

Dec. 29, 1970

D. C. KRAMER ET AL

3,550,276

MULTIPLE-PEN AUTOMATIC DRAFTING MACHINE

Filed April 25, 1968

3 Sheets-Sheet 2

FIG. 3.

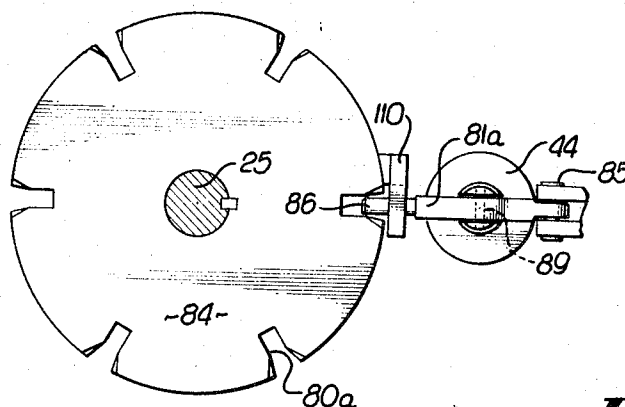


FIG. 4.

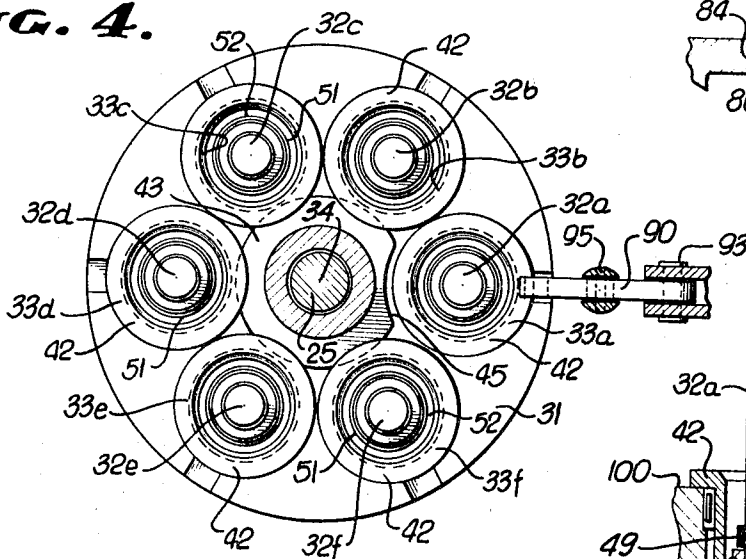
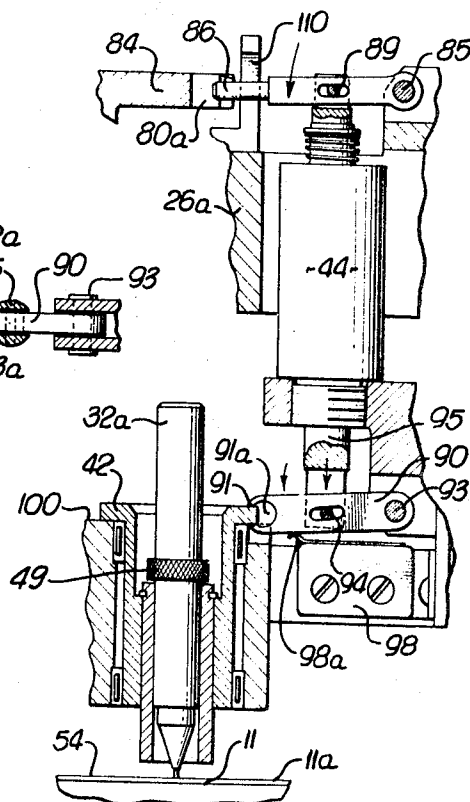


FIG. 5.



INVENTORS.
DAVID C. KRAMER
WALDO I. ROGERS
By *White & Hoefliger*
ATTORNEYS.

