# United States Patent [19]

**Seifert**

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[45] **Apr. 29, 1975**


[54] **APPARATUS FOR AUTOMATICALLY POSITIONING AND PRINTING WITH RESPECT TO AN INDEX MARK**


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[52] **U.S. Cl.** ..... **101/38 A;** 101/126; 198/249; 198/257; 198/283

[51] **Int. Cl.** ..... **B41f 17/22;** B65g 47/24

[58] **Field of Search** ..... 101/35, 44, 114, 126, 38 A, 101/40, 38 R, 39; 73/1 F; 198/33 AA, 33 AB, 248, 249, 257, 282–284



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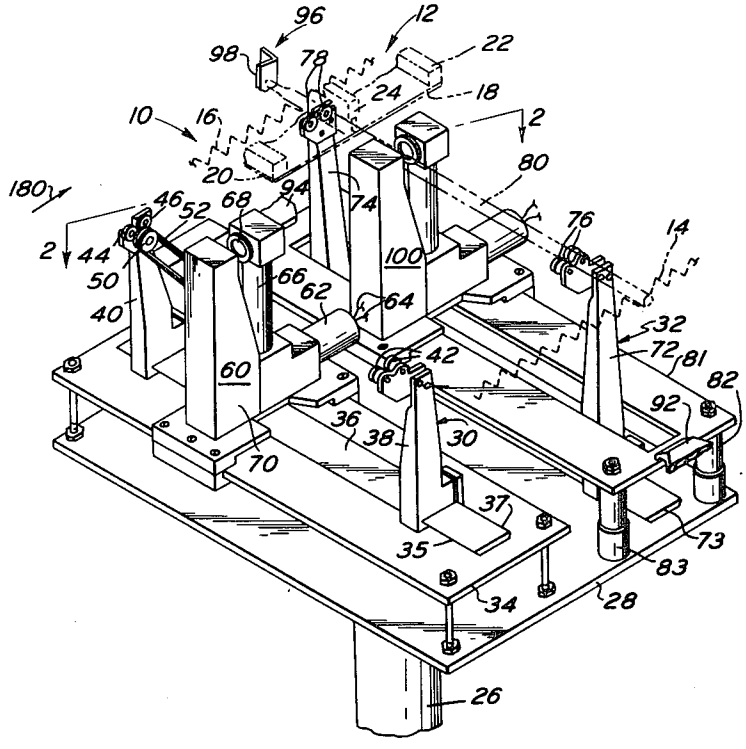
*Primary Examiner*—Clifford D. Crowder
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[57] **ABSTRACT**

Apparatus for automatically positioning and printing on an elongated element. The elongated element may be a pipette having an index mark thereon. In one embodiment, the pipette is rotated at a first work station in order to place the index mark in a predetermined rotational position for easy detection at a second work station. At the second work station, the pipette is moved longitudinally until the index mark is detected. The pipette is then automatically moved into contact with a printing device which prints a scale on the pipette.


