United States Patent

Speicher et al.

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[54] POSITION INDICATOR FOR A MULTIPLE CHARACTER MARKING DEVICE

[72] Inventors: **Edwin W. Speicher**, Pittsburgh; **Charles E. Fry, Jr.**, Coraopolis, both of Pa.

[73] Assignee: **M. E. Cunningham Company**, Ingomar, Pa.

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Related U.S. Application Data

[62] Division of Ser. No. 769,112, Oct. 21, 1968, Pat. No. 3,541,954.

[52] **U.S. Cl.** **101/110**, 101/95, 336/30, 336/136, 340/324

[51] **Int. Cl.** **B41j 1/54**, B44b 5/00

[58] **Field of Search** 101/110, 99, 95, 4, 29, 72, 101/78, 80, 79; 235/23, 24, 25, 61; 336/30, 131, 130, 134, 136; 340/324–325

[56] **References Cited**

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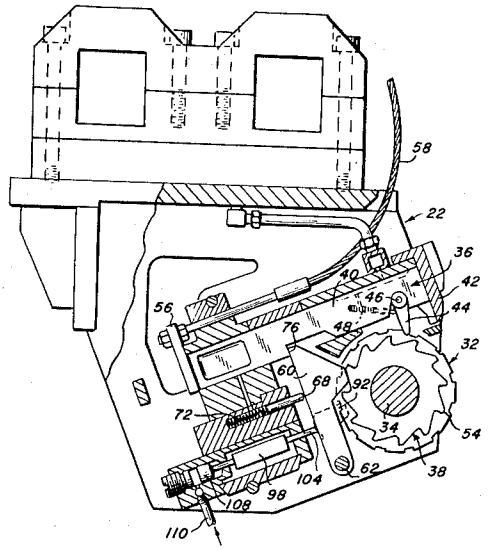
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Primary Examiner—William B. Penn
Attorney—Stanley J. Price, Jr.

[57] **ABSTRACT**

This disclosure relates to a marking device with a plurality of marking wheels for marking slabs, billets or the like with a group of characters. Each marking wheel has a plurality of characters on the outer periphery and character selection is accomplished by rotating the marking wheel until the desired character on the wheel periphery is in marking position. Each wheel has a ratchet on one side that is actuated by a pawl connected to an actuating slide. The pawl on the actuating slide engages a segment of the ratchet and rotates the marking wheel for character selection. On the other side of the wheel there is a spiral cam with different preselected radial dimensions for each of the characters. A linear transducer is biased against the cam surface and generates a voltage signal that is proportional to the radial dimension of the portion of the cam aligned with the transducer to thus indicate the particular character in the marking position. The voltage signal from the transducer is compared with fixed reference voltages and when the voltages match, a relay is actuated to indicate the character on the wheel in marking position. The circuitry includes a logic section to count sequentially so that a transducer malfunction at the steeply sloping portion of the cam between the longest and shortest dimension of the cam cannot produce an incorrect character indication.