1

2

3,550,276 MULTIPLE-PEN AUTOMATIC DRAFTING MACHINE

David C. Kramer, Redondo Beach, and Waldo I. Rogers,
Sierra Madre, Calif., assignors to Baldwin Kongsberg
Company, Cincinnati, Ohio, a corporation of Ohio
Filed Apr. 25, 1968, Ser. No. 724,183
Int. Cl. B43I 13/00

U.S. Cl. 33—18

12 Claims

ABSTRACT OF THE DISCLOSURE

The disclosure concerns the provision in a drafting machine of a head carrying multiple drafting surface markers, with feedback control for moving the head to bring a selected marker into predetermined positions relative to the drafting surface, unusually advantageous apparatus also being provided for advancing and retracting selected marker holders at and relative to the head.

BACKGROUND OF THE INVENTION

This invention relates generally to automatic drafting machines, and more particularly concerns the use of different drafting surface markers in conjunction with such machines.

The use of photoexposure devices in conjunction with movable carriages, as for example in automatic drafting machines or their equivalent, is well known. Such devices utilize the known technique of directing a narrow beam of light at a photosensitive surface to expose that surface in accordance with carriage movement, for forming indices of various sorts, one example being lines. While this technique is useful, a drafting machine utilizing photoexposure apparatus alone is too limited in its application. It has therefore become desirable to accommodate a drafting machine to both photoexposure and tool (or pen) marking modes of operation; however such accommodation introduces serious problems of complexity and expense.

A further problem concerns the desirability of providing for ready availability and use in an automatic drafting machine of different types of markers, as for example wet ink pens, ball point pen cartridges and scribing tools. The problem is made acute by the requirement that different ones of such markers be selectively movable into predetermined position relative to the drafting surface and with extremely small variance from centered relationship with respect to a fixed axis at that position.

SUMMARY OF THE INVENTION

Major objects of the invention include the provision of a system and multiple marker apparatus having such construction and mode of operation as will eliminate the problems referred to above, as well as other problems encountered in the automatic drafting art. Basically, the invention is embodied in the system or combination that comprises a carriage controllably and relatively movable over a drafting surface; a plurality of drafting surface markers; a head carrying the markers and mounted on the carriage (as for example interchangeably with a photoexposure head) to be movable relative to the carriage; and feedback or servo control means for so moving the head to bring a selected marker into predetermined position relative to the drafting surface. Further, that position may typically be retracted relative to the surface so that the marker will not mark the surface as the head is moved relative to the carriage; and other means is provided to advance the selected marker in a direction to effect and maintain its engagement with the surface as the carriage moves. In this regard, the referred to other means is

typically connected to the control means to advance the selected marker only after the head has moved sufficiently to bring the selected marker to predetermined position.

Further, and in regard to the construction and mode of operation of the specific multiple marker apparatus, which is found to be unusually advantageous, it basically comprises a support, a head in the form of a turret on the support and rotatable about an axis; multiple markers and holders therefor carried by the turret and spaced about that axis, the holders being subject to advancement and retraction in the direction of that axis; a feedback control including first actuator means to rotate the turret about the axis for bringing a selected marker and holder therefor into predetermined location at which the holder is to be advanced for marker engagement with a markable (or drafting) surface, the holders not at that location being retained in retracted condition; and second actuator means to so advance and retract the selected holder at that location. As will appear, the holders may typically include marker receiving sleeves and shoulders thereon, the support engaging the shoulders of the holders which are not at the referred to predetermined position to retain the holders in retracted position, and the support being out of engagement with the shoulder of that holder which is at the predetermined position, to permit its advancement. Further, the second actuator means typically may comprise a linkage removably engageable with a holder at the predetermined location, and a solenoid for actuating the linkage to advance and retract the holder at that location. As will appear, the holders may have flanges movable into and out of proximity with the linkage in response to turret rotation.

Other objects and advantages include the provision of a second actuator having a vertically reciprocable plunger, and latching means operable during plunger reciprocation to block turret rotation; and the provision of the latching means in the form of a keeper rotatable by the turret and having angularly spaced guideways corresponding to the holders and extending in the direction of the axis, and a latch movable with the plunger and blocked by the keeper against movement with the plunger until the latch aligns with a guideway corresponding to a holder at the predetermined location.