**19 Claims, 9 Drawing Figures**



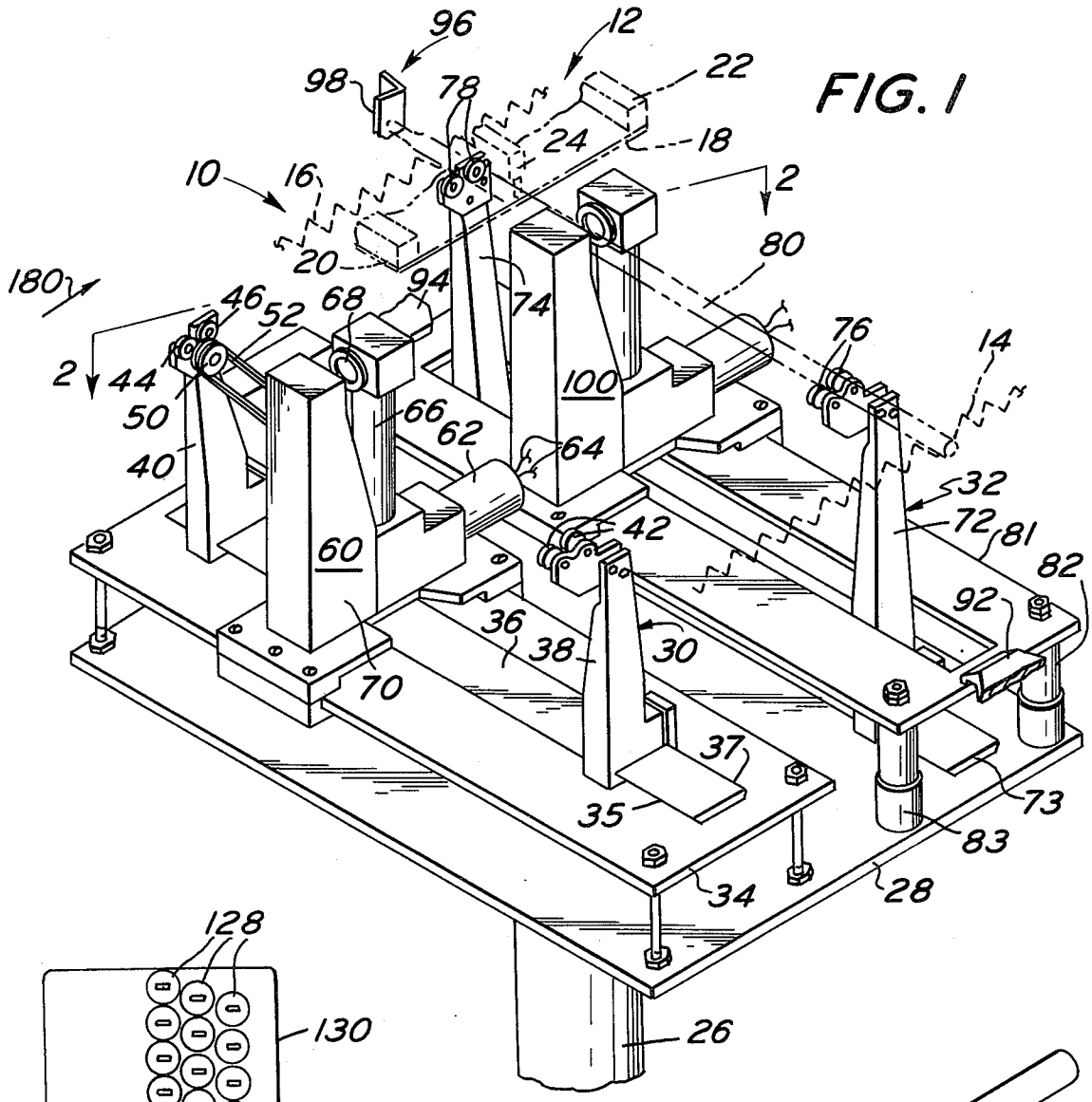



FIG. 1

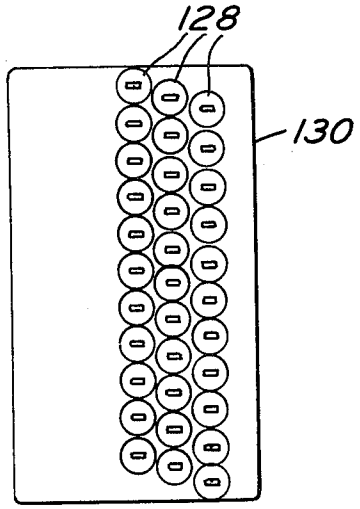



FIG. 8

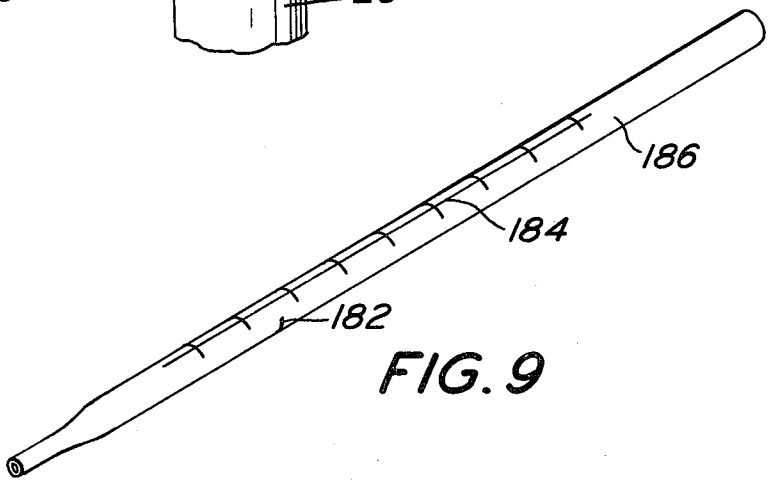



FIG. 9

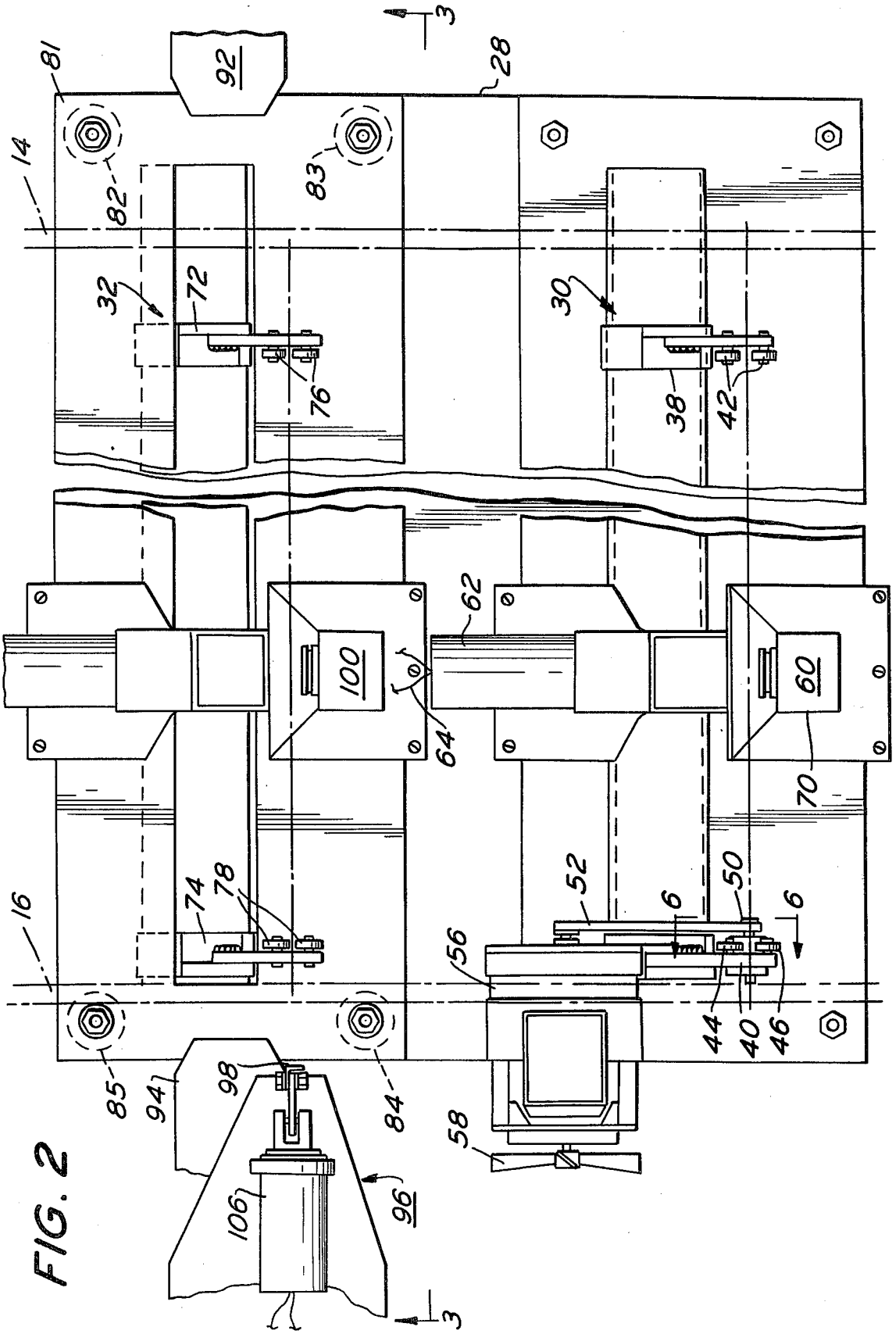

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FIG. 2

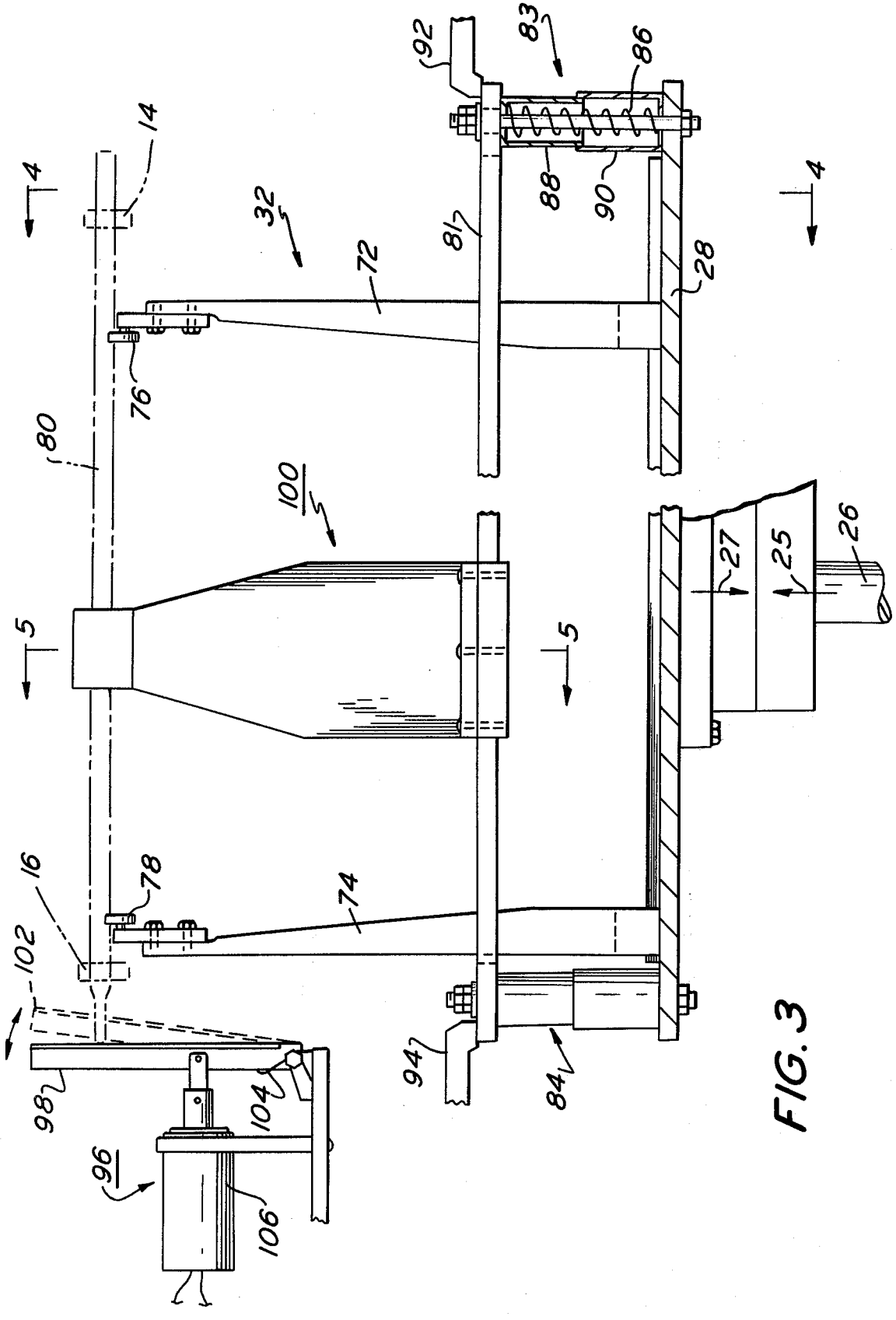

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FIG. 3

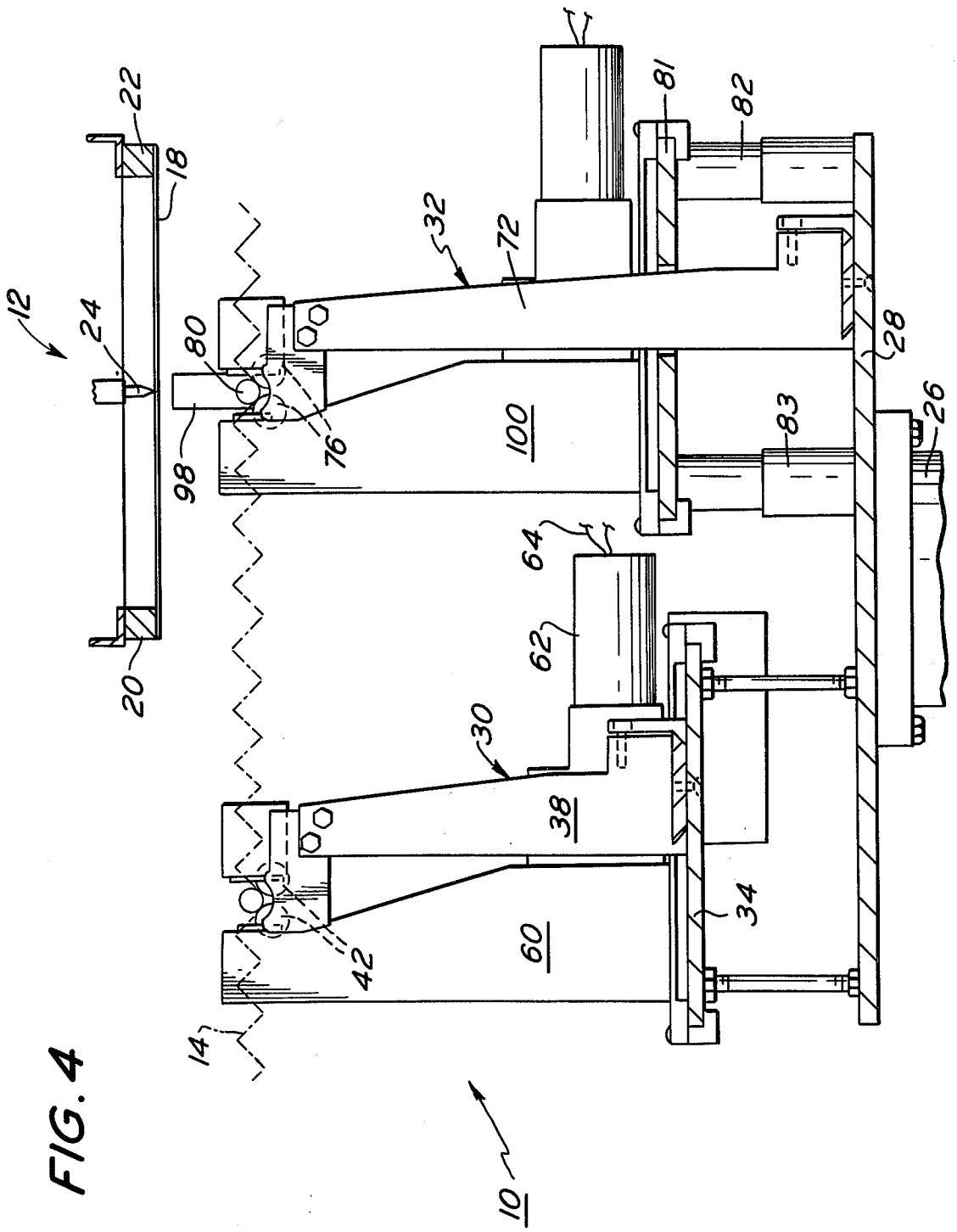

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FIG. 4

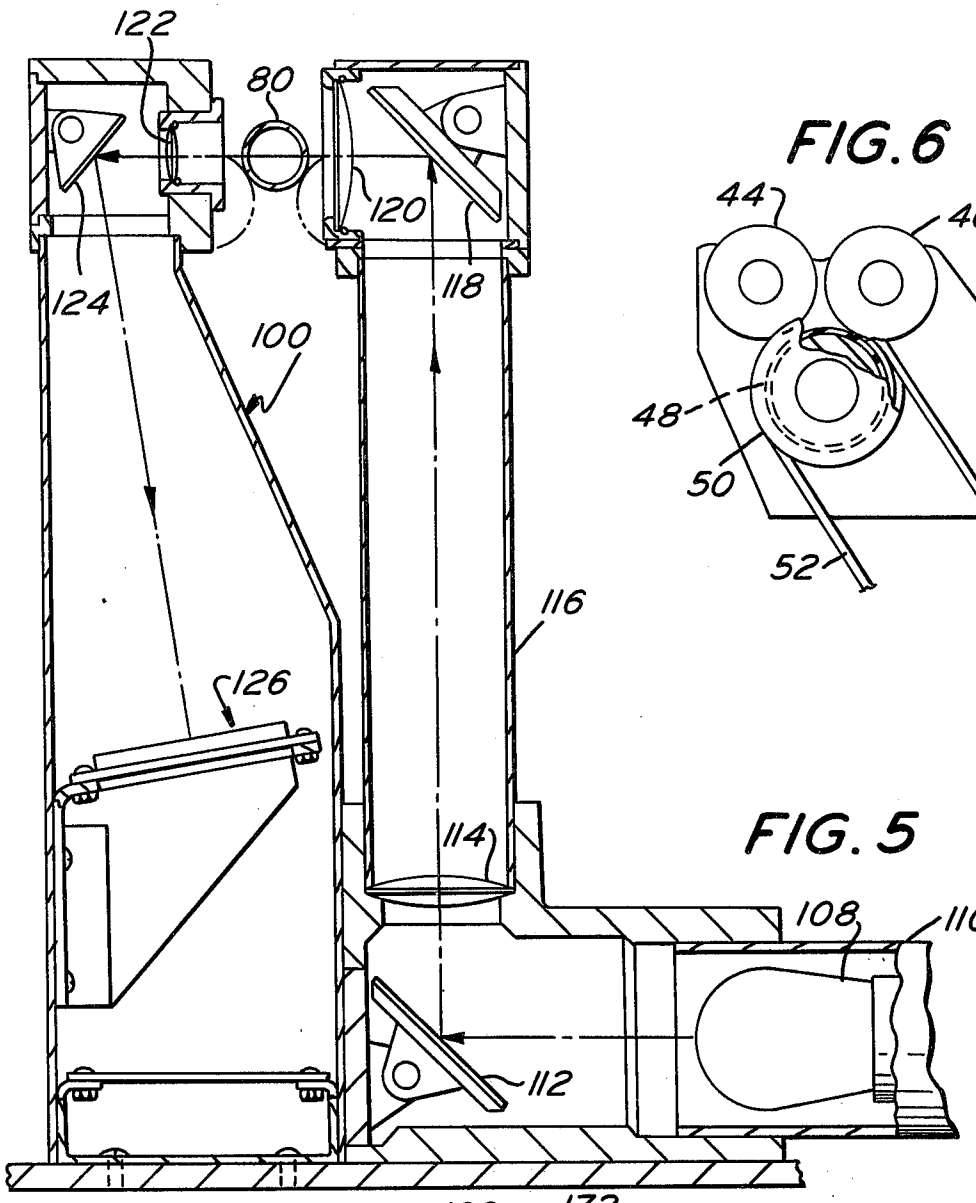



FIG. 5




FIG. 6

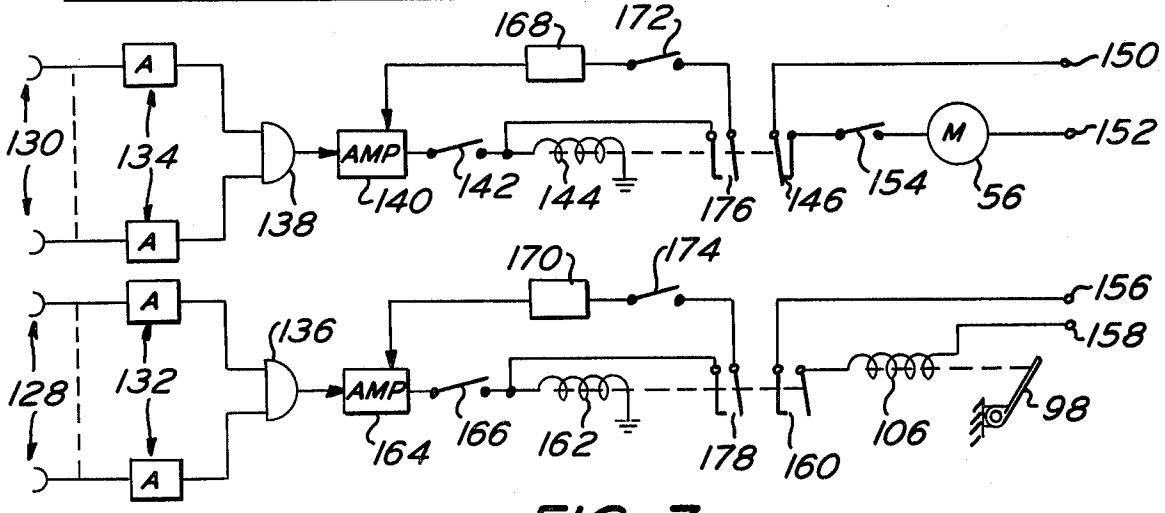



FIG. 7

# APPARATUS FOR AUTOMATICALLY POSITIONING AND PRINTING WITH RESPECT TO AN INDEX MARK

The present invention relates to apparatus for automatically positioning and printing on an elongated element with respect to an index mark. More particularly, the present invention relates to an apparatus which automatically receives an elongated element having an index mark thereon, positions the elongated element both rotationally and longitudinally, prints a scale on the elongated element and then returns the elongated element to a conveyor means.