5 Claims, 10 Drawing Figures



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SHEET 1 OF 3

FIG. 3

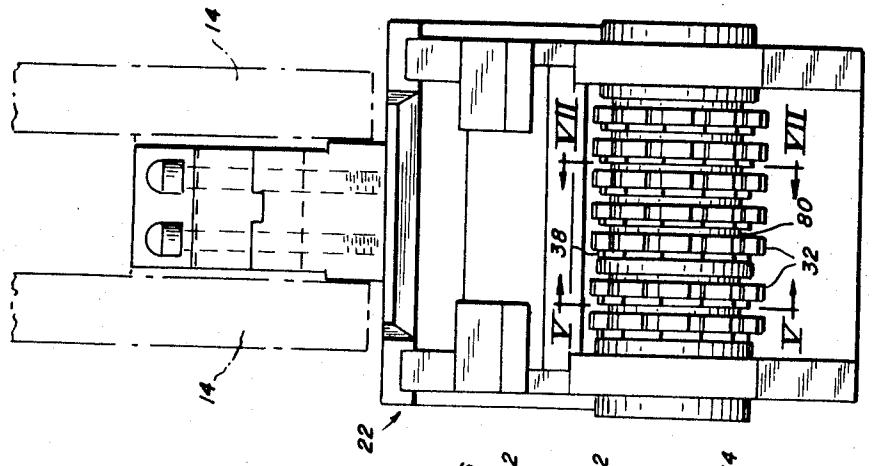


FIG. 2

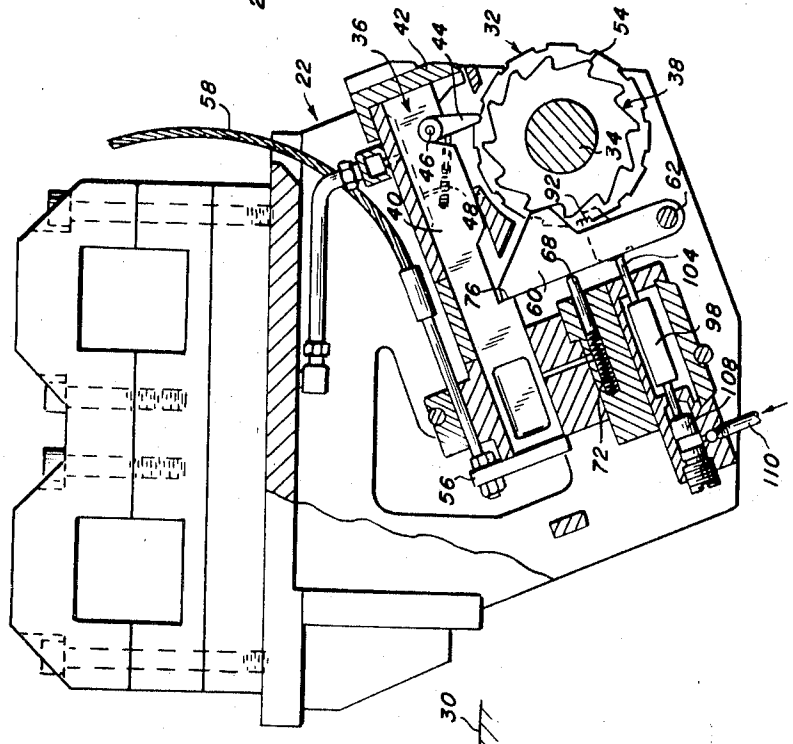
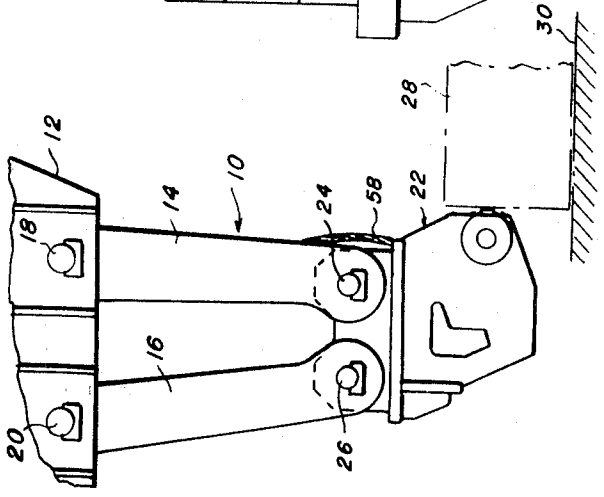


FIG. 1



INVENTORS
CHARLES E. FRY Jr.,
EDWIN W. SPEICHER
By Stanley J. Friedman
their Attorney

