position the drive  
10 shaft thereby adjusting the speed of the Reeves drive.

11 Accordingly, it is an object of the instant  
12 invention to provide a speed selector for a Reeves drive.

13 It is another object to provide a speed selector  
14 which is programmable with a plurality of preselected  
15 speeds.

16 It is another object to provide a speed selector for  
17 a Reeves drive which quickly and consistently adjusts the  
18 Reeves drive to a plurality of preselected speeds.

19 Other objects, features and advantages of the  
20 invention shall become apparent as the description  
21 thereof proceeds when considered in connection with the  
22 accompanying illustrative drawings.

1       **Description of the Drawings:**

2               In the drawings which illustrate the best mode  
3 presently contemplated for carrying out the present  
4 invention:

5               Fig. 1 is a perspective view of a milling machine  
6 with the programmable speed selector of the instant  
7 invention mounted thereon;

8               Fig. 2 is a top view of the programmable speed  
9 selector with a portion of the housing cut away to show  
10 the drive components of the device;

11              Fig. 3 is a side view thereof with a portion of the  
12 housing cut away to show the drive components thereof;

13              Fig. 4 is a schematic block diagram of the  
14 electrical components thereof; and

15              Fig. 5 is a plan view of a Reeve's drive variable  
16 speed transmission unit.

17

18       **Description of the Preferred Embodiment:**

19              Referring now to the drawings, the programmable  
20 speed selector of the instant invention is illustrated  
21 and generally indicated at 10 in Figs. 1 through 4. As  
22 will be more fully described hereinafter, the  
23 programmable speed selector 10 of the instant invention  
24 is operative for automatically adjusting a Reeves drive  
25 variable speed transmission unit generally indicated at

11 in Fig. 5 to a plurality of pre-selected speeds. In the preferred embodiment, the speed selector of the instant invention 10 is illustrated in combination with a vertical knee type milling machine generally indicated at 12 in Fig. 1, wherein the speed selector 10 is operative for automatically adjusting the rotational speed of the milling machine 12. The milling machine 12 comprises a head portion 14, a spindle 16 rotatably mounted on the head portion 14, and a conventional Reeves drive transmission unit 11 for providing variable speed adjustment of the spindle 16. The Reeves drive 11 comprises a pair of split pulleys, 11a and 11b respectively, a drive belt 11c extending around both pulleys 11a and 11b, and a worm screw 17 for adjusting the distance between the two halves of one of the split pulleys 11a. The worm screw includes a crank shaft portion 18 which is manually rotatable for adjusting the Reeves drive 11. The crank shaft 18 extends outwardly from the head portion 14 of the milling machine 12 to facilitate manual rotation thereof by an operator. In this regard, the milling machine normally includes a crank wheel or handle (not shown) which is received onto the crank shaft 18 to facilitate rotation thereof. The milling machine 12 includes a speed indicator generally indicated at 20 for indicating the speed at which the

1       milling machine 12 is set.     The speed indicator 20  
2       includes a low speed range indicator (80 - 500 RPM) 22  
3       and a high speed range indicator (500 - 4500 RPM) 24.  
4       Speed adjustment of the milling machine 12 is accom-  
5       plished by selecting a high speed range or low speed  
6       range by means of a gear lever (not shown) on the milling  
7       machine 12 and manually rotating the crank shaft 18 until  
8       the appropriate speed indicator, 22 or 24, reads the  
9       speed desired.

10       The programmable speed selector 10 of the instant  
11       invention comprises a housing generally indicated at 26,  
12       an output shaft 28 rotatably mounted in the housing 26,  
13       a reversible electric motor 30 having a drive shaft 32  
14       for driving the output shaft 28, a sensor device  
15       generally indicated at 34 for sensing the direction of  
16       rotation and the number of revolutions of the drive shaft  
17       32, and a controller unit 36.

18       The housing 26 is preferably of one-piece  
19       construction, and it is preferably formed from a rigid  
20       and durable sheet metal. The housing 26 comprises a body  
21       portion 38 which encloses the motor 30, the sensor  
22       device 34, and the controller unit 36, an angled neck  
23       portion 39, and a head portion 40 which encloses the  
24       output shaft 28. The body portion 38 of the housing 26  
25       further encloses a power supply unit 42 for energizing

1 the motor 30 and the controller unit 36. The housing 26  
2 also preferably includes suitable mounting hardware (not  
3 shown), such as mounting brackets, for securely mounting  
4 the housing 26 to the head 14 of the milling machine 12.