The present invention relates to the art of handling and accurately printing scales on elongated elements having an index mark already placed thereon. For example, pipettes are today manufactured by production line techniques. Pipettes are used to accurately measure a desired volume of liquid. Although the production line manufacturing techniques produce relatively uniform pipettes, the accuracy required in the scale on a pipette requires accurate positioning of the printing of the scale with respect to a mark which indicates a premeasured amount of liquid.

In the manufacturing of pipettes, it is especially difficult to make the tips or narrowing ends of the pipettes exactly uniform. Therefore, when the pipettes are formed from glass or other suitable substance, they are filled with a predetermined volume of liquid. The point to which the predetermined volume of liquid fills the pipette is marked, and this mark is termed an index mark herein. In the past, it was necessary for a person to manually affix or print a scale on the pipette in relation to this index mark. That is, if the index mark indicated the point to which a 3 milliliter volume of liquid would fill the pipette, the scale was printed on the pipette so that the 3 milliliter mark on the scale would appear at the index mark. This process in the past was tedious and time consuming. Errors made in the printing caused a loss of a pipette which had been already fully manufactured except for the printing of the scale. Therefore, this manual process in the past, was expensive both in terms of wages paid in a time consuming operation and in terms of lost production due to errors in printing.

The present invention obviates these problems in the prior art. The present invention may be used to automatically handle, position and print pipette scales accurately and at a high production rate.

Briefly, the present invention includes conveying means for conveying elongated elements to a single work station or to a first and a second work station in sequence. In a preferred embodiment, a first and a second work station are used in order to increase the output rate. In the preferred embodiment, the first work station having means for receiving the elongated element is provided with means for rotating the elongated element and detecting an index mark on the elongated element in a predetermined rotational position. The elongated element is then conveyed to the second work station by the conveying means. At the second work station, the elongated element is positioned longitudinally until a second detecting means detects the index mark. The elongated element is then placed in contact with a printing means for printing a scale or other indicia on the elongated element. However, it is understood that the rotational and longitudinal positioning means could be incorporated into a single work station.



However, in the preferred embodiment, a first elongated element may be positioned rotationally while a second elongated element is being positioned longitudinally, thereby increasing the overall speed of operation of the apparatus. Also, in a preferred embodiment, the first and second work station may be mounted on a base which moves in a first and second direction. When the work stations are moved in a first direction, they automatically pick an elongated element from the conveying means. When the work stations are moved in a second direction, the elongated element is replaced on the conveyor system, thereby automatically carrying the elongated element away.

For the purpose of illustrating the invention, there are shown in the drawings forms which are presently preferred; it being understood, however, that this invention is not limited to the precise arrangements and instrumentalities shown.