FIG. 6

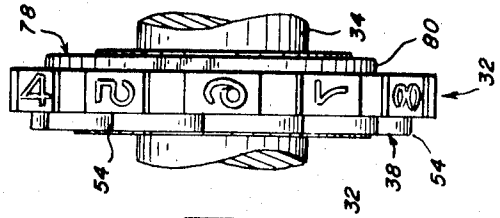


FIG. 5

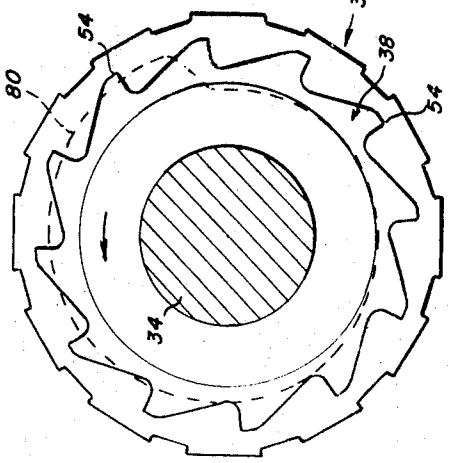


FIG. 7

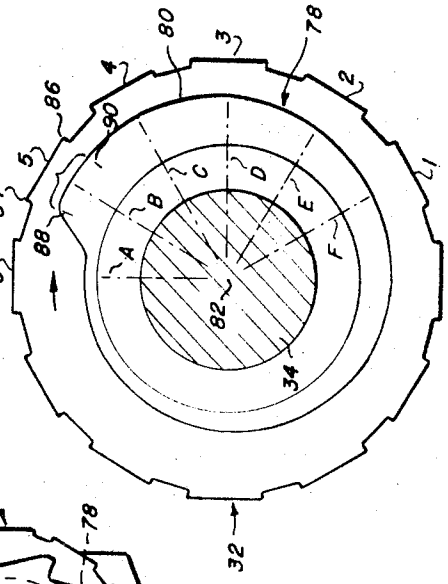
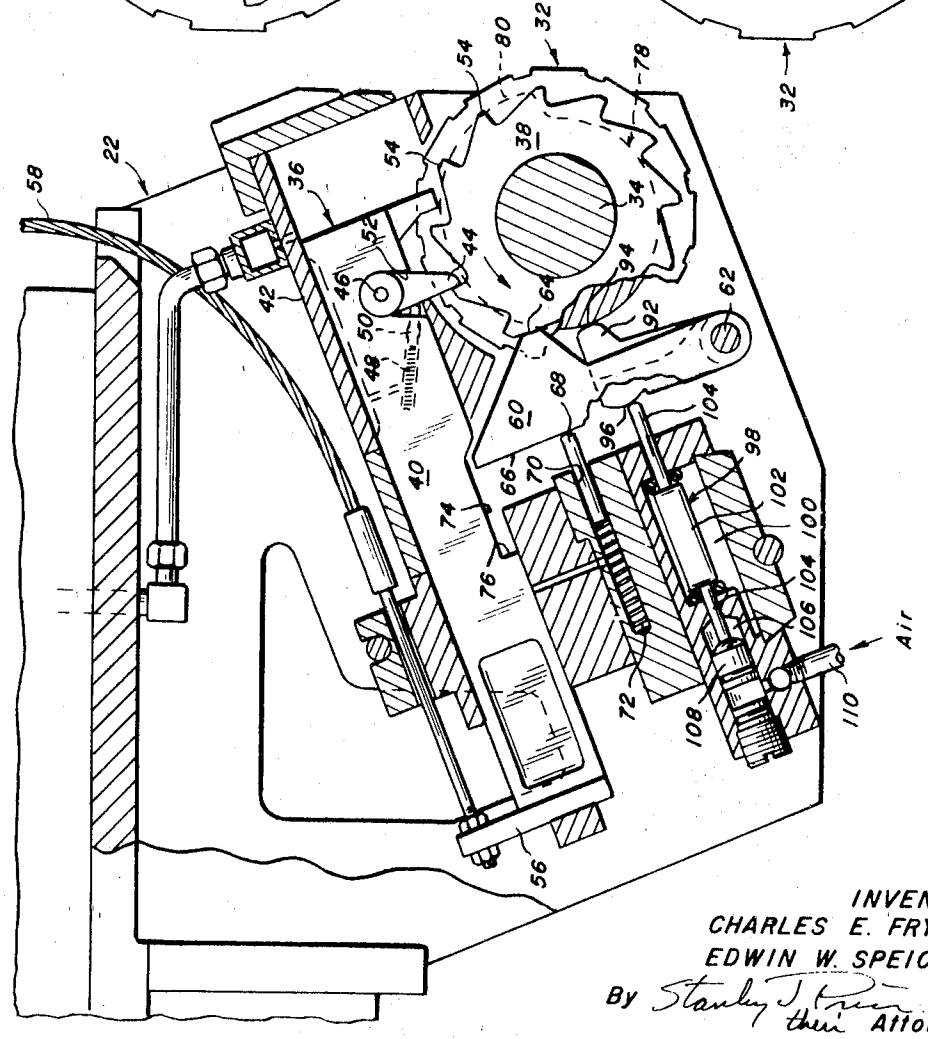


FIG. 4



INVENTORS
CHARLES E. FRY Jr.,
EDWIN W. SPEICHER
By Stanley J. Price
their Attorney