5 The output shaft 28 is rotatably mounted in a  
6 bearing mount 44 in the head portion 40 of the housing  
7 26, and it includes an axial bore (shown in broken lines)  
8 46 which is slidably received over the crank shaft 18 of  
9 the Reeves drive. A set screw 48 is provided for fixedly  
10 attaching the output shaft 28 to the crank shaft 18, and  
11 a conventional pulley wheel 50 is also mounted on the  
12 output shaft 28.

13 The motor 30 preferably comprises a reversible DC  
14 (Direct Current) electric motor having a drive shaft 32  
15 which is rotatable in clockwise and counterclockwise  
16 directions. A pulley wheel 52 is mounted on a first end  
17 of the drive shaft 32, and a toothed belt 54 extends  
18 around the pulley wheel 52 on the drive shaft 32 and the  
19 pulley wheel 50 on the output shaft 28 to drive the  
20 output shaft 28 and crank shaft 18. In this regard,  
21 rotation of the drive shaft 32 causes a corresponding  
22 equal rotation of the crank shaft 18 and a resulting  
23 adjustment in speed of the Reeves drive.

24 The sensing device 34 comprises a conventional  
25 optical encoder unit which is well known in the

1       electrical/optical arts. The optical encoder unit 34  
2       preferably comprises a BEI MOTION SYSTEMS Module No. 90-  
3       Q-I Optical Encoder generally indicated at 56, and a BEI  
4       MOTION SYSTEMS optical wheel element Model No. 610-I-08  
5       generally indicated at 58 which is mounted on the drive  
6       shaft 32 of the motor 30. The optical wheel element 58  
7       has an outer surface 60 and a plurality of alternating  
8       dark and light bar-shaped areas (not shown), i.e. similar  
9       to bar code on the outer surface 60. In the preferred  
10      optical encoder, the wheel element 58 includes 512 bars.  
11      The module 56 includes two light emitting diodes (not  
12      shown) which are operative for sensing movement of the  
13      wheel element 58 as the drive shaft 32 rotates. One of  
14      the light emitting diodes is operative for sensing the  
15      direction of rotation of the bar-shaped areas (clockwise  
16      or counterclockwise) and the other diode is operative for  
17      sensing the number of bar-shaped areas which travel past  
18      the diode during rotation of the wheel element 58 (512  
19      bars representing a full rotation). In this regard, the  
20      sensing device 34 is operative for sensing the direction  
21      of rotation and the number of full and partial revolu-  
22      tions of the drive shaft 32 as it is rotated. The  
23      controller unit 36 preferably comprises a conventional  
24      micro-controller integrated circuit which includes a  
25      logic unit 62 and a memory unit 64. The micro-controller

1 is programmed according to conventional programming  
2 techniques and it is electrically interconnected with the  
3 optical encoder unit 34. The micro-controller 36 is  
4 operative in two modes: a manual mode and an automatic  
5 mode. In the manual mode, the micro-controller 34 is  
6 operative for learning a plurality of preselected  
7 rotational positions of the drive shaft 32 and for  
8 storing the preselected rotational positions in selected  
9 locations in the memory unit 64. It is pointed out that  
10 each rotational position of the drive shaft 32  
11 corresponds to a speed of the Reeves drive. In the  
12 automatic mode, the micro-controller 34 is operative for  
13 automatically rotating the drive shaft 32 to a plurality  
14 of preselected positions, thereby adjusting the milling  
15 machine 12 to a plurality of preselected speeds.

16 The speed selector 10 further includes a push-button  
17 type keypad generally indicated at 66 (Fig. 1) for  
18 inputting information to the micro-controller unit 34.  
19 The key pad 66 is mounted on the angled neck portion 39  
20 of the housing 26, and it preferably comprises a membrane  
21 type keypad, or a dome and conductive rubber keypad, both  
22 of which are capable of withstanding continuous exposure  
23 to oily and dusty environments. The keypad 66 includes  
24 a manual/automatic mode button 68 and two momentary push-  
25 button switches 70 and 72 respectively, which are