FIG. 1 is a perspective view of an apparatus, partially in schematic form, in accordance with the present invention.

FIG. 2 is a top view of the apparatus of FIG. 1 taken along line 2—2 of FIG. 1.

FIG. 3 is a side view of the apparatus of the present invention.

FIG. 4 is a view, partly in section, taken along the line 4—4 of FIG. 3.

FIG. 5 is a sectional view taken along line 5—5 of FIG. 3.

FIG. 6 is an enlarged view of a portion of the rotating mechanism of the present invention.

FIG. 7 is a schematic diagram of circuitry in accordance with the present invention.

FIG. 8 is a drawing of a photocell array used in the present invention.

FIG. 9 is a drawing of a pipette having an index mark thereon and having a scale printing thereon by the apparatus of the present invention.

Referring now to the drawings in detail, wherein like numerals indicate like elements, there is shown in FIG. 1 an apparatus in accordance with the present invention including a conveyor **10** and a printing means **12**. The conveyor **10** may be any suitable conveor having a pair of suitably shaped carriers **14** and **16**. The printing means **12** may be a silk screen or screen printing apparatus. A screen **18** is tightly stretched across a frame made of members **20** and **22**. The screen **18** may be made of organdy, silk, nylon, dacron, stainless steel, bronze or other material on which a design is traced or lettered and the non-printing parts painted over with an ink and water resistant lacquer. The ink or paint is forced out of head **24** when a pipette comes in contact with the screen **18**.

Reference is now made to FIGS. 1–5 since a clearer understanding of the present invention will be had by viewing the various views simultaneously. There is shown in FIG. 1 a ram or piston **26**. Base member **28** is mounted on piston **26**. A first work station **30** and a second work station **32** are mounted on base member **28**.

The first work station **30** is comprised of a plate **34** bolted by means of four bolts to base member **28**. Plate **36** is mounted on plate **34** by means of screws in order to form ways **35** and **37**. Posts **38** and **40** are mounted in the ways **35** and **37** formed by plates **34** and **36**. Receiving means comprised of rollers **42** are mounted on post **38**. Receiving means comprised of rollers **44** and

46 are mounted on post 40. As may best be seen from FIG. 6, roller 46 is engaged by surface 48 of belt driven roller 50. Belt driven roller 50 is driven by belt 52. As may be more clearly seen from FIG. 2, belt 52 is driven by means of a pulley 54 which is in turn driven by a geared electric motor 56. The electric motor 56 is provided with a fan 58 for cooling.

The first work station 30 is provided with a photo detector means 60. Photo detector means 60 includes a light housing 62 and electrical conductors 64 for transmitting electrical energy to energize a light located within light housing 62. The light is transmitted by means of mirrors (not shown) up through housing 66 and out through lens 68. The light is then transmitted through a lens (not shown) in housing 70, reflected from a mirror (not shown) located in housing 70 and irradiated upon an array of photocells as shown in FIG. 8. The details of photo detector means 60 are substantially identical to those of photo detector means 100 and will be described in detail hereinafter.

The second work station 32 includes posts 72 and 74 mounted in the ways formed by plate 73 and base member 28. Posts 72 and 74 are provided with rollers 76 and 78, respectively, for receiving an elongated element such as a pipette 80. A plate 81 is resiliently mounted to base member 28 by means of four spring members 82–85. A clearer view of these spring members as shown in FIG. 3 wherein spring member 83 is shown partially in cross section. There is shown in FIG. 3 a spring 86 enclosed in an upper casing 88 which slides into a lower casing 90 when plate 81 is forced downward by means of latches 92 and 94.

Referring to FIGS. 1, 2 and 3, there is shown a means 96 for moving an elongated element or pipette 80 longitudinally as piston 26 is moved in a first or upward direction. Means 96 comprises a member 98 which is biased in dotted line position 102 by means of spring 104. Member 98 is retracted to the position shown by means of solenoid 106 when photo detector means 100 detects the presence of an index mark.

Photo detector means 100 is mounted upon plate 81. As more clearly shown in FIG. 5, photo detector means 100 comprises a light source or lamp 108 enclosed in a housing 110. The light from light source or lamp 108 is reflected from mirror 112 and transmitted through lens 114 up through housing 116. The light is then reflected from mirror 118 and transmitted through lens 120. The light passes through pipette 80, lens 122 and is reflected from mirror 124 on to photo detector cell array 126. Photo detector cell array 126 is more clearly shown in FIG. 8. In FIG. 8 there is shown a plurality of photocells 128 mounted in a plate 130. A number of rows of photocells is provided in plate 130 with the centers of the photocells in each row offset between the centers of the photocells in adjacent rows in order to provide a high degree of resolution as to the position of a light beam.

The angles between the various mirrors in photo detector means 60 and 100 is set at 81° in order to avoid refractionreflection problems. Also, the housing of photo detector means 60 and 100 are constructed so as to admit no stray light. The light source 108 may be any suitable light source including an incandescent light bulb, a neon light, or a laser.

Referring now to FIG. 7, there is shown a schematic diagram of the circuitry of the present invention. There is shown a plurality of photocells 128 and 130. The dotted lines indicate that additional photocells may be used. The outputs of photocells 128 and 130 are amplified by amplifiers 132 and 134, respectively, and applied to AND gates 136 and 138, respectively. The photocells 128 are physically located at second work station 32, and photocells 130 are physically located at first work station 30. When any of the photocells 130 connected to AND gate 138 through amplifier 134 are darkened by the presence of an index mark on a pipette or other elongated element, AND gate 138 produces an output which is amplified by amplifier 140. The output of amplifier 140 is applied through limit switch 142, when closed, to energize relay coil 144. When relay coil 144 is energized, switch contacts 146 are open causing electric motor 56 to be de-energized. When relay contacts 146 are closed, electric motor 56 is energized by means of line voltage across terminals 150 and 152 through limit switch 154. Similarly, line voltage is applied to solenoid 106 through relay contacts 160 via terminals 156 and 158.