INVENTORS
CHARLES E. FRY Jr.,
EDWIN W. SPEICHER
By Stanley J. Price
their Attorney

POSITION INDICATOR FOR A MULTIPLE CHARACTER MARKING DEVICE

CROSS REFERENCE TO RELATED APPLICATIONS

This application is a division of U.S. application Ser. No. 769,112, filed Oct. 21, 1968 and entitled "Position Indicator For a Multiple Character Marking Device" now U.S. Pat. No. 3,541,954, patented Nov. 24, 1970.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to a position indicator for a wheel and more particularly to a position indicator for a marking wheel that remotely indicates the character in marking position.

2. Description of the Prior Art

U. S. Pat. No. 2,994,264 illustrates and described apparatus for impressing upon billets, slabs and the like a group of characters to identify the heat, the ingot and the particular cut. The marking apparatus disclosed includes a remotely controlled actuator to rotate each marking wheel to position the desired character in marking position. This type of marking apparatus has reduced substantially the time required to change the position of the characters on the various marking wheels and eliminates the prior practice of slowing down the mill to keep pace with the marking process.

One problem encountered with the remotely controlled switching device for character selection is the possibility that the character remotely indicated on the panel as being in marking position is not the same as the character on the marking wheel that is actually in the marking position. There is a need, therefore, for a position indicator that transmits a signal to a remote location corresponding to the character on the marking wheel that is in marking position.

SUMMARY OF THE INVENTION

The instant invention relates to a position indicator associated with a marking wheel that accurately and positively transmits a signal to a remote location indicating the relative position of the marking wheel.

One of the objects of this invention is to provide a position indicator associated with a rotating wheel for accurately indicating at a remote location the angular position of the wheel.

Another object of this invention is to provide a position indicator for marking wheel having a plurality of characters on its periphery, indicating remotely the relative angular position of the wheel and the character in marking position.

A still further object of this invention is to provide a spiral cam on a rotatable wheel and a signal device in abutting relation with the spiral cam to transmit a signal to a remote location indicating the relative angular relation of the wheel.

These and other objects and advantages of this invention will be more completely disclosed and described in the following specification, the accompanying drawings and the appended claims.

BRIEF DESCRIPTION OF THE DRAWING

In the drawings:

FIG. **1** is a view in side elevation of the marking device as it impresses a group of characters on a slab.

FIG. **2** is a view in side elevation and partially in section illustrating the apparatus for rotating one of the marking wheels.

FIG. **3** is a view in front elevation of the marking device illustrating a plurality of marking wheels, each having a ratchet wheel on one side and a cam member on the opposite side.

FIG. **4** is an enlarged view similar to FIG. **2** with portions broken away to illustrate the manner in which the cam follower rides on the cam and the transducer is maintained in abutting relation with the cam follower.

FIG. **5** is a view in section taken along the line **5—5** of FIG. **3** illustrating a marking wheel in side elevation and the ratchet wheel for rotating the marking wheel.

FIG. **6** is a view in front elevation of a single marking wheel with the ratchet wheel and spiral cam on opposite sides thereof.

FIG. **7** is a view in side elevation taken along the line **7—7** of FIG. **3** illustrating the spiral cam on the side of a marking wheel.

FIG. **8** is a block diagram of the marking wheel selection system illustrating diagrammatically the principal mechanical and electrical components for a single marking wheel.

FIGS. **9** and **10** are simplified schematic and block diagrams of the electrical control system for selecting the character for marking and the correct positioning of the character selected.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawings and particularly to FIG. **1**, the marking wheel device generally designated by the numeral **10** has an upper frame **12** suitably secured adjacent the location where the slabs or billets are to be marked. As described in U.S. Pat. No. 2,994,264, the frame **12** may be movable toward and away from the location where the slabs or billets are to be marked. A pair of arms **14** and **16** are pivotally secured to the frame **12** by means of pins **18** and **20** and are pivotally secured at their lower end to a marking head **22** by means of pins **24** and **26**. Suitable actuating means are provided (not shown) to move the marking head toward and away from the slab or billet **28** and positioned on a support **30**. The marking head **22** strikes the billet **28** and impresses a series of characters thereon, as later described. Rotatable marking wheels **32** having a plurality of characters on the outer peripheral surface (FIG. **6**) are rotatably mounted on a shaft **34**.