1       operative for selectively energizing the motor 30 for  
2       rotation of the drive shaft 32. One of the momentary  
3       switches 70 is operative for rotation of the drive shaft  
4       32 in a clockwise direction to decrease the speed of the  
5       Reeves drive, and the other momentary switch 72 is  
6       operative for rotation of the drive shaft 32 in a  
7       counterclockwise direction to increase the speed. In  
8       this regard, the push-button switches 70 and 72, are  
9       operative for manually adjusting the Reeves drive to a  
10      plurality of preselected speeds. To adjust the speed of  
11      the Reeves drive using the manual switches 70 and 72, the  
12      operator selects the manual mode using the manual/auto-  
13      matic mode button 68, depresses one of the momentary  
14      switches 70 or 72, until the desired speed is indicated  
15      on the speed indicator 22, and then releases the switch.  
16      The keypad 66 further includes a program button 74, a low  
17      speed set button 76, a high speed set button 78, a low  
18      speed range reminder button 80, twelve numerical speed  
19      set buttons 82 for setting and selecting the desired  
20      speeds, and a clear button 84 for clearing the memory  
21      locations. Each of the numbered speed buttons 82  
22      represents an individual speed setting. The electrical  
23      circuitry interconnecting the electrical components of  
24      the speed selector is conventional in the electrical  
25      arts, and therefore it is shown only schematically in

1        Fig. 4. The keypad 66 may also comprise a plurality of  
2        LED indicators for indicating various operating modes of  
3        the device, such as for indicating whether the speed  
4        selector 10 is in the manual mode or automatic mode.    ¶  
5        program the speed selector 10, an operator selects the  
6        manual mode and then manually operates or jogs the motor  
7        30 via the momentary switches 70 and 72, until a desired  
8        minimum speed is indicated on the speed indicator 22.  
9        This minimum speed represents the lowest speed at which  
10       the operator desires the milling machine 12 to operate.  
11       After jogging the machine 12 to the lowest speed, the  
12       operator presses the low speed set button 76 to store the  
13       speed into memory. The low speed setting represents a  
14       datum or reference point from which all other rotational  
15       positions of the drive shaft 32 are measured. There-  
16       after, when the drive shaft 32 is manually rotated to  
17       other desired speeds, the optical encoder unit 34 senses  
18       the direction of rotation of the drive shaft 32 and the  
19       number of revolutions away from the datum point by  
20       sensing the direction of rotation of the bars and the  
21       number of bars which rotate past the counting diode.  
22       This information (direction of rotation and number of  
23       bars) is fed to the micro-controller 36 which is  
24       operative for monitoring the present position of the  
25       drive shaft 32 with respect to the datum point, and for

1 learning and storing the specific rotational positions  
2 into memory. The highest operational speed of the  
3 milling machine 12 is programmed in a similar manner  
4 using the high speed set button 78.

5 To program a preselected speed for automatic  
6 operation, the operator again selects the manual mode and  
7 uses the momentary jogging switches 70 and 72 to adjust  
8 the desired speed setting of the Reeves drive. When the  
9 desired speed is indicated, the operator presses the  
10 program button 74, and one of the number buttons 82 to  
11 store the desired speed setting into a memory location.  
12 It is again pointed out that the micro-controller 36  
13 senses the present rotational position of the drive shaft  
14 32 with respect to the datum position by sensing the  
15 direction of rotation of the bars and the number of bars  
16 which rotate past the counting diode. The micro-  
17 controller 36 then stores the information into a memory  
18 location corresponding to the number button 82. In this  
19 manner, the speed selector is operative for storing 12  
20 preselected speed settings. While there are 12 pre-  
21 selected speed settings in the instant embodiment, it is  
22 to be understood that the speed selector can be easily  
23 adapted to store a greater or lesser number of preset  
24 speeds. Each time a desired speed is set, the micro-  
25 controller 36 measures the present rotational position of

1       the drive shaft 32 with respect to the datum position,  
2       and stores the information into memory.