When photocells 128 at the second work station 32 detect a decrease in radiation, relay coil 162 is energized by the output of amplifier 164 via limit switch 166. Direct current supply 168 provides a holding current for solenoid 144 through limit switch 172 and holding contacts 176. Similarly, direct current supply 170 provides a holding current for solenoid 162 through limit switch 174 and holding contacts 178. When solenoid 162 is energized, holding contacts 178 and relay contacts 160 are closed. The closing or relay contacts 160 energizes solenoid 106 which causes member 98 to be retracted. When member 98 is retracted, the longitudinal movement of the pipette or other elongated element ceases.

The limit switches 142, 154, 166, 172 and 174 provide added features which insure proper operation. Limit switches 142 and 166 prevent actuation of solenoids 144 and 162, respectively, until the pipette or elongated element is properly positioned between lenses 120 and 122. In this manner, energization of solenoid 144 or 162 is prevented when the edge of the pipette or elongated element passes through the light path. Limit switch 154 prevents energization of electric motor 56 and rotation of roller 46 until the pipette or other elongated element is picked up from conveyor 10. The prevention of rotation of roller 46 during the period of time that the pipette or other elongated element is being picked up from conveyor 10 prevents occasional problems or malfunctions in the picking up process. Similarly, limit switch 172 prevents operation of the motor via holding contacts 176 until ram or piston 26 has traveled sufficiently upward and the pipette or other elongated element has been picked up from conveyor 10. Limit switch 174 is opened when ram or piston 26 returns to its lower position in order to de-energize solenoid 162 allowing member 98 to return to its extended position. The limit switches 142, 154, 166, 172 and 174 may be physically mounted in a conventional and well known manner in any convenient position on the apparatus so that the switches open and close as described.

In operation, pipettes or other elongated elements having an index mark thereon are carried by means of conveyor 10 in the direction of arrow 180. Ram or piston 26 is raised from its lowermost position and the pipette or other elongated element is picked up from conveyor means 10 by first work station 30. Roller 46,

driven by geared electric motor **56**, rotates the pipette until the index mark **182** as shown in FIG. **9** is detected by photo detector means **60**. Photo detector means **60** detects the index mark **182** when the index mark is in a plane substantially parallel to the plane of lens **68**. As may be seen from the schematic diagram of FIG. **7**, the index mark **182** is detected by photocell **130**. When all of the photocells **130** detect the presence of index mark **182**, AND gate **138** produces an output which is amplified by amplifier **140**. Limit switch **142** is closed since the pipette is present within the light path and therefore amplifier **140** energizes solenoid **144**. Energization of solenoid **144** opens relay contacts **146** causing electric motor **56** to be de-energized. De-energization of electric motor **56** causes the rotation of roller **46** to cease. Therefore, the pipette is placed in the rotational position in which photo detector means **100** will be able to detect the presence of index mark **182** on a highly reliable basis. As ram or piston **26** is lowered, the pipette with its desired rotational position is replaced onto conveyor **10**.

Conveyor **10** may be synchronized with the movement of ram or piston **26** by means of a Geneva gear mechanism or any other suitable conventional well known apparatus. On one of the succeeding operations or strokes of ram or piston **26**, the pipette is picked up from conveyor **10** by second work station **32** in a similar manner. While this pipette is being picked up by work station **32** for longitudinal positioning, a succeeding pipette may be picked up by first work station **30** for rotational positioning. It is understood, that the functioning of first work station **30** and second work station **32** could be combined into a single work station. However, by the use of two work stations, a higher production rate may be achieved since one pipette may be being positioned rotationally while a second pipette is being positioned longitudinally.

As may best be seen from FIG. **3**, the pipette is forced to move in a longitudinal direction as ram or piston **26** is moved in the direction of arrow **25** due to member **98** being in position **102**. As may be seen from the schematic diagram in FIG. **7**, when index mark **182** is detected by photocells **128**, solenoid **106** is energized by means of solenoid **162** thereby causing member **98** to be retracted to the position as shown in heavy lines in FIG. **3**.

Referring now to FIGS. **1** and **3**, as ram or piston **26** continues in the direction of arrow **25**, latches **92** and **94** depress plate **81** against the force of spring members **82–85**. The depression of plate **81** causes photo detector means **100** to be lowered with respect to pipette **80** in second work station **32**. As ram or piston **26** continues in the direction of arrow **25**, pipette **80** is pressed against printing means **12** causing the printing of a scale or other indicia thereon similar to scale **184** of pipette **186** shown in FIG. **9**.

Ram or piston **26** is then moved in the direction of arrow **27** causing the pipette to be returned to conveyor **10**. When ram or piston **26** is returned a sufficient amount in the direction of arrow **27**, limit switch **174** is opened thereby causing the holding current through solenoid **162** to cease. This causes relay contacts **160** of solenoid **162** to open thereby allowing member **98** to return to its extended position.

The present invention may be embodied in other specific forms without departing from the spirit or essential attributes thereof and, accordingly, reference should be made to the appended claims, rather than to the foregoing specification as indicating the scope of the invention.

It is claimed:

**1.** Apparatus for automatically silk screening indicia upon transparent tubular members in precise registration with reference marks previously incorporated thereon as a measure of calibrated internal capacity, each of said reference marks being in the form of an opaque short arcuate line on the outer tubular wall normal to the tubular axis, comprising

a silk screen stencil having calibrated spaced openings therein disposed along a predetermined axis, including a squeegee for pressing paint through such openings,

conveyor menas for transporting the tubular members so that the axes thereof are arranged in substantially parallel disposition with the axis of the stencil openings,

first photoelectric means interposed at a first station in the path of travel of the tubular members,

manipulating means for rotating said tubular members in a predetermined direction at the first station until the arcuate reference line on such tubular member intercepts the first photoelectric means and orients the arcuate reference line in a predetermined direction,

second photoelectric means interposed at a second station in the path of travel of said tubular members,

second manipulating means for shifting the tubular members axially within said conveyor means until the reference line intercepts said second photoelectric means so that the reference mark on such tubular member is displaced to a position in registration with the calibrated spaced openings of the stencil,

carriage means for relatively moving one tubular member at a time into contact with said stencil, and

means for drawing said stencil over the tubular member in registered contact therewith so that the squeegee forces paint through the calibrated openings and imprints said tubular member.