Each marking wheel **32** has a ratchet wheel portion **38** on one side. An actuating mechanism generally designated by the numeral **36** and illustrated in FIGS. **2** and **4** rotates the respective marking wheel **32** to position the preselected character in marking position. The actuating mechanism **36** has a slide **40** movably supported within a housing **42**. The slide **40** is free to move longitudinally within the housing **42** and has a pawl or pick **44** pivotally secured thereto by means of pin **46**. A spring **48** is positioned within a recess in the slide **40** and urges a pin **50** against the pawl **44** to urge the pawl in a counterclockwise direction against a stop **52** provided in the slide **40**. The pawl **44** engages one of the teeth **54** on the marking wheel **32** and rotates the wheel in a counterclockwise direction, as illustrated in FIG. **4**, upon longitudinal rearward movement of the slide **40**.

The slide **40** has an upstanding end portion **56** to which is secured a flexible cable **58**. The cable **58** is connected to a suitable servomechanism, later described, that moves the cable **58** longitudinally and in turn, moves the slide **40** within the housing **42**. With this arrangement, rearward movement of the actuating slide **40** from the position illustrated in FIG. **2** to the position illustrated in FIG. **4**, engages the pawl **44** to the ratchet wheel **38** on the marking wheel **32** and rotates the marking wheel a distance equal to one character in the marking position.

A lock pawl **60** is rotatably mounted on pin **62** within the housing **42** and has a front face **64** that is substantially parallel to the inclined portion of the ratchet teeth and a vertical rear face **66**. The lock pawl **60** is urged toward the ratchet wheel **38** by a pin **68** positioned in a recess **70** in housing **42**. A spring **72** urges the pin **68** against the vertical face **66** of the lock pawl **60**. The actuating slide **40** has a recessed portion **74** with a depending end wall **76**. When the actuating slide **40** is moved to a forward position, as illustrated in FIG. **2**, the vertical rear face **66** on lock pawl **60** abuts the stop **76** of the actuating slide **40** to lock the marking wheel in a preselected position and prevent the marking wheel from moving.

Each of the marking wheels **32** has a spiral cam **78** positioned thereon on the side opposite the ratchet wheel **38**. The spiral cam has a cam surface **80** that has different radial dimensions from the shaft axis **82**. For example, the radial dimension of the highest point on the cam surface **80** is greater

than the radial dimension of the lower point on the cam surface **80**. For exemplary purposes, several radial lines are included in FIG. **7** from the axis of the shaft **34** to the cam surface **80** at the center of the character on the wheel periphery. A character portion on the outer periphery of the marking wheel **32** that has the raised numeral **6** thereon is indicated by the numeral **6**, and the radial dimension from the shaft axis **82** to the cam surface **80** is indicated by the letter A. Likewise, an adjacent character that has the raised numeral **5** thereon is indicated by the numeral **5**, and the radial dimension from the shaft axis to the cam surface at that angular location is indicated by the letter B. Similarly, surfaces are designated by the numerals **4**, **3** and **2**, and the radial distance to the cam surface beneath the respective characters is designated by the letters C, D and E. It should be understood that other character designations may be formed on the particular raised portions.

It should be noted that the radial lines A through E, if extended, would intersect the center of the raised character. Thus, a projection of a radius to intersect the peripheral ends **84** and **86** of the character **2** would include a segment of the cam between lines **88** and **90**.

As later described, the transducer voltage transmitted to the converter will actuate the relays if the voltage transmitted has a value between the values of the limits indicated by the distances **88** and **90** so that a "window" will be provided to permit operability with minor voltage variations. The mechanical apparatus assures the centering of the preselected character and the voltage signal between the limits indicated will indicate the character in marking position.