These and other objects and advantages of the invention, as well as the details of illustrative embodiments, will be more fully understood from the following detailed description of the drawings, in which:

DRAWING DESCRIPTION

FIG. 1 is a perspective showing of an automatic drafting machine in which the invention may be embodied;

FIG. 2 is a vertical elevation, taken in section, through marker selecting apparatus, and showing a selected marker in retracted condition;

FIG. 3 is a horizontal section taken on line 3—3 of FIG. 2;

FIG. 4 is a horizontal section taken on line 4—4 of FIG. 2;

FIG. 5 is a fragmentary view, taken in elevation, of a selected marker in advanced position;

FIG. 6 is a schematic showing of carriage actuation and movement; and

FIG. 7 is a block diagram of control apparatus for the multiple marker apparatus.

DESCRIPTION OF PREFERRED EMBODIMENTS

Referring first to FIGS. 1, and 6, the illustrated drafting table 10 includes a flat-drafting area 11 on which a sheet 11a retained, as for example by vacuum applied from beneath. Carried on the table are a carriage 12 movable in the X direction, and a carriage 13 movable in the Y direction. Appropriate guides 14 for the X-carriage

are located within the housing 15 and 16, and suitable antifriction rollers may be provided to support the carriage on such guides. Similar guides and rollers may be provided for Y-carriage movement along the X-carriage, and in the Y-direction.

Referring now to FIG. 6, a pinion 17 driven by servomotor 18 is shown engaging a rack 19 within the housing 16, for moving the X-carriage in the X-direction. Similarly, a pinion 20 driven by servo-motor 21 engages a rack 22 extending in the Y-direction. Instead of racks and pinions, lead screws and followers may be used. A control indicated at 23 in FIG. 6 controls operation of the motors to cause the head 24 in the carriage 13 to move in a precisely controlled manner over the drafting surface. Control 23 may also embody circuitry to control operation of the head 24, whether it be a photo-exposure device, or the multiple marker apparatus 24a to be described herein. The head 24 is removably mounted on the carriage 13, and appropriate connections are made from the mounted head to control 23, permitting selective use of either type head.

In accordance with the invention, the head 24a carries a plurality of drafting surface markers, and it is mounted on the carriage (which may be considered as carriage 13 or both carriages 12 and 13) to be movable relative thereto; further control means is provided for so moving the head 24a as to bring a selected marker into predetermined and accurate position relative to the drafting surface and when the invention is embodied in the specific apparatus of FIG. 2, the head 24a comprises a turret 24b having a vertical shaft 25 mounted on a support 26, as by means of ball bearings 27, turret flanges 102 straddling the support body 26a. The support is carried by a vertical side plate 28 provided with ways 29 by means of which it may be removably mounted to the carriage 13. The plate carries a housing 30 enclosing the turret and the remainder of the apparatus, as shown.

The turret is flanged at 31, and carries multiple markers 32a-32f as well as holders 33a-33f for the markers, all in such manner that the holders and markers are spaced symmetrically about the axis 34 of the turret. The holders are subject to advancement and retraction in the direction of that axis, and for that purpose the holders may comprise sleeves 36 receivable within annular bearings 37 mounted within vertical bores 38 formed in the turret. The sleeves have upper and lower shoulders 40 and 41, as defined by flanges 42 spaced above the turret flange 31, and a lower support flange 43 engages the flanges 42 of those sleeves 36 which are not at the predetermined position occupied by the sleeve to be advanced downwardly by the solenoid 44 as seen in FIG. 2. Accordingly, the sleeves not at that position are retained in retracted or up position as the turret rotates, whereas the flange 42 of that sleeve at the right-most or predetermined position as seen in FIG. 2 is not engaged by the support flange 43 to permit downward advancement of the sleeve. Note in this regard the cut-away 45 at the support flange 43, in FIG. 4.