**2.** Apparatus for positioning a transparent elongated element having an index mark thereon located within a predetermined portion of the length of the elongated element, comprising:

means for rotating the elongated element about its elongated axis;

an optical source of energy means mounted for passing light through the transparent elongated element;

an array of optical detectors receiving light from said optical source means, said array of optical detectors being comprised of a plurality of optical detectors arranged to detect the light over a predetermined area;

means for stopping said rotating means in response to at least one of said optical detectors of said optical array detecting said index mark in a predetermined position relative to a second optical detecting means;

means for moving the elongated element lengthwise; and

means for stopping said moving means in response to said second optical detecting menas detecting said index mark whereby said transparent elongated el-

ement is positioned in a predetermined longitudinal position.

3. Apparatus in accordance with claim 2 including means for printing on the elongated transparent element after it has been positioned.

4. Apparatus for positioning an elongated element having an index mark thereon, comprising:

a work station having means for receiving the elongated element;

first means at said work station for detecting the index mark on the elongated element;

means at said work station for rotating the elongated element, said rotating means stopping in response to said first detecting means detecting the index mark in a predetermined rotational position;

second means at said work station for detecting the index mark on the elongated element; and

means at said work station for moving the elongated element longitudinally, said moving means ceasing to move the elongated element in response to said second detecting means detecting the index mark in a predetermined longitudinal position.

5. Apparatus for positioning an elongated element as recited in claim 4 including means for printing on the elongated element after it has been positioned.

6. Apparatus for positioning an elongated element as recited in claim 5 wherein said printing means includes a silk screen printing apparatus for printing scale indicia on the elongated element.

7. Apparatus for positioning an elongated element as recited in claim 5 including means for conveying the elongated element to said work station and away from said work station after printing.

8. Apparatus for positioning an elongated element as recited in claim 4 wherein said first and second detecting means include photocells illuminated by light passing through the elongated element.

9. Apparatus for positioning an elongated element as recited in claim 4 wherein said rotating means includes at least one roller of a pair of rollers being rotated by a motor, the elongated element being supported by said pair of rollers.

10. Apparatus for positioning an elongated element as recited in claim 4 wherein said moving means includes means for vertically moving said receiving means, a member for causing the elongated element to move longitudinally as said receiving means moves vertically and means for retracting said member when said second detector means detects the index mark in a predetermined longitudinal position.

11. Apparatus for positioning an elongated element having an index mark thereon, comprising:

a first work station having means for receiving the elongated element;

means for conveying the elongated element, said conveying means conveying the elongated element to said first work station;

first means at said first work station for detecting the index mark on the elongated element;

means at said first work station for rotating the elongated element, said rotating means stopping in response to said first detecting means detecting the index mark in a predetermined rotational position;

a second work station, said conveying means conveying the elongated element from said first work station to said second work station;

second means at said second work station for detecting the index mark on the elongated element; and

means at second work station for moving the elongated element longitudinally, the movement caused by said moving means stopping in response to said second detecting means detecting the index mark in a predetermined longitudinal position.

12. Apparatus for positioning an elongated element as recited in claim 11 including means for printing on the elongated elements after it has been positioned.

13. Apparatus for positioning an elongated element as recited in claim 12 wherein said printing means includes a silk screen printing apparatus for printing indicia on the elongated element.

14. Apparatus for positioning an elongated element as recited in claim 12 including means for conveying the elongated element to said second work station and away from said second work station after printing.

15. Apparatus for positioning an elongated element as recited in claim 11 wherein said first and second detecting means include photocells illuminated by light passing through the elongated element.

16. Apparatus for positioning an elongated element as recited in claim 11 wherein said rotating means includes at least one roller of a pair of rollers being rotated by a motor, the elongated element being supported by said pair of rollers.

17. Apparatus for positioning and elongated element as recited in claim 11 wherein said moving means includes means for vertically moving said receiving means, a member for causing the elongated element to move longitudinally as said receiving means moves vertically and means for retracting said memeber when said second detector means detects the index mark in a predetermined longitudinal position.

18. Apparatus for automatically printing a scale on a transparent elongated element having an index mark thereon, said scale being printed relative to said index mark, comprising:

a base;

means for reciprocally moving said base in a first and a second direction;

a first work station having means for receiving the elongated element, said first work station being mounted on said base;

a second work station having means for receiving the elongated element, said second work station being mounted on said base;

means for conveying the elongated element to said first and second work stations in sequence, the elongated element being removed from said conveying means when said reciprocally moving means moves in said first direction and replaced on said conveying means when moved in said second direction;

first means at said first work station for detecting the index mark on the elongated element;

means at said first work station for rotating the elongated element, said rotating means stopping in response to said first detecting means detecting the index mark in a predetermined rotational position;

second means at said second work station for detecting the index mark on the elongated element;

means at said second work station for moving the elongated element longitudinally, the movement caused by said moving means stopping in response to said second detecting means detecting the index mark in a predetermined longitudinal position; and

means for printing on said elongated element, said printing means being contacted by said elongated element when said reciprocally moving means reaches its limit of travel in said first direction.

**19.** Apparatus as recited in claim **18** wherein said moving means at said second work station comprises a member having a pivoted end and a free end, said free end being slanted toward said receiving means in said first direction, and means for moving said free end away from said receiving means in response to said second detecting means detecting the index mark in a predetermined longitudinal position.

* * * * *