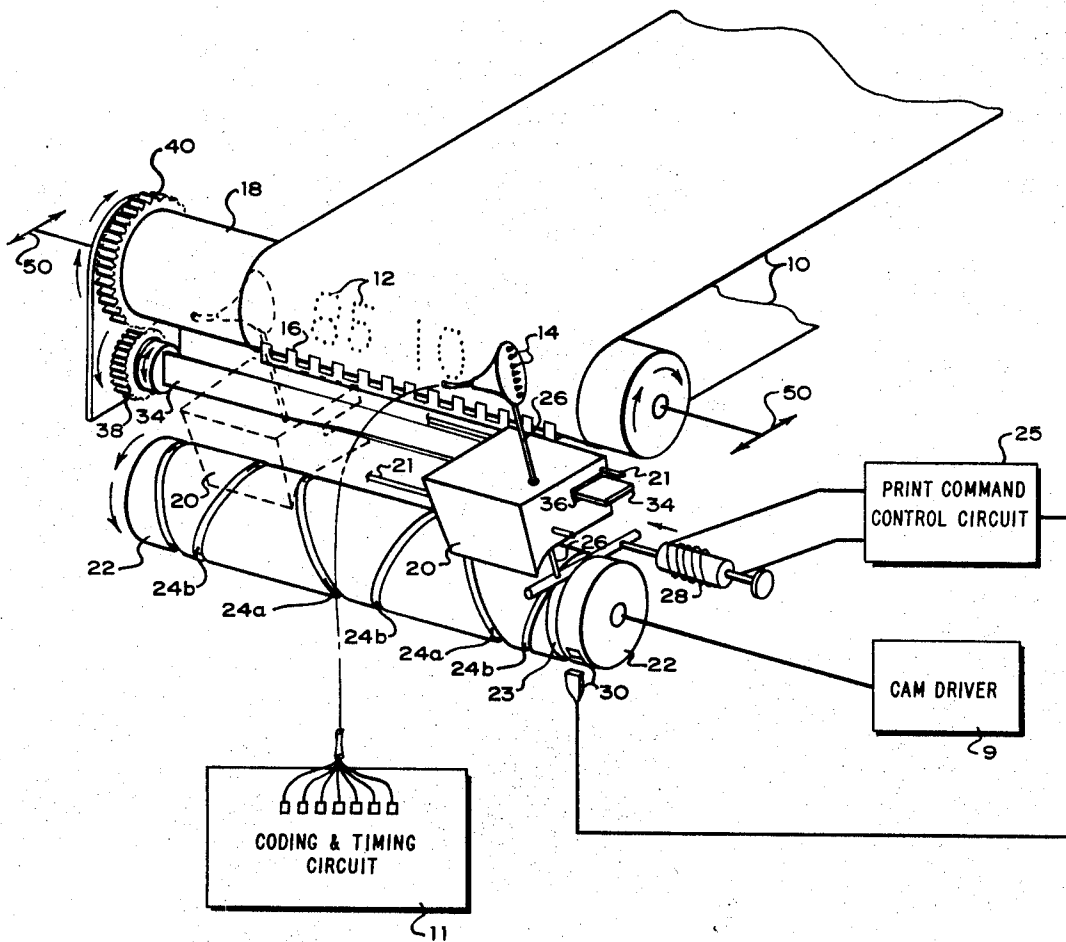


June 30, 1970

C. S. MITCHELL
SCANNING APPARATUS FOR DRIVING AN ELECTROSTATIC
RECORDING STRUCTURE
Filed Oct. 23, 1967

3,518,699



INVENTOR
CHARLES S. MITCHELL

BY *Roland J. Griffin*

ATTORNEY

1

2

3,518,699

SCANNING APPARATUS FOR DRIVING AN ELECTROSTATIC RECORDING STRUCTURE

Charles S. Mitchell, Palo Alto, Calif., assignor to Hewlett-Packard Company, Palo Alto, Calif., a corporation of California

Filed Oct. 23, 1967, Ser. No. 677,316

Int. Cl. G01d 15/06; H04n 1/16

U.S. Cl. 346—74

14 Claims

ABSTRACT OF THE DISCLOSURE

A cam follower is supported for being driven back and forth across an electrosensitive recording sheet as it follows a rotatable helical cam. An electrode structure is coupled to the cam follower for selectively discharging current into the recording sheet to print a line of alphanumeric characters thereon as the follower is driven across the recording sheet in one direction from an idle position. The cam follower helps to turn the electrodes into an operative position when recording is to occur. The recording sheet is advanced to the position of a new line as the following is driven across the recording sheet in the opposite direction back to the idle position.