Referring to FIG. **4**, there is illustrated a cam follower **92** rotatably positioned on shaft **62** within housing **42** and having a front edge portion **94** abutting the cam surface **80** and a rear portion **96**. A transducer generally designated by the numeral **98** is positioned within a receiver **100** secured to the housing **42**. The transducer **98** has an annular body portion **102** fixed within receiver **100** and a rod **104** extending therethrough and movable longitudinally therein with its front edge in abutting relation with the rear edge **96** of cam follower **92**. The other end of rod **104** extends rearwardly from the transducer **98** into a cylinder portion **106** in the housing **42**. The rod **104** has a piston end portion **108**. Air supplied through conduit **110** into cylinder **106** urges the piston **108** in a direction toward the marking wheel **32** to continually urge the front end of rod **104** against the rear face **96** of cam follower **92** which, in turn, maintains the front face **94** of the cam follower **92** in abutting relation with cam surface **80**. The transducer may be any suitable device that will transmit a signal to a remote location indicating its relative position within the receiver **100**. For example, the transducer may comprise a pair of spaced windings or coils supplied with regulated alternating current. Each of the coils is connected in series with a loading resistor and the coils are connected in parallel with each other. Positioned within the coils is rod **104** with a segment of magnetic material. The rod **104** is arranged to move axially within the core in response to movement by the cam follower **92** and cam **78**. A variation in voltage drop occurs across the loading resistors due to the change in magnetic inductance in the coils caused by the change in position of the segment of rod **104** of magnetic material. Thus, the relative position of the segment of magnetic material within the windings will transmit different voltages to the remote indicator.

With this arrangement, there is provided a means for transmitting a signal to a remote location indicating the relative angular position of the marking wheel and the character on the marking wheel periphery that is in marking position. For example, when the cam follower front edge **94** abuts the cam surface **80** when it is in overlying relation with the radially projected line A in FIG. **7**, the transducer rod **104** with the segment of magnetic material has moved a substantial distance toward the marking wheel **32** and thus transmits a voltage signal indicating this position. Upon rotation of the wheel in a clockwise direction, as viewed in FIG. **7**, to a location where the pawl front end portion **94** is in abutting relation with the cam surface **80** along the projected line B in FIG. **7**, the rod **104** of transducer **98** has moved linearly away from the marking wheel **32** and will transmit a different voltage to an indicator at a remote location. It will thus be seen, for each of the characters, the core of the transducer assumes a predetermined position relative to the windings and will transmit a different signal or voltage indicating this relative linear position which, in turn, indicates the relative angular position of the marking wheel **32**.

Referring now to FIGS. **8**, **9** and **10** that schematically illustrate the electrical system and he principal mechanical and electrical components, the operation of the marking device will be set forth. FIG. **8** illustrates the principal electrical and mechanical components for a single marking wheel. It should be understood that other similar mechanical and electrical components are provided for other marking wheels on the marking device **10**. The marking wheel **32** in FIG. **8** is indicated as connected to the transducer **98** by the dotted line and is intended to designate the rod **104** previously described. The dotted line **58** is intended to designate the cable between an actuating cylinder **112** and the actuating slide **40** illustrated in FIG. **2**. A pneumatic solenoid valve supplies air to the cylinder and moves a piston **114** within the cylinder. The piston **114** has a rod connected to and moves the cable **58** and thus, the slide **40**.

Limit switches LS1, LS2 and LS3 are associated with the piston **114** and are arranged to indicate the position of piston **114** within cylinder **112** and because of cable connection **58**, the relative position of slide **40**. Limit switch LS1 is actuated when the piston rod **114** has moved forward a full stroke to move the slide **40** rearwardly as illustrated in FIG. **4**. Limit switch LS3 and LS2 are actuated and their contacts close when the piston has moved from its rearmost position and are opened only when the piston is at rest after moving rearwardly a full stroke.

As will be appreciated from the description of the slide actuator **40** and the manner in which the marking wheels **32** are rotated thereby, the marking wheel is arranged to rotate to position the next adjacent character in marking position. By means of the circuitry, later described, the selection of a character spaced from the character presently in the marking position, permits the slide to continue to reciprocate in the housing **42** until the correct character, as indicated by the character selection device, is moved into the marking position, Character selection means such as a perforated tape, computer or the like, is utilized to close the character selection contacts illustrated in FIG **10**.

FIG. **9** and **10**, numerals **120** through **162**, indicate the lines of the control and actuating circuits including the various switches, relays and other control devices. Portions of the complete control circuit are separated to illustrate the particular function of the control elements. In FIG. **10**, only three character selection contacts C1, C2, and C3 are illustrated. It should be understood, however, any number of character selection contacts equal to the number of characters on the marking wheel are present and used.