3               To automatically adjust the milling machine 12 to a  
4       preset speed, the operator first depresses the  
5       automatic/manual mode button 68 to select the automatic  
6       mode, and then depresses the number button 82 corresponding to the desired speed, for example, speed button  
7       number 4. If speed number 4 is in the low speed range,  
8       the operator should also depress the low speed range  
9       reminder button 80. In this regard, the low speed range  
10       reminder button 80 is operative for illuminating one of  
11       the LED indicators. The illuminated LED acts as a  
12       reminder for the operator to adjust the high/low speed  
13       gear lever to the correct position. The micro-controller  
14       36 senses the present rotational position of the drive  
15       shaft 32 and compares it to the rotational position  
16       stored in low speed range memory location number 4. The  
17       micro-controller 36 then calculates the proper direction  
18       of rotation and the number of revolutions of the drive  
19       shaft 32, i.e. the number of bars, required to reach the  
20       desired rotational position (speed setting), and then  
21       automatically operates the motor 30 to rotate the drive  
22       shaft 32 the required number of revolutions. It is again  
23       pointed out that the high speed/low speed gear lever (not  
24       shown) must be adjusted to the correct position by the  
25

1 operator for the milling machine 12 to operate at the  
2 desired speed.

3 To clear any one of the preset speeds, the operator  
4 depresses the clear button 84 and the setting button  
5 which it is desired to clear. For example, to clear the  
6 high speed setting, the operator depresses the "clear"  
7 button 84 and then depresses high speed set button 78.

8 The programmable speed selector 10 also preferably  
9 includes an RS 232 communication port 86, a 0-10 V DC  
10 port 88, and a 4-20 milli-amp current loop port 90 (Fig.  
11 4) for communicating with computer numerical control  
12 (CNC) systems. The plurality of communication ports  
13 enable the speed selector to communicate with any one of  
14 the currently available CNC systems. In this manner of  
15 operation, the CNC system sends command signals to the  
16 speed selector via one of the communication ports to  
17 automatically select a desired speed setting from the  
18 speed selector's memory 64 and to operate the motor 30.

19 It is seen therefore, that the instant invention  
20 provides an effective programmable speed selector 10 for  
21 a Reeves drive variable speed transmission device. The  
22 speed selector 10 is operative for learning and storing  
23 a plurality of preselected speeds and for automatically  
24 adjusting the Reeves drive to the preselected speeds.  
25 The speed selector is simple to program and operate, and

1       it effectively eliminates the inefficient and inconsis-  
2       tent manual adjustment of speeds in milling machines that  
3       were previously required. It is pointed out that the  
4       programmable speed selector 10 is universally adaptable  
5       to any article of mechanical machinery which employs a  
6       Reeves drive device having a manual hand crank. For  
7       these reasons, the speed selector of the instant inven-  
8       tion is believed to represent a significant advancement  
9       in the art which has substantial commercial merit.

10       While there is shown and described herein certain  
11       specific structure embodying the invention, it will be  
12       manifest to those skilled in the art that various  
13       modifications and rearrangements of the parts may be made  
14       without departing from the spirit and scope of the  
15       underlying inventive concept and that the same is not  
16       limited to the particular forms herein shown and  
17       described except insofar as indicated by the scope of the  
18       appended claims.

**What is claimed is:**

- 1 1. A programmable speed selector for a Reeves type  
2 variable speed transmission unit having a worm screw  
3 which is rotatable in clockwise and counterclockwise  
4 directions for adjusting a speed setting thereof, said  
5 programmable speed selector comprising:
  - 6 reversible motor means having a drive shaft which is  
7 operable for clockwise and counterclockwise rotation,  
8 said drive shaft being coupled to said worm screw for  
9 rotation thereof;
  - 10 power means for energizing said motor means;
  - 11 means for selectively energizing said motor means  
12 for clockwise or counterclockwise rotation of said drive  
13 shaft to a plurality of preselected rotational positions,  
14 said preselected rotational positions corresponding to a  
15 plurality of preselected speed settings of said Reeves  
16 type transmission unit;
  - 17 means for sensing said rotational positions of said  
18 drive shaft, said sensing means sensing a direction of  
19 rotation of said drive shaft and a number of full or  
20 partial revolutions of said drive shaft with respect to  
21 a datum rotational position;
  - 22 memory means for storing said plurality of  
23 rotational positions; and

24           input means for inputting said rotational positions  
25   to said memory means and for selecting one of said stored  
26   rotational positions from said memory means; and

27           controller means for controlling said motor means to  
28   automatically rotate said drive shaft to said selected  
29   rotational position in response to said input means  
30   thereby selecting a speed of said Reeves transmission  
31   unit.