The various markers, such as pens, scribes, etc. are centered within the sleeves as by adapters 46, as is clear from FIG. 2. The adapters may also comprise sleeves of a size for reception in the sleeve bores 48, and for receiving the markers in supporting relation. Note the flange 49 on the marker 32a which seats on the top of the adapter 46, and the ring 51 on the adapter which seats on the sleeve interior shoulder 52. This arrangement allows the adapter, or the marker, to slide relatively upwardly within the sleeve 36 when the latter is advanced downwardly, and after the lower tip of the marker engages the drafting surface. See for example surface 54 in FIG. 5. Accordingly, the weight of the turret is not transmitted to the drafting surface via the marker, and damage to that surface and to the markers is avoided; at the same time, the weight of the marker and its barrel acts to hold the marker lower tip in pre-

determined light but forcible engagement with the drafting surface for marking purposes as the turret is moved about over that surface.

The invention also contemplates the provision of feedback or servo control means for moving the head, as for example turret 24a to bring a selected marker into predetermined position relative to the carriage and marking surface. That position may be considered as retracted, or spaced from, the surface 54. Such control means, one form of which is indicated generally in FIG. 7, may typically include a first actuator, such as a servo-motor 60 having drive connection to the turret via coupling 61 and the turret shaft 25. The control also includes sensing apparatus connected to sense the extent of rotation of the turret by the servomotor and to effect stoppage of the servomotor in response to turret rotation to bring a selected holder into predetermined location. Such sensing apparatus typically includes a position transducer such as a rotary potentiometer or encoder 63 indicated in FIGS. 2 and 7. As the motor 60 rotates the turret, the transducer 63 is also rotated, as by meshing spur gearing 64 and 65, and a corresponding electrical analog signal is generated for transmission at 66 for comparison with the pen selection command analog signal at 68.

Pen selection digital signals are generated at 69 and converted at 70 to the analog signal 68. Any differences between signals 66 and 68 is detected by the comparator 67, whose corresponding output error signal E is transmitted at 71 and via the operational amplifier 72 and power amplifier 73 to drive the servomotor 60 until the error signal is eliminated, at which time the selected pen has been brought to preselected position as described.

A further aspect of the invention concerns the provision of latching means operable to block turret rotation during selected marker advancement toward the drafting surface. As seen in FIG. 7, the latching means includes keepers 80 rotatable with the turret and defining guideways or slots with angular spacing corresponding to the angular spacing of the various markers on the turret. The latching means also includes a latch 81 controlled at 82 to advance into a keeper slot when the error signal at 71 (and sensed by the control 82) has dropped to a low level indicating that the turret has brought a selected marker into predetermined position.

In the specific form the invention seen in FIGS. 2 and 3, the keepers 80a are defined by a disc 84 that is keyed to the turret shaft 25. The latch is defined by a lever 81a pivoted at 85 to the support 26 and projecting at 86 to ride on the disc 84 and to drop into a keeper slot 80a only after a selected slot is brought directly beneath the lever and also only after a control solenoid 44 is actuated. That solenoid has an upper shaft 88 with lost motion connection at 89 to the lever 81a.

A further function of the solenoid 44 is to advance and retract the holder sleeve 36 for the selected marker. This is effected through an element such as link 90 carrying a jaw 91 removably engageable with a holder flange 42, as shown, the link element and solenoid providing a second actuator means. In this regard, as the turret rotates, the flanges 42 of the holders move through the jaw opening 91a, so that the holder for the selected marker is embraced by the jaw to be ready for advancement after the turret comes to rest. Further, the link 90 is pivoted at 93 and has lost motion connection at 94 with the solenoid lower shaft 95.

In this regard, the solenoid can only advance to the selected marker after the keeper disc 84 has rotated to precisely locate a keeper slot 80a directly beneath the latch lever 86, whereby precision location of a marker is determined by the keeper disc, and the interfitting of the latch with the latch lever blocks rotation of the turret during advancement and retraction of the marker. Note also the vertical guide 110 for the latch lever. Accordingly, the apparatus affords precision location of selected markers

5

of different types for automatically controlled drafting purposes.