SUMMARY OF THE INVENTION

According to the illustrated embodiment of this invention, record forming means is driven back and forth across a recording medium by a cam follower that is supported for reciprocating linear motion across the recording medium while following a rotatable helical cam. The follower is shaped like an inverted T, the cross bar of which follows the helical cam and the leg of which is coupled to the record forming means so that the angle of the helical cam controls the position and velocity of the record forming means as the record forming means is driven across the recording medium. The angle of the helical cam positions the record forming means in contact with the recording medium as the record forming means is driven across the recording medium in one direction from an idle position to print a line. Similarly, the angle of the helical cam positions the record forming means away from the recording medium as the record forming means is driven across the recording medium in the opposite direction back to the idle position. A twisted flat member is coupled to a capstan and to the cam follower for driving the capstan to advance the recording medium to the position of a new line only during the return of the follower and record forming means to the idle position. Apparatus is also provided for smoothly starting the follower along the helical cam from the idle position in which the follower is disengaged from the helical cam.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawing, which is a perspective view of the preferred embodiment of the invention, there is shown a recording medium in the form of a sheet of electrosensitive recording paper 10 which produces a contrasting mark when electric current is passed through it. An example of such electrosensitive recording paper is described in the copending patent application Ser. No. 358,191 filed by Charles S. Reis on Apr. 8, 1964, issued as U.S. Pat. No. 3,411,948 on Nov. 19, 1968, and entitled Electrosensitive Recording Medium. A line of alphanumeric characters 12 may be printed on the electrosensitive sheet 10 with a record forming means comprising, for example, a vertical row of seven electrodes 14 insulated and equidistantly spaced from each other. Each alpha-

numeric character is printed by linearly moving the row of electrodes 14 across the sheet 10 and by applying electrical impulses to selected electrodes 14 at one to five successive positions of the row of electrodes as it moves across the sheet. Each electrode 14 to which an electrical impulse is applied at one of these positions discharges through the electrically conductive sheet 10 to a stationary electrode 16. This forms on sheet 10 a pattern of discrete dots defining the alphanumeric character. A coding and timing circuit 11 responsive, for example, to the output of a desk calculator may be employed for supplying coded electrical impulses in the appropriate time sequence to the electrodes 14 as required to produce each alphanumeric character.

The electrodes 14 may be poles of a high temperature alloy such as tungsten formed at the end of signal carrying wires. They must withstand the intense heat resulting from rapid electrical discharge. The stationary electrode 16, if disposed on the same side of sheet 10 as electrodes 14, may serve to hold sheet 10 down against a capstan 18 that drives the sheet forward to expose a clean area so a new line can be printed.

The electrodes 14 are moved in parallel straight lines and at a constant linear velocity across sheet 10 by follower means that is supported for reciprocating linear motion across the sheet while following a helical cam groove 24 on the surface of a rotatable cylindrical element 22 that is driven by a cam driver 9 such as a motor. This follower means comprises a cam follower element 26 and a follower carriage 20 for restraining the cam follower element 26 to linear motion across sheet 10 along a path defined by constraining guide bars 21. The angular velocity of cylindrical element 22 and the angle of helical cam groove 24 with respect to the axis of cylindrical element 22 control the linear velocity of cam follower element 26 and electrodes 14 across sheet 10. If these parameters are constant, the velocity of electrodes 14 will be constant across sheet 10. Essentially, the velocity of cam follower element 26 is directly proportional to the helix angle for a given cam rotational velocity. Helical cam groove 24 runs along cylindrical element 22 from a rest or idle position near one end of the cylindrical element to a position near the other end of the cylindrical element, as specifically indicated by the reference numeral 24a. It then runs back along cylindrical element 22 to the rest or idle position, as specifically indicated by the reference numeral 24b. The rest or idle position is defined by a groove 23 running circumferentially around cylindrical element 22. This groove 23 comprises a substantially zero-rise cam allowing cylindrical element 22 to turn without any resulting linear motion of cam follower element 26.