In operation, assume the marking wheel is positioned to mark the character **3** and it is desired to change the angular position of the marking wheel so that the character **2** is in marking position, the character selection contact C2 in the line **122** is closed and relay CL in line **120** is energized through normally closed contacts RY2 in line **122**. Relay CL closes the normally open contacts CL in line **128** and energizes relay CR1 if the machine interlock contacts M1 are closed and switch TR1 is closed. Machine interlock contacts M1 are closed if other operating conditions (not described) are met. Switch TR1 is controlled by limit switch LS1, line **130** and the relative position of the piston **114** as hereinafter discussed.

The relay CR1 line **128** closes contacts CL line **144** FIG. **9**, and energizes the pneumatic solenoid valve and admits air into the cylinder to extend the rod of piston **114** and move the actuating slide **40** rearwardly as viewed in FIG. **4** by means of cable **58** to thus rotate the marking wheel **32** one character.

Upon initial movement of the cylinder, first limit switch LS3, line 134, then limit switch LS2, line 126 are actuated and their contacts close. Limit switch LS3, line 134 functions as a failure indication circuit and an interlock circuit, to be later described. Limit Switch LS2, line 126, upon closing, energizes relay TR1, line 126, which is a time delay relay. Relay TR1 line 126 closes switch TR1, line 128 in series with the CL contacts to prevent another movement of the actuating slide 40 until a preselected time has elapsed and the cylinder has returned to its reset position. When the cylinder has reached the end of its stroke, limit switch LS1, line 130 is opened and switch TR1, line 128 is opened and relay CR1, line 128 is deenergized and opens contacts CR1, line 144 associated with the solenoid valve (FIG. 9). Suitable means are provided to return the piston to its retracted position. As long as the relay CL line 120 remains energized by a closed character selection contact C in line 120, or 122 or 124, the above sequence will be repeated and the wheel will move ahead one character at a time.

The transducer 98 indicates the angular position of the marking wheel 32 and converts this angular position to an analog voltage. As previously described, the transducer is coupled to the marking wheel mechanically to produce a different voltage for each character. The transducer output within the limits per character previously described is fed to an analog to digital converter which produces a specific output for each character which is either "on" or "off." The "on" condition is reported by the matching of the transmitted voltage level within the limits discussed from the transducer and a matching voltage in the receiver. The receiver has a series of relay devices that are actuated when matched with a preselected voltage transmitted by the transducer. Thus, relay RY3, line 150 is not energized until the transducer provides a voltage within the prescribed limits that matches the voltage of the particular actuator for the relay RY3.

The actuation of the relays RY1 to RY3 in lines 146, 148 and 150 is dependent on and must be compatible with a logic circuit. The purpose of the logic circuit is to prevent wrong character identification by the transducer when the rod moves in a descending direction along the cam surface between the projected lines A and B in FIG. 7. For example, if the transducer rod would hang upon the intermediate portion of the sharply sloping surface, because the radial dimension of the intermediate portion of the sharply sloping surface approximates the radial dimension E for the character 2, an incorrect signal would be transmitted by the transducer. The logic circuit requires a counter to sequentially move from 12 to one so that a transducer signal of a character that is out of sequence will indicate a malfunction of the character designation.

The output from the logic circuit is transmitted by means of the relay drive to a specific relay for each character (FIG. 9 - relays RY1, RY2, RY3, lines 146, 148, 150). Normally closed contacts RY1, RY2, RY3, lines 120, 122, 124 (FIG. 10) are in series with the character selection contacts C1, C2, C3. Therefore, when the relay RY3, line 150 is energized, normally closed switch RY3, line 124 is opened to indicate that the selected character 3 is in marking position. Switch RY3, upon opening, will deenergize relay CL, line 120 and stop the actuating mechanism from advancing the character positioned on the marking wheel. The relays RY1, RY2, and RY3, lines 120, 122, 124 also have normally open contacts RY1, RY2, RY3, lines 152, 154, 156, FIG. 9, associated with a visual indicator to visually show the character in position to mark. Other contacts RY1, RY2, RY3, lines 158, 160 and 162 (FIG. 9) may be provided to operate other equipment requiring the character information.