1    2.   In the programmable speed selector of claim 1, said  
2   sensing means comprising an optical encoder, said optical  
3   encoder comprising an optical wheel element mounted to  
4   said drive shaft and at least two sensing diodes posi-  
5   tioned around the circumference of the optical wheel  
6   element, said optical wheel element including alternating  
7   dark and light stripes on the circumference thereof, one  
8   of said diodes being operative for sensing direction of  
9   rotation of said stripes, and the other of said diodes  
10   being operable for sensing a number of stripe rotations.

1    3.   The programmable speed selector of claim 1, further  
2   comprising:

3           housing means;

4           an output shaft rotatably mounted in said housing  
5   means;

6 means for attaching said output shaft to said worm  
7 screw; and

8 means for coupling said drive shaft to said output  
9 shaft for rotation thereof.

1 4. In the programmable speed selector of claim 3, said  
2 means for coupling comprising:

3 first pulley means on said output shaft;

4 second pulley means on said drive shaft; and

5 belt means extending around said first and second  
6 pulley means.

1 5. In the programmable speed selector of claim 1, said  
2 means for selectively energizing said motor means  
3 comprising momentary switches.

1 6. In the programmable speed selector of claim 1, said  
2 controller means comprising micro-controller circuit  
3 means.

1 7. The programmable speed selector of claim 1 further  
2 comprising means for communicating with a computer  
3 numerical control system.

1     8.    In the programmable speed selector of claim 7, said  
2     means   for   communicating   comprising   an   RS   232  
3     communication port.

1     9.    A programmable speed selector for a Reeves type  
2     variable speed transmission unit having a worm screw  
3     which is rotatable in clockwise and counterclockwise  
4     directions for adjusting a speed setting thereof, said  
5     programmable speed selector comprising:

6         a housing;

7         an output shaft rotatably mounted in said housing;

8         means for attaching said output shaft to said worm  
9     screw;

10        reversible motor means having a drive shaft which is  
11     operable for clockwise and counterclockwise rotation,  
12     said drive shaft being coupled to said output shaft for  
13     rotation of said worm screw;

14        power means for energizing said motor means;

15        momentary switch means for selectively energizing  
16     said motor means for clockwise or counterclockwise  
17     rotation of said drive shaft to a plurality of  
18     preselected rotational positions, said preselected  
19     rotational positions corresponding to a plurality of  
20     preselected speed settings of said Reeves type  
21     transmission unit;

22           optical encoder means for sensing said rotational  
23   positions of said drive shaft, said sensing means sensing  
24   a direction of rotation of said drive shaft and a number  
25   of full or partial revolutions of said drive shaft with  
26   respect to a datum rotational position;

27           memory means for storing said plurality of rota-  
28   tional positions; and

29           input means for inputting said rotational positions  
30   to said memory means and for selecting one of said stored  
31   rotational positions from said memory means; and

32           controller means for controlling said motor means to  
33   automatically rotate said drive shaft and said coupled  
34   worm screw to said selected rotational position in  
35   response to said input means, thereby selecting a speed  
36   of said Reeves type transmission unit.

1   10. In the programmable speed selector of claim 9, said  
2   controller means comprising micro-controller circuit  
3   means.

1   11. The programmable speed selector of claim 9 further  
2   comprising means for communicating with a computer  
3   numerical control system.

1     12. In the programmable speed selector of claim 11, said  
2     means for communicating comprising an RS 232  
3     communication port.

1     13. In the programmable speed selector of claim 11, said  
2     means for communicating comprising a 0-10 V DC  
3     communication port.

1     14. In the programmable speed selector of claim 11  
2     comprising a 4-20 milli-amp current loop communication  
3     port.