Cam follower element 26 is shaped like an inverted T, the leg of which passes freely through a bearing in the main body of follower carriage 20. Cam follower element 26 is thus free to rotate on the axis of its leg as its cross bar follows the angle of the helical cam groove 24. Electrodes 14 are rigidly attached to the leg or cam follower element 26 so that they are positioned in a non-printing position away from the sheet 10 when the cam follower element is in the idle position. The turning of cam follower element 26 as it enters helical cam groove 24a from the idle position in circumferential groove 23 moves electrodes 14 into a printing position in contact with sheet 10 as shown in the broken line representation of electrodes 14. Similarly, the turning of cam follower element 26 as it begins the return path along helical cam groove 24b back to the idle position in circumferential groove 23 again moves electrodes 14 to a non-printing position away from sheet 10. The cross bar of the T-shaped cam follower element 26 also serves to properly guide the cam follower element along cam

groove 24 even though groove portions 24a and 24b cross one another.

Cam follower element 26 rides in the idle position in circumferential groove 23 until a print command control circuit 25 actuates a solenoid 28 to push the leading end of the cross bar of cam follower element 26 into helical groove 24a. Interlock detecting means 30 is used to detect the position of cylindrical element 22 at which solenoid 28 must be actuated to insure that cam follower element 26 smoothly enters cam groove 24a. This interlock detecting means 30 may comprise a mechanical microswitch or an encoder for detecting the instantaneous position of cylindrical element 22. The interlock detecting means 30 is connected to the print command control circuit 25 for inhibiting actuation of solenoid 28 until detection of the position of cylindrical element 22 at which cam follower element 26 may be smoothly inserted into cam groove 24a. Once the cross bar of cam follower element 26 enters cam groove 24a, the electrodes 14 attached to the leg of cam follower element 26 are driven in the printing position and at a constant linear velocity across sheet 10 by rotation of cylindrical element 22 at a constant angular velocity. As electrodes 14 are driven across sheet 10 in the printing position, they are selectively supplied with electrical impulses as from the coding and timing circuit 11 to print a line of alphanumeric characters. At the end of this printing scan the angle of cam groove 24a diminishes to zero thereby moving electrodes 14 away from sheet 10 and momentarily bringing cam follower element 26 to a stop. The angle of cam groove 24b then builds up in the opposite direction so that electrodes 14 are moved still further away from the paper and returned with cam follower element 26 to the idle position in circumferential groove 23. Cam follower element 26 remains in this idle position with attached electrodes 14 in a non-printing position away from sheet 10 until a print command is again initiated as by print command control circuit 25.

Sheet 10 is advanced by capstan 18 during the return of the follower means to the idle position after a line has been electrically printed on the sheet. This is accomplished by a twisted flat finger 34 (in effect, a simplified screw gear) that runs at one end in a slot 36 in the follower carriage 20 and that is mechanically coupled at the other end to a gear 38. As the follower means scans back and forth across sheet 10, the follower carriage 20 causes twisted finger 34 to oscillate through an angle determined by the amount of twist in finger 34. The gear 38 meshes with another gear 40 fixedly attached to one end of the capstan 18 and drives the capstan to advance sheet 10. Gear 38 is a one way or overrunning clutch gear that idles when finger 34 is rotated in the clockwise direction by follower carriage 20 during the printing of a line. It turns and thereby drives capstan 18 to advance sheet 10 only when finger 34 is rotated in the counterclockwise direction by follower carriage 20 as cam follower element 26 returns to the idle position along cam groove 24b. The angle of twist of finger 34 and the gear ratio between gears 38 and 40 control the amount of sheet advance accomplished during each return of the follower means to the idle position and are therefore selected to provide the desired line spacing on sheet 10.

The capstan 18, the gears 38 and 40, the twisted finger 34, and the stationary electrode 16 may be rigidly coupled together for small translational displacements relative to the electrodes 14 as indicated by arrows 50. This permits adjustment of the pressure with which electrodes 14 bear against sheet 10 and thereby enables the operator to increase the useful lifetime of electrodes 14.

What is claimed is:

1. Apparatus for scanning a recording medium, said apparatus comprising:

a rotatable element having a helical cam on its surface;

follower means supported for engaging and following

said helical cam and for reciprocally moving across the recording medium while following the helical cam; and

scanning means coupled to said follower means for reciprocally moving therewith across the recording medium;

said follower means including means driven by said helical cam for turning said scanning means to an operative position relative to the recording medium during movement of the follower means in one direction across the recording medium and to an inoperative position relative to the recording medium during movement of the follower means in the opposite direction across the recording medium.

2. Apparatus as in claim 1 including drive means for moving the recording medium in a predetermined direction, said drive means comprising a capstan intermittently driven during movement of said follower means in said opposite direction across the recording medium.