Thus, by means of the transducer 98 providing a signal of a voltage proportional to the position of the marking wheel and this voltage matching through an analog to digital converter to an "on" condition for a matching with a selected relay, the normally closed switch associated with the relay is opened. If the switch opened by the relay is in the same line, i.e., lines 120, 122, 124 with the closed character selection switch, the circuit to the relay C1 line 120 is opened to deenergize the solenoid valve through contacts CR1, line 144, FIG. 4. The marking wheel then has the selected character in marking position. The transducer 98, cam 78 and the above described circuitry provides a means at the marking wheel for determining positively that the selected character is in marking position. If the selected normally closed switch RY1, RY2 and RY3, lines 120, 122 and 124 is not opened by the previously described sequence, the actuating cylinder 112 continues to rotate the marking wheel until the preselected character is in marking position and this condition is verified and confirmed by the transducer 98.

Timer TR2, line 137 is provided to prevent a stamp cycle from being made when the marking wheel is moving to a new position. As soon as relay CR1, line 128 is energized, contacts CR1, line 132 are closed and relay TR2, line 137 is energized opening its contacts, line 142 and preventing the solenoid valve from being energized. The TR2 contacts, line 142 do not close until a short period of time after the limit switch LS3 has been actuated on the previous return stroke of the wheel cylinder.

Limit switch LS3 also functions to indicate a mechanical failure of the wheel positioning mechanism. In normal operation a green light, indicated by the letter G in FIG. 10, line 130, and an amber light, indicated by the letter R in FIG. 10, line 136 are energized as the cylinder starts its forward stroke. At the end of the forward stroke, the green light is deenergized because of the opening of switch LS1, line 130 and the amber light R remains on until the actuating cylinder completes its return stroke and opens switch LS3, line 134. The green and amber lights are controlled by limit switches LS1 and LS3 and each flash once for a movement of the marking wheel to a position for the adjacent character. When either the green or amber lights remain on, they indicate the cylinder has not completed it forward stroke. When the amber light remains on and the green light is off, this indicates that the cylinder has completed its forward stroke but has not completed a full reverse stroke due to the association of the green and amber lights with the limit switches LS1 and LS3.

If the marking wheel has moved out of position by the impact of the marking head against the slab or billet, through the mechanical connection of slide 40, cable 58 and the actuation cylinder, will cause the piston 114 to move and close limit switch LS3 to energize relay CR3, line 138, through normally closed switches CR2 and CR1. Relay CR3 in turn, closes contact CR3, line 140 and energizes the alarm bell to indicate that the wheel is out of position.

According to the provisions of the patent statutes, we have explained the principle, preferred construction and mode of operation of our invention and have illustrated and described what we now consider to represent its best embodiment. However, we desire to have it understood that, within the scope of the appended claims, the invention may be practiced otherwise than as specifically illustrated and described.

We claim:

1. Apparatus for indicating the relative position of a device rotatable about an axis comprising,
a member rotatable about an axis,
a cam having an axis coaxial with said member and rotatable tHerewith,
a cam follower biased against said cam surface,
signal generating means associated with said cam follower and operable to provide a signal proportional to the radial distance from said cam axis to said cam follower to thereby indicate the relative position of said cam and said member to said cam follower, and
fluid means urging said signal generating means into abutting relation with said cam follower.

2. Apparatus for indicating the relative position of a device rotatable about an axis as set forth in claim 1 in which said signal generating means includes a transducer in operative relation with and movable longitudinally by said cam follower.

3. Apparatus for indicating the relative position of a device rotatable about an axis as set forth in claim 1 which includes means urging said cam follower against said cam surface.

4. Apparatus for indicating the relative position of a device rotatable about an axis as set forth in claim 2 in which said transducer includes,

coil means fixed relative to said cam,

a rod member positioned in said coil with a front end portion in abutting relation with said cam follower,

said rod member having a piston positioned in a cylinder fixed relative to said cam,

means to supply air to said cylinder to urge said rod front end portion into abutting relation with said cam follower,

means to supply current to said coil means, and

means associated with said rod member to vary the inductance of said coil relative to the position of said rod within said coil means so that said transducer coil transmits a voltage proportional to the radius of the cam portion in abutting relation with said cam follower.

5. Apparatus for indicating the relative position of a device rotatable about an axis as set forth in claim 1 which includes,

drive means to rotate said member about said axis,

selection means to actuate said drive means and rotate said member to a preselected position relative to said cam follower, and

other means responsive to said signal generating means operable to deenergize said drive means when said member is in said preselected position relative to said cam follower.

* * * * *