Downward stroking of the solenoid is sensed by operation of a microswitch 98 having a contact 98a deflected by link 90, in FIG. 5 position. This signals the control 23 to indicate completion of advancement of the selected marker. Note in this regard shouldering of sleeve flange 42 at stop surface 100 of the turret, in FIG. 5. Suitable reverse operation of the solenoid 44 is effected when all markers are to be retracted, or when a different marker is selected.

We claim:

1. In a drafting machine, the combination comprising a carriage controllably and relatively movable over a drafting surface, a plurality of drafting surface markers, and holders therefor, a head carrying said markers and holders and mounted on the carriage to be movable relative thereto, the holders being supported by the head for up and down movement relative thereto and the markers being openly received downwardly into the holders for up and down movement relative thereto when the holders are in down position relative to the head, and feedback control means for so moving the head to bring a selected marker into predetermined position relative to said surface.
2. The combination of claim 1 wherein said predetermined position is retracted relative to said surface and including other means to advance the holder for the selected marker in a direction effecting its engagement with said surface.
3. The combination of claim 2 in which said other means is connected to the control means to advance the holder for the selected marker only after the head has moved sufficiently to bring the selected marker to said predetermined position.
4. In a drafting machine, the combination comprising, a support, a turret on the support and rotatable about an axis, multiple markers and holders therefor carried by the turret and spaced about said axis, the holders having upwardly open receptacle configuration and being subject to advancement and retraction toward and away from a drafting surface and in the direction of said axis and the markers being carried by the holders for movement relative thereto in said direction in response to marker tip engagement with the drafting surface.
5. a feedback control including first actuator means to rotate the turret about said axis for bringing a selected marker and holder therefor into predetermined location at which the holder is to be advanced for marker engagement with the drafting surface, the holders not at said location being retained in retracted condition;

6

and second actuator means to so advance and retract the selected holder at said location.

5. The combination of claim 4 wherein the support retains in retracted positions the holders not at said predetermined positions.

6. The combination of claim 5 wherein said holders include marker receiving sleeves and shoulders, the support engaging the shoulders of the holders not at said location to retain said holders in retracted position, and the support unblocking the shoulder of the holder at said location to permit advancement thereof.

7. The combination of claim 6 wherein the sleeves mount the markers so that the selected marker in predetermined position may be displaced relative to the mounting sleeve in response to engagement of the tip of said marker with a drafting surface.

8. The combination of claim 4 wherein said second actuator means comprises an element removably engageable with a holder at said location and a solenoid for actuating said element to advance and retract the holder at said location.

9. The combination of claim 8 wherein the holders have flanges movable into and out of proximity with said element in response to turret rotation.

10. The combination of claim 4 wherein said second actuator has a vertically reciprocable plunger, and including latching means operable during plunger reciprocation to block turret rotation.

11. The combination of claim 10 wherein said latching means comprises a keeper rotatable by the turret and having angularly spaced guideways corresponding to said holders and extending in the direction of said axis, and a latch movable with the plunger and blocked by the keeper against movement with the plunger until the latch aligns with a guideway corresponding to a holder at said location.

12. The combination of claim 10 wherein said first actuator means comprises a servomotor, and said control includes sensing apparatus connected to sense the extent of rotation of the turret by the servomotor and to effect stoppage of the servomotor in response to turret rotation to bring a selected holder into said location.

References Cited

UNITED STATES PATENTS

2,778,710	1/1957	Komas	346—46X
3,145,070	8/1964	Miller et al.	346—141X
3,330,182	7/1967	Gerber et al.	346—29X
3,340,447	9/1967	MacDonald	318—20.105
3,398,452	8/1968	Little et al.	33—18(A)
3,413,702	12/1968	Burg	77—25

HARRY N. HAROIAN, Primary Examiner

U.S. Cl. X.R.

33—1, 23