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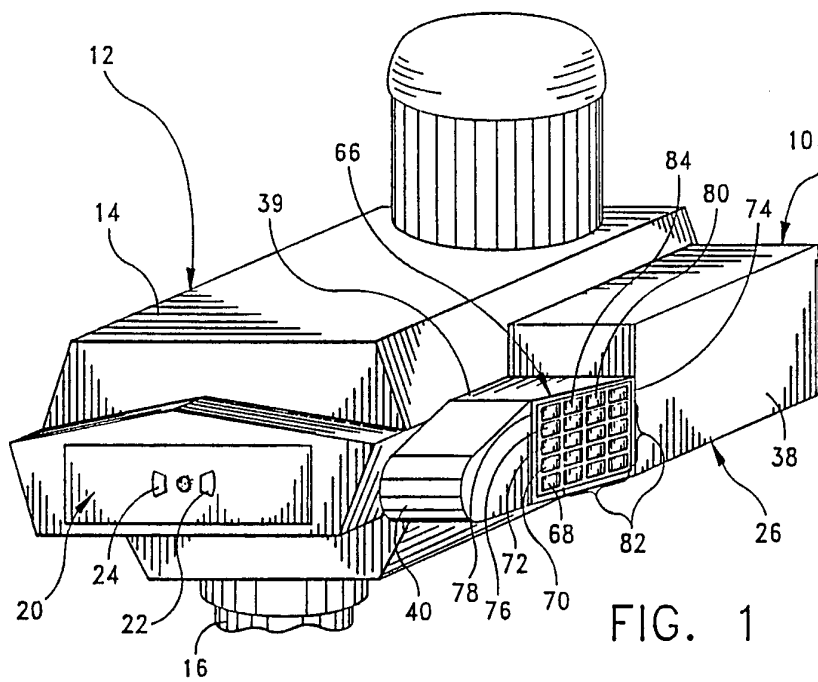