3. Apparatus as in claim 2 wherein:

said drive means for moving the recording medium further comprises a screw gear coupled to said capstan for rotating it in one direction; and

said follower means is movably supported and restrained to linear motion in a direction generally transverse to the direction of movement of said recording medium and is coupled to said screw gear for converting the linear motion of said follower means to rotary motion of said screw gear to drive said capstan.

4. Apparatus as in claim 3 wherein said drive means for moving the recording medium still further comprises a one-way clutch means coupled between said screw gear and said capstan for rotating said capstan in only one direction.

5. Apparatus as in claim 1 including:

idler means for disengaging said follower means from said helical cam and for retaining said follower means and said scanning means in an idle position to prevent them from moving across the recording medium; and

control means for selectively engaging said follower means with said helical cam from the idle position whereupon rotation of the rotatable element reciprocally moves said follower means and said scanning means across the recording medium and back to the idle position.

6. Apparatus as in claim 5 wherein:

said scanning means comprises record forming means for producing a record on the recording medium; and

said control means comprises an electrical solenoid for engaging said follower means with said helical cam.

7. Apparatus as in claim 6 wherein said control means further comprises:

a detector means for determining a position of said rotatable element for which said follower means may be smoothly engaged with said helical cam from the idle position; and

means for selectively energizing said electrical solenoid at the position determined by said detector means.

8. Apparatus as in claim 7 wherein said idler means for retaining said follower means in the idle position comprises a substantially zero-rise cam on the surface of said rotatable element.

9. Apparatus as in claim 5 wherein:

said helical cam comprises a helical groove in the surface of said rotatable element;

said follower means is disposed for riding in said helical groove and for turning with changes in the angle of said groove; and

said scanning means comprises record forming means for producing a record on the recording medium, said record forming means being moved to the op-

5

erative position relative to the recording medium in response to movement of said follower means from the idle position along said helical groove.

10. Apparatus as in claim 9 wherein said follower means includes an inverted generally T-shaped element supported with its crossbar riding in said helical groove.

11. Apparatus as in claim 10 wherein:

said record forming means comprises a first electrode structure driven by said follower means and adapted to scan back and forth across the recording medium with said follower means in a direction transverse to the direction of movement of the recording medium, said first electrode structure including a plurality of conductive electrodes aligned transversely with respect to the direction of movement of said first electrode structure, said electrodes following substantially parallel linear paths as said first electrode structure scans across the recording medium; said apparatus includes a second electrode structure positioned along the recording medium; and said apparatus includes circuit means for selectively applying electrical signals to selected ones of the electrodes of said first electrode structure to produce selected patterns of marks on the recording medium one after the other as said first electrode structure scans in said one direction across the recording medium.

12. Apparatus as in claim 11 wherein:

said control means for selectively engaging said follower means with said helical groove comprises an electrical solenoid, detector means for determining a position of said rotatable element for which said follower means may be smoothly engaged with said helical groove from the idle position, and means for selectively energizing said electrical solenoid at the position determined by said detector means; said idler means for retaining said follower means in

6

the idle position comprises a substantially zero-like cam on the surface of said rotatable element; and said apparatus includes drive means for moving the recording medium in a predetermined direction, said drive means comprising a capstan intermittently driven during movement of said follower means in said opposite direction across the recording medium and comprising a screw gear coupled to said capstan by a one-way coupling means for rotating said capstan in one direction;

said follower means is movably supported and restrained to linear motion in a direction generally transverse to the direction of movement of said recording medium and has an opening for receiving said screw gear to convert the linear motion of said follower means to rotary motion of said screw gear to drive said capstan.

13. Apparatus as in claim 12 wherein said first electrode structure and said capstan are mounted for relative movement to adjust the pressure with which the electrodes of said first electrode structure bear against the recording medium.

14. Apparatus as in claim 12 including means for controlling the pressure with which said first electrode structure bears against the recording medium.

References Cited

UNITED STATES PATENTS

2,587,145	2/1952	Grib	346—139
3,300,017	1/1967	Yazajian et al.	346—74

BERNARD KONICK, Primary Examiner

G. M. HOFFMAN, Assistant Examiner

U.S. Cl. X.R.

178—6.6; 346—139

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,518,699 Dated June 30, 1970

Inventor(s) C. S. Mitchell

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 1, line 23, "following" should read -- follower --;

Column 6, line 1, "zero-like" should read -- zero-rise --.

SIGNED AND
SEALED

SEP 29 1970

(SEAL)

Attest:

Edward M. Fletcher, Jr.

Attesting Officer

WILLIAM E. SCHUYLER, JR.
Commissioner of Patents