FIG. 1

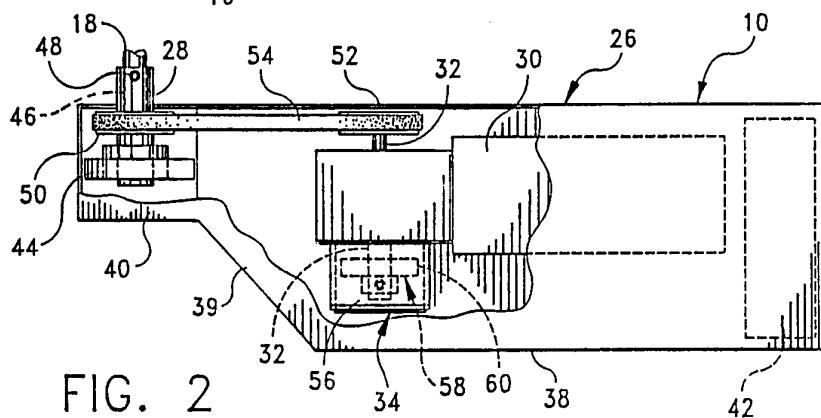


FIG. 2

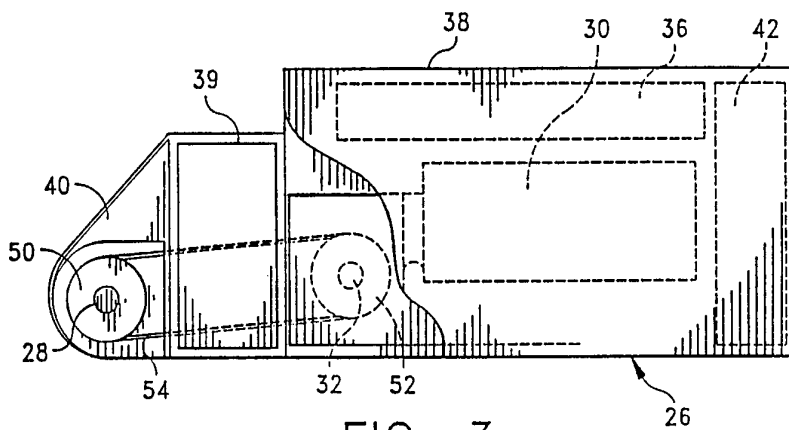


FIG. 3

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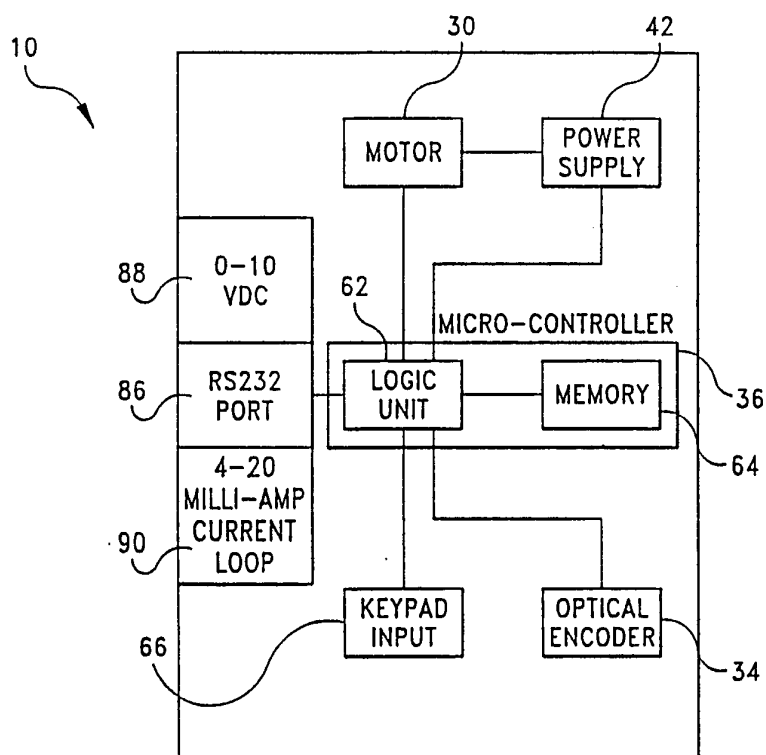


FIG. 4

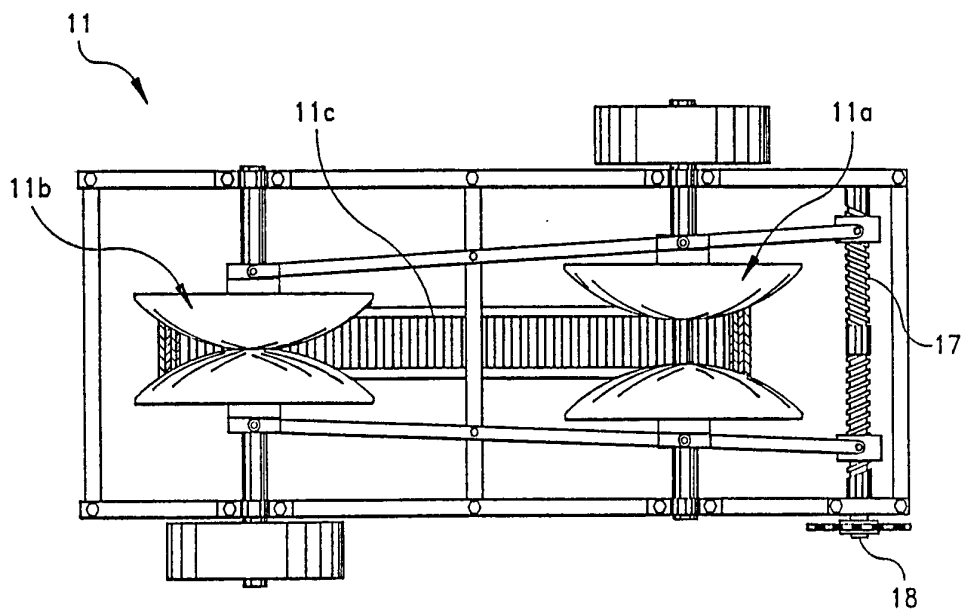


FIG. 5

# INTERNATIONAL SEARCH REPORT

i. national application No.

PCT/US94/01521

## A. CLASSIFICATION OF SUBJECT MATTER

IPC(5) : Please See Extra Sheet.

US CL : Please See Extra Sheet.

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. : 318/280,600,603;388/907.5,838

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.
Y	US,A, 4,933,834 (Gotou et al) 12 June 1990 Col. 1, lines 60-65; Col. 2, lines 10-15	1-14
Y	US, A, 5,028,854 (Moline) 02 July 1991 Fig 2	1-14
Y	US, A, 4,020,406 (Tokuno et al) 26 April 1977 Col. 1, lines 20-30	1-14
A,P	US, A, 5,228,077 (Darbee) 13 July 1993	12



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 part 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

05 May 1994

Date of mailing of the international search report

JUN 01 1994

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MASIH, KAREN

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# INTERNATIONAL SEARCH REPORT

national application No.  
PCT/US94/01521

A. CLASSIFICATION OF SUBJECT MATTER:  
IPC (5):

G05B 19/29

A. CLASSIFICATION OF SUBJECT MATTER:  
US CL :

318/280,600,603;388/907.5,838